

Application Note AN-NIR-143

近红外光谱技术用于粗粒小麦粉与硬质小麦粗粉品质检测

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).

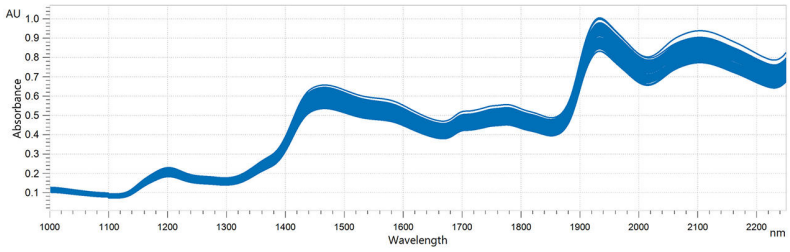


Figure 2. Near-infrared spectra of semola samples analyzed in reflection mode on an OMNIS NIR Analyzer Solid.

RESULT MOISTURE CONTENT IN SEMOLINA

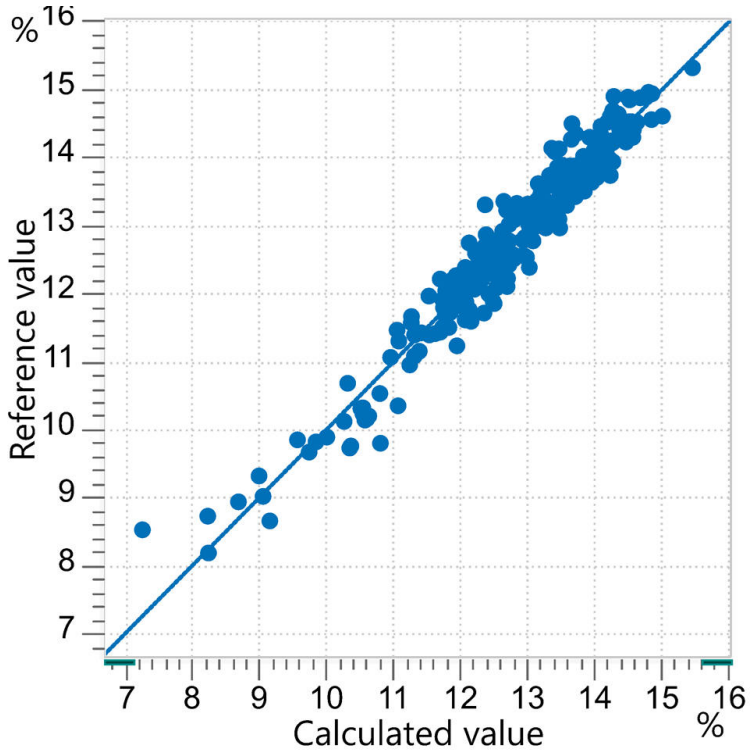


Figure 3. Correlation diagram and the respective figures of merit for the prediction of moisture in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT PROTEIN CONTENT IN SEMOLINA

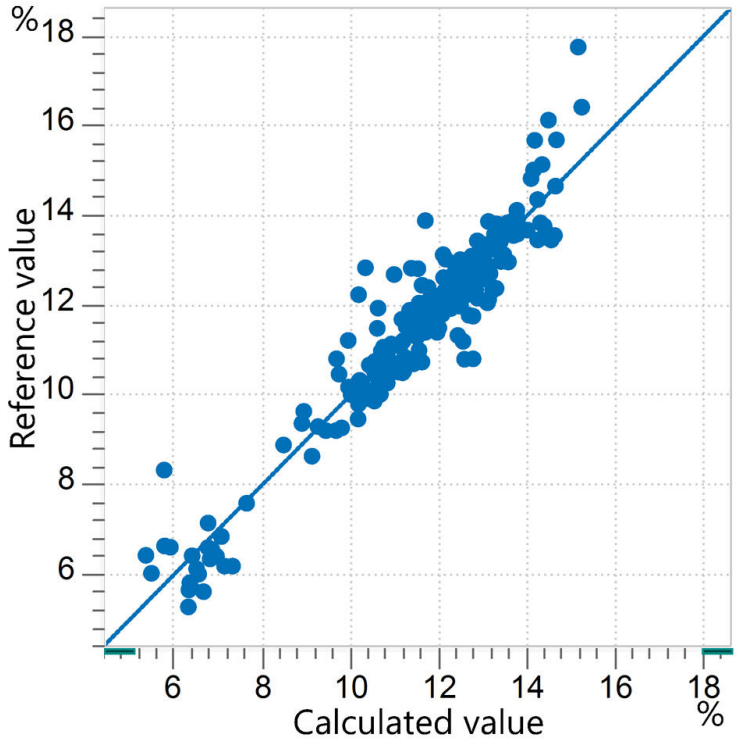


Figure 4. Correlation diagram and the respective figures of merit for the prediction of protein in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT ASH CONTENT IN SEMOLINA

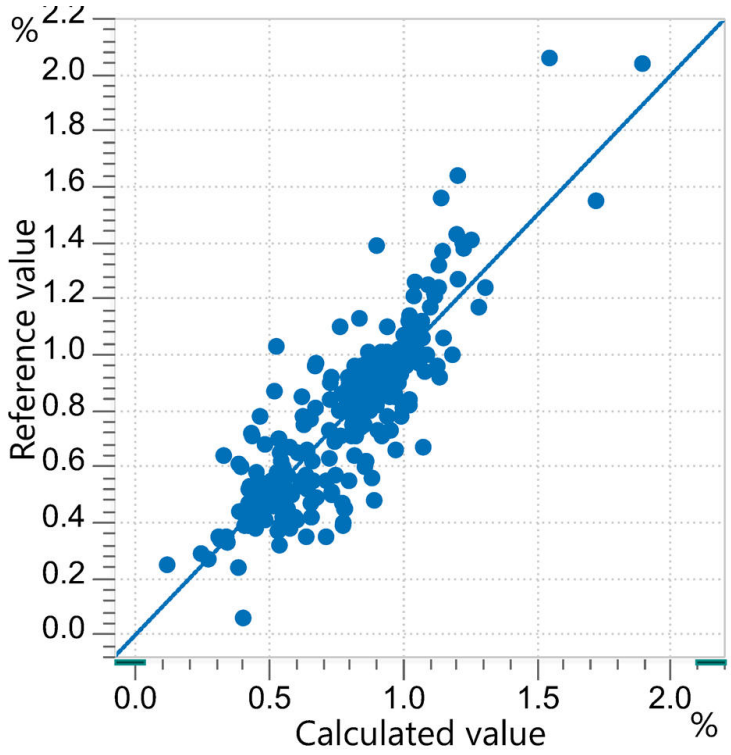


Figure 5. Correlation diagram and the respective figures of merit for the prediction of ash in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT GLUTEN CONTENT IN SEMOLINA

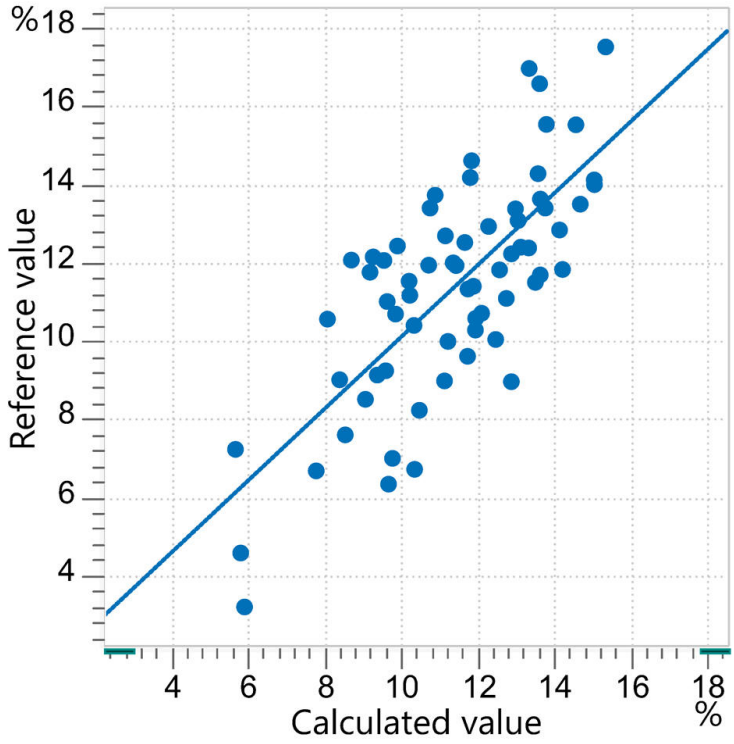


Figure 6. Correlation diagram and the respective figures of merit for the prediction of gluten in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT PROTEIN CONTENT IN SEMOLA

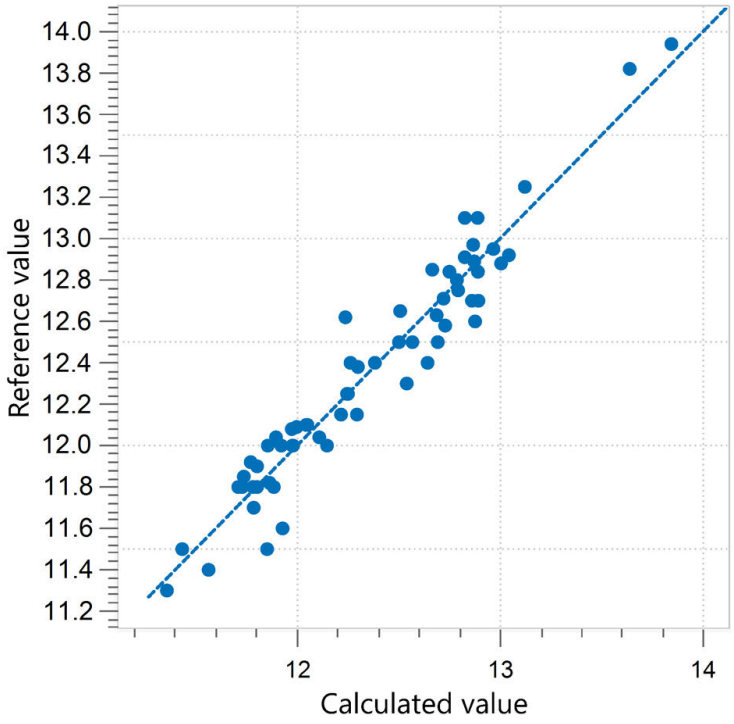


Figure 7. Correlation diagram and the respective figures of merit for the prediction of protein in semola measured with an OMNIS NIR Analyzer Solid.

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

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CONFIGURATION



OMNIS NIR Analyzer Solid

用于固体物质和粘稠样品的近红外光谱仪。

OMNIS NIR Analyzer 按照瑞士质量标准开发和制造,是用于整个生产链中常规分析的近红外光谱 (NIRS) 解决方案。最新技术的应用以及与现代 OMNIS Software 的集成,体现在这款 NIR 光谱仪的速度、操作性和灵活应用上。

OMNIS NIR Analyzer Solid 的优势概览:

- 固体物质和粘稠样品测量时间小于 10 秒
- 自动多位置测量,确保即使在非均质样品中也能获得可重现的结果
- 可轻松集成至自动系统,或与其它分析技术(滴定)联用
- 支持多种样品容器



OMNIS NIR100 mm

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

允许明确地定位样品容器和旋转样品容器。



OMNIS NIR100 mm

用于在不同样品位置处通过反射进行粉末和颗粒光谱记录的大样品容器。

玻璃底板由坚固耐用的 Gorilla® 玻璃制成。

兼容:

- 大支架 OMNIS NIR,100 mm (6.07402.100)



OMNIS

允许单机版 OMNIS 软件在一台 WindowsTM 计算机上运行。

特性:

- 该许可证已含有一份 OMNIS 设备许可证。
- 须通过万通许可授权平台进行激活。



Quant Development

用于在独立 OMNIS Software 安装套件中编写和编辑量化模型的软件许可证。