Application Note AN-NIR-134

Paprika powder analysis with NIR spectroscopy

Multiparameter determination in a few seconds

Paprika powder is a common cooking spice. The bright red color makes paprika powder an ideal natural colorant in seasonings, sauces, confectionary products, processed cheeses, etc. Its quality is directly associated with the presence and proportions of flavoring, coloring, and pungent compounds. Paprika's pungency is primarily attributed to capsaicinoids. Capsaicin accounts for ~71% of the total capsaicinoids in the most pungent paprika varieties [1]. Spiciness is measured using the Scoville Heat Unit (SHU) scale (sweet paprikas <500 SHU, hot paprikas 2500–8000 SHU). The color is determined according to the American Spice Trade Association (ASTA) [2]. In this study, quality parameters including the capsaicin content, ASTA color, SHU, water activity (a_w), and ash content were measured simultaneously in paprika powder samples using near-infrared spectroscopy (NIRS).

EXPERIMENTAL EQUIPMENT

Paprika samples were measured using a Metrohm NIR Analyzer. No sample preparation nor solvents were required. All measurements were performed in reflection mode (1000–2250 nm) using the large cup accessory. The samples were measured in rotation to collect spectral data from several areas. Spectral averaging of signals from different spots helped to reduce sample inhomogeneity. Metrohm software was used for all data acquisition and prediction model development.

RESULT

The obtained NIR spectra of paprika powder (Figure 1) were used to create prediction models for quantification of capsaicin content, ASTA color, SHU, water activity (a_W), and ash content. The quality of the prediction models was evaluated using correlation diagrams (Figures 2–6) 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.

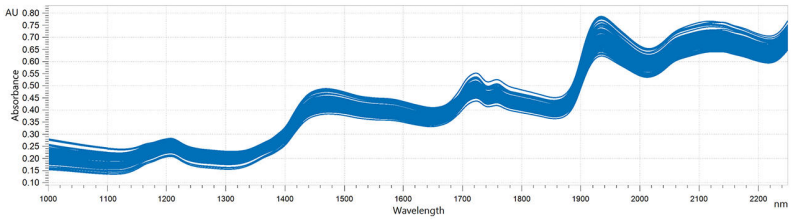

Figure 1. NIR spectra of paprika powder analyzed on a Metrohm NIR Analyzer.

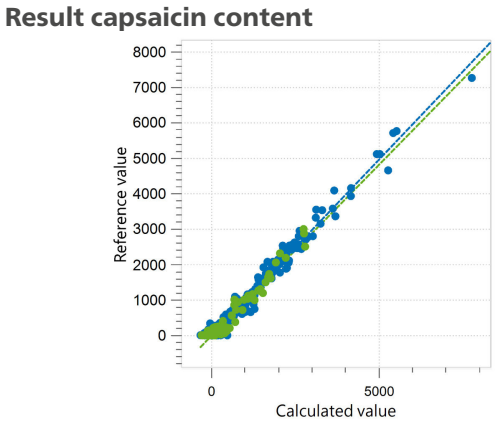

Figure 2. Correlation diagram and the respective figures of merit for the prediction of capsaicin content in paprika powder.

R2	SEC (ppm)	SECV (ppm)	SEP (ppm)

0.947	141	180	171

Result ASTA color

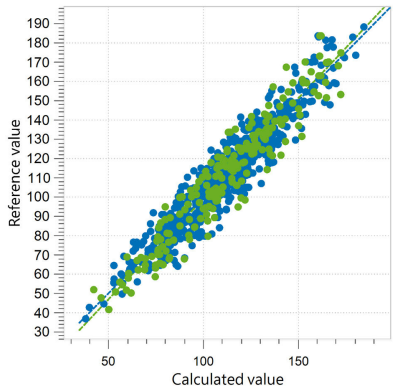

Figure 3. Correlation diagram and the respective figures of merit for the prediction of ASTA color in paprika powder.

R2	SEC (ASTA Color Units)	SECV (ASTA Color Units)	SEP (ASTA Color Units)
0.911	8.30	8.66	9.34

Result Scoville Heat Unit

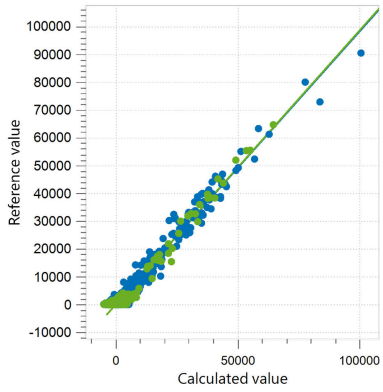

Figure 4. Correlation diagram and the respective figures of merit for the prediction of SHU in paprika powder.

R2	SEC (SHU)	SECV (SHU)	SEP (SHU)
0.973	2229	2870	2626

Result water activity

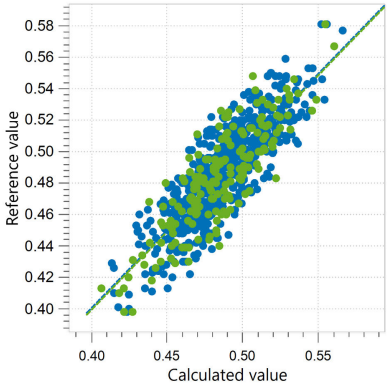

Figure 5. Correlation diagram and the respective figures of merit for the prediction of water activity in paprika powder.

R2	SEC (a_w)	SECV (a_w)	SEP (a_w)
0.719	0.02	0.02	0.02

Result ash content

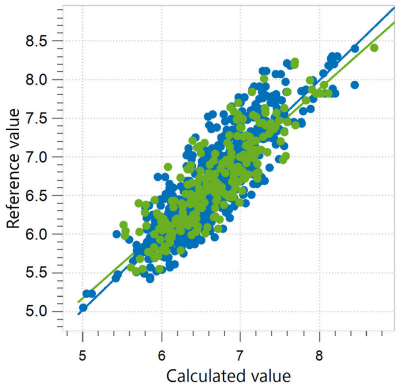

Figure 6. Correlation diagram and the respective figures of merit for the prediction of ash content in paprika powder.

R2	SEC (%)	SECV (%)	SEP (%)
0.741	0.29	0.30	0.30

CONCLUSION

This Application Note displays the benefits of analyzing paprika powder with NIR spectroscopy. NIRS allows all the mentioned quality parameters (i.e., capsaicin content, ASTA color, SHU, water activity (a_w), and ash content) to be measured simultaneously in only a few seconds. Measurements performed with NIR spectroscopy do not need any sample preparation nor solvents, unlike other conventional analytical methods (Table 1). This ultimately leads to a reduction in workload and related costs, and also keeps lab personnel safer.

Table 1. Overview of standard methods used for the determination of reference values in paprika powder.

Parameter	Norm	Method
Capsaicin	ISO 7543-2:1993 Chillies and chilli oleoresins — Determination of total capsaicinoid content Part 2: Method using high-performance liquid chromatography	HPLC
ASTA Color	ASTA Method 20.1 Determination of Extractable Color in Capsicums and Their Oleoresins	UV-Vis
SHU	ISO 3513:1995 Chillies — Determination of Scoville index	Scoville scale
a_w	ASTA Method 6.0 Analysis of Water Activity in Spices	Dew point chilled mirror method
Ash	ISO 928:1997 Spices and condiments — Determination of total ash	Loss on drying

REFERENCES

1. D.D., D.; Sharma, V.; Mangal, M.; et al. NIR Spectroscopy Prediction Model for Capsaicin Content Estimation in Chilli: A Rapid Mining Tool for Trait-Specific Germplasm Screening. *Journal of Food Composition and Analysis* **2025**, *137*, 106915. DOI:10.1016/j.jfca.2024.106915
2. *American Spice Trade Association*. ASTA. https://astaspice.org/ (accessed 2025-05-19).

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