Models for estimating nutrition quality of *Urochloa humidicola* using near infrared reflectance spectroscopy

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Introduction

Breeding forage crops requires a genetic evolution to optimize the agronomic and compositional characteristics of the new hybrids. As a dynamic process, it is necessary to evaluate with precision and speed the parameters that determine the nutritional quality, in particular the contents of digestibility and fibers. Near infrared reflectance spectroscopy (NIRS) offers a low cost-effective alternative to measure these parameters.

Objective

To develop a chemometric model based on measurements taken in the near infrared (Fig. 1) which can predict the contents of neutral detergent fiber (NDF), acid detergent fiber (ADF), *in vitro* dry matter digestibility (IVDMD) and crude protein (CP) for a hybrid population of *Urochloa humidicola* of the CIAT breeding program.

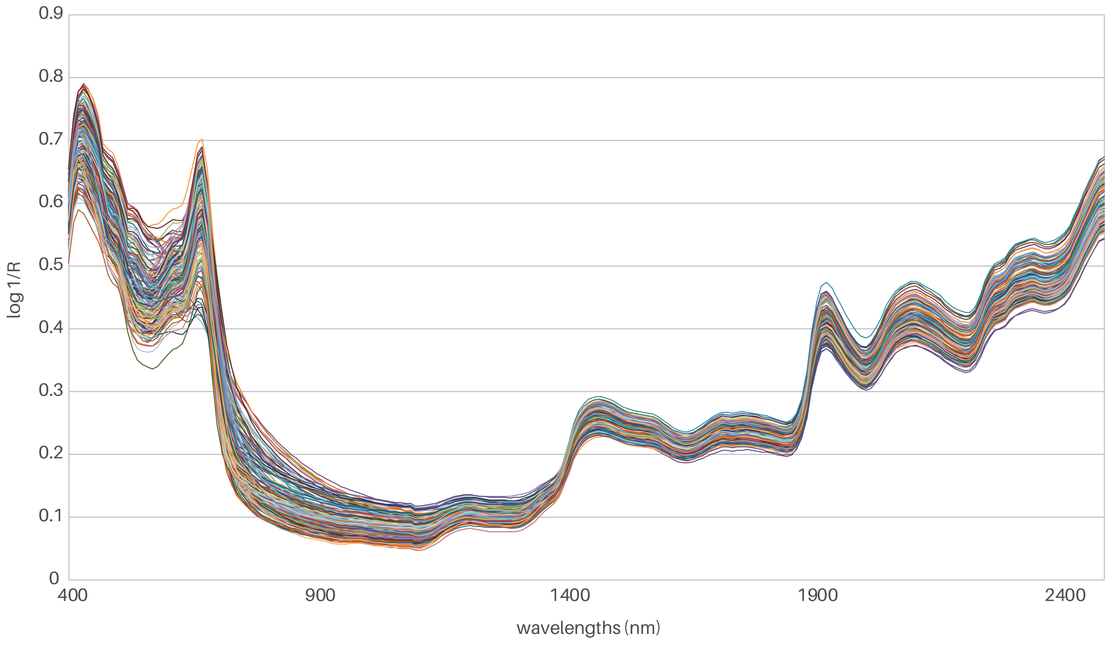


Figure 1: NIRS spectra of *Urochloa humidicola* samples in the calibration population.

Materials and Methods

The models to predict the forage quality parameters were generated using spectral information captured within the range between 400 to 2500nm in a Foss NIRS Model 6500 spectrophotometer (FOSS-NIRS Systems Inc., Silver Spring, MD) coupled with ISIScan software (IS-2250) v. 2.71 (FOSS and Infrasoft International, USA, 2005). In the same way, the physical-chemical composition (reference method) of samples from a population of 614 samples in total were recorded. This population comprised samples of *U. humidicola* (*Uh*) hybrids harvested at CIAT HQ (Valle del Cauca, Fig. 2), Meta and in six farms from Casanare, Colombia.

Samples were collected and oven-dried at 60 °C for 72h and grinded at 1 mm sieve size (Fig. 3). The spectral and reference data sets were used to perform a modified partial least square regression as well as a major component analysis and transformations such as standard normal variate and detrend (SNVD), and transformations on the first and second derivatives. All models were externally validated using a validation set with samples not included in the calibration set.

Figures 1 and 2: Plots used of *U. humidicola* hybrids in experimental stations, Valle and Meta, Colombia.

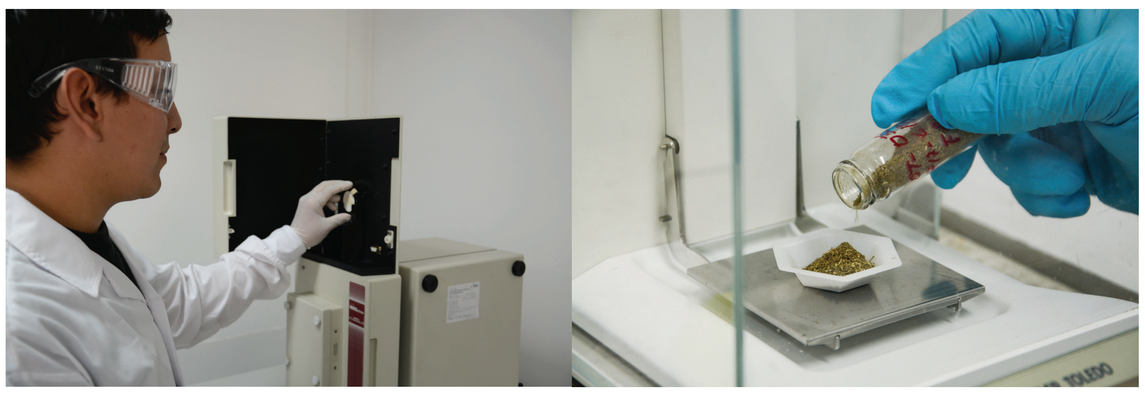
Results

Selected models with mathematical treatments were 1,4,4,1 for ADF and IVDMD parameters, and 2,4,4,1 for NDF and CP parameters. the 1st digit is the derivative, the 2nd the gap, and the 3rd and 4th numbers are the smooth. An external validation was performed with a group of samples (different to the calibration group) obtaining a good correlation coefficients such as R^2, 1-VR with values between 0.90 and 0.95, a standard error of cross-validation of 1.18%, 0.74%, 1.59% and 0.53 % for each parameter respectively and a predictive efficiency coefficient of RPD > 3.0 (Table 1).

Table 1: Statistics of selected chemometric models developed to predict forage quality parameters of *Urochloa humidicola* forage grass.

Parameter	MT	Spectral region	Calibration				Cross-Validation			External validation		
			n	Mean	SD	SEC	R^2	SECV	1-VR	n	R^2	SEP	RPD
NDF	2,4,4,1	1100-2500nm	403	64.73	4.73	1.00	0.95	1.18	0.93	180	0.92	1.41	3.6
ADF	1,4,4,1	1100-2500nm	402	34.33	3.38	0.69	0.96	0.74	0.95	180	0.95	0.79	4.4
IVDMD	1,4,4,1	400-2500nm	399	66.35	5.13	1.41	0.92	1.59	0.90	180	0.93	1.55	3.6
CP	2,4,4,1	400-2500nm	50	8.13	2.31	0.23	0.99	0.53	0.95	20	0.87	0.91	2.6

† **MT**: Mathematical treatment; **NDF:** neutral detergent fiber; **ADF:** acid detergent fiber; **IVDMD:** in vitro dry matter digestibility; **CP:** crude protein; **R^2:** coefficient of multiple determination; **SD:** standard deviation; **SEC:** standard error calibration; **SECV:** standard error of cross validation; **1-VR:** coefficient of determination for cross-validation minus one variance ratio; **SEP:** Standard error of prediction; **RPD:** ratio of performance to standard deviation (SD/SEP).



Figures 3 and 4: Spectral and chemistry analysis (Reference Method).

Conclusion

A good correlation and prediction was possible as the model equations were developed using *U. humidicola* samples of a relatively homogeneous nature. The calibrations obtained in this study showed an adequate adjustment and provide an appropriate predictive tendency of the model for a hybrid population of *Urochloa humidicola,* an important forage grass for grazing for grazing animals in the tropics.

References

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