

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.

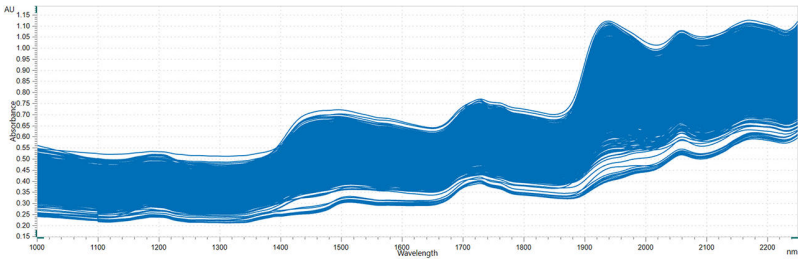


Figure 2. Spectral overlay of fish meal powder samples measured in reflection mode with an OMNIS NIR Analyzer Solid.

RESULT PROTEIN CONTENT

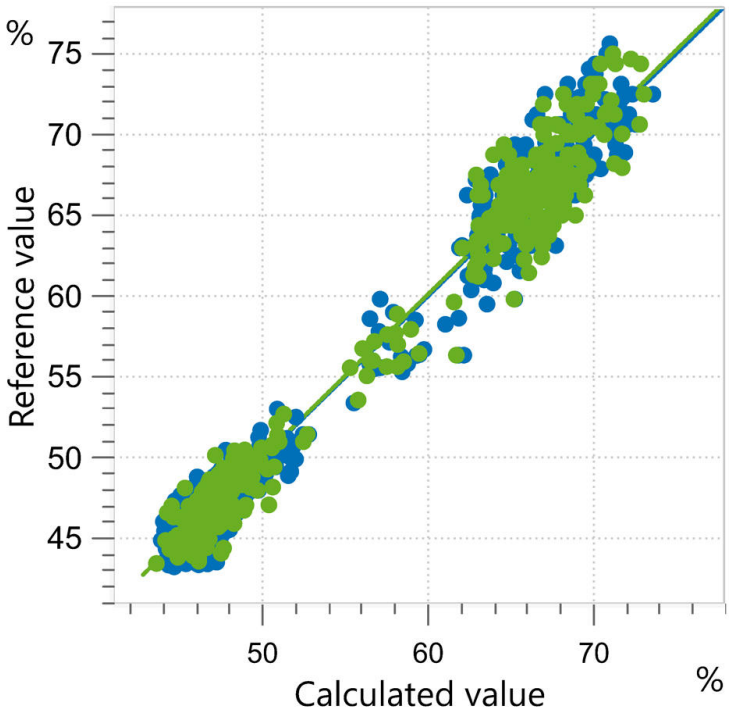


Figure 3. Correlation diagram and the respective FOMs for the prediction of protein content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT FAT CONTENT

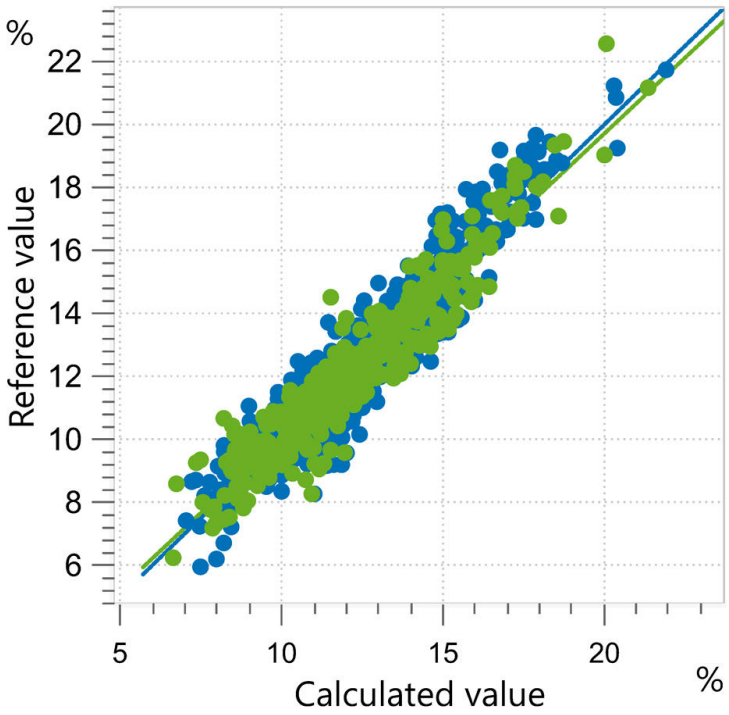


Figure 4. Correlation diagram and the respective FOMs for the prediction of fat content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT MOISTURE CONTENT

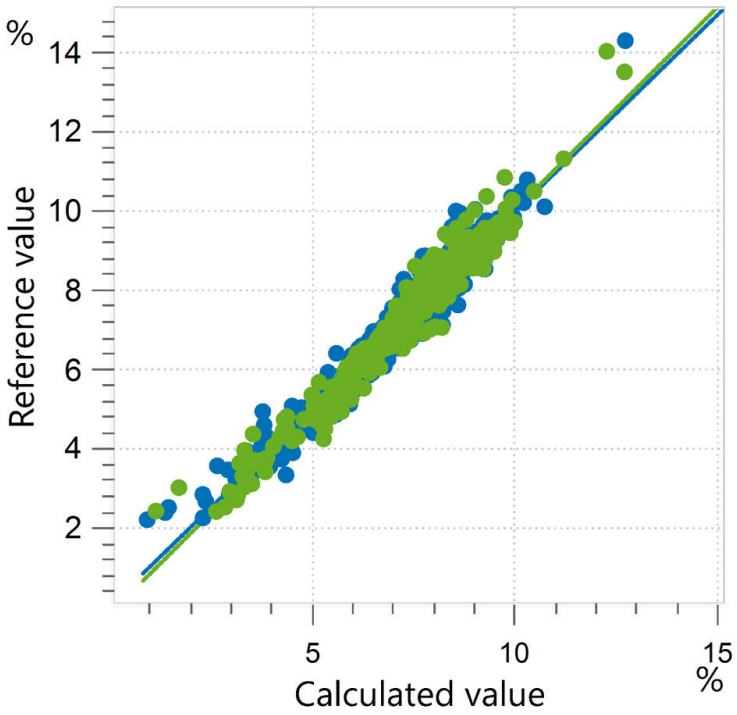


Figure 5. Correlation diagram and the respective FOMs for the prediction of moisture content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT ASH CONTENT

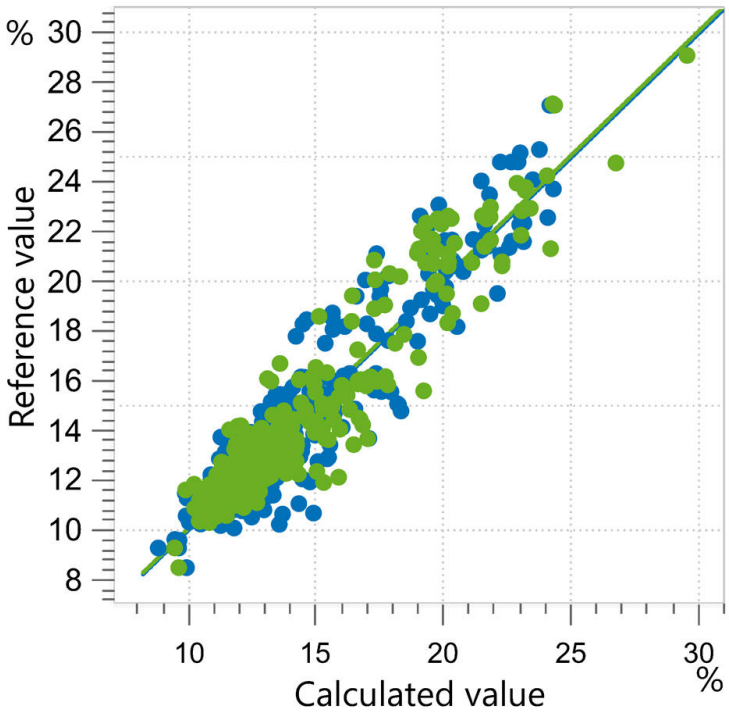


Figure 6. Correlation diagram and the respective FOMs for the prediction of ash content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT FIBER CONTENT

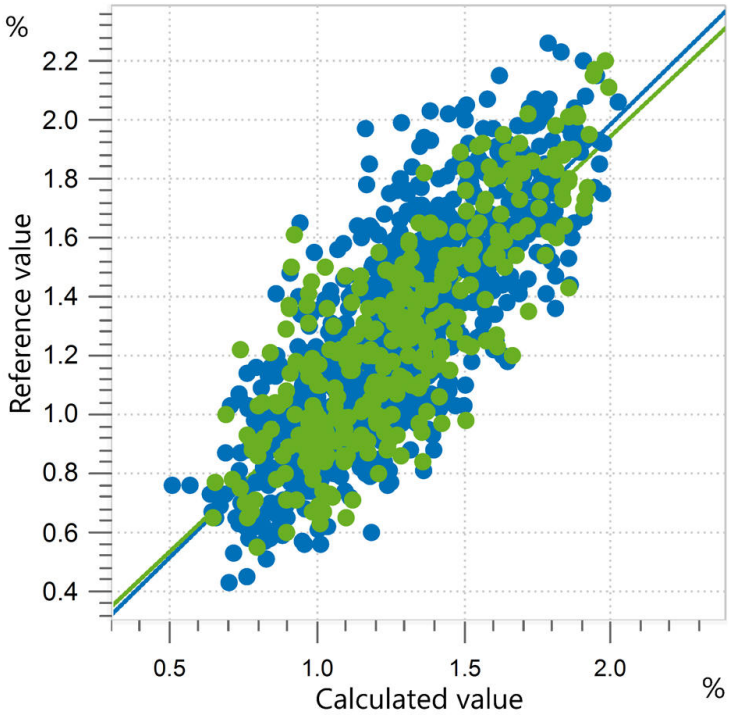


Figure 7. Correlation diagram and the respective FOMs for the prediction of fiber content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

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CONFIGURATION



OMNIS NIR Analyzer Solid

固形物および粘性のあるサンプル用の近赤外スペクトロメーター。

スイスの品質規格に基づいて開発および製造された OMNIS NIR Analyzer は、生産工程全体にわたる日常的な分析に対応する近赤外分光法(NIRS)ソリューションです。最新技術の適用と、最新の OMNIS Software との統合により、この NIR スペクトロメーターは速度、操作性、そして柔軟な活用が可能となっています。

OMNIS NIR Analyzer Solid の利点の概要:

- 固形物および粘性サンプルの測定を 10 秒未満で実施
- 不均一なサンプルであっても再現性のある結果が得られる、自動多点測定
- オートメーションシステムへの容易な統合、または追加の分析技術 (滴定) との連携
- 多数のサンプル容器に対応



OMNIS NIR100 mm

様々なサンプル位置における反射中の粉末および顆粒のスペクトル記録のための大型サンプル容器。
ガラス底面は高い強度を誇る Gorilla® Glass 製です。
次の製品と互換性があります:

- 大型ホルダー OMNIS NIR、100 mm (6.07402.100)



OMNIS NIR100 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.

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OMNIS

WindowsTMコンピューター上のOMNISソフトウェアをスタンドアローン操作することが可能になります。

特徴:

- ライセンスには、既に1つのOMNISデバイスライセンスが含まれています。
- メトローム・ライセンシングポータルにて、アクティブ化する必要があります。

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Quant Development

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



NIR 分光法を使用して、魚粉に含まれるタンパク質、脂質、水分、繊維、灰分の含有量を測定するための OMNIS プリキャリブレーション。