

ANALYSIS OF MIXED SWARD SILAGE BY NEAR INFRARED REFLECTANCE SPECTROSCOPY (NIRS)

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ABSTRACT

NIR calibration equations were developed to determine crude protein (CP), acid detergent fibre (ADF), organic matter (OM), *in vivo* organic matter digestibility (OMD) and metabolizable energy (ME) in mixed swards silages. Spectra of 96 *in vivo* evaluated silages were recorded on a PSCO 6250 monochromator spectrophotometer using NSAS (NIRS Spectral Analysis Software) and converted to NewISI software. NIR calibrations were obtained by modified PLS regression of the 2nd. derivative of SNV and De-trended spectra on laboratory and *in vivo* data. Determination coefficients (R^2) ranged from 0.77 for ME to 0.98 for CP and OM. Highest standard errors of calibration and cross-validation were respectively 2.20 and 2.40 for OMD and lowest were 0.43 and 0.78 for CP. A set of 199 silages from commercial farms was used to validate OM, CP and ADF data. CP was the most precise of these determinations ($R^2=0.90$, SEP=1.20).

KEY WORDS

Nutritive value, digestibility, energy, protein, fibre, NIR calibratio.

INTRODUCTION

NIRS has been shown to be a suitable technique to determine both laboratory and *in vivo* nutritive parameters in herbage silage (Murray, 1986; Robert *et al.*, 1986; Downey, 1987; O'Keeffe *et al.*, 1987; Biston *et al.*, 1989 and Barber *et al.*, 1990). NIR calibrations to determine crude protein (CP) and acid detergent fibre (ADF) were developed by NSAS (NIRS Spectral Analysis Software) in a previous work (Castro *et al.*, 1995). The aim of this present work was to improve those calibrations by using NewISI software and adding new samples to the calibration set and to obtain NIR calibrations for *in vivo* organic matter digestibility (OMD) and metabolizable energy (ME).

MATERIALS AND METHODS

Spectra of 96 mixed sward silages were recorded on a PSCO 6250 monochromator spectrophotometer by NSAS, converted to NewISI software and standardized to the same spectral conditions. 31 silages were evaluated from 1986 to 1989 in a research program and the other 65 samples were commercial farms silages evaluated from 1992 to 1994. *In vivo* values result from measures carried out in the CIAM feed unit on 6 sheep fed *ad libitum* for a period of 6 days. All samples were oven dried at 60°C and ground in a Christy & Norris mill to pass 1 mm. Analysis by wet chemistry was performed to determine CP (Castro *et al.*, 1990), ADF (Goering and Van Soest, 1970) and OM by ashing at 460°C overnight. All determinations were carried out in duplicate and repeated two times. Another set of 199 silages from dairy farms was used to validate calibrations for laboratory data.

RESULTS AND DISCUSSION

Calibration equations obtained from 58 samples evaluated from 1986 to 1992 (Castro *et al.*, 1995) were validated against 38 samples (1993-94) for *in vivo* and laboratory data and against 199 commercial farms samples for laboratory data. Determination coefficients (R^2) and standard errors of calibration (SEC) and cross-validation (SECV) were acceptable, but validation results showed high standard errors (SEP) and low determination coefficients, mainly for *in vivo* data (table 1). For this reason, new calibrations were obtained from all *in vivo* evaluated samples. Table 2 shows results obtained for calibration, cross-validation and validation of laboratory data. R^2 , SEC and SECV values were similar to those obtained from 58 samples but prediction values for laboratory data were improved. Nevertheless all calibrations must be improved by adding new samples to the calibration set, mainly for *in vivo* parameters

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Table 1
Calibration and validation results of equations obtained with 58 samples.

	Calibration n=58			Validation			
	R ²	SEC	SECV	n=38		n=199	
	R ²	SEC	SECV	R ²	SEP	R ²	SEP
CP	0.96	0.71	0.86	0.81	1.90	0.86	1.49
ADF	0.97	0.63	1.18	0.83	1.88	0.88	1.38
OM	0.99	0.46	0.91	0.61	2.04	0.73	1.88
OMD	0.96	1.35	2.03	0.73	4.83		
ME	0.82	0.74	0.81	0.54	1.59		

Table 2
Calibration and validation results of equations obtained with 96 samples.

	Calibration n=96			Validation n=199	
	R ²	SEC	SECV	R ²	SEP
CP	0.98	0.43	0.78	0.90	1.20
ADF	0.95	0.98	1.19	0.86	1.74
OM	0.98	0.57	0.92	0.79	1.59
OMD	0.89	2.20	2.40		
ME	0.77	0.74	0.80		