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.

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).

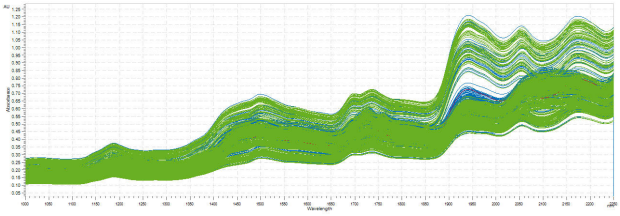
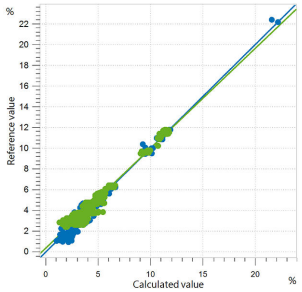


Figure 2. NIR spectra of milk powder samples. Data was obtained with an OMNIS NIR Analyzer. Spectra shown in blue have been used to calibrate the model, while green spectra have been used for validation.

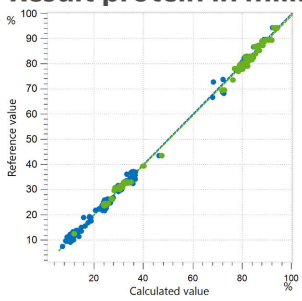
Result moisture in milk powder



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.

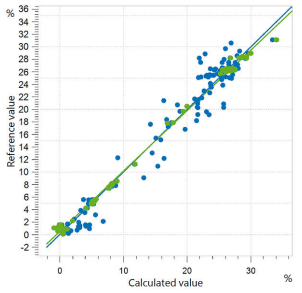
Result protein in milk powder



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.

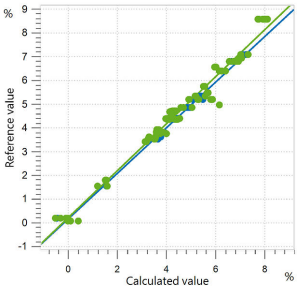
Result fat in milk powder



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

液体、固体および粘性サンフルのための近赤外スヘクトロメーター。

OMNIS NIR Analyzer は、スイスの品質基準に従って開発・製造された、生産チェーン全体に沿ったルーチン分析のための近赤外分光法 (NIRS) ソリューションてす。最新技術の適用と最新の OMNIS Software への統合は、この NIR スヘクトロメーターの速度、ユーサヒリティ、柔軟な使用に反映されています。

OMNIS NIR Analyzer Liquid/Solid の利点の概要:

- 10秒未満て液体サンフル、固体サンフルと粘性サンフルを測定
- システムの組み換えなして液体サンフル、固体サンフルを迅速に連続測定
- オートメーションシステムへの統合、またはその他の分析技術 (滴定) との連結か容易
- 多数のサンフル容器に対応

液体測定のハイライト:

- 25° C ~ 80° C のサンフルの温度制御
- サンフルの自動検出

固体測定のハイライト:

- 不均質なサンフルても再現性のある結果を得るための自動マルチホシション測定

OMNIS NIR100 mm

大型サンフル容器 OMNIS NIR、100 mm (6.07402.110) 用大型ホルター。

サンフル容器の確実な配置と回転を可能にします。

OMNIS NIR100 mm

様々なサンフル位置における反射中の粉末および顆粒のスヘクトル記録のための大型サンフル容器。
次の製品と互換性かあります:

- 大型ホルター OMNIS NIR、100 mm (6.07402.100)

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS

WindowsTMコンヒューター上のOMNISソフトウェアをスタントアローン操作することか可能になります。
特徴:

- ライセンスには、既に1つのOMNISテハイスライセンスか含まれています。
- メトローム・ライセンシンクホータルにて、アクティフ化する必要かあります。
- 他のコンヒューターに移行することはてきません。

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

Quant Development

スタントアロン型 OMNIS Software のインストールにおける定量化モテルの作成と編集のためのソフトウェアライセンス。

近赤外分光法による、粉ミルク中の湿気、脂肪、乳糖含有量の測定のための OMNIS フリキャリフレーション。