Prediction of indigestible NDF content of grass and legume silages by NIRS

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Keywords: NIRS, indigestible NDF, grass silage, legume silage

Introduction The future feed evaluation systems based on mechanistic digestion models require reliable estimates of forage digestible and indigestible NDF content (DNDF and INDF). The objective of this study was to examine the potential of near infrared reflectance spectroscopy (NIRS) in predicting INDF content of grass and legume silages.

Materials and methods The INDF content of silages was determined by 12 d ruminal incubation in nylon bags (NB; pore size 6 or 17 µm) with two dairy cows fed grass silage-based diets. After incubations, the NBs were washed with a household washing machine and the residues were analysed for NDF. INDF (g/kg DM) was expressed as ash-free NDF of NB-residues. Dried and milled samples were scanned with a NIRSystems 6500 spectrometer using a small ring cup. After treatments (math treatments 1,4,4,1 and standard normal variate and de-trending) the spectra (1100-2498 nm) were used to develop MPLS equations for INDF with WinISI II 1.50a software. The basic calibration included 52 experimental and 42 farm grass silages (Nousiainen *et al*., 2004), which was extended with 50 farm grass silages and 36 legume silages (Table 1). Both basic and extended calibrations were used to predict the INDF content of 50 grass and 36 legume silages (Figure 1). The majority of the samples were of Finnish origin, but some legume samples were provided by FAL (Germany), IGER (UK) and Estonian Agricultural University.

Results The performance of calibration (all samples included) was satisfactory (SD/SECV >2.5). The prediction error (SEP) of grass silages was noticeably higher than the SECV of the basic calibration (10.0 vs. 18.0 g/kg DM, (see Nousiainen *et al*., 2004), but it decreased to 15.6 g/kg DM after extending the calibration with both grass and legume samples (Figure 1a). The prediction performance of legume samples was essentially improved when the basic calibration (only grass silages) was extended with legume samples (Figure 1b: SEP 49.7 vs. 17.3 g/kg DM).

Table 1 NIRS calibration statistics in predicting indigestible NDF content (g/kg DM) of grass and legume samples

	Calibration					Cross-validation		
Outliers	n	Mean	SD	SEC[a]	R^2	SECV[b]	R^2	SD/SECV
Included	180	90.0	44.69	14.88	0.889	17.56	0.847	2.5
Excluded	176	89.6	44.29	13.87	0.902	15.24	0.883	2.9

[a]SE of calibration, [b]Pooled SE over cross validation sub-sets

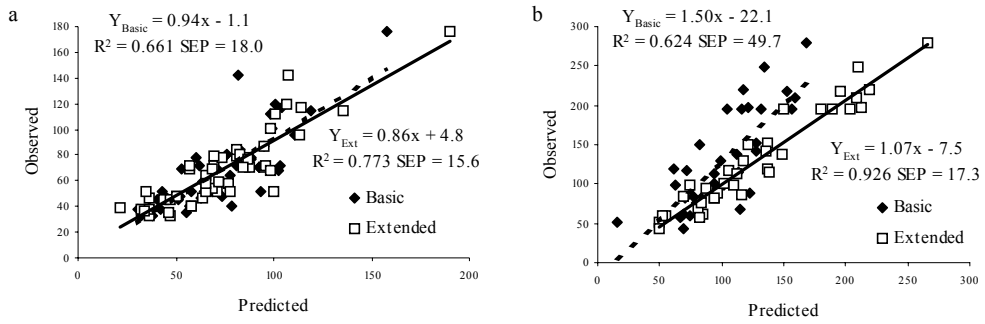

Figure 1 Relationship between observed and predicted INDF content of (a) grass (n = 50) and (b) legume (n = 36) silages

Conclusions The results imply that NIRS has a great potential in predicting INDF content of silages. A general calibration both for grasses and legumes may be developed. Further work is needed to extend the INDF calibration, and to examine whether NIRS can be used to predict the potential rate of silage DNDF digestion.

References

Nousiainen, J., S. Ahvenjärvi, M. Rinne, M. Hellämäki & P. Huhtanen (2004). Prediction of indigestible cell wall fraction of grass silage by near infrared reflectance spectroscopy. *Animal Feed Science and Technology*, 115, 295-311.