Application Note AN-NIR-106

NIRS gives mixture analysis results within one minute

The use of non-nutritive sweeteners as sugar substitutes in foodstuffs has risen dramatically in the last decade, e.g., in soft drinks and snacks. Two examples are sucralose, a halogenated sucrose derivative, and Stevia, derived from the leaves of the *Stevia rebaudiana* plant. Both are much sweeter than sugar and are used in much lower concentrations in foodstuffs. To ensure food safety, regulations for non-nutritive sweeteners are becoming stricter. Several analytical methods are available to determine various sweeteners using, e.g., high-performance liquid chromatography (HPLC), ion chromatography, and thin-layer chromatography. However, these methods are time-consuming and incur high running costs. Near-infrared spectroscopy (NIRS) allows the simultaneous determination of several sweeteners in less than one minute without any chemicals or sample preparation.

Mixtures of both Stevia (0.5–4.5%) and sucralose (0.5–4.5%) in sucrose (95%) were prepared and analyzed to create a prediction model for quantification.

Samples were measured with a Metrohm NIRS DS2500 Solid Analyzer (Figure 1) using 15 mm disposable vials, a DS2500 holder, and a DS2500 Iris in reflection mode. The Metrohm software package Vision Air Complete was used for all data acquisition and prediction model development.

Table 1. Hardware and software equipment overview.

Equipment	Article number
DS2500 Solid Analyzer	2.922.0010
DS2500 Iris	6.7425.100
Disposable vials, 15 mm	6.7402.110
Vision Air 2.0 Complete	6.6072.208

Figure 1. Metrohm NIRS DS2500 Solid Analyzer used to determine Stevia and sucralose content in sucrose mixtures.

All measured Vis-NIR spectra (Figure 2) were used to create a prediction model for quantification of sucralose and Stevia in sucrose. The quality of the prediction models was evaluated using correlation diagrams which display a very high correlation between the Vis-NIR prediction and the reference values. The respective figures of merit (FOM) display the expected precision of a prediction during routine analysis (Figures 3–4).

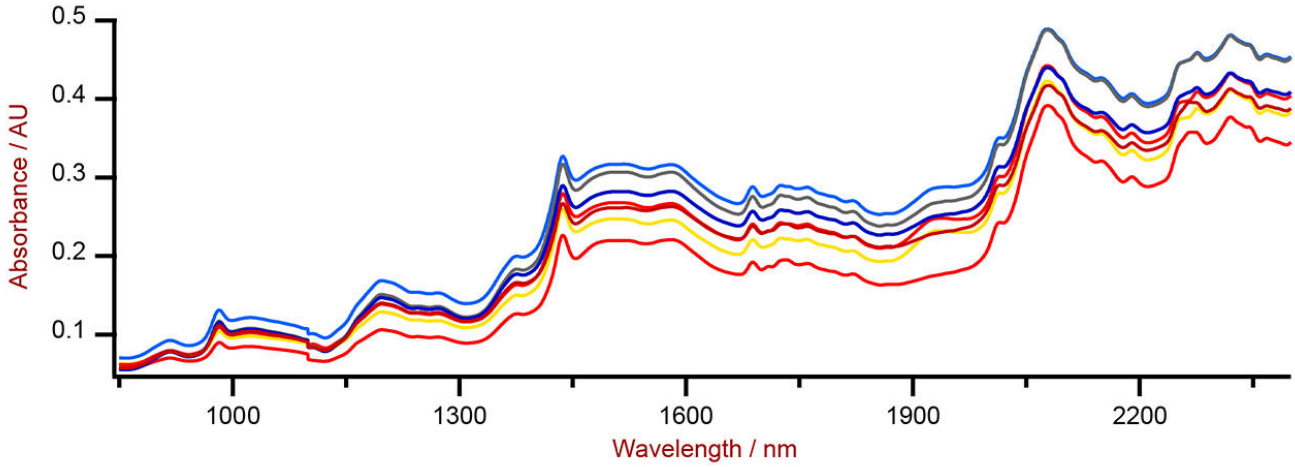

Figure 2. Selection of Vis-NIR spectra of Stevia and sucralose in sucrose samples which were analyzed on a DS2500 Solid Analyzer.

RESULT SUCRALOSE CONTENT IN SUCROSE

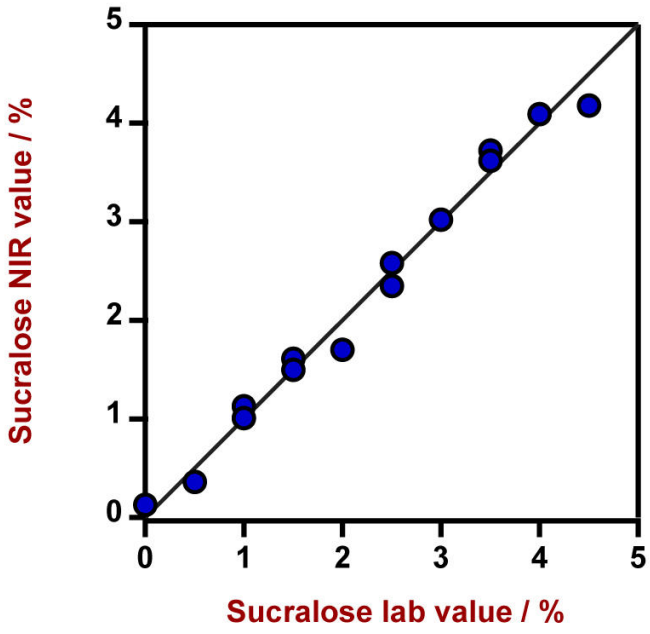

Figure 3. Correlation diagram and the respective figures of merit for the prediction of sucralose content in sucrose using a DS2500 Solid Analyzer. The lab values were determined using HPLC.

Figures of Merit	Value
R^2	0.9854
Standard Error of Calibration	0.1898%
Standard Error of Cross-Validation	0.1997%

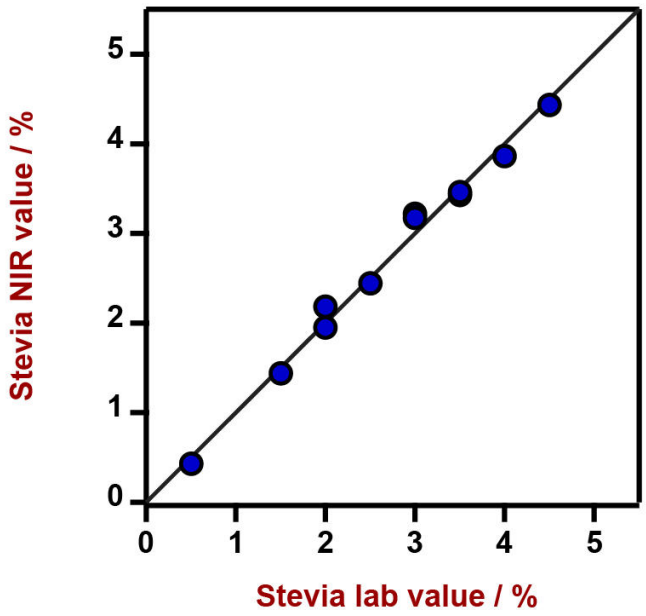

Figure 4. Correlation diagram and the respective figures of merit for the prediction of Stevia content in sucrose using a DS2500 Solid Analyzer. The lab values were determined using HPLC.

Figures of Merit	Value
R^2	0.9885
Standard Error of Calibration	0.1500%
Standard Error of Cross-Validation	0.1997%

CONCLUSION

This Application Note demonstrates the feasibility to determine the concentration of the non-nutritive sweeteners sucralose and Stevia in sucrose blends with NIR spectroscopy. Vis-NIR spectroscopy enables fast and cost-effective measurements with high accuracy, thereby offering a suitable alternative to other standard analytical methods (Table 2).

Table 2. Time to result overview for the different non-nutritive sweeteners examined in this study.

Parameter	Method	Time to result
Stevia	HPLC	5 min (preparation) + 40 min (HPLC)
Sucralose	HPLC	5 min (preparation) + 40 min (HPLC)

CONTACT

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CONFIGURATION

DS2500 Solid Analyzer

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DS2500 , DS2500 Analyzer ,

DS2500 400 2500 nm ,DS2500 Analyzer ,

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