

Application Note AN-NIR-148

近红外光谱法分析鱼粉

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.

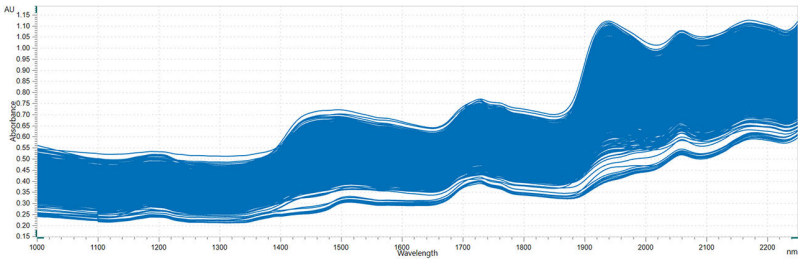


Figure 2. Spectral overlay of fish meal powder samples measured in reflection mode with an OMNIS NIR Analyzer Solid.

RESULT PROTEIN CONTENT

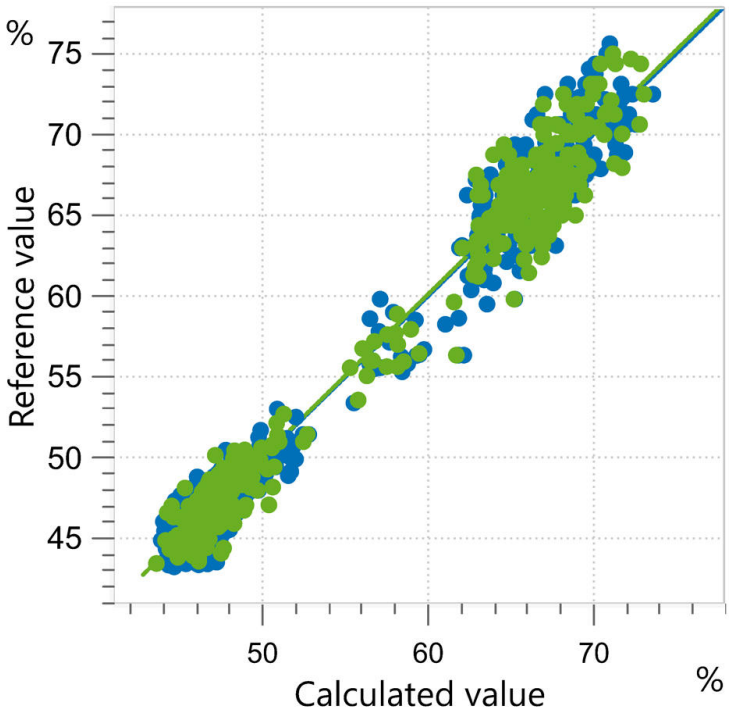


Figure 3. Correlation diagram and the respective FOMs for the prediction of protein content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT FAT CONTENT

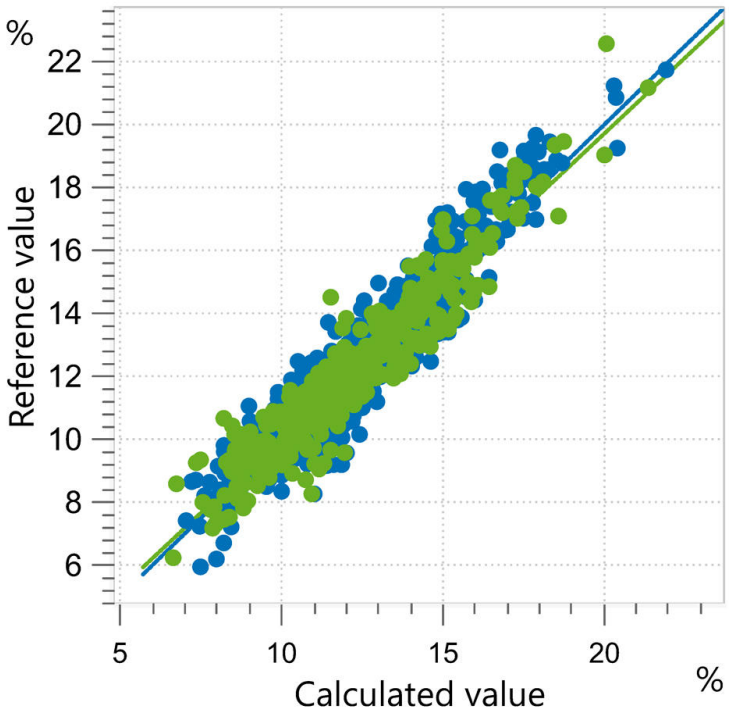


Figure 4. Correlation diagram and the respective FOMs for the prediction of fat content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT MOISTURE CONTENT

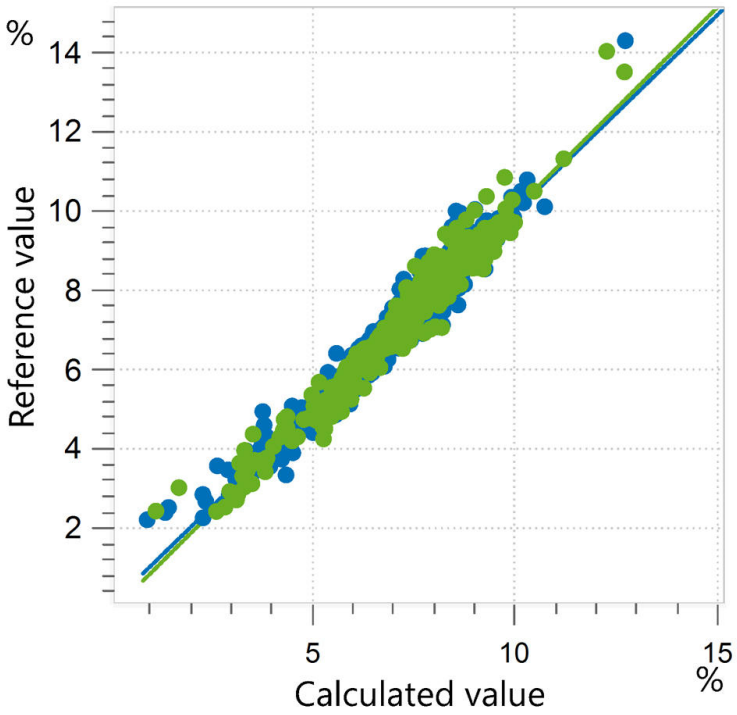


Figure 5. Correlation diagram and the respective FOMs for the prediction of moisture content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT ASH CONTENT

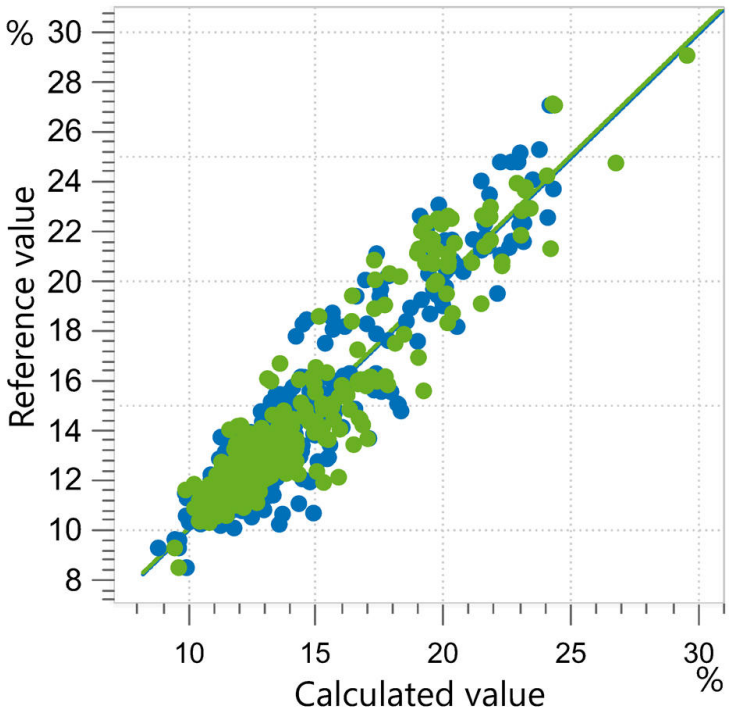


Figure 6. Correlation diagram and the respective FOMs for the prediction of ash content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

RESULT FIBER CONTENT

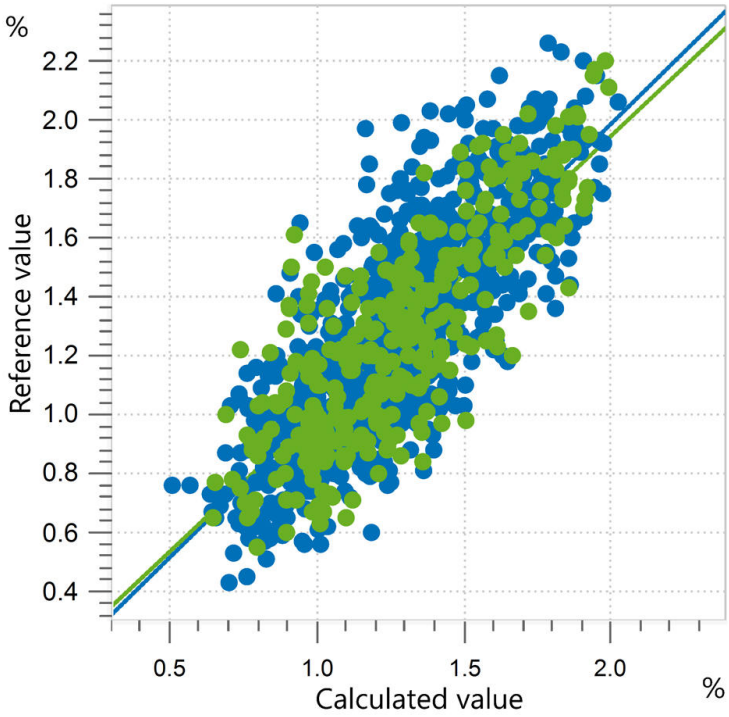


Figure 7. Correlation diagram and the respective FOMs for the prediction of fiber content in fish meal using an OMNIS NIR Analyzer Solid. The calibration dataset is shown in blue, and the external validation dataset is in green.

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

用于固体物质和粘稠样品的近红外光谱仪。

OMNIS NIR Analyzer 按照瑞士质量标准开发和制造,是用于整个生产链中常规分析的近红外光谱 (NIRS) 解决方案。最新技术的应用以及与现代 OMNIS Software 的集成,体现在这款 NIR 光谱仪的速度、操作性和灵活应用上。

OMNIS NIR Analyzer Solid 的优势概览:

- 固体物质和粘稠样品测量时间小于 10 秒
- 自动多位置测量,确保即使在非均质样品中也能获得可重现的结果
- 可轻松集成至自动系统,或与其它分析技术(滴定)联用
- 支持多种样品容器



OMNIS NIR100 mm

用于在不同样品位置处通过反射进行粉末和颗粒光谱记录的大样品容器。

玻璃底板由坚固耐用的 Gorilla® 玻璃制成。

兼容:

- 大支架 OMNIS NIR,100 mm (**6.07402.100**)



OMNIS NIR100 mm

适合大样品容器的大支架 OMNIS NIR,100 mm (**6.07402.110**)。

允许明确地定位样品容器和旋转样品容器。

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS

允许单机版 OMNIS 软件在一台 WindowsTM 计算机上运行。

特性:

- 该许可证已含有一份 OMNIS 设备许可证。
- 须通过万通许可授权平台进行激活。

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

Quant Development

用于在独立 OMNIS Software 安装套件中编写和编辑量化模型的软件许可证。



用于利用 NIR 光谱测定鱼粉中蛋白质、脂肪、水分、纤维和灰分含量的 OMNIS 预校准。