



Application Note AN-NIR-128

Milk powder analysis by near-infrared spectroscopy

Determination of moisture, fat, lactose, and protein content

For milk powder producers, final product control is essential to meet strict regulatory standards, guarantee comprehensive quality assurance, ensure consistent nutritional quality, and extend shelf life. These are all especially important for infant formula and dairy ingredients used in sensitive applications. Near-infrared spectroscopy (NIRS) is a fast, reagent-free method for measuring key quality parameters

such as moisture, protein, lactose, and fat content directly in milk powder. The NIRS solution requires no sample preparation, enabling real-time monitoring either in the lab or directly on the production line. This allows producers to react quickly to process variations, minimize waste, and maintain product integrity batch after batch.

EXPERIMENTAL EQUIPMENT

More than 600 samples of powdered milk from different suppliers were analyzed on an OMNIS NIR Analyzer (Figure 1). The different milk powders were placed into an OMNIS sample cup and analyzed in diffuse reflection mode. To include sample variety, the sample rotated during measurement to collect spectra from different locations. The automatically averaged spectra were used for model development. Reference values were obtained by official methods, e.g., AOAC 927.05 (moisture), AOAC 939.02 (protein), and AOAC 932.06 (fat). For the lactose content determination, a phenol-sulfuric acid method was used.

RESULT

The obtained NIR spectra (Figure 2) were used to create prediction models for the different reference parameters. An external validation set was used to verify the predictive performance of the calculated

prediction models. Correlation diagrams which display the relation between the NIR prediction and the reference values are shown in Figures 3–6 together with the respective figures of merit (FOM).



Figure 1. OMNIS NIR Analyzer Liquid/Solid.

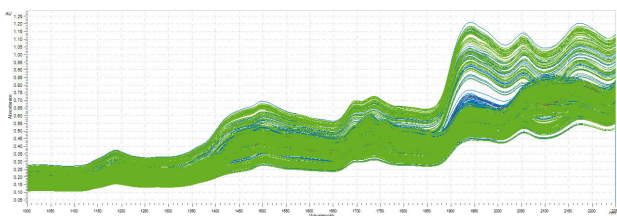


Figure 2. NIR spectra of milk powder samples. Data was obtained with an OMNIS NIR Analyzer. Spectra shown in blue have been used to calibrate the model, while green spectra have been used for validation.

Result moisture in milk powder

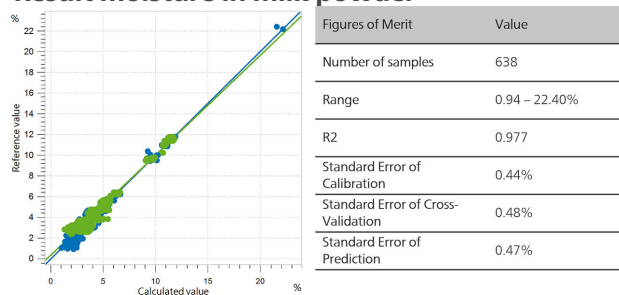


Figure 3. Correlation diagram and the respective FOMs for the prediction of moisture content in milk powder using an OMNIS NIR Analyzer. Reference values were obtained according to AOAC 927.05.

Result protein in milk powder

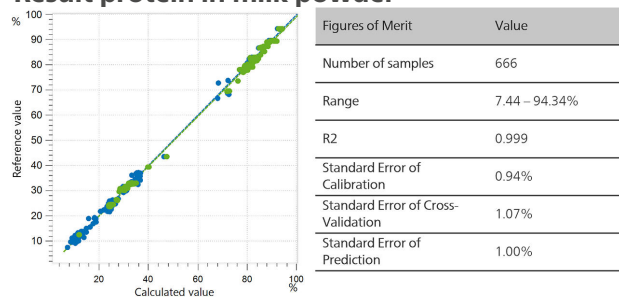


Figure 4. Correlation diagram and the respective FOMs for the prediction of protein content in milk powder using an OMNIS NIR Analyzer. Reference values were obtained according to AOAC 939.02.

RESULT

Result fat in milk powder

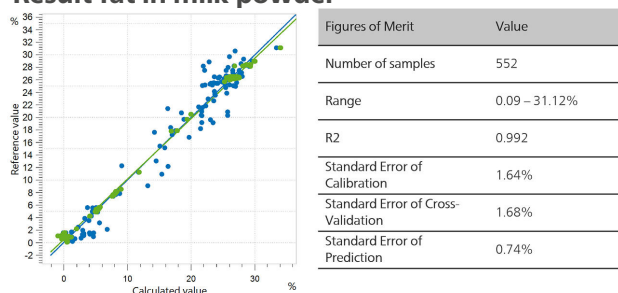


Figure 5. Correlation diagram and the respective FOMs for the prediction of fat content in milk powder using an OMNIS NIR Analyzer. Reference values were obtained according to AOAC 932.06.

Result lactose in milk powder

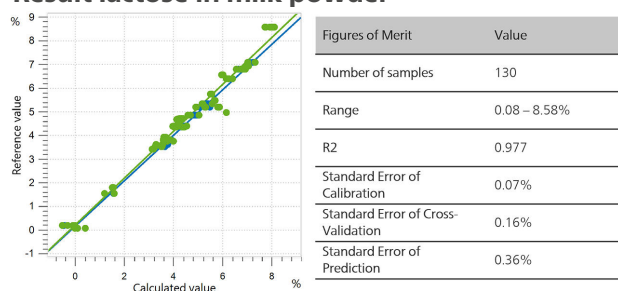


Figure 6. Correlation diagram and the respective FOMs for the prediction of lactose content in milk powder using an OMNIS NIR Analyzer.

CONCLUSION

This Application Note presented the analysis of milk powder using NIR spectroscopy. Models for several quality parameters (fat, protein, lactose, and moisture content) were created. Independent validation samples confirmed the robustness and reliability of the models, with high correlation coefficients and low

prediction errors achieved across all parameters. Notably, the dataset included samples from diverse global origins, capturing a broad range of product variability. This study shows that NIRS can be successfully integrated into the quality control workflow for dairy powder analysis.

CONTACT

Metrohm Schweiz AG
Industriestrasse 13
4800 Zofingen

info@metrohm.ch

CONFIGURATION



OMNIS NIR Analyzer Liquid/Solid

Nahinfrarot-Spektrometer für flüssige, feste und viskose Proben.

Der OMNIS NIR Analyzer ist die nach Schweizer Qualitätsstandards entwickelte und produzierte Nahinfrarot-Spektroskopie (NIRS) Lösung für die Routineanalytik entlang der gesamten Produktionskette. Die Nutzung neuester Technologien und die Einbindung 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 Liquid / Solid im Überblick:

- Messungen von flüssigen, festen und viskosen Proben in weniger als 10 Sekunden
- Schnelle sequenzielle Messung von flüssigen und festen Proben ohne Umbau des Systems
- Einfache Einbindung in ein Automationssystem oder Verknüpfung mit weiteren Analysetechnologien (Titration)
- Unterstützung zahlreicher Probengefässe

Highlights Flüssigmessungen:

- Temperaturkontrolle an der Probe von 25°C – 80°C
- Automatische Erkennung der Probe

Highlights Feststoffmessungen:

- Automatisierte Mehrpositionenmessungen für reproduzierbare Ergebnisse auch bei inhomogenen Proben.



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.

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 Windows™ 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.



Vorkalibrierung, Milchpulver, fest

OMNIS Vorkalibrierung für die Bestimmung der Feuchtigkeit, des Protein, Fett und Lactosegehalts in Milchpulver mittels NIR-Spektroskopie.