

Application Note AN-NIR-145

近红外光谱法检测椰子水

Determination of Brix, salinity, conductivity, and pH with one instrument

Fresh coconut water is the main edible part of the coconut (aside from the coconut meat) and has gained popularity as a health drink in recent years. Multiple factors influence the quality, such as harvesting time, growth location, and storage duration. This poses a challenge for industrial producers to achieve and maintain the desired product quality.

Testing the properties of coconut water with standard laboratory methods can be challenging, since trained lab personnel are needed. In contrast, near-infrared spectroscopy (NIRS) is fast, chemical-free, and does not require sample preparation. This Application Note explains how NIRS is used for the multiparameter analysis of coconut water. The NIRS solution is easy to use and can be implemented either atline or in a quality control lab.

EXPERIMENTAL EQUIPMENT

An OMNIS NIR Analyzer Liquid with a 1 mm flow-through cell (Figure 1) was used to analyze 206 coconut samples from a commercial supplier. In this configuration, a peristaltic pump injects the sample into the flow-through cell, which is inserted into the cuvette holder. The cell is rinsed with water after each measurement.



Figure 1. The OMNIS NIR Analyzer Liquid from Metrohm featured with a flow-through cell and holder.

RESULT

The obtained NIR spectra (Figure 2) were used to create prediction models for the different reference parameters (i.e., Brix, salinity, conductivity, and pH). An independent validation set of 25% was used to validate the calibration models. Correlation diagrams which display the relation between the NIR prediction and the reference values are shown in Figures 3–7 together with the respective figures of merit (FOM). The displayed standard errors of cross validation (SECV) and standard errors of prediction (SEP) show the expected accuracy during routine analysis in QC laboratories. The pH value FOM data indicate that the model can be used for classification or trend monitoring because of the limited NIRS correlation.

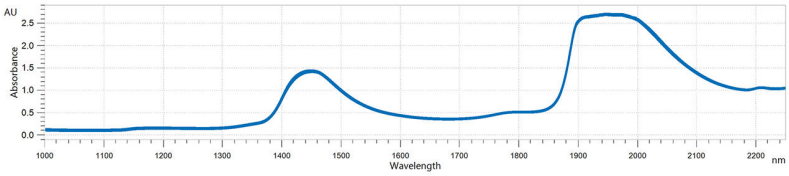


Figure 2. Selection of NIR spectra of coconut water samples measured with a 1 mm flow-through cell on an OMNIS NIR Analyzer Liquid.

RESULT BRIX VALUE

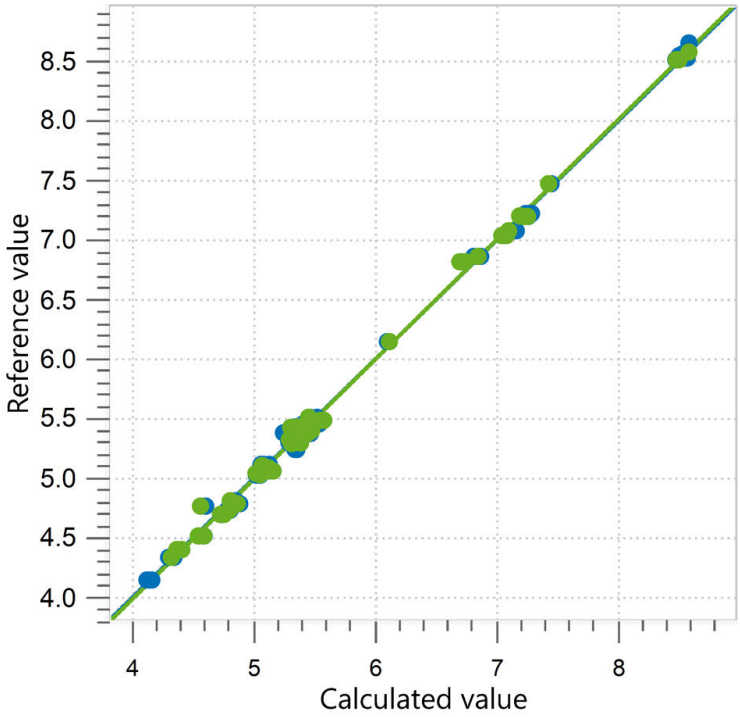


Figure 3. Correlation diagram and the respective FOMs for the prediction of Brix in coconut water using an OMNIS NIR Analyzer Liquid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (° Bx)	SECV (° Bx)	SEP (° Bx)
0.997	0.04	0.04	0.05

RESULT SALINITY

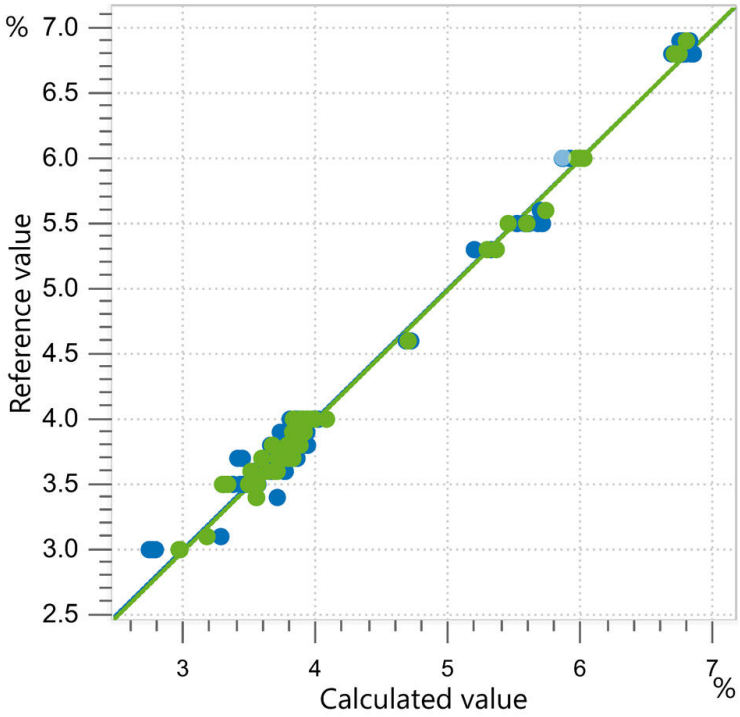


Figure 4. Correlation diagram and the respective FOMs for the prediction of coconut water salinity using an OMNIS NIR Analyzer Liquid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (%)	SECV (%)	SEP (%)
0.992	0.08	0.10	0.09

RESULT PH VALUE

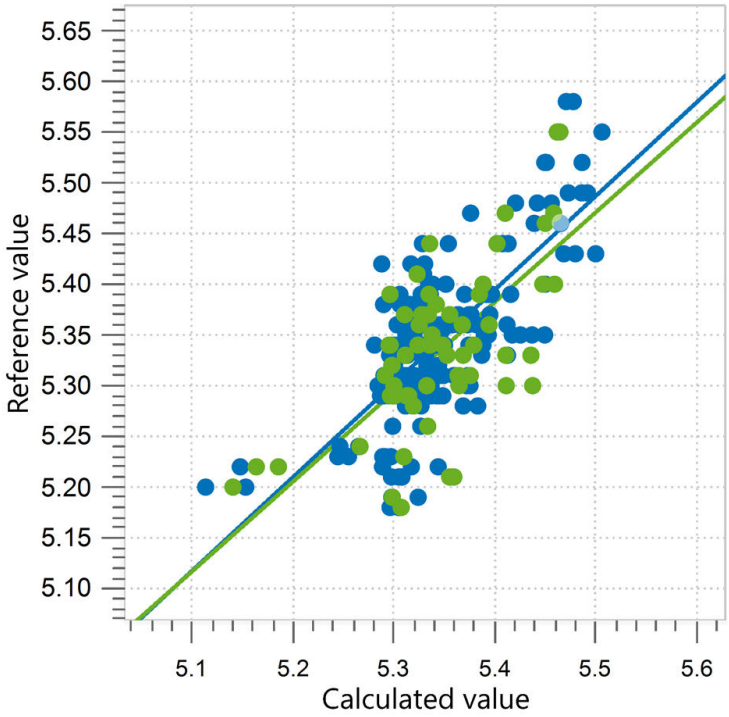


Figure 5. Correlation diagram and the respective FOMs for the prediction of coconut water pH value using an OMNIS NIR Analyzer Liquid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC	SECV	SEP
0.658	0.05	0.05	0.06

RESULT CONDUCTIVITY

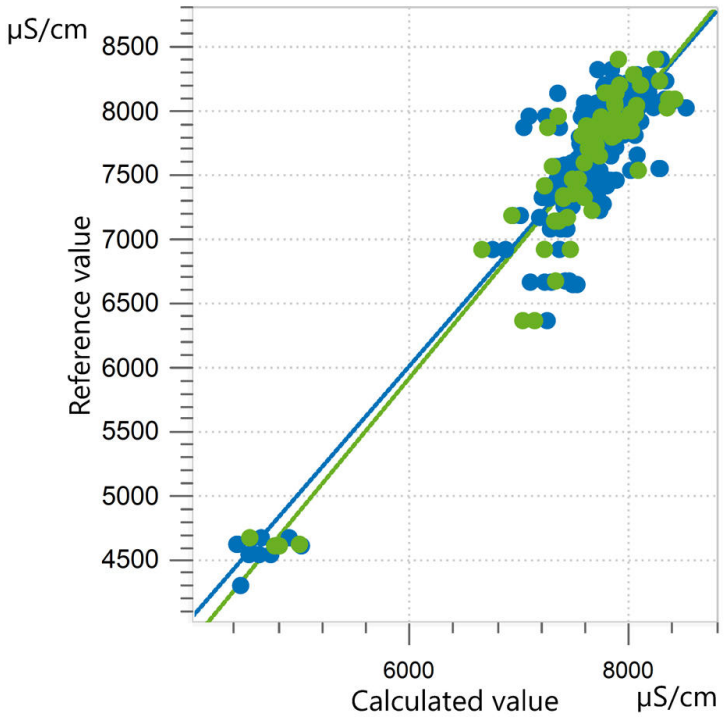


Figure 6. Correlation diagram and the respective FOMs for the prediction of coconut water conductivity using an OMNIS NIR Analyzer Liquid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (µS/cm)	SECV (µS/cm)	SEP (µS/cm)
0.892	250	286	285

RESULT TURBIDITY

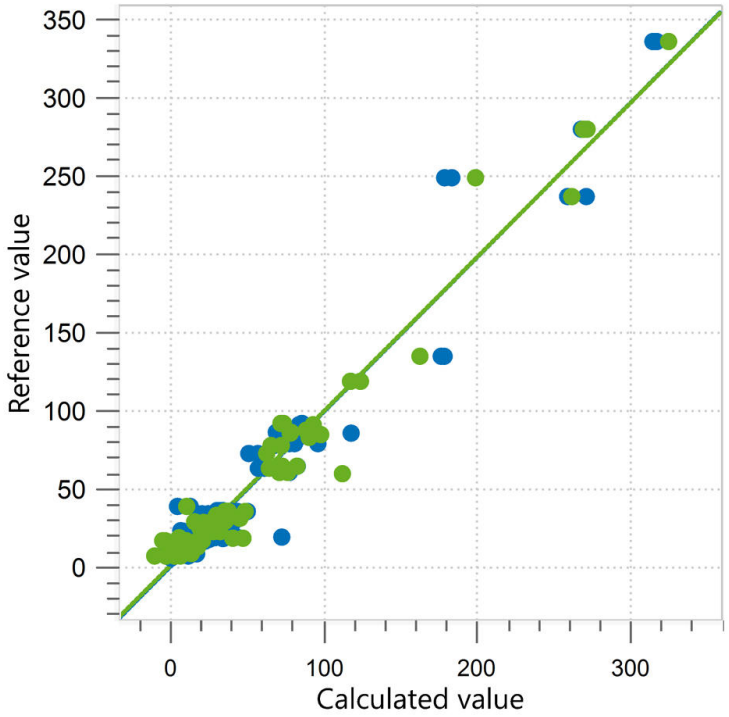


Figure 7. Correlation diagram and the respective FOMs for the prediction of coconut water turbidity using an OMNIS NIR Analyzer Liquid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (ppm)	SECV (ppm)	SEP (ppm)
0.956	10.05	13.04	14.90

CONCLUSION

This Application Note shows the feasibility of using NIR spectroscopy for the quality control of coconut water. The parameters Brix, conductivity, turbidity, pH value, and salinity can be monitored by NIRS in seconds without any sample preparation. The presented setup with a flow-through cell not only simplifies sample handling but also allows full automation when using an OMNIS Sample Robot.

In addition to coconut water, the coconut fruit itself can also be analyzed using near-infrared spectroscopy.

CONTACT

瑞士万通中国
北京市海淀区上地东路1号
院1号楼7层702
100085 北京
marketing@metrohm.com.cn

CONFIGURATION



OMNIS NIR Analyzer Liquid

用于液体样品的近红外光谱仪。

OMNIS NIR Analyzer 按照瑞士质量标准开发和制造,是用于整个生产链中常规分析的近红外光谱解决方案。最新技术的应用以及与现代 OMNIS Software 的集成,体现在这款 NIR 光谱仪的速度、操作性和灵活应用上。

OMNIS NIR Analyzer Liquid 的优势概览:

- 液体样品测量时间小于 10 秒
- 样品温度调节范围为 25–80 °C
- 自动检测样品容器的放入和移除
- 可轻松集成至自动系统,或与其它分析技术(滴定)联用。
- 支持多种不同路径长度的样品容器



OMNIS NIR

适合流通池的 OMNIS NIR Analyzer 的比色皿支架 (6.7401.300; 6.7401.310; 6.7401.320; 6.7401.330; 6.7401.340)。



1 mm

光路长度 1.0 mm 的流量石英皿适用于近红外光谱 (NIRS) 分析。

兼容:

- 支架 OMNIS NIR、流通池 (6.07401.100)
- DS2500 支架适用于流动池(6.7493.000)

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