



Application Note AN-NIR-148

Fish meal analysis by near-infrared spectroscopy

NIR spectroscopy reduces analysis time from hours to seconds

Regarding animal nutrition, fish meal is a premium source of omega-3 fatty acids, protein, and essential minerals. Due to its nutritional properties, it is not only widely used in aquaculture, but also as an additive to swine feed and poultry feed. To analyze the main quality components of fish meal, such as fiber, fat, protein, moisture, and ash content, multiple wet

chemistry methods are usually needed.

Instead of waiting hours for the results from these wet chemical techniques, near-infrared spectroscopy (NIRS) delivers results within seconds without the use of chemicals. This allows manufacturers to execute frequent checks against product specifications and perform fish meal quality control with ease.

EXPERIMENTAL EQUIPMENT

More than 1700 samples of fish meal from different suppliers were analyzed with an OMNIS NIR Analyzer Solid (Figure 1) and a large sample cup. Every fish meal powder sample was measured in reflection measurement mode at five different positions to create an average spectrum. This minimizes sample inhomogeneities and results in a more representative NIR spectrum. Model development and validation was performed with the OMNIS Software.



Figure 1. The OMNIS NIR Analyzer Solid from Metrohm.

RESULT

The collected NIR spectra of fish meal samples (Figure 2) were used to create prediction models for the following parameters: protein, fat, moisture, ash, and fiber content. To validate the models, 25% of the data set was used to create an independent validation set. Correlation diagrams which display the relation between the NIR prediction and the lab values

measured with standard methods are shown in Figures 3–8 together with the respective figures of merit (FOM). The standard errors displayed of cross validation (SECV) and standard errors of prediction (SEP) show the expected accuracy during routine analysis of fish meal in QC laboratories.

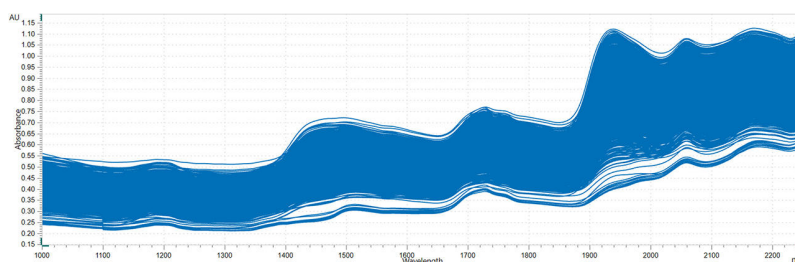


Figure 2. Spectral overlay of fish meal powder samples measured in reflection mode with an OMNIS NIR Analyzer Solid.

RESULT PROTEIN CONTENT

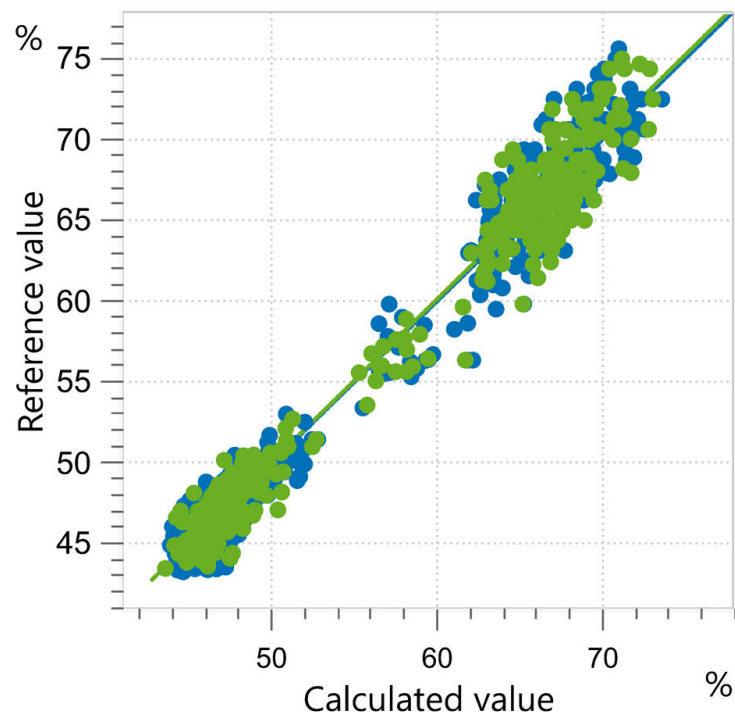


Figure 3. Correlation diagram and the respective FOMs for the prediction of protein content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (%)	SECV (%)	SEP (%)
0.973	1.25	1.27	1.64

RESULT FAT CONTENT

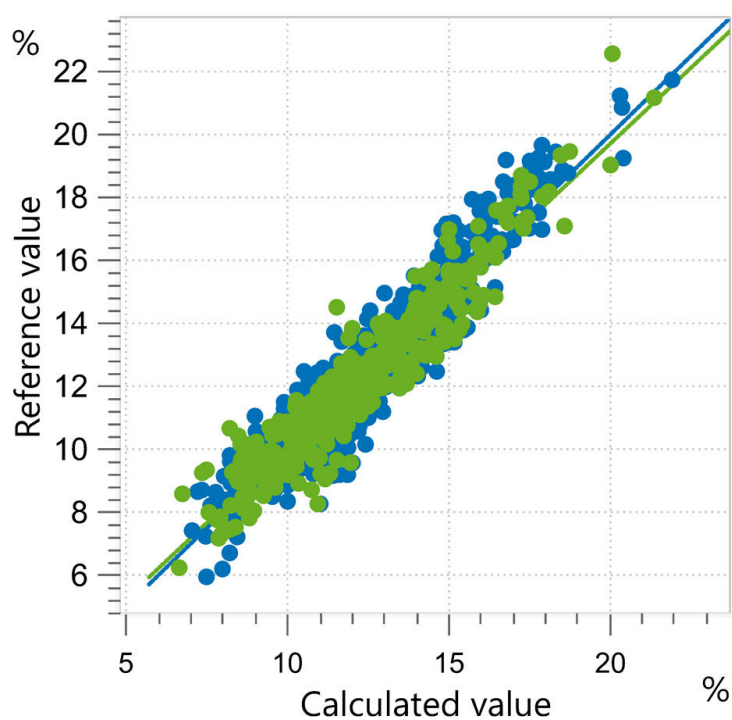


Figure 4. Correlation diagram and the respective FOMs for the prediction of fat content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (%)	SECV (%)	SEP (%)
0.902	0.72	0.73	0.80

RESULT MOISTURE CONTENT

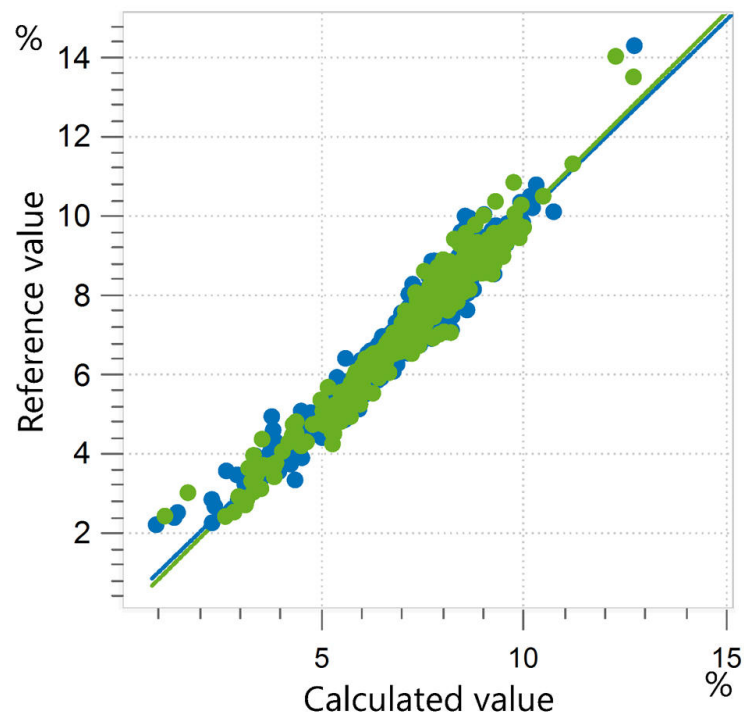


Figure 5. Correlation diagram and the respective FOMs for the prediction of moisture content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R ²	SEC (%)	SECV (%)	SEP (%)
0.955	0.27	0.28	0.35

RESULT ASH CONTENT

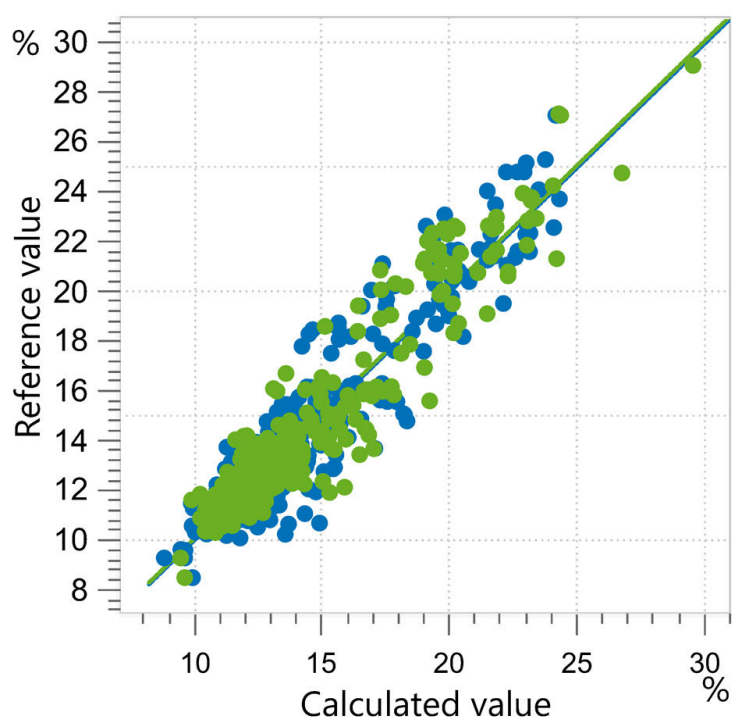


Figure 6. Correlation diagram and the respective FOMs for the prediction of ash content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (%)	SECV (%)	SEP (%)
0.900	0.78	0.80	1.10

RESULT FIBER CONTENT

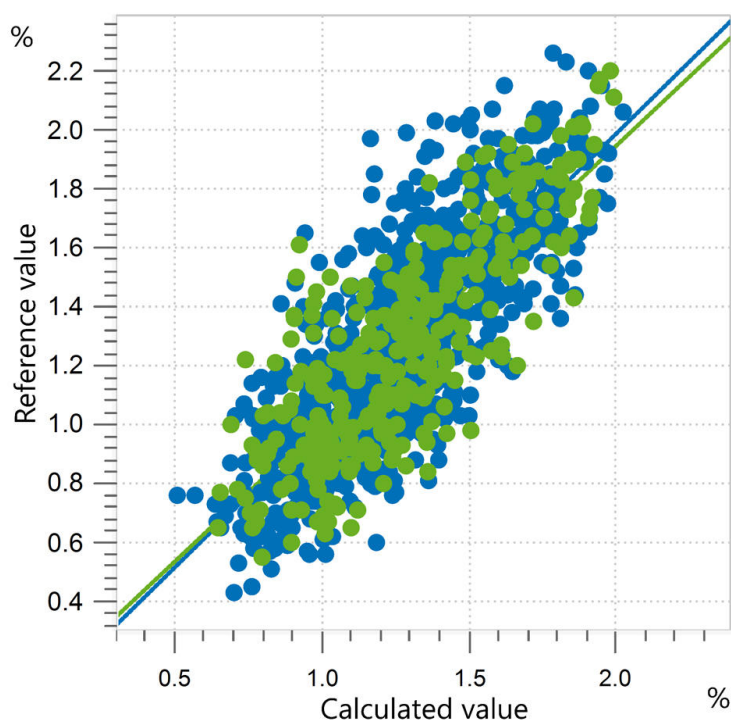


Figure 7. Correlation diagram and the respective FOMs for the prediction of fiber content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

R^2	SEC (%)	SECV (%)	SEP (%)
0.647	0.21	0.22	0.21

CONCLUSION

This Application Note shows the feasibility of using near-infrared spectroscopy for fish meal feed analysis. The main composition parameters of protein, fat, ash, fiber, and water content are determined in seconds without the use of chemicals. NIRS helps to save costs and improve lab safety when compared to standard

wet chemistry methods. By using NIRS for efficient multiparameter analysis, quality control laboratories can save hours of time per sample measurement (**Table 1**), resulting in much higher sample throughput.

Table 1. Overview of standard methods and time to result for the determination of key parameters in fish meal.

Parameter	Norm	Method	Time to analysis
Protein	ISO 5983	Kjeldahl method	~ 2–4 hours
Fat	ISO 6492	Hydrolysis and extraction	~ 7–10 hours
Moisture	ISO 6496	LOD: loss on drying	~ 5 hours
Fiber	ISO 6865	Acid-alkali digestion	~ 4–7 hours
Ash	ISO 5984	Oven furnace	~ 3–6 hours

CONTACT

Metrohm France
13, avenue du Québec - CS
90038
91978 VILLEBON
COURTABOEUF CEDEX

info@metrohm.fr

CONFIGURATION



OMNIS NIR Analyzer Solid

Spectromètre proche infrarouge pour échantillons solides et visqueux.

L'OMNIS NIR Analyzer est la solution de spectroscopie proche infrarouge (NIRS) développée et produite selon les normes de qualité suisses pour les analyses de routine tout au long de la chaîne de fabrication. L'application des technologies les plus récentes et l'intégration dans le logiciel OMNIS moderne se reflètent dans la vitesse, la facilité du maniement et la flexibilité d'utilisation de ce spectromètre NIR.

Aperçu des avantages de l'OMNIS NIR Analyzer Solid :

- Mesures d'échantillons solides et visqueux en moins de 10 secondes
- Mesures multi-positions automatisées pour des résultats reproductibles, même avec des échantillons non homogènes
- Intégration simple dans un système d'automatisation ou liaison avec d'autres technologies d'analyse (titrage)
- Prise en charge de nombreux récipients d'échantillon



Grande coupelle OMNIS NIR, 100 mm

Grand récipient d'échantillon pour l'enregistrement de spectres par réflexion de poudres et de granulés en différents points de l'échantillon.

Le fond en verre est en Gorilla® Glass résistant.

Compatible avec:

- Grand support OMNIS NIR, 100 mm (6.07402.100)



Grand support OMNIS NIR, 100 mm

Grand support pour grand récipient d'échantillon OMNIS NIR, 100 mm (6.07402.110).

Permet un positionnement univoque du récipient d'échantillon et sa rotation.

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Licence OMNIS autonome

Elle permet l'exploitation autonome du logiciel OMNIS sur un ordinateur Windows™.

Caractéristiques :

- La licence comprend déjà une licence pour appareils OMNIS.
- Elle doit être activée via le portail d'octroi de licences Metrohm.

Licence logicielle Quant Development

Licence logicielle pour la création et l'édition de modèles de quantification dans une installation du logiciel OMNIS Stand-Alone.

Pré-calibration de farine de poisson, solide

Pré-calibration OMNIS pour la détermination de la teneur en protéines, graisse, humidité, fibres et cendres dans la farine de poisson à l'aide de la spectroscopie NIR.