Application Note AN-NIR-123

Flour analysis by near-infrared spectroscopy (NIRS)

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

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).

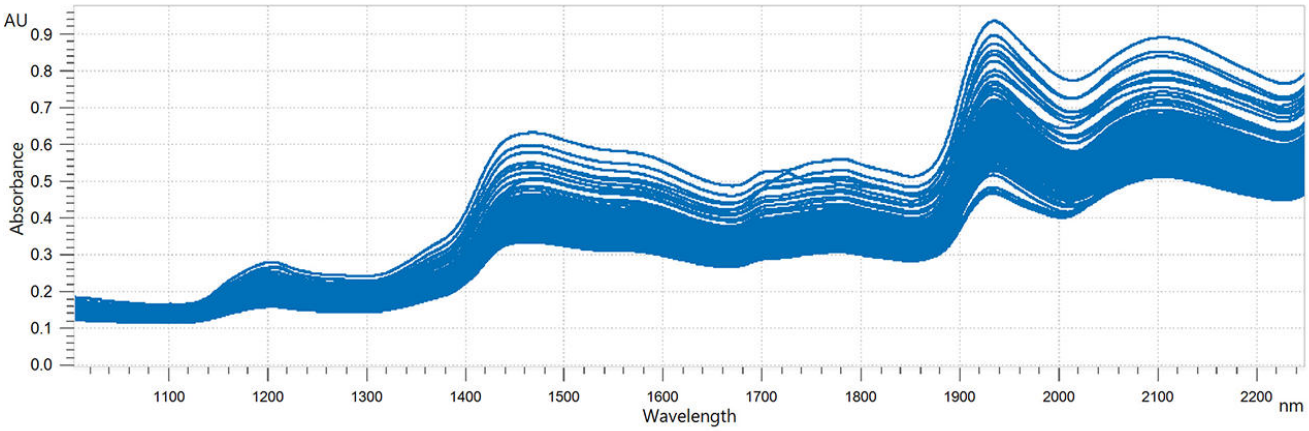

Figure 2. Overlaid NIR spectra of flour samples. Data was obtained with an OMNIS NIR Analyzer Solid.

Result moisture in flour

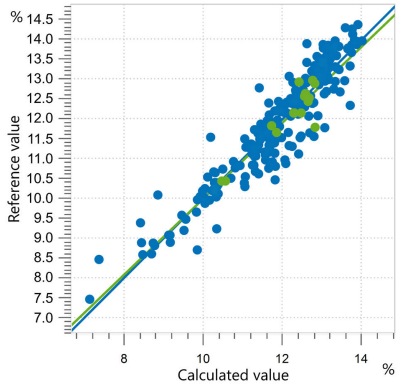

Figure 3. Correlation diagram and the respective FOMs for the prediction of moisture in flour. Blue dots represent calibration samples; green dots represent samples used to validate the model.

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

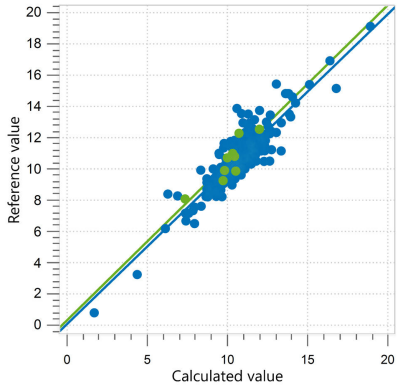

Figure 4. Correlation diagram and the respective FOMs for the prediction of protein in flour. Blue dots represent calibration samples; green dots represent samples used to validate the model.

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

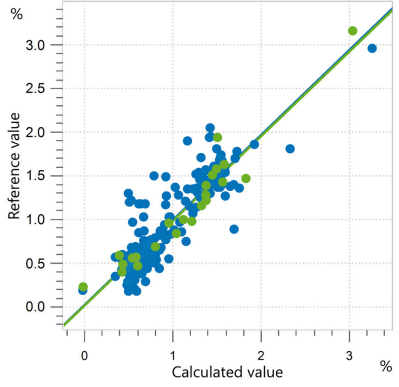

Figure 5. Correlation diagram and the respective FOMs for the prediction of ash in flour. Blue dots represent calibration samples; green dots represent samples used to validate the model.

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

固体および粘性のサンフルのための近赤外スヘクトロメーター。

OMNIS NIR Analyzer は、スイスの品質基準に従って開発・製造された、生産チェーン全体に沿ったルーチン分析のための近赤外分光法 (NIRS) ソリューションてす。最新技術の適用と最新の OMNIS Software への統合は、この NIR スヘクトロメーターの速度、ユーサヒリティ、柔軟な使用に反映されています。

OMNIS NIR Analyzer Solid の利点の概要:

- 10秒未満て固体サンフルと粘性サンフルを測定
- 不均質なサンフルても再現性のある結果を得るための自動マルチホシション測定
- オートメーションシステムへの統合、またはその他の分析技術 (滴定) との連結か容易
- 多数のサンフル容器に対応

OMNIS NIR100 mm

大型サンフル容器 OMNIS NIR、100 mm (6.07402.110) 用大型ホルター。

サンフル容器の確実な配置と回転を可能にします。

OMNIS NIR100 mm

様々なサンフル位置における反射中の粉末および顆粒のスヘクトル記録のための大型サンフル容器。

次の製品と互換性かあります:

- 大型ホルター OMNIS NIR、100 mm (6.07402.100)

OMNIS

WindowsTMコンヒューター上のOMNISソフトウェアをスタントアローン操作することか可能になります。

特徴:

- ライセンスには、既に1つのOMNISテハイスライセンスか含まれています。
- メトローム・ライセンシンクホータルにて、アクティフ化する必要かあります。
- 他のコンヒューターに移行することはてきません。

Quant Development

スタントアロン型 OMNIS Software のインストールにおける定量化モテルの作成と編集のためのソフトウェアライセンス。