THE USE OF NIR IN PREDICTING NUTRITIVE VALUE OF GRASS SAMPLES AT ANIMAL FEED LABORATORY, IVM.

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The rapid analysis for predicting nutritive value of grass samples with near infrared reflectance spectroscopy was studied. Wet chemistry analysis for dry matter, total ash, crude protein, crude fat, crude fibre and minerals were time consuming, involve high cost and maintenance. NIRs technology can save considerable time by testing all the parameters simultaneously; however accurate calibration of the equipment is essential. Near infrared (NIR) partial least square (PLS) regression models for determination of several grasses quality parameters were developed from NIRFlex Model N-500 (Buchi). In general, reliable prediction results were obtained for crude protein (*SEP* = 0.72 r^2 = 0.98) and total ash (*SEP* = 0.64 r^2 = 0.95) PLS regression models.

Fifty-seven percent from 10,338 of forage samples received by Animal Feed Laboratory, IVM since 2000 to 2014 are grass samples. Data showed grass samples are among the most frequent samples sent by costumer. Nutritive value of grass is not consistence due to geographic location, environmental conditions (temperature, humidity and precipitation), types and age of grass, and grazing management (Stockin *et al*. 2006). It is important to evaluate grass sample quality periodically to ensure that nutrient needs of the farm's animal group are met. Therefore, a new and reliable method should be developed to analyze grass quality accurately and fast. NIRs technology definitely can be a solution, it also has been approved by the Association of Official Analytical Chemists (AOAC) for use in determining moisture, Kjeldahl nitrogen and acid detergent fibre for feed and forage analysis (Undersander, 2006).

The discovery of the infrared region is begun on 1800 by William F. Hershel, but first industrial application began in the 1950s. To date NIR technology is becoming increasingly widespread and is used in various fields such as pharmaceuticals, food technology, agriculture and medical. Direct determination of a constituent by obtaining both the NIRs spectrum and a wet chemistry analysis on a number of individual grass samples, and then using this information to develop a predictive equation, is the manner in which NIRs is used to quantify nutritive value of grass. Although the initial cost of developing NIRs laboratory quite high, but in fact it is cheaper in the long run. There are other advantages of NIRs compared to conventional wet chemistry such as non-destructive procedure, no reagents requires and allows for the determination of multiple values (e.g. crude protein, crude fat and crude fibre) in a single analysis.

The objective of the present study is to develop NIR calibrations for predicting nutritive value of grass samples. Parameters studied were dry matter, total ash, crude protein, crude fat, crude fibre, and metabolisable energy (ME). A total of 448 of grass samples were used to perform NIRs calibration. Samples received were considered different due to environmental conditions and consequent variability in grass quality. Variability is essential for development of meaningful calibrations for NIR equipment (Edney *et al.*, 1994). The proximate analysis, NIR analysis and statistical analysis in this study were prepared according to the method presented in a paper by Norlindawati *et al.*, (2013).

The descriptive statistics of the sample sets for each respective parameter used for PLS regression model development are summarized in Table 1.

Table 1 Summary of descriptive statistics for the reference values

Parameter	**Calibration set**				**Validation set**			
	n	**Range**	**Mean**	***SD***	***n***	**Range**	**Mean**	***SD***
Dry matter (%)	260	2.2-11.9	4.86	1.69	87	2.3-11.9	5.14	1.73
Total Ash (%)	320	4.8-16.2	7.94	2.04	107	4.8-16.2	8.05	2.04
Crude Protein (%)	327	3.6-22.3	11.48	4.27	110	3.6-21.4	11.54	3.95
Crude Fat (%)	334	0.5-4.6	2.25	0.74	110	0.5-4.2	2.19	0.68
Crude Fibre (%)	303	25.9-43.1	33.23	3.83	101	25.9-42.0	33.28	3.77
ME (MJ/kg)	329	6.73-10.79	8.59	0.83	113	6.73-10.79	8.58	0.86

SD =Standard deviation

In developing calibrations for dry matter, total ash, crude protein, crude fat, crude fibre, and metabolisable energy, PLS regression was employed. The results of PLS regression model prediction are shown in Table 2. The prediction results of this study included extremely low and high reference values. The calibration should be improved further if all the extreme reference values are excluded.

Table 2 Prediction results for the optimised PLS regression models

Parameter	***SEP***	r^2	***Bias***	***RPD***
Dry matter (%)	0.85	0.87	0.15	2.04
Total Ash (%)	0.64	0.95	0.08	3.19
Crude Protein (%)	0.72	0.98	-0.03	5.49
Crude Fat (%)	0.33	0.88	-0.02	2.06
Crude Fibre (%)	1.08	0.96	0.02	3.49
ME (MJ/kg)	0.40	0.88	0.00	2.15

SEP (Standard error of prediction); RPD (Ratio Performance Deviation)= $SD_{validation}SEP^{-1}$

According to the Ratio Performance Deviation *(RPD)* values ($SD_{validation}SEP^{-1}$), the crude protein value model is good and suitable for quality control purposes. *RPD* value for total ash is classified as fair and applicable for screening only. Dry matter, crude fat and metabolism energy value models performed poorly with this instrument. Prediction data has been successfully developed for predicting the nutrient composition of grass. However, calibration for dry matter,

crude fat and metabolism energy should be improved to get a reliable prediction result and increase the *RPD* value.

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