APPLICATION NOTE

FT-NIR Spectroscopy

Authors:

Erica Placido

Ritta Chahine

PerkinElmer, Inc.
Stockholm, Sweden

Hannah Rance

PerkinElmer, Inc.
Seer Green, UK

Analysis of Properties of Poultry Feed Using FT 9700 FT-NIR Analyzer

Introduction

Poultry meat is the most consumed meat worldwide with 122.5 million tons being produced in 2018.[1] As the global population increases, the poultry market has been steadily growing accordingly and is now estimated to have a 38% share in the global meat market.[2] This large and highly profitable industry relies heavily on high quality poultry feed being readily available.

The nutritional parameters of poultry feed should be measured in order to formulate the most suitable and effective diet for each breed of bird. The regulatory feeding standards vary between different types of poultry and often require the nutrient levels to be met precisely.

Major components of poultry feed, such as moisture, protein, fat, and ash, can have a key influence on poultry growth or egg production. Therefore, accurate analysis of these nutritional parameters within the feed is highly important for both animal well-being and the overall profits of farmers.

PerkinElmer
For the Better

Traditional methods for analysing the quality of poultry feed can be time-consuming and may produce hazardous chemical waste. Near-infrared (NIR) spectroscopy, on the other hand, can provide rapid quantification of each of these parameters without the need for solvents. When combined with chemometric techniques, such as partial least squares (PLS), NIR spectroscopy can provide a simple, fast and accurate method for quantifying these parameters in poultry feed. FT 9700™ is a new PerkinElmer FT-NIR analyzer and its' performance analysing poultry feed was evaluated.

Experimental

107 samples were collected from a range of countries of origin, including US, France, South Africa and Denmark, in order to maximise the sample variation. Reference values for the moisture, protein, fat, and ash for each sample were obtained from Eurofins Scientific testing laboratory using the standard method used to analyze each parameter.

Table 1. Scanning parameters for poultry feed samples.

Scanning Parameters	
Spectral Range	10,600 – 4,000 cm^{-1}
Resolution	16 cm^{-1}
Number of Scans	32

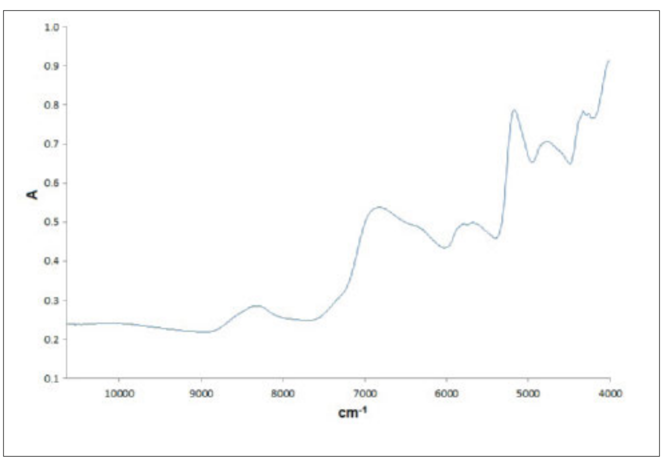

Figure 1. Example NIR spectrum of poultry feed.

The samples were ground using a LM 3310 disc mill and scanned in replicate using multiple FT 9700 NIR analyzers, using the settings shown in Table 1.

81 samples (303 spectra) were used to create a calibration model for each of the measured parameters. The remaining 26 samples (75 spectra) were used for independent validation of the models. The calibrations were stabilized for natural temperature variations that may be present in the samples.

Results

The calibration plots for each analyzed parameter can be seen in Figures 2-5. The calibration (blue) and validation (red) data points are evenly distributed about the unity line, indicating that there is a good level of agreement between the reference and predicted values for each parameter.

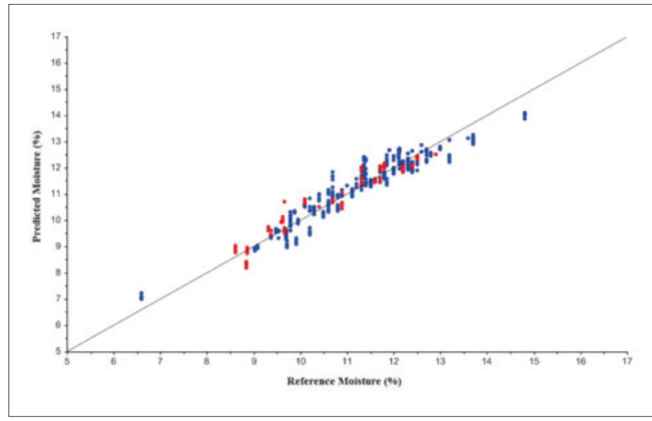

Figure 2. Correlation plot for moisture analysis of poultry feed.

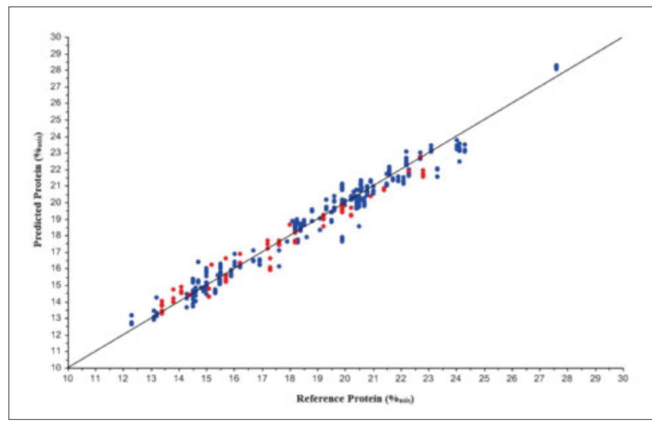
Figure 3. Correlation plot for protein analysis of poultry feed.

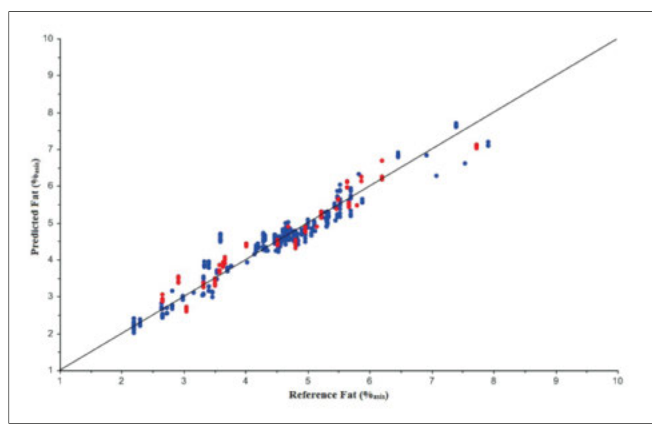
Figure 4. Correlation plot for fat analysis of poultry feed.

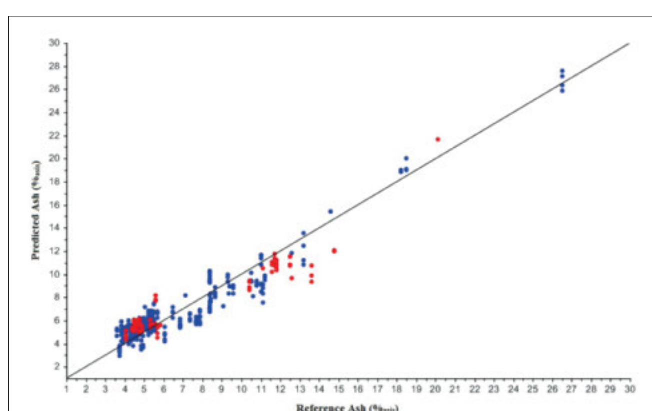
Figure 5. Correlation plot for ash analysis of poultry feed.

Table 2 illustrates the overall regression data for each of the calibration models. The standard error of prediction (SEP) is relatively low for each of the models, indicating that the models have good prediction capabilities.

The SEP is slightly higher for the ash parameter model which may be due to inaccuracies in the reference method or a lack of variation within the samples. To improve the models, more samples could be collected from different batches or countries of origin to further maximise the natural variation present within the samples.

Conclusion

The results show that the FT 9700 NIR analyzer is capable of accurately quantifying multiple parameters of poultry feed samples. The relatively low SEP values indicate that the models have good predictive capabilities. Additionally, the results are transferable as the spectra were collected on multiple different instruments.

Overall, the FT 9700 NIR analyzer is suitable for accurately and rapidly quantifying a variety of quality and nutritional parameters of poultry feed samples, without the need for solvents. This technique can be utilized to allow routine checks of poultry feed to be performed at any stage of the production process.

Table 2. Regression summary for poultry feed parameter models (where SEC is standard error of calibration and SEP is standard error of prediction).

Parameter	Range	R^2	SEC	SEP
Moisture (%)	4.5 – 26.5	0.94	0.40	0.35
Protein ($\%_{asis}$)	12.3 – 27.6	0.96	0.59	0.59
Fat ($\%_{asis}$)	2.2 – 7.9	0.94	0.30	0.31
Ash ($\%_{asis}$)	4.5 – 26.5	0.88	1.09	1.43

References

1. *The Statistical Reference for Poultry Executives*, Poultry Trends, 2018, pp 6-7.
2. *Global Meat Industry – Statistics and Facts*, Statista, 2018.

PerkinElmer, Inc.
940 Winter Street
Waltham, MA 02451 USA
P: (800) 762-4000 or
(+1) 203-925-4602
www.perkinelmer.com

59363_01 PKI