

Application Note AN-NIR-129

Dried pet food analysis by near-infrared spectroscopy (NIRS)

Rapid determination of moisture, protein, fat, and ash

Pet food testing involves accurate monitoring and control of moisture, protein, fat, and ash content. This allows pet food manufacturers to satisfy nutritional adequacy requirements, meet regulatory guidelines, and provide high-quality foods to pet owners.

Traditional analysis methods are often slow and labor-intensive. Near-infrared (NIR) spectroscopy provides a fast, nondestructive alternative for analyzing these key quality control parameters with minimal sample preparation. This study evaluates the use of NIR spectroscopy in the pet food industry for efficient and reliable quality control during dried pet food production.

EXPERIMENTAL EQUIPMENT

199 dried pet food samples (mainly dog and cat food) from different suppliers were analyzed in whole and ground forms on an OMNIS NIR Analyzer Solid (Figure 1). The samples were added to 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 such as ISO 6496 (moisture), ISO 5983 (protein), ISO 5984 (ash), and ISO 6492 (fat).



Figure 1. OMNIS NIR Analyzer 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 3–10 together with the respective figures of merit (FOM).

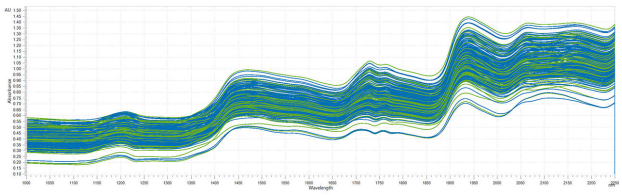
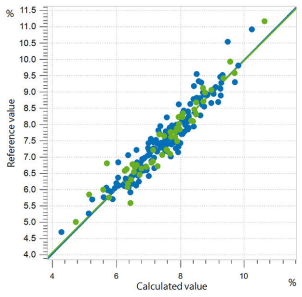


Figure 2. NIR spectra of pet food samples. Data was obtained with an OMNIS NIR Analyzer Solid. Spectra shown in blue have been used to calibrate the model, while green spectra have been used for validation.

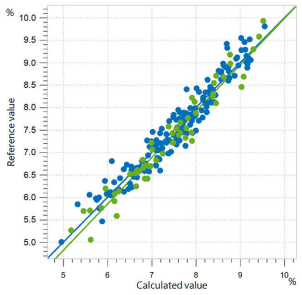
Result moisture in dried pet food (whole)



Figures of Merit	Value
R2	0.921
Standard Error of Calibration	0.32%
Standard Error of Cross-Validation	0.34%
Standard Error of Prediction	0.34%

Figure 3. Correlation diagram and the respective FOMs for the prediction of moisture in dried pet food (whole) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

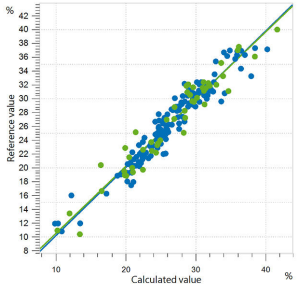
Result moisture in dried pet food (ground)



Figures of Merit	Value
R2	0.948
Standard Error of Calibration	0.25%
Standard Error of Cross-Validation	0.26%
Standard Error of Prediction	0.28%

Figure 4. Correlation diagram and the respective FOMs for the prediction of moisture in dried pet food (ground) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

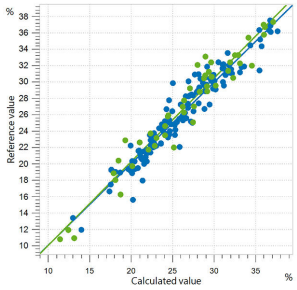
Result protein in dried pet food (whole)



Figures of Merit	Value
R2	0.932
Standard Error of Calibration	1.43%
Standard Error of Cross-Validation	1.51%
Standard Error of Prediction	1.71%

Figure 5. Correlation diagram and the respective FOMs for the prediction of protein in dried pet food (whole) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

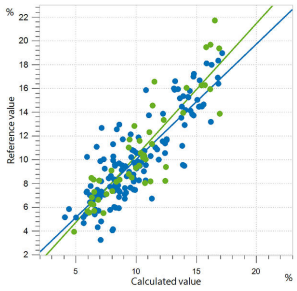
Result protein in dried pet food (ground)



Figures of Merit	Value
R2	0.942
Standard Error of Calibration	1.32%
Standard Error of Cross-Validation	1.39%
Standard Error of Prediction	1.55%

Figure 6. Correlation diagram and the respective FOMs for the prediction of protein in dried pet food (ground) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

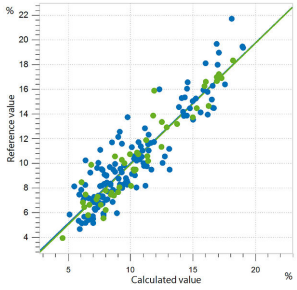
Result fat in dried pet food (whole)



Figures of Merit	Value
R2	0.795
Standard Error of Calibration	1.81%
Standard Error of Cross-Validation	1.89%
Standard Error of Prediction	1.99%

Figure 7. Correlation diagram and the respective FOMs for the prediction of fat in dried pet food (whole) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

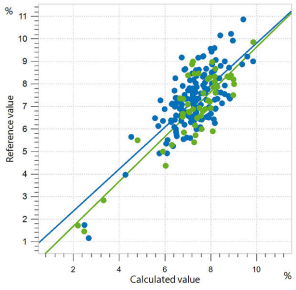
Result fat in dried pet food (ground)



Figures of Merit	Value
R2	0.889
Standard Error of Calibration	1.45%
Standard Error of Cross-Validation	1.52%
Standard Error of Prediction	1.25%

Figure 8. Correlation diagram and the respective FOMs for the prediction of fat in dried pet food (ground) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

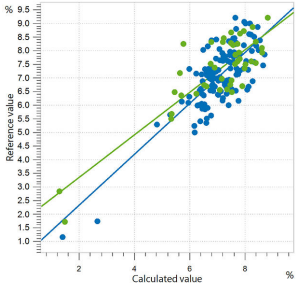
Result ash in dried pet food (whole)



Figures of Merit	Value
R2	0.733
Standard Error of Calibration	0.81%
Standard Error of Cross-Validation	0.88%
Standard Error of Prediction	0.95%

Figure 9. Correlation diagram and the respective FOMs for the prediction of ash in dried pet food (whole) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

Result ash in dried pet food (ground)



Figures of Merit	Value
R2	0.733
Standard Error of Calibration	0.62%
Standard Error of Cross-Validation	0.71%
Standard Error of Prediction	0.83%

Figure 10. Correlation diagram and the respective FOMs for the prediction of ash in dried pet food (ground) using an OMNIS NIR Analyzer Solid. Blue dots represent calibration samples, green dots represent samples used to validate the model.

CONCLUSION

This Application Note demonstrates the feasibility of using NIR spectroscopy for the analysis of several pet food quality parameters, including protein, moisture, fat, and ash. Results indicate that lower prediction errors can be obtained when grinding pet food samples before their analysis. A comparison between different methods used for the analysis of pet food clearly highlights the significant time-saving potential of NIR spectroscopy (Table 1).

Furthermore, the simplicity of the analysis and the availability of a pre-calibrated instrument, using the pre-calibration, dry pet food, solid (6.06008.027), make both the implementation and the application of NIR spectroscopy with OMNIS NIRS straightforward.

Table 1. Overview of time effort for the analysis of different parameters in pet food by traditional methods and NIR spectroscopy.

Parameter	Standard	Process	Estimated time
Moisture	ISO 6496	Oven drying	2.5 hours
Protein	ISO 5983	Kjeldahl method	4.0 hours
Fat	ISO 6492	Soxhlet extraction	4.0 hours
Ash	ISO 5984	Incineration	4.0 hours
Moisture, protein, fat, ash	ASTM D6122	NIR spectroscopy	1.0 minute

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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)

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS Stand-Alone license

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.

OMNIS
A WHOLE NEW LEVEL OF PERFORMANCE

Software license Quant Development

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



Pre-calibration, dry food for household pets, solid

OMNIS pre-calibration for determination of moisture, protein, fat, and ash content in dry food for household pets using NIR spectroscopy.