Near Infrared Spectroscopy to assess feeding value and antinutritional compounds in Legume species

M. Odoardi, S. Colombini, G. Piluzza and M. Confalonieri
Istituto Sperimentale per le Colture Foraggere, 29 V.le Piacenza, 26900 Lodi, Italy Email: m.odoardi@stanca.it

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Introduction There is an increasing demand for information on the quality characteristics and chemical composition of forages in order to meet the demands of dietary specifications for feeding animals. Near Infrared (NIR) spectroscopy provides a tool for rapid and non-destructive analysis in agronomic and breeding programs of a number of chemical components of forages and grains. NIR spectroscopy in particular has the advantage of being able to simultaneously evaluate the samples for a number of qualitative traits of whole plants and seeds. In two experiments here presented, NIR Spectroscopy was used to predict: i) qualitative characteristics of field pea seeds and, as regards secondary metabolites responsible of detrimental or beneficial effects on animal nutrition ii) condensed tannins in legume forages, based on calibration sets of samples previously chemically analysed.

Materials and methods Up to 300 seed samples of 50 field pea cultivars of different geographical origin have been used in the first study. Standard methods were applied to determine crude protein (CP) and NDF content (% DM). In the latter case, the concentration of condensed tannins (CT) was evaluated on 320 sulla (*Hedysarum coronarium* L.) plant samples, determined according to Terrill *et al.* (1992). In both cases, the samples were scanned as dry ground powder in reflectance mode using a NIRSystems 5000 monochromator, and WIN-ISI version 2 software was used for spectral data collection, spectral processing and calibration development.

Results The chemical composition of a number of field pea seeds, determined on samples derived from comparative trials, allowed the characterization of the best performing materials to start specific breeding programs for selection of new high yielding genotypes with increased levels of crude proteins. In Table 1 the range and mean values of crude protein (CP) and NDF content in the two sets of samples randomly selected used for deriving the NIRS calibration equations are reported, together with the statistics of the calibration and validation procedures applied. The narrow degree of variation found with such materials could explain the good but not excellent coefficients of determination in validation (r^2 = 0.88 and 0.69 for CP and NDF, respectively) resulting from NIRS analyses, particularly for the prediction of CP, as usually found with different plant materials (Berardo *et al*. 1997). A wider variability on the contrary was found for the condensed tannin concentration in sulla (from 1.0 to 6.8% DM), which permitted a very good calibration (r^2 = 0.91, *SEP*=0.42), suitable to accurately predict CT percentage in sulla, as shown in Figure 1.

Table 1 Range of the Crude Protein and NDF content (%DM) and statistics of the calibration and validation sets of randomly selected pea meal samples used for developing NIRS equations

CALIBRATION					
Trait	N	Mean ± SD	Range	R^2	SECV
CP	88	20.6 ± 1.0	17.6 – 23.7	0.86	0.42
NDF	95	13.2 ± 2.0	7.2 - 19.3	0.67	1.16

VALIDATION					
Trait	N	Mean ± SD	Range	r^2	SEP
CP	58	20.7 ± 1.0	18.5 - 23.0	0.88	0.43
NDF	58	13.4 ± 1.4	10.7 – 18.5	0.69	1.47

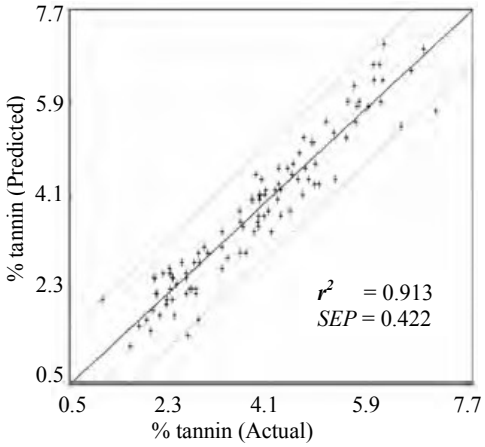

Figure 1 Relationship between actual and predicted % tannin in sulla

Conclusions The calibration and validation statistics presented in this work showed the potential of NIRS to predict both primary and secondary metabolites with good accuracy, confirming NIRS as an alternative approach for the rapid and reliable estimation of forage quality.

References

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