



Application Note AN-NIR-143

Semola and semolina quality control using NIR spectroscopy

Nondestructive analysis of protein, moisture, gluten, and more in semolina-based products

Good pasta products start with good ingredients—including flour. Semola and semolina are special types of flour made from durum wheat, known for giving the resulting pasta a firm texture, bright yellow color, and superior cooking character. The difference is that semola is coarse (milled once) and semolina is exceptionally fine (milled twice). To make high-quality pasta, it is important to check key

properties of these flours, like protein, moisture, ash content, gluten, and water absorption. This Application Note shows how monitoring these parameters with near-infrared spectroscopy (NIRS) can help pasta manufacturers quickly detect the best semola and semolina to keep their products consistent, tasty, and of high quality.

EXPERIMENTAL EQUIPMENT

Samples of semola and semolina flours were analyzed using an OMNIS NIR Analyzer Solid (Figure 1). Measurements were carried out in reflection mode while using a large sample cup. To enhance representativeness, the samples were rotated during the measurement, allowing the device to capture spectral data from multiple regions of each flour. OMNIS Software was used for all data acquisition and prediction model development.



Figure 1. OMNIS NIR Analyzer Solid.

RESULT

The OMNIS NIR Analyzer was used to monitor the quality of semolina and semola flours, focusing on protein, moisture, ash, gluten content, and water absorption. Figure 2 shows an example of some semola spectra gathered by the OMNIS NIR Analyzer Solid.

For semolina, moisture showed the strongest performance (Figure 3), with low prediction errors and a high correlation between NIR

predictions and laboratory reference values. Ash, protein, and gluten content (Figures 4–6) were also quantified with good accuracy.

For semola, protein content was predicted with excellent correlation to the reference data (Figure 7), while moisture, ash, gluten, and water absorption also showed reliable calibration performance (Table 1).

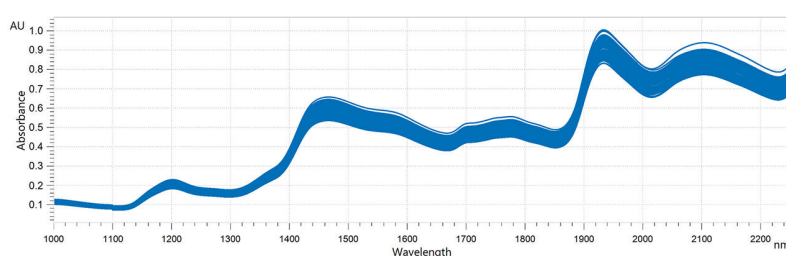


Figure 2. Near-infrared spectra of semola samples analyzed in reflection mode on an OMNIS NIR Analyzer Solid.

RESULT MOISTURE CONTENT IN SEMOLINA

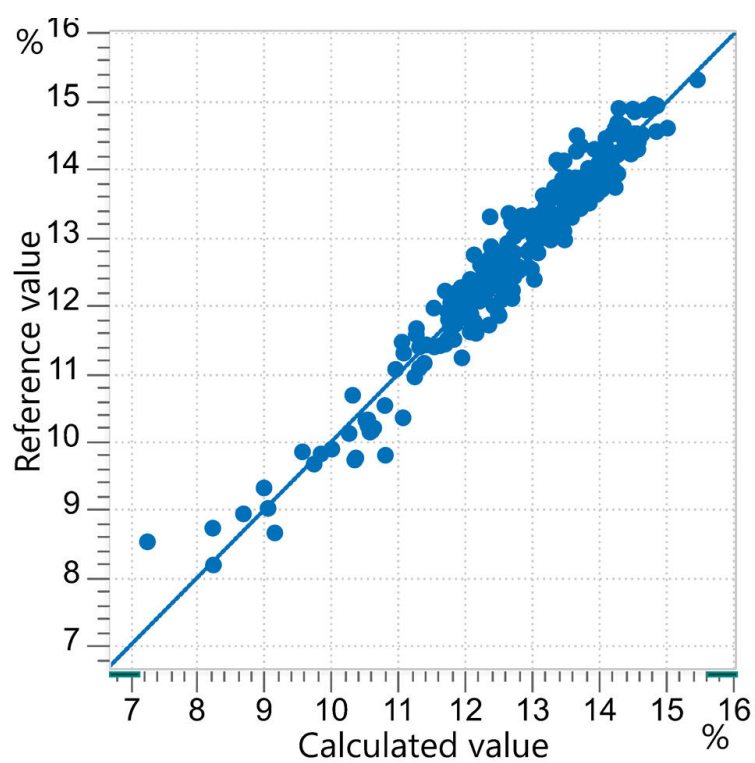


Figure 3. Correlation diagram and the respective figures of merit for the prediction of moisture in semolina measured with an OMNIS NIR Analyzer Solid.

R^2	SEC (%)	SECV (%)
0.949	0.29	0.31

RESULT PROTEIN CONTENT IN SEMOLINA

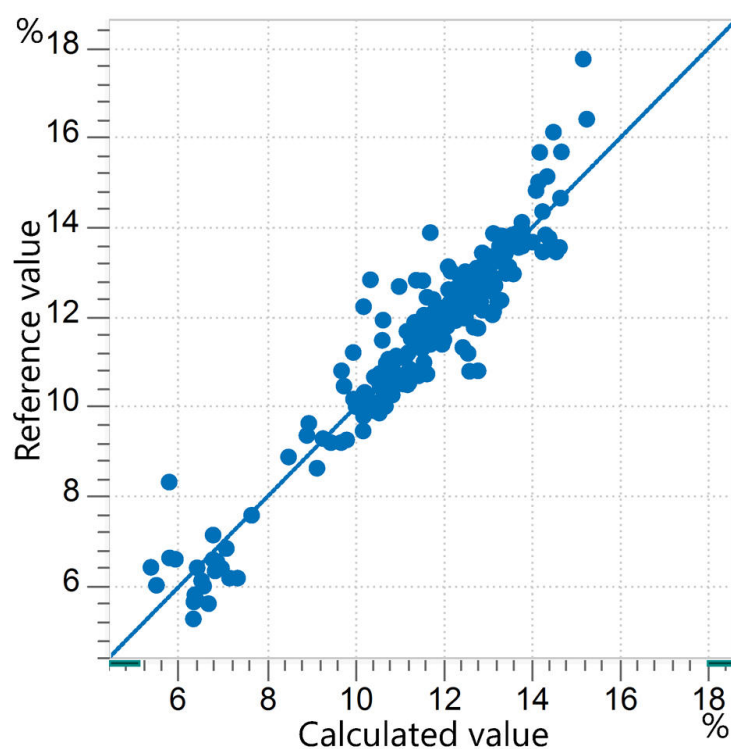


Figure 4. Correlation diagram and the respective figures of merit for the prediction of protein in semolina measured with an OMNIS NIR Analyzer Solid.

R^2	SEC (%)	SECV (%)
0.907	0.60	0.63

RESULT ASH CONTENT IN SEMOLINA

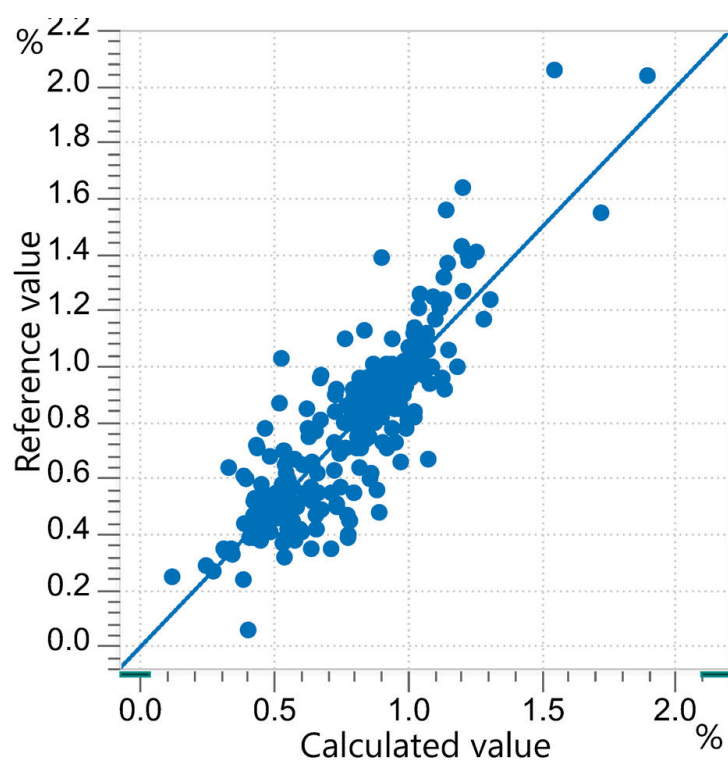


Figure 5. Correlation diagram and the respective figures of merit for the prediction of ash in semolina measured with an OMNIS NIR Analyzer Solid.

R^2	SEC (%)	SECV (%)
0.734	0.14	0.14

RESULT GLUTEN CONTENT IN SEMOLINA

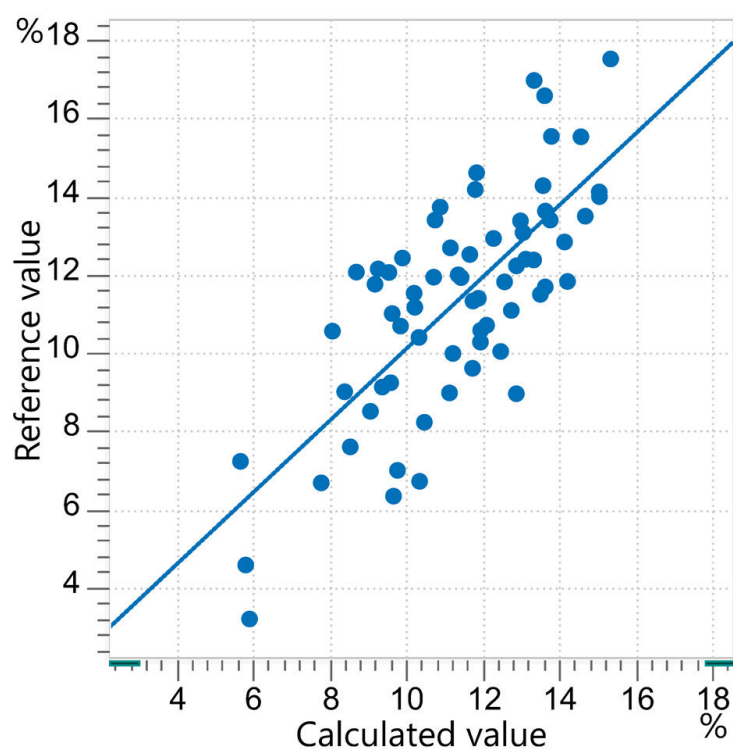


Figure 6. Correlation diagram and the respective figures of merit for the prediction of gluten in semolina measured with an OMNIS NIR Analyzer Solid.

R^2	SEC (%)	SECV (%)
0.550	1.71	1.87

RESULT PROTEIN CONTENT IN SEMOLA

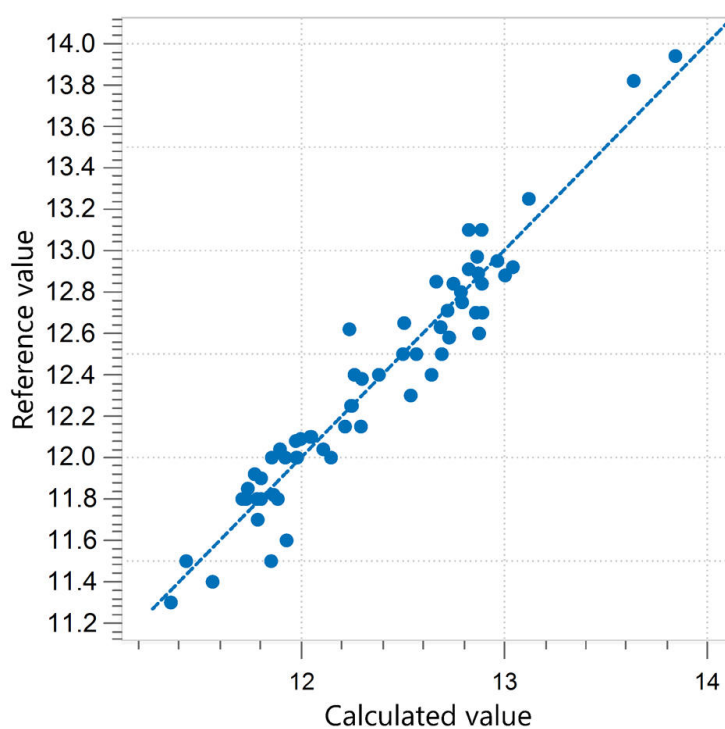


Figure 7. Correlation diagram and the respective figures of merit for the prediction of protein in semola measured with an OMNIS NIR Analyzer Solid.

R^2	SEC (%)	SECV (%)
0.933	0.14	0.14

Table 1. Figures of merit for the prediction of moisture, ash, protein, gluten, and water absorption in semola.

Parameter (range)	No. Spectra	SEC (%)	SECV (%)	R^2
Moisture (12.5–15.1%)	146	0.20	0.20	0.834
Ash (0.74–1.12%)	99	0.04	0.04	0.787
Gluten (23–32%)	43	0.67	0.81	0.815
Water absorption (53.7–58.8%)	37	0.37	0.44	0.82

CONCLUSION

This Application Note demonstrates the feasibility of using NIR spectroscopy to determine multiple key parameters in semolina and semola flours. As shown in **Table 2**, various traditional analytical methods are typically used

for these measurements. However, NIR spectroscopy has proven to be a faster, simpler, and highly accurate alternative, offering excellent precision while streamlining the analysis process.

Table 2. Overview of the ISO norms used as a reference method for the different parameters measured in semola and semolina flours.

Parameter	Method
Protein	ISO 1871 – Kjeldahl method
Moisture	ISO 760 – Karl Fischer
Ash	ISO 2171 – Determination of ash content
Gluten	ISO 21415 – Methods for determining gluten
Water Absorption	ISO 5530-1 – Determination of water absorption using a farinograph

CONTACT

メトロームジャパン株式会
社
143-0006 東京都大田区平
和島6-1-1
null 東京流通センター アネ
ックス9階

metrohm.jp@metrohm.jp

CONFIGURATION



OMNIS NIR Analyzer Solid

固形物および粘性のあるサンプル用の近赤外スペクトロメーター。

スイスの品質規格に基づいて開発および製造された OMNIS NIR Analyzer は、生産工程全体にわたる日常的な分析に対応する近赤外分光法(NIRS)ソリューションです。最新技術の適用と、最新の OMNIS Software との統合により、この NIR スペクトロメーターは速度、操作性、そして柔軟な活用が可能となっています。

OMNIS NIR Analyzer Solid の利点の概要:

- 固形物および粘性サンプルの測定を 10 秒未満で実施
- 不均一なサンプルであっても再現性のある結果が得られる、自動多点測定
- オートメーションシステムへの容易な統合、または追加の分析技術 (滴定) との連携
- 多数のサンプル容器に対応



OMNIS NIR100 mm

Large holder for large sample vessel OMNIS NIR, 100 mm (6.07402.110). Permits unambiguous positioning of the sample vessel and the rotation of the sample vessel.



OMNIS NIR100 mm

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

ガラス底面は高い強度を誇る Gorilla® Glass 製です。

次の製品と互換性があります:

- 大型ホルダー OMNIS NIR、100 mm (6.07402.100)

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Windows™コンピュータ上のOMNISソフトウェアをスタンドアローン操作することが可能になります。

特徴:

- ライセンスには、既に1つのOMNISデバイスライセンスが含まれています。
- メトローム・ライセンシングポータルにて、アクティブ化する必要があります。

Quant Development

Software license for the creation and editing of quantification models in a stand-alone OMNIS Software installation.