Fast screening method for fish meal quality using near infrared spectroscopy

Maxim Yu. Filippov[1]* and Volker J. Frost[2]

[1]Provimi Russia-Research, Service &Consulting Dept., Moscow, 117556, Russia
[2]BUCHI Labortechnik AG – NIR Division, Flawil, 9230, Switzerland
*Corresponding author: mfilippov@ru.provimi.com

Introduction

The identification of falsified fish meal is a critical step for feed producers. Fish meal is both a very expensive component and a significant source of lysine and high-digestible protein for animal feed. Some suppliers mix fish meal with cheap components to gain larger profits. As a result, feed producers lose money when the final complete feed is produced from falsified "fish meal". Using a FT-NIR spectrometer working in reflectance mode, coupled with chemometric software able to develop identification routine applications, Provimi Russia is developing a fast screening method for qualification of fish meal that can be used by feed producers to assess the quality of one of their more expensive raw materials.

Materials and Methods

Near infrared spectroscopy

An application for the fast identification of fish meal was created using an FT-NIR Spectrometer NIRFlex N-500 (BÜCHI Labortechnik AG, Switzerland). Samples in petri dishes were measured in reflectance between 4000 and 10000 cm^{-1} at a spectral resolution of 8 cm^{-1}. Working on spectra data obtained with chemometric software NIRCal (BÜCHI Labortechnik AG, Switzerland), an identificative model for fast screening of fake samples was created and tested.

Figure 1. Fish meal sample prepared for NIR measurement

Samples

146 samples were used to create a first identificative model: 35 samples of natural fish meal from different countries and production plants were used together with 111 samples of fake "fish" meal which comprised mixtures of natural fish meal with contaminants (meat meal, feather meal, soya bean meal, bran, etc.) in different combinations. Testing the reliability and accuracy of this application used an additional 219 samples declared by suppliers to be a natural fish meal. Testing with the reference method identified 183 of these samples as natural fish meal and 36 samples as a falsification (mixed with extra undeclared components).

Reference paper as:
Filippov, M.Y. and Frost, V.J. (2012).Fast screening method for fish meal quality using near infrared spectroscopy,
in: Proceedings of the 15th International Conference on Near Infrared Spectroscopy,
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Reference method

Microscopy was used as a reference method for sample identification, as shown in Figure 2.

Figure 2. Microscopy picture of fishmeal to identify the presence of low-cost materials like feather meal.

Results and Discussion

The identification model created using the first set of 146 standard samples is summarised in Figure 3.

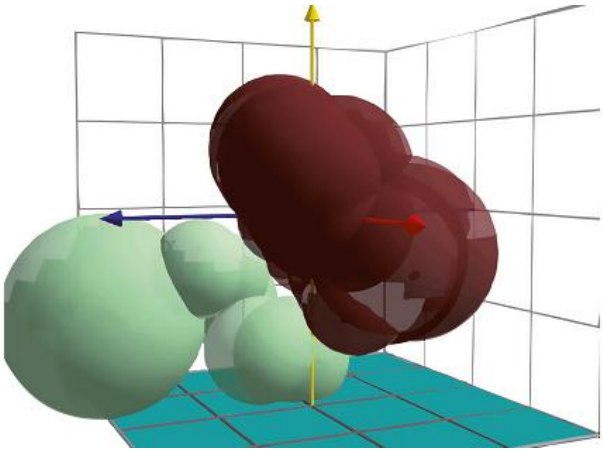

Figure 3. Principal components graph to represent the identificative model developed. Green = cluster of fake fish meal with contaminants; Red = cluster of true fish meal without contaminants.

From 219 samples declared as natural products by suppliers, 195 were identified correctly by the application (89%). This included 183 samples of natural fish meal, 178 (97%) of which were classified as natural and 5 (3%) classified as fake (false negative results). From 36 samples of fake meal, 17 were classified as falsifications and 19 as natural fish meal (false positive results).

Table 1. Result of test carried on second set of 219 samples.

	NIR identity as natural	NIR identity as fake
Natural fish meal (183 total samples)	178	5
Fake fish meal (36 total samples)	19	17

Conclusion

A NIR method for identifying falsified fish meal was developed and showed positive results in confirming "good-quality" samples. Regarding the assessment of fake materials, the method needs further study and development. Although NIR has previously been shown to provide quantitative measurements of pure fish meal, the study presented here demonstrates the potential of this technology as a fast screening method for fish meal qualification purposes.

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