



# Local botanical knowledge of cacti in the semi-arid region of Paraíba, northeastern Brazil.

Thamires Kelly Nunes Carvalho, Camilla Marques de Lucena, José Ribamar Farias Lima, Denise Dias da Cruz, Reinaldo Farias Paiva de Lucena

## Research

### Abstract

**Background:** The semi-arid region of Brazil has different physiognomies characterized by caatinga vegetation, represented by several botanical families, such as the Cactaceae, which stands out economically due to its diverse utilities. This study was conducted in the rural community of Capivara, from 2012 to 2015. This community is located in the municipality of Solânea, in the 'Agreste' Mesoregion and 'Curimataú Oriental' Microregion, in the state of Paraíba, northeastern Brazil.

**Methods:** A semi-structured questionnaire was applied to 101 informants, family breadwinners (44 men and 57 women). The questionnaire addressed questions about the knowledge of the use of Cactaceae species in the region.

**Results:** Ten species belonging to five genera were recorded, among which, the 'facheiro' (*Pilosocereus pachycladus* F. Ritter subsp. *pernambucoensis* (F. Ritter) Zappi) was the most cited and had the highest number of uses. Species were classified into twelve use categories and eleven usable parts were recorded. Fodder was the most prominent category (386 citations). The knowledge of plant species that grow in association with cacti was also recorded (18 species).

**Conclusions:** Farmers in the community of Capivara have great knowledge of local Cactaceae species. However, they mainly use these species as fodder resources, especially *C. jamacaru* and *P. pachycladus*.

**Keywords:** Ethnobotany, Cacti, Caatinga, Traditional

knowledge, Rural community.

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**Ethnobotany Research & Applications**  
**18:42 (2019)**

### Resumo

O semiárido brasileiro apresenta diferentes fisionomias marcadas pela vegetação do bioma

Caatinga, representado por várias famílias botânicas, dentre elas a Cactaceae que se destaca economicamente devido às suas diversas utilidades. O presente estudo foi desenvolvido na comunidade rural de Capivara entre os anos de 2012 e 2015. A comunidade está localizada no município de Solânea, na Mesorregião do Agreste e Microrregião do Curimataú Oriental, no estado da Paraíba, Nordeste do Brasil. Aplicou-se um formulário semiestruturado com 101 informantes, mantenedores da família (44 homens e 57 mulheres). O formulário continha perguntas sobre o conhecimento acerca do uso de espécies de Cactaceae da região e suas utilidades. Foram registradas 10 espécies pertencentes a 5 gêneros, entre elas o facheiro (*Pilosocereus pachycladus* F. Ritter subsp. *pernambucoensis* (F. Ritter) Zappi) foi a mais citada e apresentou maior número de utilidades. As espécies foram enquadradas em 12 categorias de uso e apresentaram 11 partes utilizáveis. A categoria que mais se destacou foi forragem (386 citações). Também foi registrado o conhecimento sobre espécies vegetais que crescem em associação com cactos, sendo citadas 18 espécies; e com tipos solos, sendo reconhecidos 8 tipos. Os agricultores da comunidade Capivara detêm grande conhecimento acerca das espécies de Cactaceae encontradas na região, entretanto, destaca-se a sua importância como recurso forrageiro para os produtores rurais de Capivara, em especial *C. jamacaru* e *P. pachycladus*.

Palavras-chave: Etnobotânica, Cactos, Caatinga, Conhecimento tradicional, Comunidade rural.

## Background

Semi-arid environments are in the third position in the world in terms of loss of vegetation cover (Hansen et al. 2010) and are among those most affected by human presence (Challenger 1998). In Brazil, the Caatinga ecosystem (semi-arid region of northeast Brazil) covers an area of 912,529 km<sup>2</sup> and can be described as a complex socio-ecological system and a natural and cultural heritage in the world (Silva et al. 2017).

The environmental variation found in more than one hundred geoenvironmental units and nine ecoregions sustain more than 1,000 animal species and 3,150 plant species (Silva et al. 2017). Cactaceae is one of the main botanical families distributed in these environments and comprises the third-highest number of species, including a large part of their biodiversity (Trejo-Vázquez 1998).

Plants of this family have adaptive morphological characteristics, such as thick cuticle, stem differentiated into cladodes, a large volume of mucilaginous tissue, and water-saving in the processes of energy obtainment. These characteristics make them more resistant to the hot and dry climate, especially in the semi-arid region of Brazil (Duque 1980, Terrazas & Mauseth 2002).

Thirty-nine genera and 260 species of cacti have already been recorded in Brazil (Zappi et al. 2016), distributed in all the phytogeographic domains of this country, such as in the Caatinga, which mainly represents the northeast region, accounting for eighteen genera and fifty-five species of cacti recorded (Flora of Brazil 2017). *Pilosocereus*, *Cereus*, and *Melocactus* are the most representative genera because they are widely distributed in the semi-arid region (Cavalcanti & Resende 2007, Lucena et al. 2015, Taylor & Zappi 2004).

Currently, the Caatinga accounts for 28.6 million people, and 36% of this population lives in rural areas. The lack of infrastructure, in addition to cultural factors, leads to dependence on native vegetation by the local populations, resulting in a slowly changing process of the ecosystem (Silva et al. 2017).

For local populations, this family is economically important especially due to its fodder potential of both native and exotic species, which are used as animal feed during long dry seasons (Cavalcanti & Resende 2007), playing important cultural and economic roles in farmers' communities (Lucena et al. 2015). In addition, Cactaceae species are also used to make traditional medicines, in rural and domestic constructions (in the construction of live fences and as rafters and laths), in the ornamentation of houses, as human food, and for technological purposes such as the manufacturing of wooden spoon (Lucena et al. 2013, Lucena et al. 2015, Andrade 2008).

Thus, some authors point out the need for studies aimed at understanding the dynamics of use of plant resources by local populations, emphasizing the importance of their results for the development of conservationist goals, considering participatory management (Lucena et al. 2012a). Therefore, ethnobotany, which studies the interrelationship between people and plants, is used as a tool to record knowledge and may contribute to the conservation of cultural values relating to cacti species (Lucena et al. 2015).

There are still few studies on cacti conducted in this perspective in Brazil (Andrade et al. 2006), except for Lucena et al. (2012a, 2013, 2014) who have carried out research in different areas in the semi-arid region of Paraíba, Brazil. In other countries, the number of scientific studies is considerably higher; some of them performed by Apocada (2001), in the United States; Fuentes (2005) in Cuba; and Cruz & Casas (2002), Cruse-Sanders et al. (2013), Guillén et al. (2015) and Perez-Negrón et al. (2014) in Mexico. Moreover, aspects such as ecological interactions and the role of cacti in the ecosystem balance have also been cited as important factors in studies on Cactaceae (Ruedas et al. 2006), considering its biological and cultural diversities, which are affected by constant loss of habitat and lack of appropriate management (Meiado et al. 2015, Rizinni 1982).

In this context, this study aimed to record and analyze the knowledge of Cactaceae species and their uses in a rural community in the 'Curimataú' region, in the state of Paraíba, Brazil.

## Material and methods

### Study area

This study was carried out in the rural community of Capivara, from 2012 to 2015, in the municipality of Solânea, which is located in the 'Agreste' Mesoregion and 'Curimataú Oriental' Microregion, in the semi-arid region of Paraíba State, northeastern Brazil. Solânea has about 26,689 inhabitants, 7,357 of them are rural residents. Its vegetation is typical of the Caatinga, which is characterized by dry climate and long periods of drought (Prado 2004). It is at about 626 m of altitude and has a mean annual temperature of 25°C. Solânea borders the municipalities of Casserengue, Serraria, Dona Inês, Remígio, Arara, Barra de Santa Rosa, Borborema, Bananeiras, and Cacimba de Dentro, and is at about 138 km from the state capital (João Pessoa), which can be accessed through the highways BR230/BR041/PB105 (Ribeiro et al. 2014) (Figure 1).

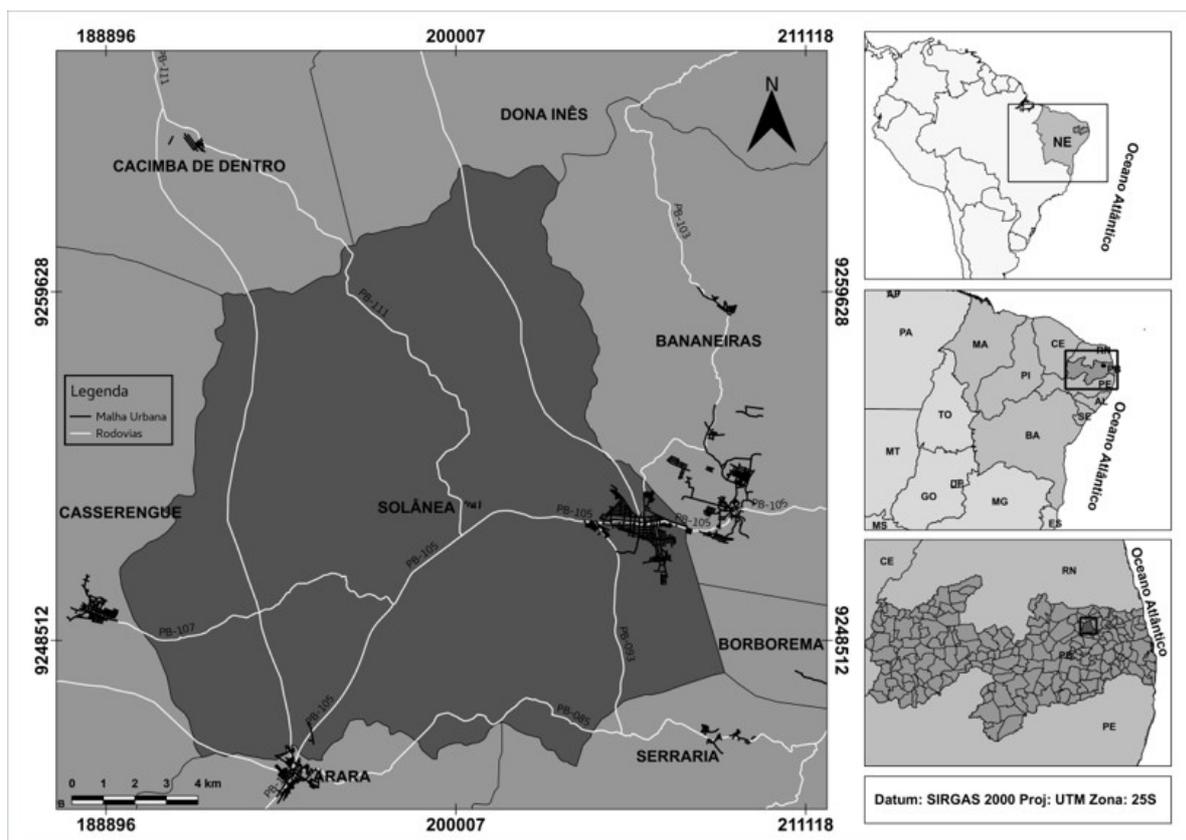


Figure 1. Location Map of the municipality of Solânea, Paraíba, northeastern Brazil. Map: Ramon Santos Souza.

The rural community of Capivara accounts for 60 residences distributed in three different areas (Capivara I, II and III) and is located 15 km from

downtown Solânea. In Capivara, there is an association of farmers, who perform agropastoral activities, such as the cultivation of corn and beans

in rainfed agriculture, and goat and sheep rearing. Health care is provided by health workers who visit the residents monthly (Ribeiro et al. 2014). Currently water supply is made by the Brazilian Army using tank trucks.

### Ethnobotanical survey

Initially, all the residences were visited and the purpose of the study was explained to each informant, who were then asked to sign the Informed Consent Form (Resolution 510/16). All those who agreed to participate in this research signed the Form. The present study was approved by the Ethics Committee for Human Research (CEP) of the Federal University of Paraíba and was registered under protocol CEP/HULW No. 297/11.

Semi-structured questionnaires were applied to 101 informants, family breadwinners (44 men and 57 women), addressing questions about the knowledge of use, practices preferred for the extraction and planting, and environmental perception aspects of Cactaceae species in the region. The cacti species recorded in the interviews were categorized according to the way they are used, based on specific literature (Lucena et al. 2012a,b, 2013, 2014, 2015).

The specimens cited by the interviewees were collected, herborized and deposited in the collection of the Jaime Coelho de Moraes Herbarium (EAN), in the Center of Agrarian Sciences (Campus II) of the Federal University of Paraíba. FLORA of BRASIL (2020) was used for the correct classification and revision of the botanical nomenclature.

## Results

### Recorded species

Ten species of cacti belonging to five genera were recorded, as follow: 'cardeiro' (*Cereus jamacaru* DC. subsp. *jamacaru*), 'cardeiro' without thorns (*Cereus* sp.), 'coroa-de-frade' (*Melocactus* sp.), 'cumbeba/gogóia' (*Tacinga inamoena* (K. Schum) (N.P. Taylor & Stuppy), 'facheiro' (*Pilosocereus pachycladus* F. Ritter subsp. *pernambucoensis* (F. Ritter) Zappi), forage cactus (*Opuntia ficus indica* (L.) Mill.), 'palma de espinho' (*Opuntia dillenii* (Ker Gawl.) Haw.), 'palma doce' (*Nopalea cochenillifera* (L.) Salm-Dick.), 'palmatória' (*Tacinga palmadora* (Britton & Rose) N.P. Taylor & Stuppy), and 'xique-xique/sodoro' (*Pilosocereus gounellei* (F.A.C.) Weber & Rowley subsp. *gounellei*) (Table 1).

Table 1: List of cacti species recorded in interviews conducted in the rural community of Capivara (municipality of Solânea, Paraíba, northeastern Brazil), and their corresponding use categories, parts used, and citations of use attributed to each species. \*Where: Fo = food, Bi = bioindication, Fu = fuel, Ct = construction, Fd = fodder, Mr = magic/religious, Me = medicinal, Or = ornamentation, Ot = others, Sd = shade, Tc = technology, and Vt = veterinary; and 1 = entire plant, 2 = inner bark, 3 = thorn, 4 = flower, 5 = fruit, 6 = branch, 7 = wood, 8 = pulp, 9 = root, 10 = cladode, and 11 = marrow.

Botanical classification	Vernacular name	Use category	Part used	No. of citations
<i>Cereus jamacaru</i> DC. subsp. <i>jamacaru</i>	Cardeiro	Fo, Bi, Fu, Ct, Fd, Mr, Me, Or, Ot, Vt	1, 2, 3, 4, 5, 6, 7, 8, 9	270
<i>Cereus</i> sp.	Cardeiro without thorns	Or	1	2
<i>Melocactus</i> sp.	Coroa de frade	Fo, Fd, Mr, Me, Or	1, 5, 8	88
<i>Nopalea cochenillifera</i> (L.) Salm-Dick.	Palma doce	Fd, Or	1, 10	6
<i>Opuntia dillenii</i> (Ker Gawl.) Haw.	Palma de espinho	Fo, Fd, Mr, Or, Sd	1, 5	51
<i>Opuntia ficus indica</i> (L.) Mill.	Palma	Fo, Fd, Mr, Sd	1, 5, 10	152
<i>Pilosocereus pachycladus</i> F. Ritter subsp. <i>pernambucoensis</i> (F. Ritter) Zappi	Facheiro	Fo, Bi, Fu, Ct, Fd, Mr, Me, Or, Sd, Tc	1, 5, 6, 7, 9	292
<i>Pilosocereus gounellei</i> (F.A.C.) Weber & Rowley subsp. <i>Gounellei</i>	Xique xique/sodoro	Fo, Ct, Fd, Mr, Or	1, 5, 6, 9, 11	124
<i>Tacinga inamoena</i> (K. Schum) (N.P. Taylor & Stuppy)	Combeba / Gogóia	Fo, Fd, Me, Or	1, 5	18
<i>Tacinga palmadora</i> (Britton & Rose) N.P. Taylor & Stuppy	Palmatória	Fo, Bi, Fd, Mr, Ort	1, 4, 5	21
<b>TOTAL</b>				<b>1024</b>

**Use categories**

A total of 1,024 citations of use were recorded, and *P. pachycladus* subsp. *pernambucoensis* (293 citations), *C. jamacaru* subsp. *jamacaru* (270), and *Opuntia ficus indica* (152) were the species most cited by the interviewees. *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* were the most versatile species in terms of uses since both were classified into ten use categories and had nine and five useful parts recorded, respectively. Cladode, branch (extension of cladodes), fruit, flower, wood, pulp (mucilaginous tissue), marrow, root, thorn, inner bark, and the

entire plant were considered as useful parts. Branch (341 citations), the entire plant (219), wood (176), and fruit (166) were the specimens' most cited parts (Table 1).

Twelve categories of use (food, bioindication, fuel, construction, fodder, magic/religious, medicinal, ornamentation, others, shade, technology, and veterinary) were identified, of which, fodder (386 citations), construction (201) and food (171) proved to be the most important ones due to their high number of citations (Table 2).

Table 2: Number of cacti species citations within each category of use, and total number of citations for each category, where: Fo = food, Bi = bioindication, Fu = fuel, Ct = construction, Fd = fodder, Mr = magic-religious, Me = medicinal, Or = ornamentation, Ot = others, Sd = shade, Tc = technology, and Vt = veterinary. Uses attributed by informants from the community of Capivara in the municipality of Solânea, Paraíba, Brazil.

Category Species	Bi	Ct	Fd	Fo	Fu	Me	Mr	Or	Ot	Sd	Tc	Vt
<i>Cereus jamacaru</i> DC. subsp. <i>jamacaru</i>	3	33	97	40	7	45	10	19	1	13	-	2
<i>Cereus</i> sp	-	-	-	-	-	-	-	2	-	-	-	-
<i>Melocactus</i> sp.	-	-	2	8	-	28	17	33	-	-	-	-
<i>Nopalea cochenillifera</i> (L.) Salm-Dick.	-	-	5	-	-	-	-	1	-	-	-	-
<i>Opuntia dillenii</i> (Ker Gawl.) Haw.	-	43	4	-	-	-	1	1	-	2	-	-
<i>Opuntia ficus indica</i> (L.) Mill.	-	-	109	31	-	-	1	-	-	11	-	-
<i>Pilosocereus gounellei</i> (F.A.C.) Weber & Rowley subsp. <i>gounellei</i>	-	7	67	44	-	1	2	3	-	-	-	-
<i>Pilosocereus pachycladus</i> F. Ritter subsp. <i>pernambucoensis</i> (F. Ritter) Zappi	1	118	85	37	28	1	3	4	-	12	3	-
<i>Tacinga inamoena</i> (K. Schum) (N.P. Taylor & Stuppy	-	-	3	10	-	4	-	1	-	-	-	-
<i>Tacinga palmadora</i> (Britton & Rose) N.P. Taylor & Stuppy	1	-	14	1	-	-	1	4	-	-	-	-
<b>TOTAL</b>	<b>5</b>	<b>201</b>	<b>386</b>	<b>171</b>	<b>35</b>	<b>79</b>	<b>35</b>	<b>68</b>	<b>1</b>	<b>38</b>	<b>3</b>	<b>2</b>

Fodder category accounted for nine of the ten species recorded in this study, and *O. ficus indica* was the most cited (109 citations), followed by *C. jamacaru* subsp. *jamacaru* (97 citations) and *P.*

*pachycladus* subsp. *pernambucoensis* (85 citations). These findings evidence the high representativeness of native species used as fodder resources (Table 3). However, they are only used during long dry season

periods, as immediate substitutes for pastures and cultivated forage species, which makes their use current and cyclic, as confirmed by reports:

"Last year we saved the animals by using it (Cardeiro). At four o'clock in the morning, he was

(her husband) out looking for *cardeiro*." (M.S.S., 42 years old)

"I use *cardeiro* to this day, it is one that when drought hits, we use it." (S.M.S., 56 years old)

Table 3 Species recorded for medicinal purposes and their respective used parts and methods of use for each disease reported in the rural community of Capivara, municipality of Solânea, northeastern Brazil. \*Where: Decoction = Tea made by boiling part of the plant; Sauce = Part of the plant is put into a container with water and the liquid obtained is ingested; 'Lambedor' 1 (homemade syrup) = Part of the plant is boiled in water with sugar; 'Lambedor' 2 = Part of the plant added with sugar or honey is left in the dew and the liquid obtained is ingested in the next day; 'Garrafada': Part of the plant is soaked in water or white wine with several other plant species

Species	Part used	Method of use	Treated disease
<i>Cereus jamacaru</i> DC. subsp. <i>jamacaru</i>	Inner bark	Sauce	Inflammation
	Fruit	<i>In natura</i>	Blood pressure, worms
	Pulp	Decoction, 'Lambedor' 1, sauce	Tiredness, inflammation, cough, prostate, ulcer, worms
	Root	Decoction, 'Garrafada', 'Lambedor' 1, Sauce	Thinning the blood, diabetes, backache, body aches, flu, swelling, inflammation, urethral/uterus/kidneys inflammation, snakebite, prostate, cough
<i>Melocactus</i> sp.	Pulp	'Lambedor' 1	Catarrh, cough, flu
	Pulp	'Lambedor' 2	Cough, flu, whooping cough
	Pulp	Sauce	Whooping cough
<i>Pilosocereus gounellei</i> (F.A.C.) Weber & subsp. <i>gounellei</i>	Thorn	<i>In natura</i>	Remove other thorns from the skin
<i>Pilosocereus pachycladus</i> F. Ritter subsp. <i>pernambucoensis</i> (F. Ritter) Zappi	Root	'Garrafada'	Inflammation
<i>Tacinga inamoena</i> (K. Schum) (N.P. Taylor & Stuppy)	Fruit	<i>In natura</i>	Cough, flu
	Fruit	'Lambedor' 1	Cough

When the specimens are managed, they (cacti) are often burned where they are found in order to remove their thorns, affecting their natural regeneration process. They can be also taken to be burned in other areas, in this case, only some parts of them are cut. This is the case of *P. gounellei* and *P. pachycladus* subsp. *pernambucoensis*. The removal of thorns can also be made without burning the plant, such as in the case of *C. jamacaru* subsp. *Jamacaru*, which is more practical to be used. Its

wood is used to produce meal to complement animal feeding.

There is a diversity of uses attributed to cacti species in the community of Capivara. Regarding the food category, the pulp and marrow are used in the preparation of salads, stew, and flour, in addition to jam and juice made from fruit, which is also consumed *in natura*. About fruit preference by the interviewees, *P. pachycladus* subsp.

*pernambucoensis*, *C. jamacaru* subsp. *jamacaru*, *O. ficus indica*, and *T. inamoena* had 56, 19, 12 and 2 citations, respectively. Ten of the informants do not like, do not eat or do not have preferences for fruits.

Despite the higher prominence of the construction category, lignified wood of *P. pachycladus* subsp. *pernambucoensis* and *C. jamacaru* subsp. *jamacaru* is also used for energetic and technological purposes, which together result in the production of firewood, planks, doors, laths, windows, ridgepoles, and wooden spoons and ladles to be used in the kitchen. Of these, lath production (77 citations) and live fences (47 citations) were the most representative. Another aspect of the fuel category is the use of *P. pachycladus* subsp. *pernambucoensis* in the production of artisanal torches.

Other uses were recorded for medicinal, shade and magic-religious purposes. In the preparation of homemade medicines, five methods were identified for the treatment of 19 types of diseases, of which, cough (24 citations), inflammation (18 citations) and the flu (6 citations) were the most cited ones (Table 3). *C. jamacaru* subsp. *jamacaru* (45 citations) and *Melocactus* sp. (28 citations) are the species most used as raw material to make these medicines (Table 2). With regards to the shade category, columnar species are kept in the enclosures of properties to provide shade to animals. As for magic-religious uses, the interviewees claimed that keeping species close to the houses and in areas of cultivation brings prosperity, keeps away the evil eye and even pests from crops, as reported by one of the research participants:

"We make a cross from *cardeiro* and place it in the plating area to keep away the evil eye because the thorns prick the evil eye." (L.C.S., 71 years old)

#### **Collection, occurrence and environmental perception**

Regarding the collection area, 69.3% of the informants obtain Cactaceae species from nearby forests, on 'lajedos' (granite outcrops) or scrubs, 28.7% from the community areas such as enclosures, live fences and from their property itself, and 1.98% said they do not collect these plants. Seventy-five percent of the informants claimed there is no preference for collection areas, 13.8% prefer to collect the plants near their residences due to convenience, 10.8% collect in nearby forests in order to preserve the specimens close to their houses, and 1.98% have no preference because they do not collect these plants.

Fifty-seven of the informants reported planting some cactus species; among them, forty-nine especially plant *O. ficus indica*, *O. dillenii*, and *N. cochenillifera*; eight people stated planting or have already planted *C. jamacaru* subsp. *jamacaru*, *P. pachycladus* subsp. *pernambucoensis*, *P. gounellei* subsp. *gounellei* and *Melocactus* sp. The other forty-four participants said they do not plant any cactus species.

When comparing the abundance of specimens in the past decades with the present moment, 52.4% of the informants stated that the number of cacti was not higher in the past, 38.6% said there was a higher number of these plants some years ago, 4.9% reported the specimens are more abundant nowadays, and 3.9% did not know how to inform.

According to most informants, any soil (35%) is appropriate to cacti species growing well. For the other interviewees, 'lajedo' (12.8%), and clay (10.8%), stony (8.9%), manured (prepared for cultivation – 7.9%), forest (4.9%), mountain (1.98%), open area (with no other plants – 1.98%), and soft (sandy – 1.98%) soils are the best for Cactaceae. The other participants did not know how to inform (13.8%).

About the predictive knowledge, 42.5% of the informants use the flowering of *C. jamacaru* subsp. *jamacaru* as an indication of rain, 11.8% use the flowering of *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* together to predict the occurrence of rain and their fruiting as a prediction of an abundant crop. Other rain signs are also considered, such as the tilt of *O. ficus indica* cladodes (5.9%), and the flowering of *P. pachycladus* subsp. *pernambucoensis* (8.9%), *P. gounellei* subsp. *gounellei* (1.98%), and *T. palmadora* (1.98). On the other hand, *T. inamoena* flowers (1%) are used to predict long periods of drought. Twenty-five percent of the interviewees did not know how to inform or said that this practice no longer exists.

## **Discussion**

### **Main form of use and conservation**

Cactaceae species are mainly used as fodder in the community of Capivara, and both the cultivated exotic species (*O. ficus indica*) and the native ones (*C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis*) are relevant for the residents. This fact has been also recorded in studies carried out in other semi-arid regions of Brazil, reinforcing the hypothesis that the use of cacti species as fodder is common in drought periods due

to the need of maintaining goat and sheep rearing (Andrade et al. 2006, Duque 2004, Lucena et al. 2012a,b, 2013, 2015).

It was possible to observe, in informal conversations, that the use of these species as fodder is a current practice due to the lack of rain in the region between 2012 and 2014. Lucena et al. (2015) reported the same dynamics in the rural community of Santa Rita, in the 'Cariri Paraibano', and emphasized that the lack of options, such as the absence of native pasture, leads rural producers to use native species. It is noteworthy that in the case of these authors, the presence of *O. ficus indica*, which facilitates animal feeding, being cultivated for this purpose, is less evident and was cited fewer times in their study. The lack of cultivated exotic species may explain the demand for the native ones.

The areas from where these species are collected, in the study community, which are usually associated with fodder use, are similar to those described by Lucena et al. (2015), in which the collection of plants in forests is rationed due to the higher density of these areas. The demand for a higher number of specimens near the residences leads to the need to collect a higher amount of resources in a small area, due to convenience, but when there is a need for a small volume of resources, the cacti are collected in areas far from the residences.

Nevertheless, in the study community, there are no plagues decimating plantations of *O. ficus indica*, such as the carmine cochineal (*Dactylopius opuntiae*), the most common one, as explained by Santos et al. (2006). This fact in addition to the planting of this species, which is carried out by 49 of the 101 informants, makes us conclude that, in this community, the widespread use of *C. jamacon* subsp. *jamacon* and *P. pachycladus* subsp. *pernambucoensis* is not only associated with the climatic factor or lack of resource, but it is also influenced by feed preference or quality, as reported in informal conversations about the role played by *C. jamacon* subsp. *jamacon* in the goat, sheep, and cattle fattening process.

The other main uses identified in this study (food and construction) are widely cited in studies on Cactaceae in different regions of the world (Andrade et al. 2006, Casas et al. 1999, Lima 1996, Pérez-Negrón et al. 2014). However, unlike Lucena et al. (2015) who found that only the fruit of Cactaceae species is used (*in natura*) as human food, in the community of Capivara, the pulp, marrow, and fruits are also processed into juices, jams, salads, and flour to make bread dough.

The production of homemade medicines was also expressive in the study community, taking into account the record of nineteen diseases treated by cacti species. In a study conducted in three different localities in the semi-arid region of Brazil, Lucena et al. (2014) described and compared the uses of cacti with medicinal potential, and listed the main species through indices such as RI (Relative Importance) and UV (Use Value), identifying *C. jamacon* subsp. *jamacon* and *Melocactus* sp. as the most important species. Likewise, in our study, these species were most cited and a higher number of diseases treated by them was recorded.

In addition to the significant production of laths of *C. jamacon* subsp. *jamacon* and *P. pachycladus* subsp. *pernambucoensis*, which were found in the roofs of several residences in the community, the intense construction of live fences from *O. dillenii* is a particularity of Capivara. The construction of live fences using cacti is also reported by Fuentes (2005), who observed they were used to replace or to supplement stakes. In the whole area of Capivara II, the properties are delimited by long live fences built with *O. dillenii*, evidencing this is the main use of this species. This fact shows the occurrence of small nuclei of knowledge and dynamics of use according to the locality and groups of people. Even in a single rural community, there are particularities about the use of species between its localities.

#### **Environmental perception and traditional knowledge**

In a study conducted in the 'Cariri Paraibano', Lucena et al. (2015) emphasized the importance and higher number of citations of use attributed to *C. jamacon* subsp. *jamacon*. Nevertheless, in the community of Capivara, located in the 'Curimataú' region, despite this species has had a higher number of use possibilities, *P. pachycladus* subsp. *pernambucoensis* was the most cited. Considering the different distribution of cacti species in the Caatinga ecoregions and the greater abundance of *C. jamacon* specimens in the 'Cariri' region, like *P. pachycladus* in the 'Curimataú', it is believed that the knowledge and use of these species may be directly associated with their availability.

On the other hand, according to other interviewees' perceptions, soil aspects may favor the development of specimens. Traditional botanical knowledge established within a community reflects not only the cultural and socioeconomic level of relationship between the population and plant resources but also the empirical ecological knowledge, which is obtained through observation and practice. The knowledge relating to the type of soil where a

particular species may be found can be considered as a mental map to know where to find or to collect the resource.

In this way, it is inferred that through investigations it is possible to identify the niche dynamics of the species and possible dispersers and pollinators, in addition to delineating the distribution of species based on soil types, considering that the traditional knowledge holders should be objects of research and active participants in management and shared administration plans, since they can, along with the scientific community, observe the dynamics of plant resources used by them. Thus, it is emphasized the importance of ethnobotany as an auxiliary tool in applied ecology studies.

### Final considerations

Farmers in the community of Capivara know and use Cactaceae species found in the region, and it is notorious the importance of this resource as fodder for these rural producers.

The way *C. jamacaru* subsp. *jamacaru* and *P. pachycladus* subsp. *pernambucoensis* are cited as fodder alternative and the fact they are still used in emergency situations indicate that more in-depth studies should be carried out in order to investigate the possible impacts that this practice may have on ecological populations.

The continuity of the use of native species, even with the cultivation of some exotic ones (*O. ficus indica*), exclusively destined for the maintenance of cattle, goat and sheep feeding, may indicate preference and management, since this fact is not unique to that region. Complementary studies are recommended to understand the amplitude of the relationship between farmers and resources with fodder potential, regarding the management and possible species domestication processes.

The observation of the aspects involving the development and establishment of cacti specimens in the community of Capivara makes the farmers complementary objects of study propitious for future ecological investigations, aiming at management projects and shared administration.

### Declarations

**List of abbreviations:** Not applicable.

**Ethics approval and consent to participate:** The purpose of the study was explained to the community members interviewed, and they were asked to sign an informed consent form, as required by the Brazilian National Health Council through the Research Ethics Committee (Resolution 510/2016). The study is part of a larger

project entitled Identification of Patterns of Use of Native Species in Caatinga Areas: An Ethnobiological and Conservationist Approach, which has already been approved by the Human Research Ethics Committee (CEP, for its initials in Portuguese) of the Lauro Wanderley Hospital, Federal University of Paraíba, registered under protocol CEP/HULW no. 297/11 (with cover sheet no. 420134).

**Consent for publication:** Not applicable.

**Availability of data and materials:** The data was not deposited in public repositories. **Competing interests:** The authors do not have any competing interests.

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**Competing interests:** Competitive Interests: This manuscript does not present conflicting interests.

**Funding:** This research did not receive funding.

**Authors' contributions:** TKNC, CML and JRFL carried out fieldwork, data analysis and drafted the manuscript. DDC and RFPL configured the research project, supervised the work and improved the manuscript. All authors read, reviewed and approved the final version of the manuscript.

### Acknowledgements

The authors express their sincere gratitude to the residents of the rural communities of Solânea for participating and contributing to the research. This research was part of the Master's degree of TKNC in the Postgraduate Program in Development and Environment - PRODEMA/ UFPB.

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