Near infrared reflectance spectroscopy determination of the basic nutrient components in the rapeseed oil meal

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Introduction

The raw materials used in the manufacturing of feed compounds are most varied in their composition and, therefore, in their nutritional quality. The practical repercussions of this variability are most important in the feed compound manufacturing industry. The evaluation of near infrared (NIR) reflectance spectroscopy as a method for the determination of composition of the rapeseed oil meal was associated with investigations of the improvement of rapeseed oil meal nutritive value by the fractional screen separation.[1]

This work presents a method for quantitative analysis of rapeseed oil meal—an animal mixed feed component, using the NIR instrument InfraAlyzer 500 (Bran+Luebbe GmbH), Norderstedt, Germany) and suitable calibrations based on multilinear regression.

Materials and methods

The fine and coarse fractions of rapeseed oil meal were mixed in proportions varying from 0 to 100%. The main differences between the coarse and fine fractions were found in their protein and fibre contents.[2]

These mixtures created a set of 51 samples. The samples were ground using a laboratory centrifugal mill ZM1 (Retsch GmbH, Haan, Germany) with 1.0 mm sieve. A calibration set of ground rapeseed oil meal samples was used to calibrate the output from InfraAlyzer 500, taking reflectance readings every 2 nm between 1100 and 2500 nm. Each sample was measured in three replicates (turn-

Table 1. Parameters (%) of the rapeseed oil meal samples for the calibration and validation sets.

Constituent	Calibration (n = 51)			Validation (n = 21)		
	Range	Mean	SD	Range	Mean	SD
Dry matter	87.23 – 94.70	91.95	1.26	88.01 – 93.98	91.76	1.32
Crude protein	29.69 – 39.89	34.75	2.73	30.04 – 39.58	35.07	2.89
Ether extract	2.08 – 9.28	4.22	1.09	2.06 – 9.05	4.62	0.98
Crude ash	6.45 – 7.39	6.87	0.26	6.09 – 7.20	6.55	0.32
Crude fibre	7.23 – 16.07	11.83	2.17	7.39 – 15.35	10.98	2.31

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Table 2. Calibration statistics and wavelengths used to predict parameters of rapeseed oil meals samples.

Constituent	*R*	*SEC* (%)	Selected wavelengths (nm)
Dry matter	0.982	0.23	1912, 2136, 2290
Crude protein	0.958	0.30	1772, 1828, 1842, 2206, 2444
Ether extract	0.990	0.12	1758, 1786, 2066, 2304
Crude ash	0.962	0.06	1548, 1744, 2276, 2458
Crude fibre	0.979	0.34	1128, 1422, 1464, 1506

ing the sample cup to three different positions before scanning) and the mean of the replicate spectra obtained was used in the calibration. As soon as the spectral scanning had been completed, the rapeseed oil meal samples were subjected to the standard wet chemistry analysis. The basic nutrient components: dry matter (DM), crude protein (CP), ether extract (EE), crude ash (CA) and crude fibre (CF) were analysed according to ISO procedures.[3]

The spectral data from this calibration set were then statistically manipulated using the MLR method with the aid of the software SESAME ver. 2.10 (Bran+Luebbe GmbH, Norderstedt, Germany) to generate calibration models. The calibrations were validated with an independent set of 21 samples of the same types.

Results and discussion

Table 1 shows the characteristics of the sample set used in this study determined by the reference methods. The results of statistical characteristics of the calibrations are shown in Table 2. Figures 1–5 show NIR regression equations developed for DM, CP, EE, CA and CF in rapeseed oil meal samples, respectively.

Validation statistics from simple linear regression analysis, comparing the results of chemical analysis with those predicted from NIR analysis, are shown in Table 3. Statistical parameters—standard error of calibration (*SEC*), multiple correlation coefficient (*R*), F-values in calibration set, standard error of prediction (*SEP*), simple correlation coefficient (*r*) and bias—are considered useful in the evaluation of accuracy of predicting the basic nutrient component contents in the rapeseed oil meal

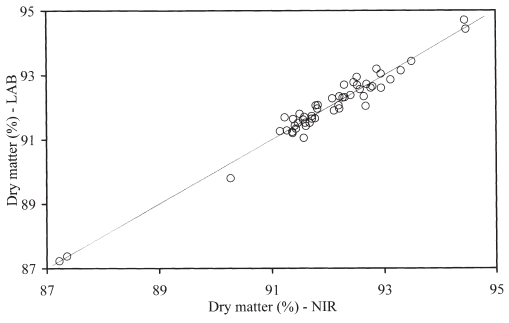

Figure 1. NIR calibration equation for dry matter.

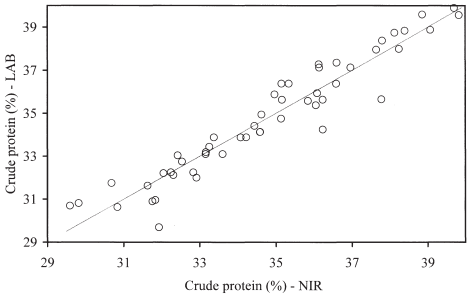

Figure 2.NIR calibration equation for crude protein

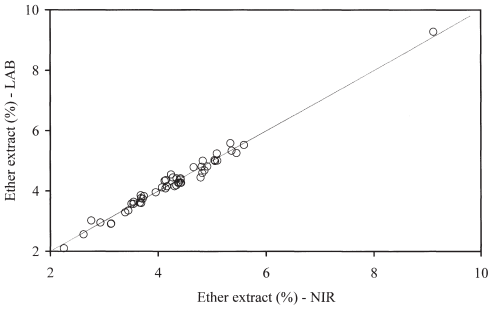

Figure 3. NIR calibration equation for ether extract.

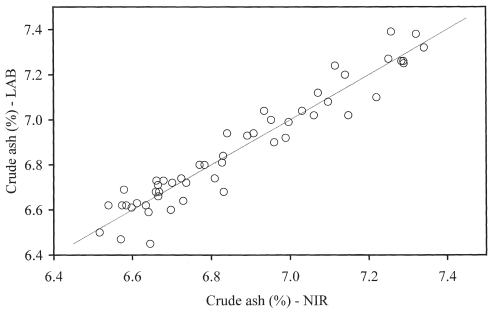

Figure 4. NIR calibration equation for crude ash.

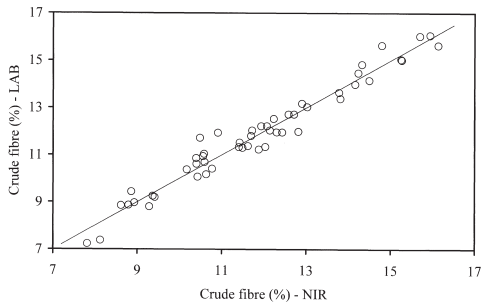

Figure 5. NIR calibration equation for crude fibre.

samples. The equations developed in this study are acceptable and capable of predicting the nutritive parameters accurately.

Conclusions

This study has shown that NIR techniques, using an InfraAlyzer 500, can be used to rapidly and accurately determine the basic nutrient components in the rapeseed oil meal samples. Availability of such predicted values will enable nutritionists to accurately formulate ratios in the practical feeding programs.

Table 3. Statistical parameters obtained in the validation of the calibration.

Constituent	*r*	*SEP* (%)	Bias (%)
Dry matter	0.976	0.24	0.003
Crude protein	0.943	0.32	–0.006
Ether extract	0.986	0.15	0.004
Crude ash	0.960	0.07	0.002
Crude fibre	0.968	0.36	–0.007

Acknowledgements

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References

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