Application Note AN-NIR-128

近外光技在粉分析中的用

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.

Figure 1. OMNIS NIR Analyzer Liquid/Solid.

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).

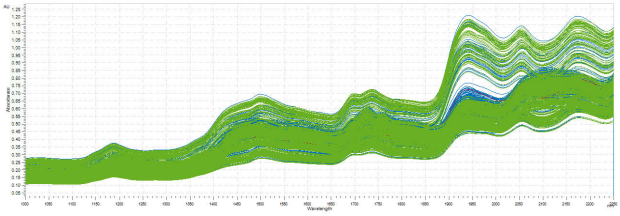
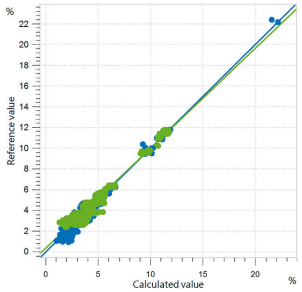


Figure 2. NIR spectra of milk powder samples. Data was obtained with an OMNIS NIR Analyzer. Spectra shown in blue have been used to calibrate the model, while green spectra have been used for validation.

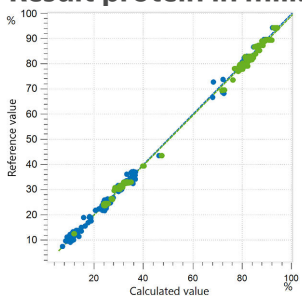
Result moisture in milk powder



Figures of Merit	Value
Number of samples	638
Range	0.94 – 22.40%
R2	0.977
Standard Error of Calibration	0.44%
Standard Error of Cross-Validation	0.48%
Standard Error of Prediction	0.47%

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.

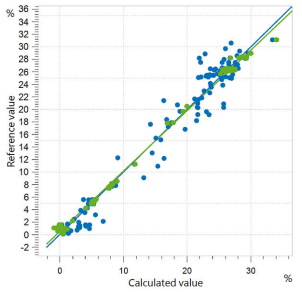
Result protein in milk powder



Figures of Merit	Value
Number of samples	666
Range	7.44 – 94.34%
R2	0.999
Standard Error of Calibration	0.94%
Standard Error of Cross-Validation	1.07%
Standard Error of Prediction	1.00%

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.

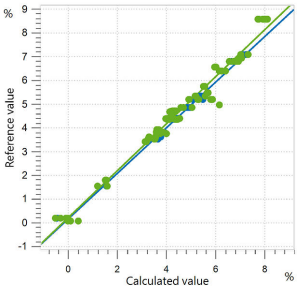
Result fat in milk powder



Figures of Merit	Value
Number of samples	552
Range	0.09 – 31.12%
R2	0.992
Standard Error of Calibration	1.64%
Standard Error of Cross-Validation	1.68%
Standard Error of Prediction	0.74%

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



Figures of Merit	Value
Number of samples	130
Range	0.08 – 8.58%
R2	0.977
Standard Error of Calibration	0.07%
Standard Error of Cross-Validation	0.16%
Standard Error of Prediction	0.36%

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

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CONFIGURATION

OMNIS NIR Analyzer Liquid/Solid

合液体、固体和粘性品的近外光。

OMNIS NIR Analyzer 是一按照瑞士量准和生的近外光 (NIRS) 解决方案,用于整个生的常分析。使用新技和嵌入先 OMNIS Software 反在 NIR 光的速度、可操作性和活使用上。

OMNIS NIR Analyzer Liquid / Solid 的点概:

- 在 10 秒以内量液体、固体和粘性品
- 快速量液体和固体品,不需要改装系
- 方便地嵌入自系,或者与其它分析技(滴定)
- 支持大量品容器

液体量亮点:

- 25° C – 80° C 的品行温度控制
- 自品

固体量亮点:

- 自化多位置量,即使在品不均匀,也能得可重的果

OMNIS NIR100 mm

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

允明地定位品容器和旋品容器。

OMNIS NIR100 mm

用于在不同品位置通反射采集粉末和粒反射光的大品容器。

兼容:

- 大支架 OMNIS NIR,100 mm (6.07402.100)

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS

允机版 OMNIS 件在一台 WindowsTM 算机上行。

特性:

- 可已含有一 OMNIS 可。
- 通万通可授平台行激活。
- 不可再外算机上使用。

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

Quant Development

用于在独立 OMNIS Software 安装套件中写和量化模型的件可。

通 NIR 光定粉中湿度、蛋白、脂肪和乳糖含量的 OMNIS 校准。