A rapid estimation of nitrogen bound to neutral detergent fibre in forages by near infrared reflectance spectroscopy

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Introduction Near infrared reflectance spectroscopy (NIRS) is widely used as a rapid method for the evaluation of the chemical composition or the nutritive value of foodstuffs (Givens *et al.*, 1997). The determination of the neutral detergent fibre (NDF) bound N (NDF-N), which is highly variable in forages (Shayo & Udén, 1999), is expensive. The purpose of this study was to test the use of NIRS in the prediction of NDF-N in various forages.

Materials and methods The study used various fresh forages and hays from temperate, tropical and Mediterranean regions (n=288), consisting of grasses (n=131), herbaceous dicotyledons (n=38) and shrubs or trees (n=119). All samples were oven dried at 60°C and ground to pass a 1 mm mesh screen. After NIRS-spectra of the samples were recorded, a subset of 118 samples underwent a NDF extraction and N content of the residues were determined. Calibrations using the partial least squares procedure were developed for NDF-N within the sub-set and tested by cross validation. They were finally used to estimate the NDF-N of the 288 forages.

Results Table 1 indicates the accuracy of the prediction of NDF-N for the 3 groups of forages. SD/SEC and R^2 values show that the quality of the calibration is satisfactory for grasses and shrubs. The predictions for the dicotyledons are less accurate (SD/SEC < 3) due to a lower number of samples, but the predicting equation can however be considered as satisfactory ($R^2 > 0.85$).

Table 1 Range of NDF-N (g/kgDM) in the prediction subsets and quality of the predicting equations

	n	Minimum NDF-N	Maximum NDF-N	Standard error of calibration (SEC)	R^2	Standard error of cross validation	SD/ SEC
Grasses	49	1.02	16.11	0.185	0.920	0.198	3.54
Herbaceous dicotyledons	23	1.93	25.63	0.510	0.864	0.673	2.71
Shrubs and trees	46	0.14	21.17	0.353	0.931	0.387	3.79

Predictions on the 288 samples (Figure 1) show an important variability in the absolute NDF-N content and in the percentage of N bound to the NDF within each group of plants, and also between them. The dicotyledons and the shrubs have a significantly higher proportion of N bound to the NDF compared to the grasses (31 % vs 22 %, respectively). However, dicotyledons have a significantly higher non NDF-N content than the grasses, followed by the shrubs. For each group, significant regression equations linking NDF-N to total-N and NDF content were also found (R^2 from 0.80 to 0.89, $p < 0.001$).

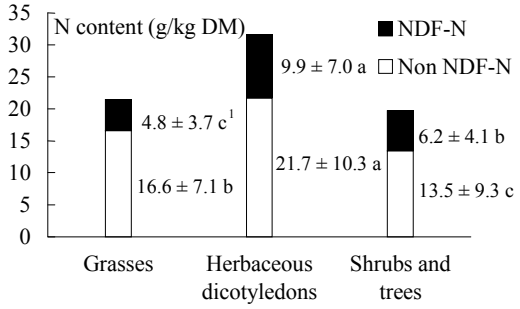

Figure 1 Predicted N fractions of the forages
[1]For a same fraction, values followed by different letters differ significantly ($p<0.05$)

Conclusions The present study showed that NIRS is a valuable method to offer a rapid estimation of the NDF-N content in forage resources. A variable and sometimes important part of the N is bound to the NDF, depending on the forage. It seemed also possible to obtain a reasonable estimate of the NDF-N fraction of a forage by considering the forage group and determining NDF and total-N contents.

References

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