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.

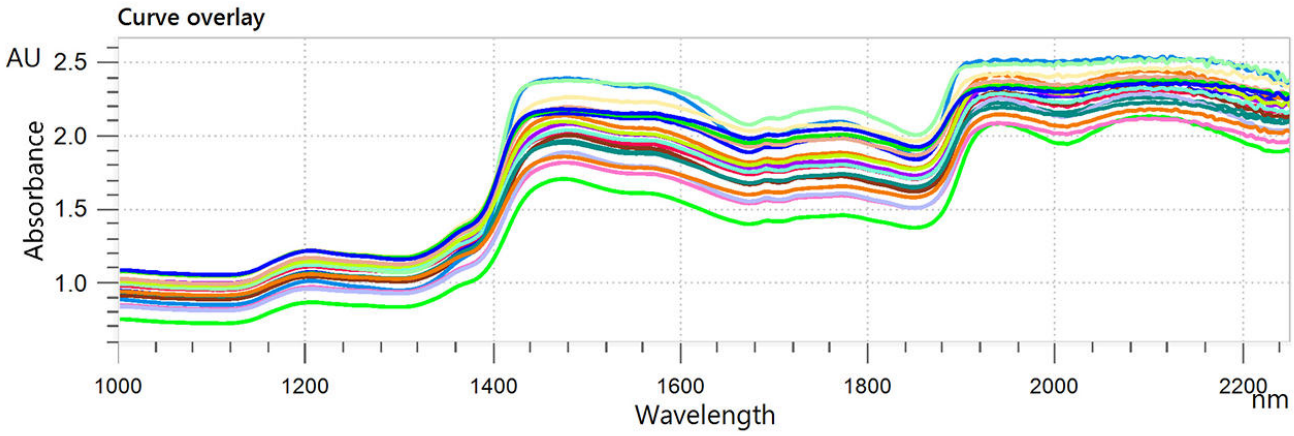

Figure 2. NIR spectra of honey analyzed on OMNIS NIR Analyzer Solid.

Result honey glucose content

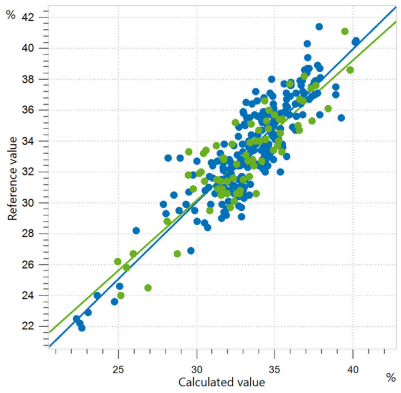

Figure 3. Correlation diagram and the respective figures of merit for the prediction of glucose content in honey. Reference values were obtained with HPLC.

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

Result honey fructose content

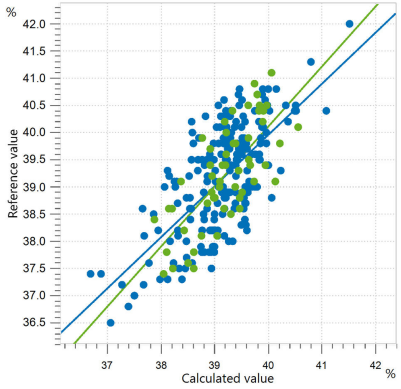

Figure 4. Correlation diagram and the respective figures of merit for the prediction of fructose content in honey. Reference values were obtained with HPLC.

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

Result honey sucrose content

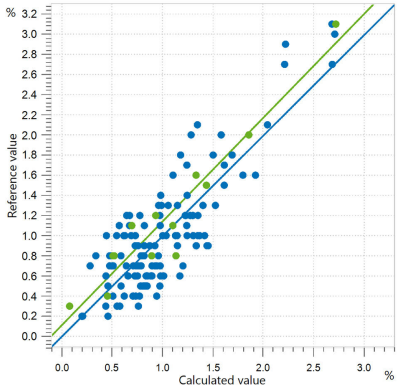

Figure 5. Correlation diagram and the respective figures of merit for the prediction of sucrose content in honey. Reference values were obtained with HPLC.

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

Result honey maltose content

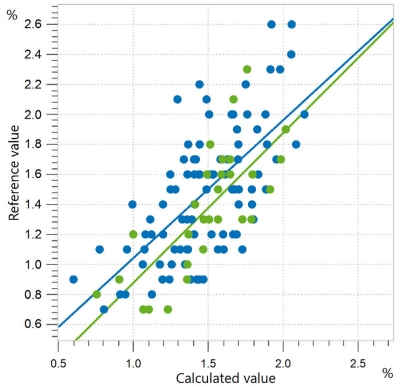

Figure 6. Correlation diagram and the respective figures of merit for the prediction of maltose content in honey. Reference values were obtained with HPLC.

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

Result honey turanose content

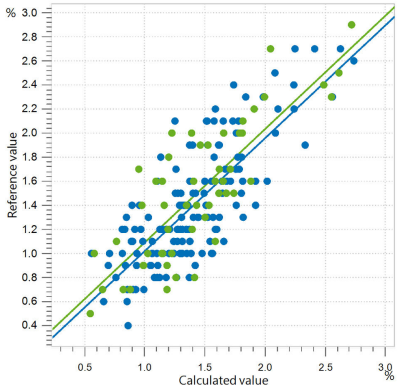

Figure 7. Correlation diagram and the respective figures of merit for the prediction of turanose content in honey. Reference values were obtained with HPLC.

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

Result color

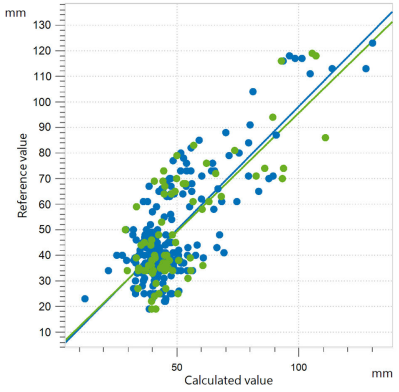

Figure 8. Correlation diagram and the respective figures of merit for the prediction of color in honey. Reference values were obtained with a Pfund colorimeter.

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

适合固体和粘性样品的近红外光谱仪。

OMNIS NIR Analyzer 是一种按照瑞士质量标准开发和生产的近红外光谱 (NIRS) 解决方案,用于整个生产链的常规分析。使用新技术和嵌入先进 OMNIS Software 反应在该 NIR 光谱仪的速度、可操作性和灵活使用上。

OMNIS NIR Analyzer Solid 的优点概览:

- 在 10 秒以内测量固体和粘性样品
- 自动化多位置测量,即使在样品不均匀时,也能够获得可重现的结果
- 方便地嵌入自动系统,或者与其它分析技术(滴定)关联
- 支持大量样品容器

OMNIS NIR2 mm

对液体进行透射反射测量的缝隙量 2 mm(光路长度 4 mm)的反射器。

适用于 28 mm 反射的一次性样品瓶 (6.7402.140)。

28 mm

216 个可封闭的玻璃一次性样品瓶,直径为 28 mm,适用于分析反射中的固体。适用于以下分析仪:

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

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Quant Development

用于在独立 OMNIS Software 安装套件中编写和编辑量化模型的软件许可证。