



## Data Article

# Near-Infrared Spectroscopy and Wet Chemistry Dataset for Forage Nutritional Quality Assessment in *Urochloa humidicola*



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## ABSTRACT

Assessing the nutritional quality traits of pastures is crucial for germplasm and breeding evaluations, enabling the selection of high-quality forages to enhance livestock productivity. However, traditional laboratory analytical methods are logistically demanding and costly, particularly in large-scale trials, underscoring the need for rapid, precise, and high-throughput evaluation methods. Near-Infrared Spectroscopy (NIRS) optimizes the estimation of forage nutritional quality parameters by developing chemometric models that predict these parameters with high accuracy and precision, based on the association between NIRS data and wet chemistry analyses. This dataset, collected over ten years by the Tropical Forages Program at the International Center for Tropical Agriculture (CIAT) in Colombia, comprises 1112 samples. It includes 995 measurements of Neutral Detergent Fiber (NDF), 996 of Acid Detergent Fiber (ADF), 995 of In Vitro Dry Matter (IVDMD), and 469 of Crude Protein (CP), all obtained through wet chemistry methodologies. Additionally, the 1112 samples contain absorbance data spanning 400 to 2498 nanometers (nm) in 2 nm intervals, generating 1050 spectral data points per sample. Finally, this dataset is a valuable resource for predicting forage nutritional quality beyond conventional parameters, incorporating plant reflectance attributes to enhance selection strategies for optimized forage selection.

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## Specifications Table

Subject	Biology
Specific subject area	Assessment of nutritional quality parameters in <i>Urochloa humidicola</i> genotypes using wet chemistry and NIRS for predictive modeling
Type of data	Table, Raw data
Data collection	Samples were collected by uniformly cutting <i>Urochloa humidicola</i> grasses to 8 cm height within a 50 × 50 cm quadrant. The tissue was dried at 60 °C for 72 h in an air-forced oven (GmH & Co. KG), ground using a laboratory mill (Retsch GmbH, 1-mm sieve), packed, and labeled for wet chemistry and spectral analyses. NDF and ADF were assessed using the Van Soest and Robertson [1] method with ANKOM 2000; CP via AOAC Method 2001.11 with a FOSS Kjeltec 8100; and IVDMD via Tilley and Terry [2]. Absorbance (log 1/R) was recorded at 2 nm intervals from 400 to 2500 nm using a FOSS 6500 spectrophotometer, averaging two spectra per sample with ISIScan software (v2.71, FOSS).
Data source location	International Center for Tropical Agriculture, Palmira, Colombia (3°30'03.1" N, 76°21'25.4" W)
Data accessibility	Repository name: Harvard database Data identification number: <a href="https://doi.org/10.7910/DVN/XPNIQY">10.7910/DVN/XPNIQY</a> Direct URL to data: Near-Infrared Spectroscopy and Wet Chemistry Dataset for Forage Nutritional Quality Assessment in <i>Urochloa humidicola</i> - The Alliance of Bioversity International and CIAT Dataverse
Related research article	

## 1. Value of the data

- This dataset will benefit researchers interested in the nutritional quality of forages, scientists working in wet chemistry, spectroscopy, NIRs, or data science for creating artificial intelligence models.
- The dataset is a valuable resource for developing chemometric models and training predictive models for forage nutritional quality, while also allowing for the evaluation of spectral fingerprint variations in *U. humidicola* either by location or across different locations.
- The dataset serves as a calibration reference for NIRS equipment, facilitating standardization across laboratory measurements by ensuring consistency in spectral readings. It also supports advancements in high-throughput phenotyping techniques, enhancing accuracy in predictive models, optimizing breeding strategies, and improving the precision and reliability of forage quality assessments.

## 2. Background

*Urochloa humidicola* is a perennial, stoloniferous grass with smooth, glossy green, lanceolate leaves. It is native to eastern and southeastern tropical Africa and has shown broad adaptation to the variability of existing climates. Adapted to humid zones, it was introduced into tropical America, showing great plasticity [3]. It is found in acidic soils of Brazil (Simon Neto & Serrão, 1974), fertile areas of Ecuador, infertile soils of the Cerrado, and the Eastern Plains of Colombia (CIAT, 1982). In Venezuela, it is promising in areas with 1600 mm/year and droughts of 4–5 months, and it is also cultivated in Florida, USA [3]. *Urochloa humidicola* is a key forage crop in tropical livestock systems, particularly in flooded regions with low-fertility, aluminum-rich soils.

Its value lies in its superior tolerance to short flooding periods, higher nutrient use efficiency, and enhanced root development, making it a reliable feed source for livestock [4]. However, its low nutritional quality constrains livestock productivity in these systems, positioning its improvement as a key objective for plant breeding programs and germplasm selection efforts [5].

Laboratory bromatological analyses are often costly and time-consuming, prompting the search for alternatives such as plant reflectance measurements to predict nutritional quality. Near-infrared reflectance (NIR) spectroscopy has emerged as a valuable technique for optimizing plant phenotyping. It enables the rapid, non-destructive, and accurate measurement of physical and nutritional properties, such as nutrient content, firmness and color [6]. This technology is a powerful tool for assessing plant quality and streamlining laboratory processes, making it highly efficient for both breeding programs and forage production.

### 3. Data Description

The dataset provided in .tab format, consists of 1,112 samples of *Urochloa humidicola* genotypes collected in seven different locations in Colombia between 2011 and 2021.

The dataset includes wet chemistry analyses and spectral data collected through Near-Infrared Spectroscopy (NIRS):

- Nutritional quality parameters: neutral detergent fiber (NDF), acid detergent fiber (ADF), in vitro dry matter digestibility (IVDMD) and crude protein (CP).
- Spectral data: Absorbance records as  $\log(1/R)$  of the plants in a spectrum from 400 to 2498 nanometers at a 2 nm intervals. Each sample contains 1050 spectral data points representing the reflectance at different wavelengths.

A complete description of the data table attributes is shown in [Table 1](#).

**Table 1**

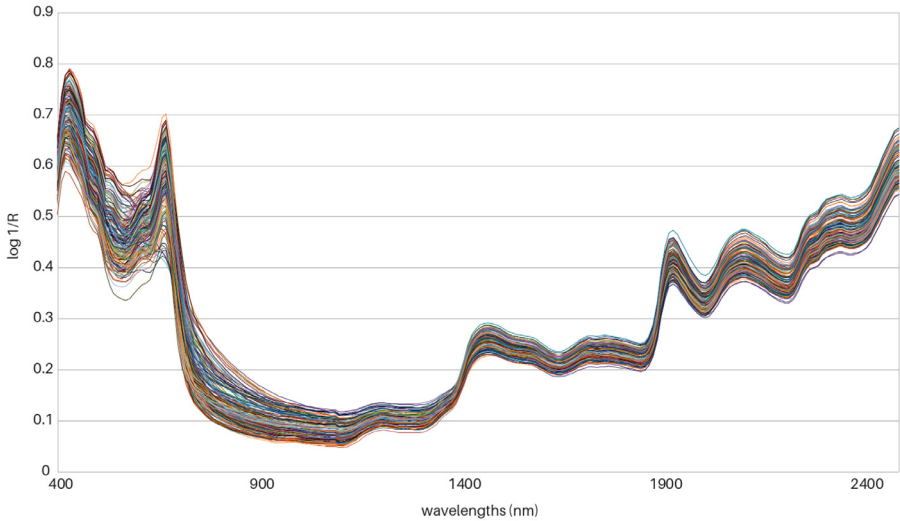
Description of columns included in the metadata table.

Column	Description	Values
Country	Country of origin of the experimental sites	Colombia
Location	Site names where the samples were collected	Caquetá, Casanare, Cauca, Llanos Orientales, Palmira, Popayán
Harvest date	Month, day and year of harvest	-
NDF	Neutral Detergent Fiber	%
ADF	Acid Detergent Fiber	%
IVDMD	In Vitro Digestibility of Dry Matter	%
CP	Crude Protein	%
400 – 2498	Reflectance ( $\log 1/R$ ) of nanometers measured in intervals each two values measuring Absorbance at 2-nm intervals.	Continuous measurements from 0 to 1

### 4. Experimental Design, Materials and Methods

The sampling and analyses methodology is described in detail by Mazabel et al. [6]. In general, samples were collected using a 50 × 50 cm frame, following two different protocols based on the experimental setup. In breeding trials, it was conducted in 1 m<sup>2</sup> plots, where sampling occurred eight weeks after a standardization cut to 8 cm height. A 200–300 g fresh matter sample was collected per plot for subsequent drying. In sward fields, samples were taken eight weeks after the last grazing event by cattle. A composite sample of 250 g was obtained from 10 randomly selected points within the field.

All samples were oven-dried at 60 °C for 72 hours using a Memmert UF750 PLUS (GmH & Co. KG), then ground to a 1 mm particle size using a Retsch SM 100 mill. The processed samples were packed and labeled in plastic bags for chemical and spectral analyses.



**Fig. 1.** Spectra of *Urochloa humidicola* samples in the calibration population.

Chemical analyses were conducted at CIAT's Forages and Animal Nutrition Quality Laboratory. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) concentrations were measured using an ANKOM 2000 fiber analyzer (ANKOM [7,8]) following the methodology of [1]. Crude protein (CP) was determined using a FOSS Kjeltac 8100 [9] according to the guidelines of the Association of Official Analytical Chemists (AOAC) [10]. In vitro dry matter digestibility (IVDMD) was assessed following standard methods [2]. All parameters were analyzed duplicate to ensure accuracy and reproducibility, obtaining a standard error laboratory for %NDF of 0.72, %ADF of 0.32, %IVDMD of 1.7 and %CP of 0.11

Each sample was packed into two separate quartz cells and scanned in duplicate using a FOSS 6500 spectrophotometer within the 400–2500 nm spectral range (Fig. 1). Absorbance readings were recorded using ISIScan software (version 2.71), and the final spectral data for each sample was obtained by averaging the two measurements. The reported laboratory data is based on dry matter obtained at 105 degrees. The scan was performed on samples dried at 60 degrees Celsius, and the laboratory data is corrected to 105 degrees Celsius.

## Limitations

None

## Ethics statement

Authors have read and follow the ethical guidelines for publishing. The present article does not include human subjects, animal experiments, or data obtained from social media platforms.

## CRediT author statement

**Rodrigo Camelo-Munear:** Data curation, Validation, Writing – original draft. **Lady Johanna Mazabel:** Conceptualization, Methodology, Validation, Investigation, Resources, Writing – Review & Editing. **Paula Espitia-Buitrago:** Writing – Review & Editing, Visualization. **Rosa N. Jauregui:**

Writing – Review & Editing, Supervision, Project Administration. **Juan Andrés Cardoso:** Conceptualization, Methodology, Supervision, Writing – Review & Editing, Project administration, Funding acquisition.

## Data Availability

Near-Infrared Spectroscopy and Wet Chemistry Dataset for Forage Nutritional Quality Assessment in *Urochloa humidicola* (Original data) (Harvard dataverse)

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## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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