Application Note AN-NIR-123

利用近外光(NIRS)分析面粉

NIR flour analysis determines moisture, protein, ash, gluten, starch, and rheological properties within seconds

SUMMARY

Monitoring ash content, along with key quality parameters such as protein and moisture content, can significantly enhance the milling yield of flour. Next to these chemical parameters, rheological parameters like baking strength or tenacity influence the product quality. Near-infrared (NIR) spectroscopy enables chemical-free quality control of both chemical and rheological parameters, producing results within seconds. This simple, efficient, and rapid analysis method is ideal for continuous quality checks and can be implemented in laboratory settings or atline, requiring minimal training for effective use.

EXPERIMENTAL EQUIPMENT

A total of 237 flour samples, including wheat flour, spelt flour, and other types, were analyzed on a Metrohm OMNIS NIR Analyzer Solid (Figure 1) with the large cup OMNIS NIR, 100 mm and OMNIS software. The samples were filled into the sample cup and analyzed in diffuse reflection mode. To include sample variety, the sample cup rotated during measurement to collect spectra from different locations. The automatically averaged spectra were used for model development. Reference values for moisture, protein, and ash content were obtained with the respective primary methods: moisture analysis followed AOAC 953.10, protein according to AOAC 2001.11, and ash content followed AOAC 923.03.

Figure 1. OMNIS NIR Analyzer Solid

Table 1. Hardware and software equipment overview.

Equipment	Article number
OMNIS NIR Analyzer Solid	2.1071.0010
Large holder OMNIS NIR, 100 mm	6.07402.100
Large cup OMNIS NIR, 100 mm	6.07402.110
OMNIS Stand-Alone license	6.06003.010
Quant Development software license	6.06008.002

RESULT

The obtained NIR spectra (Figure 2) were used to create prediction models for the different reference parameters. Correlation diagrams which display the relation between the NIR prediction and the reference values are shown in Figures 3–5 together with the respective figures of merit (FOM).

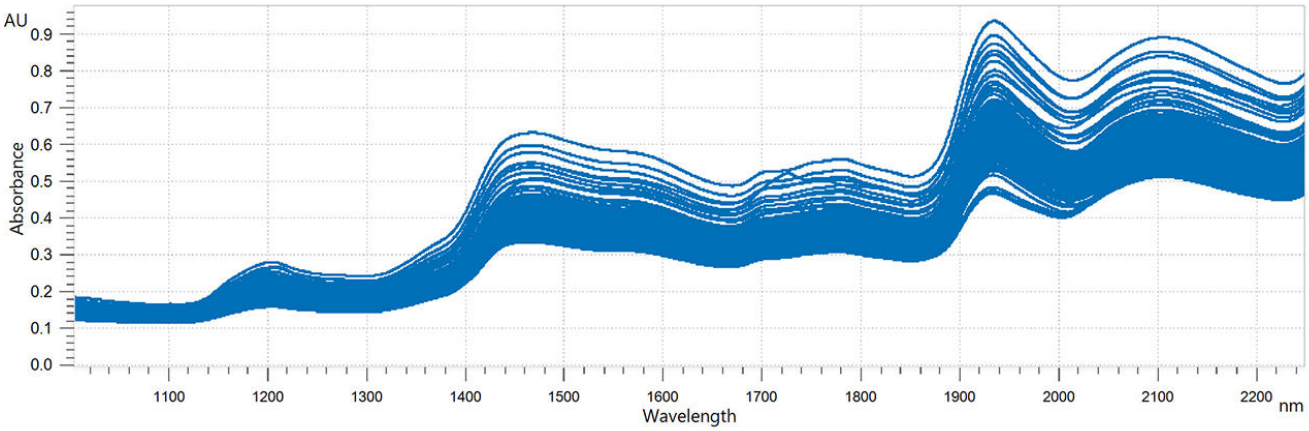

Figure 2. Overlaid NIR spectra of flour samples. Data was obtained with an OMNIS NIR Analyzer Solid.

Result moisture in flour

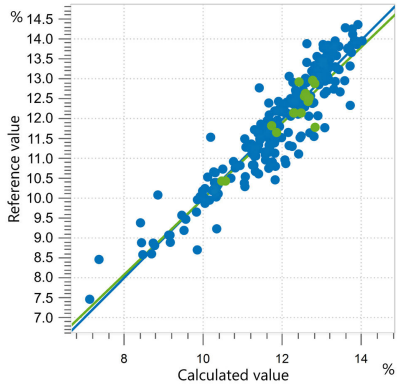

Figure 3. Correlation diagram and the respective FOMs for the prediction of moisture in flour. Blue dots represent calibration samples; green dots represent samples used to validate the model.

Figures of Merit	Value
R^2	0.827
Standard Error of Calibration	0.47%
Standard Error of Cross-Validation	0.48%

Result protein in flour

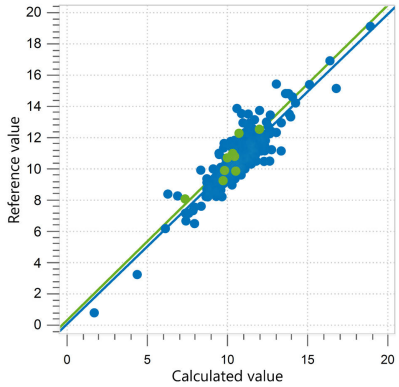

Figure 4. Correlation diagram and the respective FOMs for the prediction of protein in flour. Blue dots represent calibration samples; green dots represent samples used to validate the model.

Figures of Merit	Value
R^2	0.789
Standard Error of Calibration	1.89%
Standard Error of Cross-Validation	2.68%

Result ash in flour

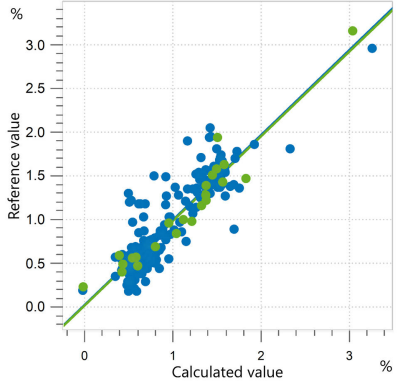

Figure 5. Correlation diagram and the respective FOMs for the prediction of ash in flour. Blue dots represent calibration samples; green dots represent samples used to validate the model.

Figures of Merit	Value
R^2	0.929

Standard Error of Calibration	0.221%
Standard Error of Cross-Validation	0.231%

Table 2. Aside from the key quality parameters, additional parameters can be determined in flour using near-infrared spectroscopy.

Parameter	Range	SEC	SECV	R2CV
Gluten	15–35%	1.39%	1.40%	0.918
Starch	15–26%	0.86%	0.97%	0.755
Baking strength	36–444	29.94	30.75	0.919
Elasticity index	30–65	2.32	2.67	0.906
Tenacity	43–382	20.00	21.69	0.910

CONCLUSION

This Application Note shows the feasibility of using NIR spectroscopy for the analysis of several quality parameters in flour. With no chemicals involved, near-infrared spectroscopy is an ideal way to avoid time-consuming sample preparation and reduce costs. NIRS instruments from Metrohm allow users to not only to monitor the flour milling process, but also to predict the rheological properties of the dough the flour is produced with.

CONTACT

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CONFIGURATION

OMNIS NIR Analyzer Solid

合固体和粘性品的近外光。

OMNIS NIR Analyzer 是一按照瑞士量准和生的近外光 (NIRS) 解决方案,用于整个生的常分析。使用新技和嵌入先 OMNIS Software 反在 NIR 光的速度、可操作性和活使用上。

OMNIS NIR Analyzer Solid 的点概:

- 在 10 秒以内量固体和粘性品
- 自化多位置量,即使在品不均匀,也能得可重的果
- 方便地嵌入自系,或者与其它分析技(滴定)
- 支持大量品容器

OMNIS NIR100 mm

合大品容器的大支架 OMNIS NIR,100 mm (6.07402.110)。

允明地定位品容器和旋品容器。

OMNIS NIR100 mm

用于在不同品位置通反射采集粉末和粒反射光的大品容器。

兼容:

- 大支架 OMNIS NIR,100 mm (6.07402.100)

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- 不可再外算机上使用。

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Quant Development

用于在独立 OMNIS Software 安装套件中写和量化模型的件可。