Plants used to feed ruminants in semi-arid Brazil: A study of nutritional composition guided by local ecological knowledge

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ABSTRACT

This study evaluated the plants of the Caatinga (seasonal dry forest) used as forage in rural communities in northeastern Brazil by comparing the known nutritional composition of species with the nutritional attributes described by the local people. Key informants were selected using the snowball technique, and these informants used their local knowledge to characterize 30 species according to their nutritional attributes and local preferences regarding their use. The nutritional composition of all of the previously described species was favorable for ruminant diets, but for some species (22), there were no prior records of their nutritional or anti-nutritional properties. The most culturally salient species included *Waltheria rotundifolia* Schrank, *Merremia aegyptia* (L.) Urb., *Croton blanchetianus* Baill., *Spondias tuberosa* Arruda and *Tragus berteronianus* Schult. The salience values (local importance) were significantly correlated with crude protein (CP) levels but not with the anti-nutritional constituents, such as tannins, indicating that these factors did not affect local preferences. The data confirm the reliability of local knowledge in evaluating the nutritional value of forage species.

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1. Introduction

Traditional populations possess rich information accumulated from their observations and experiences using natural resources (see Ladio and Lozada, 2004). This knowledge can be a source of valuable scientific information (Toledo and Barreira-Bassols, 2010), and recording this knowledge is as valuable to humanity as it is to biodiversity because these elements are interconnected and interdependent. Accordingly, several studies have investigated the knowledge of local farmers regarding plant use, but few have taken into account local knowledge regarding the selection and characterization of forage plants.

Some of this research has been conducted in developing countries, such as those Nepal, Mexico, and India as well as countries in Africa, and has demonstrated that local preferences for certain forage plants can be associated with plant quality, sampling period and availability (Chettri and Sharma, 2009; Khanal and Subba, 2001). Researchers have found that local people are able to recognize, classify and characterize the species that constitute ruminant diets (Chettri and Sharma, 2009; Khanal and Subba, 2001; Maasdorpa et al., 1999; Nahed et al., 1997; Okoli et al., 2003; Thapa et al., 1997).

In many parts of the world, livestock husbandry is a critically important activity as it ensures protection of the backcountry and provides economic support. In northeastern Brazil, especially, this ancient practice, which has been strengthened by the herding of small ruminants (Maia, 2004; Nascimento et al., 1996), is one of the most commonly used methods for producing goats and sheep (approximately 90 and 50% of the total number of animals, respectively) (IBGE, 2005).

The local vegetation in northeastern Brazil is highly diverse; an estimated 70% of the plant species are thought to have the potential to be used in ruminant diets (Araújo Filho and Silva, 2011). However, targeted studies are needed to assess the potential of this

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resource, especially its nutritional quality, such as the content of protein, carbohydrates and fiber (Heringer and Jacques, 2002; Moreira et al., 2006; Santos et al., 2010). Coupled with the knowledge of the local people, this information could contribute to improved management, conservation and bioprospecting (Albuquerque and Andrade, 2002; Aumeeruddy-Thomas et al., 2004; Chettri and Sharma, 2009). There is also growing interest in applying both traditional and scientific knowledge to biodiversity conservation and bioprospecting, especially in areas such as the Caatinga (seasonal dry forest), where more than 60% of the natural vegetation has been devastated (Sampaio, 2010; Santos et al., 2010).

The current study evaluated local knowledge of fodder plants in an area of the Caatinga in two rural communities in the municipality of Soledade, which is located in Paraíba, Brazil. The objective of this research was to increase knowledge of Caatinga forage plants by combining traditional and scientific knowledge to answer two questions. First, how do traditional communities nutritionally characterize the plants that comprise ruminant diets? Second, what is the relationship between local opinions and the nutritional components of these species? We hypothesize that local people select species based on their nutritional value.

2. Materials and methods

2.1. Area characterization

The survey was conducted in two rural communities, Barrocas and Cachoeira, (7°03′26" south latitude and 36°21′46" west longitude) located in the municipality of Soledade in Paraíba (northeastern Brazil). The seat of the municipality is 165.5 km from the capital, João Pessoa, and lies 521 m above sea level. The area receives irregular rainfall, which ranges from 100 to 600 mm per year, while seven to eight months are marked by drought. The annual average rainfall was 546.6 mm throughout 2009 and 2010 (the data collection period) (CPRM, 2005). The local climate is hot and semiarid (BSwh'), and the soil in these communities includes sandy, clay-based and stony types. The vegetation consists of thorny and dry forests that are typical of the Caatinga. Along the rivers, streams and ponds, shrub is the predominant type of vegetation, but elsewhere, the vegetation is shrub-herbaceous. In more open areas, cacti and bromeliads are used as animal feed during drought periods (Almeida et al., 2010).

The Barrocas community includes 12 residences on farms, which range from 70 to 400 ha in size. The area is intermittently crossed by rivers that enable irrigation for subsistence farming of crops such as maize and beans. The pastures house ruminants, such as cattle, goats and sheep; the latter two represent the largest animal population (Almeida et al., 2010). In the backyards of the residences, domestic animals, such as swine and poultry, are often raised to supplement the family diet (Sá e Silva et al., 2009).

In Cachoeira, 18 residences are grouped together in a small town that also includes two bars, a community center and a football field. The land where the animals are kept and from which forest resources are taken is intended for common use by the families, which may exert strong extractive pressure on the woody species.

Both of the communities rely on visits by health workers and receive assistance from the Brazilian Army and the battalion in the city of Campina Grande. These groups provide water, which is stored in cisterns. However, for other social needs, such as education, medical care, and food for both the families and their animals, the inhabitants must travel to the center of Soledade, which is 18 km from Barrocas and 14 km from Cachoeira (Fig. 1).

Despite the low rainfall, the local vegetation is rich and diverse and includes native species with multiple uses, including as fodder.

Aspidosperma pyrifolium Mart. and *Poincianella pyramidalis* Tul. are widely used in the region and are known for their high availability. In addition to these species, other trees are used for the same purposes, such as *Cynophalla flexuosa* (L.) J. Presl, *Croton blanchetianus* Baill., *Mimosa tenuiflora* (Willd.) Poir., *Myracrodruon urundeuva* Allemão, *Schinopsis brasiliensis* Engl., *Spondias tuberosa* Arruda, *Sideroxylon obtusifolium* (Roem. & Schult.) T.D. Penn and *Ziziphus joazeiro* Mart.

During the rainy season, there is increased diversity of ruderal and wasting plants, which are used for animal feed, due to the diversity of shrubs and trees. In addition to the woody and herbaceous plants, some farmers grow exotic species, such as *Opuntia ficus-indica* (L.) Mill, *Prosopis juliflora* (Sw.) DC., *Brachiaria decumbens* Stapf, *Cenchrus ciliaris* L., *Chloris orthonoton* Doll. and *Pennisetum purpureum* Schum.

The diverse local flora contributes to the maintenance of the livestock in the region. Livestock husbandry is an ancient activity of paramount importance that helps the local families meet their basic needs. The animals are freely grazed or are confined to yards within the home gardens and are only provided with feed during dry periods when plant resources are limited.

2.2. Data collection

The selection of species was based on an ethnobotanical survey that was conducted with the approval of the Ethics Committee of the University Federal of Pernambuco for research involving human beings and granted under the CEP/CCS/UFPE protocol no. 176/09. The selected communities were informed about the research, and the residents that participated in the project (44 people: 20 men and 24 women) signed a consent form. A more extensive description of the local ecological knowledge of fodder plants in the region studied can be found in Nunes et al. (2015).

Due to the procedures and protocols required by the study, six successive visits to the communities were made over one year (2009/2010). The visits ranged from two to eight days in duration and were conducted during the dry and rainy seasons. The data were collected by conducting semi-structured interviews with all active family representatives, with aged 24–92 years. Of these representatives, none were involved in domestic activities as salaried employees, 90% were engaged in agricultural activities and animal breeding, and the rest of them (10%) worked in other areas.

From this preliminary list of participants, nine key informants, aged between 31 and 58 years (all male), were selected (five from Cachoeira and four from Barrocas). The key informants were locally recognized as the most knowledgeable about forage resources based on the snowball technique (non-probabilistic intentional sampling) (Albuquerque et al., 2014).

The key informants evaluated all of the species that were described as forage by assigning attributes indicating nutritional value and cultural importance to each. This step was completed at two time points, once during the dry season and once during the rainy period, and was accompanied by direct observations. Based on these results, the key informants were asked to guide a tour for the collection and identification of the species that were highlighted as forage. In short, the interviews with the key informants were used to obtain data on the availability of plants, the local collection of plants, and their quality and nutritional effects (e.g., toxicity). Using this classification and with the help of the informants, the plant species that were available during the sampling period were collected for chemical analysis.

The complete group of 44 informants cited 137 plants, of which thirty species were selected according to the consensus of the nine key informants' classification; these species included 20