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).

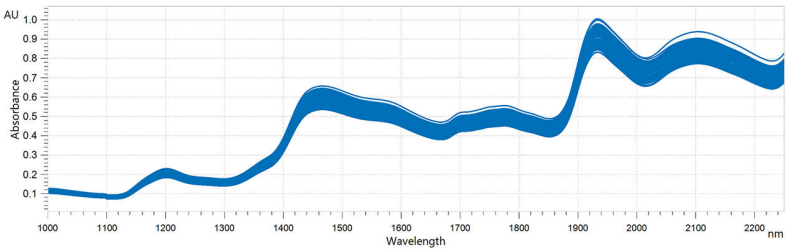

Figure 2. Near-infrared spectra of semola samples analyzed in reflection mode on an OMNIS NIR Analyzer Solid.

RESULT MOISTURE CONTENT IN SEMOLINA

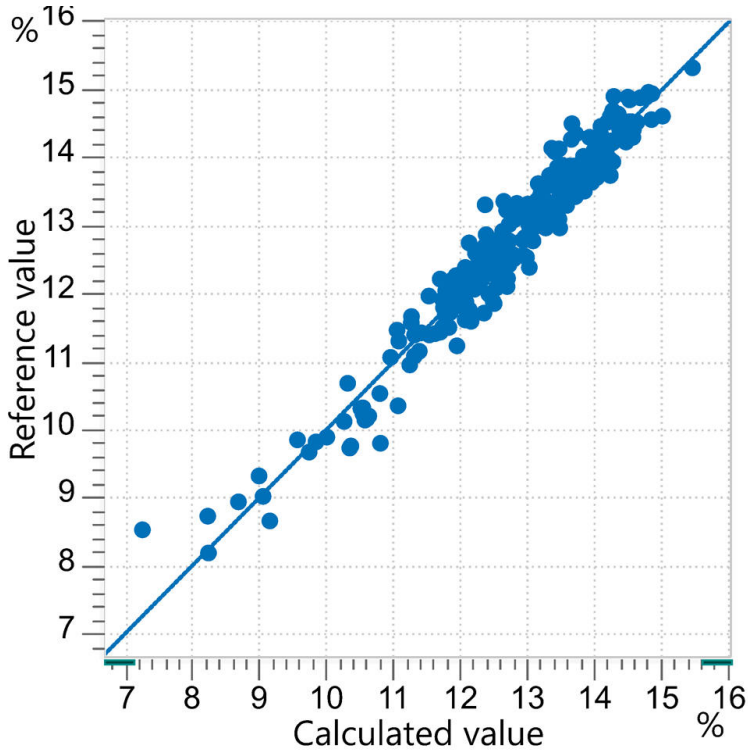

Figure 3. Correlation diagram and the respective figures of merit for the prediction of moisture in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT PROTEIN CONTENT IN SEMOLINA

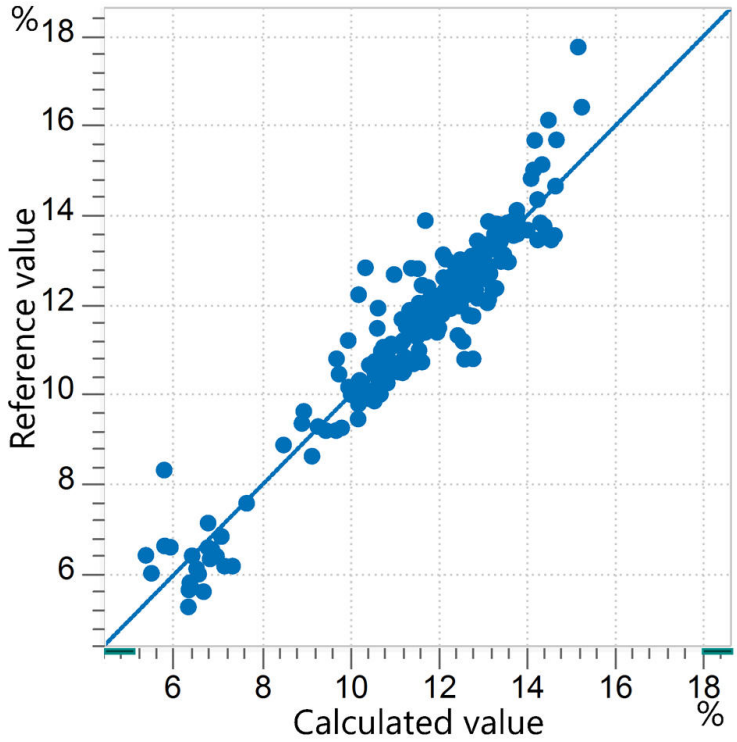

Figure 4. Correlation diagram and the respective figures of merit for the prediction of protein in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT ASH CONTENT IN SEMOLINA

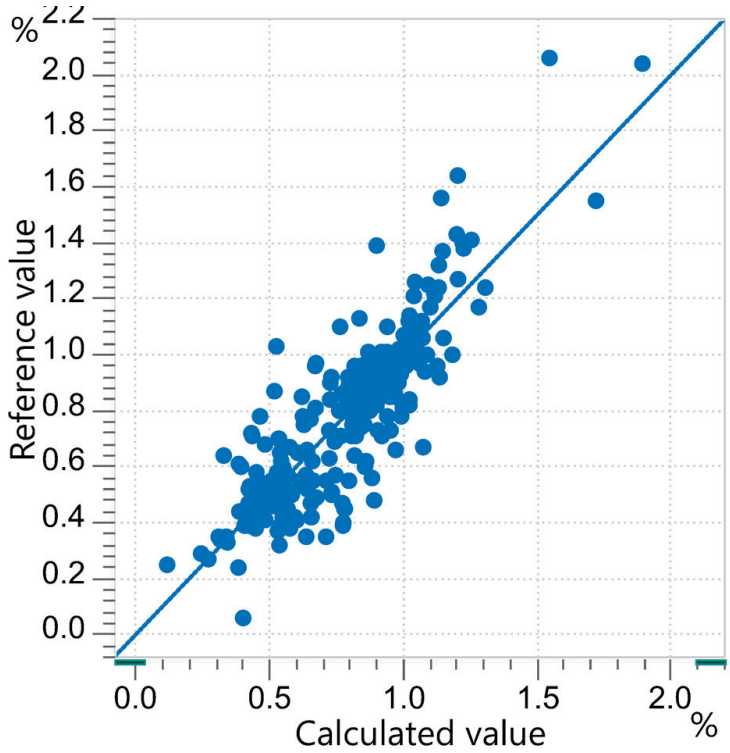

Figure 5. Correlation diagram and the respective figures of merit for the prediction of ash in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT GLUTEN CONTENT IN SEMOLINA

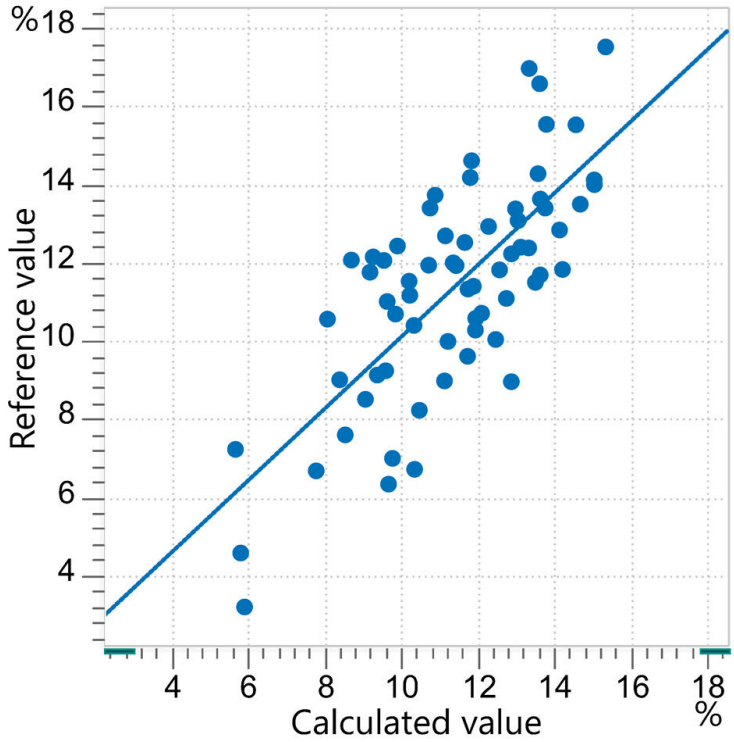

Figure 6. Correlation diagram and the respective figures of merit for the prediction of gluten in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT PROTEIN CONTENT IN SEMOLA

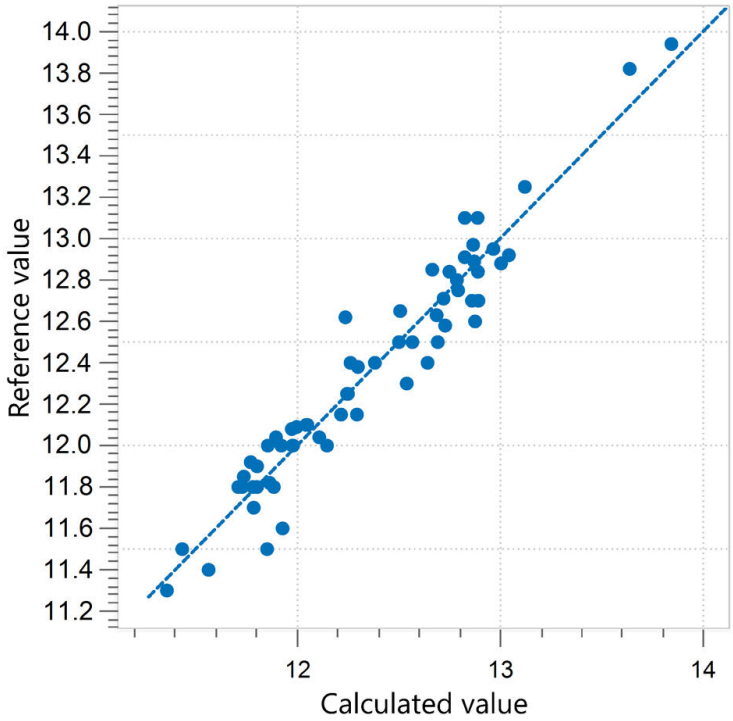

Figure 7. Correlation diagram and the respective figures of merit for the prediction of protein in semola measured with an OMNIS NIR Analyzer Solid.

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

Metrohm Nordic ApS
Lyskær 3C. 1. th.
2730 Herlev
mail@metrohm.dk

CONFIGURATION

OMNIS NIR Analyzer Solid

Near-infrared spectrometer for solid and viscous samples.

Developed and produced in accordance with Swiss quality standards, the OMNIS NIR Analyzer is the near-infrared spectroscopy (NIRS) solution for routine analysis along the entire production chain. Its application of the latest technologies and its integration in the modern OMNIS Software are reflected in its speed, operability and flexible utilization of this NIR spectrometer.

Overview of the advantages of the OMNIS NIR Analyzer Solid:

- Measurements of solids and viscous samples in less than 10 seconds
- Automated multi-position measurements for reproducible results, even with nonhomogeneous samples
- Simple integration in an automation system or link with additional analysis technologies (titration)
- Supports numerous sample vessels

Large holder OMNIS NIR, 100 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.

Large cup OMNIS NIR, 100 mm

Large sample vessel for the spectra acquisition of powders and granulates in reflection at various sample positions.

The glass bottom is made of resistant Gorilla® Glass.

Compatible with:

- Large holder OMNIS NIR, 100 mm (6.07402.100)

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Enables stand-alone operation of the OMNIS software on a WindowsTM computer.

Features:

- The license already includes one OMNIS instrument license.
- Must be activated via the Metrohm licensing portal.

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Software license Quant Development

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