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).

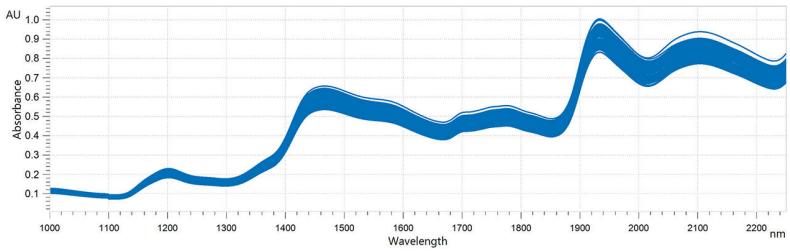

Figure 2. Near-infrared spectra of semola samples analyzed in reflection mode on an OMNIS NIR Analyzer Solid.

RESULT MOISTURE CONTENT IN SEMOLINA

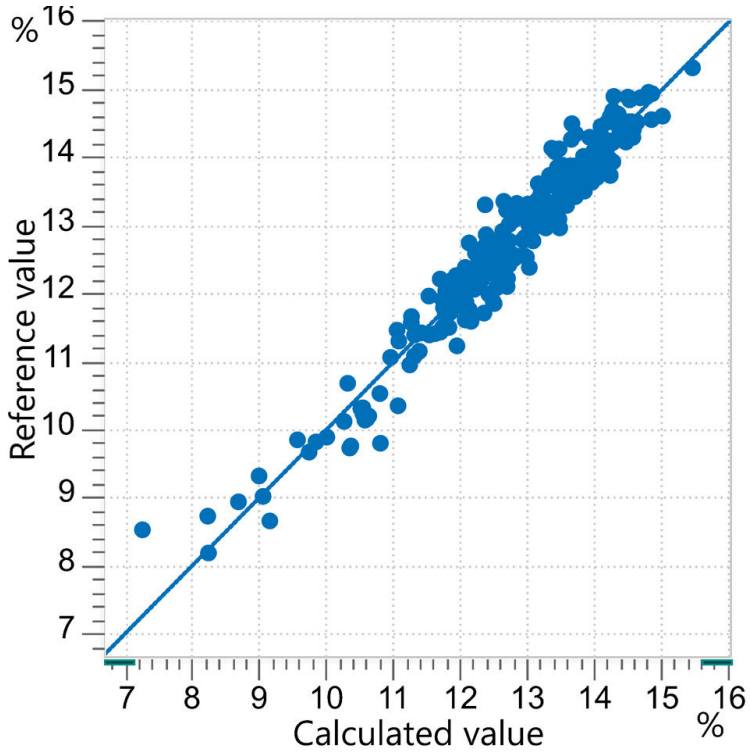

Figure 3. Correlation diagram and the respective figures of merit for the prediction of moisture in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT PROTEIN CONTENT IN SEMOLINA

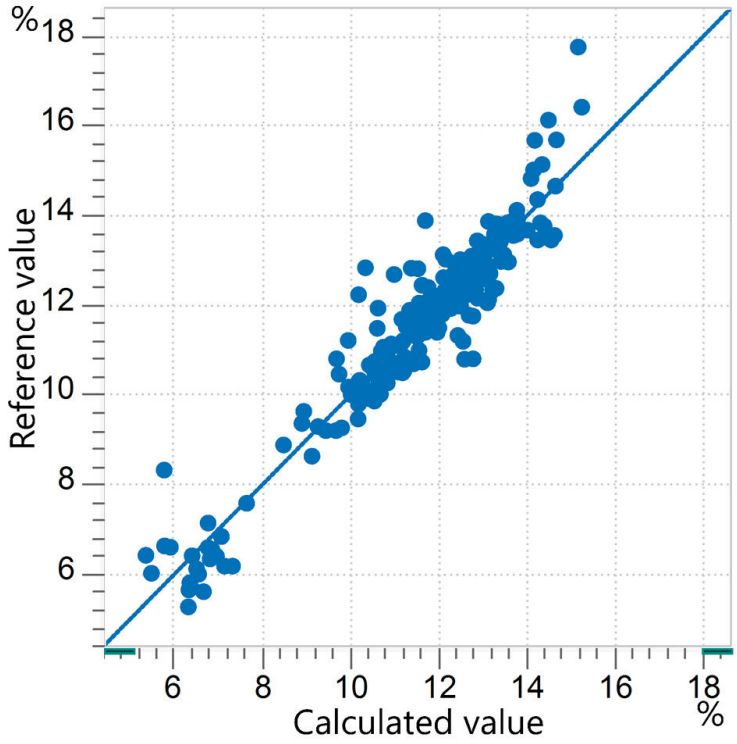

Figure 4. Correlation diagram and the respective figures of merit for the prediction of protein in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT ASH CONTENT IN SEMOLINA

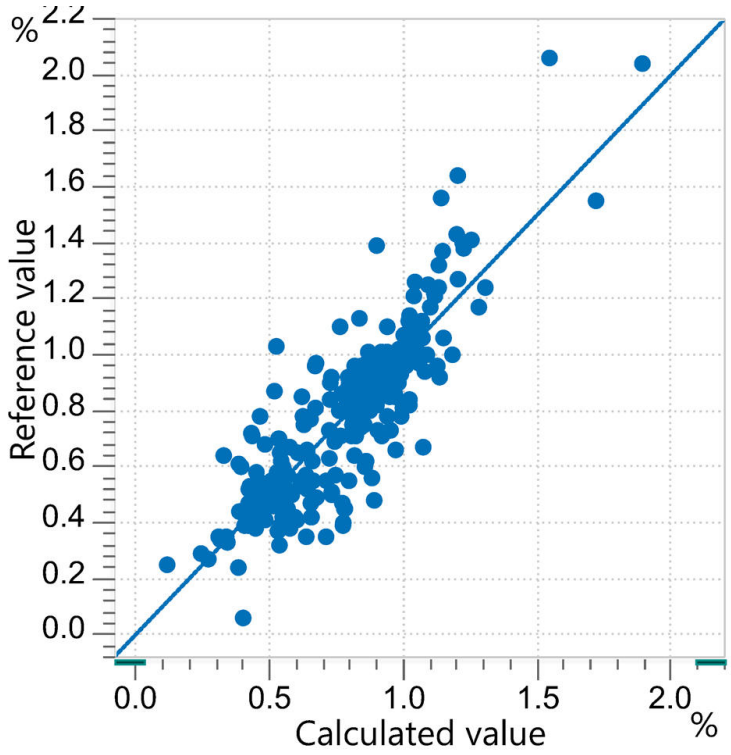

Figure 5. Correlation diagram and the respective figures of merit for the prediction of ash in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT GLUTEN CONTENT IN SEMOLINA

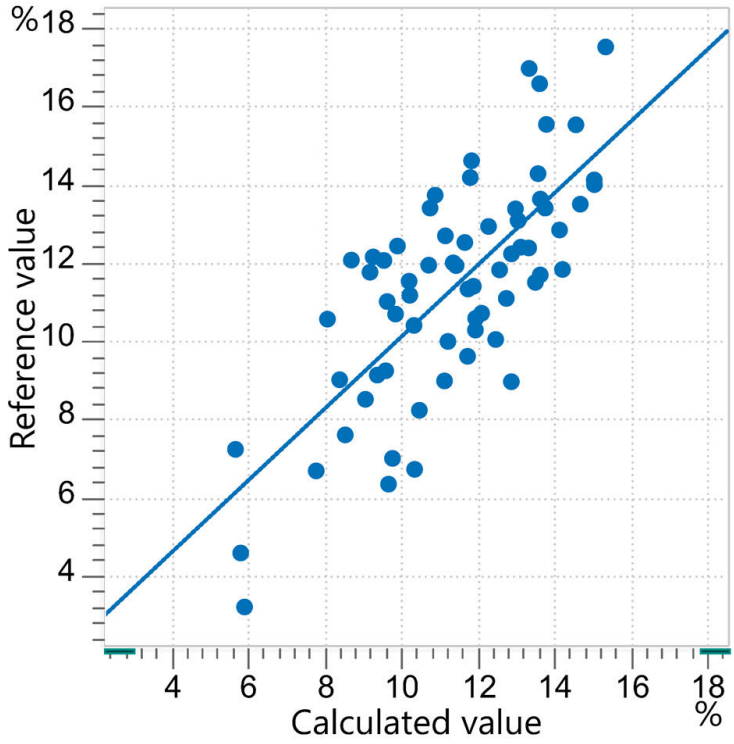

Figure 6. Correlation diagram and the respective figures of merit for the prediction of gluten in semolina measured with an OMNIS NIR Analyzer Solid.

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

RESULT PROTEIN CONTENT IN SEMOLA

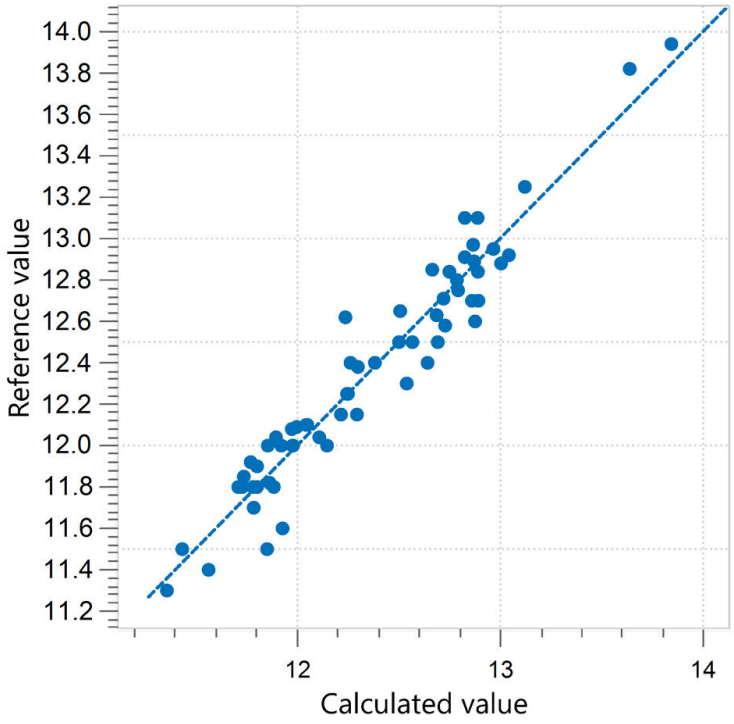

Figure 7. Correlation diagram and the respective figures of merit for the prediction of protein in semola measured with an OMNIS NIR Analyzer Solid.

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 Schweiz AG
Industriestrasse 13
4800 Zofingen
info@metrohm.ch

CONFIGURATION

OMNIS NIR Analyzer Solid

Nahinfrarotspektrometer für feste und viskose Proben.

Der OMNIS NIR Analyzer ist die nach Schweizer Qualitätsstandards entwickelte und produzierte Nahinfrarotspektroskopie(NIRS)-Lösung für die Routineanalyse entlang der gesamten Produktionskette. Die Anwendung neuester Technologien und die Integration in die moderne OMNIS Software spiegeln sich in der Geschwindigkeit, der Bedienbarkeit und dem flexiblen Einsatz dieser NIR-Spektrometer wider.

Die Vorteile des OMNIS NIR Analyzer Solid im Überblick:

- Messungen von Feststoffen und viskosen Proben in weniger als 10 Sekunden
- Automatisierte Mehrpositionenmessungen für reproduzierbare Resultate auch bei inhomogenen Proben
- Einfache Integration in ein Automationssystem oder Verknüpfung mit weiteren Analysentechniken (Titration)
- Unterstützung zahlreicher Probengefässe

Grosser Halter OMNIS NIR, 100 mm

Grosser Halter für Grosses Probengefäss OMNIS NIR, 100 mm (6.07402.110).

Erlaubt eindeutige Positionierung des Probengefässes und die Rotation des Probengefässes.

Grosse Schale OMNIS NIR, 100 mm

Grosses Probengefäss für die Spektrenaufnahme von Pulvern und Granulaten in Reflexion an unterschiedlichen Probenstellen.

Der Glasboden besteht aus widerstandsfähigem Gorilla® Glass.

Kompatibel mit:

- Grossen Halter OMNIS NIR, 100 mm (6.07402.100)

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS Stand-Alone Lizenz

Ermöglicht den Stand-Alone Betrieb der OMNIS Software auf einem WindowsTM Computer.

Merkmale:

- Die Lizenz enthält bereits eine OMNIS Geräte Lizenz.
- Muss über das Metrohm Lizenzierungsportal aktiviert werden.

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

Softwarelizenz Quant Development

Softwarelizenz für die Erstellung und Bearbeitung von Quantifizierungsmodellen in einer Stand-Alone OMNIS Software Installation.