



Local Botanical Knowledge about *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. in Rural Communities in the Semi-Arid Region of Brazil

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Research

Abstract

Sideroxylon obtusifolium (Roem. & Schult.) T.D.Penn. is a species widely used, for several purposes, by traditional populations from the semi-arid region of Brazil. This study records the knowledge and use attributed to this species by residents from two regions: the Curimataú (Coelho and Capivara communities) and the Cariri (São Francisco and Santa Rita communities) located in the semi-arid region of Paraíba State, Northeast Brazil. We interviewed all householders (244 informants) through a semi-structured form. The data were organized in eight use categories, and comparisons were made using a Mann-Whitney test and a Kruskal-Wallis test. Medicinal was the most cited use. To test the similarity in medicinal uses, we used a one-way ANOSIM permutation test. Knowledge about plant use was similar in both communities but differed by gender. Bark was the most used part for medicinal purposes, and "undefined diseases or undefined pains" was the most cited bodily system-ailment. Specific needs in each community determined how plants were employed.

Introduction

The **caatinga** region covers a large area from Ceará State to the north of Minas Gerais State, corresponding to a tenth of the area of Brazil (Bernardes 1999). Vegetation of this region includes some dry forest species occurring in the Atlantic Forest formations (Albuquerque *et al.* 2012). Paraíba State has several of these ecotones, one of which is located in the Agreste region in the semi-arid band covering the Borborema Plateau and the Tropical Atlantic Façade (Alves 2009). An important feature of the **caatinga** ecosystem is that it has long dry seasons and irregular rainfall with high temperatures and low hu-

midity, with terrain having specific characteristics between depressions and plateaus that outline the physiographic aspects of its ecoregions (Roque *et al.* 2010, Santana & Souto 2006, Trovão *et al.* 2004). Studies of **caatinga** are,

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for the most part, restricted to limited areas, which makes it difficult to make a more widespread diagnosis and determine the overall prominence of research in this ecosystem (Albuquerque *et al.* 2012). However, Leal *et al.* (2004) have already shown the progressive deterioration of semi-arid environments.

Typical of the semi-arid region, *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. (Sapotaceae) is of great importance in the **caatinga**. The tree may reach 18 m in height, with a dense crown and fruit ripening in January and February (Garrido *et al.* 2007). It is distributed in Brazil from the State of Ceará to the Rio Grande do Sul (Ferreira 2000, Lorenzi 1999), as well as occurring in other countries of Central and South America (Agra *et al.* 2005). This is not a plant exclusive to **caatinga** as it is also found in vegetation formations of semi-deciduous seasonal forest, ombrophilous forest (*Araucaria* forest), mixed ombrophilous forest and sandbank, and in the phytogeographic areas of the Amazon forest, Cerrado, Atlantic Forest, Pampa, and Pantanal (Bernardes 1999, Cabral *et al.* 2010, Carneiro *et al.* 2011). *Sideroxylon obtusifolium* common names include **quixabeira**, **quixaba**, **rompe gibão**, **coca**, and **sapotiaba** (Agra 1996).

Among the many uses of *S. obtusifolium*, its wood is used to prepare artifacts such as tool handles (Ferraz *et al.* 2005, Silva *et al.* 2004) and in rural and domestic construction. Its branches are used as hedges and living fences to discourage the escape of domestic animals; furthermore, this species is used as human food and animal feed (forage), and the bark has commercial potential (Pedrosa *et al.* 2012).

Its use in the **caatinga** has been recorded in many ethnobotanical studies (Agra *et al.* 2007, Albuquerque 2006, Ferraz *et al.* 2005, Guerra *et al.* 2010, Kneip 2009, Pedrosa *et al.* 2012, Roque 2009, Scarpa 2009, Silva & Albuquerque 2004) especially for medicines, including analgesics, astringents, tonics, anti-inflammatories, and anti-diabetics, as well for wound healing and gastrointestinal disorders (Albuquerque 2006, Albuquerque & Andrade 2002b, Almeida *et al.* 2005, 2007b, Ferraz *et al.* 2006, Lorenzi *et al.* 1999, Marques 2008, Rebouças *et al.* 2012, Silva & Albuquerque 2004, Silva *et al.* 2004)

Overharvesting threatens the survival of the tree (Albuquerque *et al.* 2007, Almeida & Albuquerque 2002, Guerra *et al.* 2012, Leite *et al.* 2012, Lucena *et al.* 2012a, Pedrosa *et al.* 2012). *Sideroxylon obtusifolium* is endangered according to decree No. 37-N of April 1992 of Brazil's Environment Ministry (MMA 1992), but over the years this context has changed, and this species was removed from the red list of endangered species by normative MMA No. 06 of September 23, 2008 (MMA 2008).

Currently, changes in the rural communities' socio-economic context have influenced the dynamics of knowl-

edge and use of **caatinga** species, since interest in passing on knowledge has decreased. The ensuing loss of traditional knowledge threatens the tree's value to humans and its management (Lucena *et al.* 2012b, Luoga *et al.* 2000, Oliveira *et al.* 2007, Voeks & Leony 2004). Therefore, this study aimed to record and compare farmers' knowledge about *S. obtusifolium* in the semi-arid region of northeastern Brazil. We specifically aim to assess the intracultural and intercultural patterns in each of the surveyed areas and compare the knowledge of men and women on the use of this species. Based on the results found, a differentiated analysis was performed about its patterns of use in the medicinal category, because it was the most cited in relation to the number of citations in all communities studied.

Materials and Methods

Study area

This study was conducted in four rural communities located in two regions of Paraíba State, northeastern Brazil, named Capivara (municipality of Solânea) and Coelho (municipality of Remigio), both belonging to the microregion of Curimataú; and São Francisco (municipality of Cabaceiras) and Santa Rita (municipality of Congo) belonging to the microregion of Cariri (Figure 1).

The microregion of Curimataú is part of the mesoregion of Agreste and has a dry and hot climate (classified as Bsw in the Köppen system). The minimum temperatures range from 18 to 22°C in July and August, and the maximums are between 28 and 31°C in November and December (Lacerda *et al.* 2005). Precipitation varies from 333.6 to 714.6 mm/year (AESA 2006). The vegetation in the western part is characteristic of dry areas, with a predominance of open shrubby **caatinga** and arboreous vegetation, with intermingled wet and dry forests.

The Cariri microregion of Paraíba State is a subregion of the Borborema Plateau, located in the south-central part of the State, with elevations ranging from 400 to 600 m and occupying an area of 13.845 km². The Cariri is one of the driest areas of the **caatinga** in Paraíba State (Cabral 1997), in which there are different types of shrubby-arboreous vegetation, with high densities of cacti and bromeliads. The characteristic vegetation is the **caatinga**.

Study communities

The municipality of Solânea is located in the Agreste mesoregion and the Curimataú Oriental microregion between coordinates 06°46'40"S and 35°41'49"W, at an altitude of 626 m (Figure 1). It is 138 km away from João Pessoa (the state capital), with access through highways BR 230, BR 041, and PB 105. It has a territorial area of 232 km², with a population density of 115 inhabitants per km² (IBGE

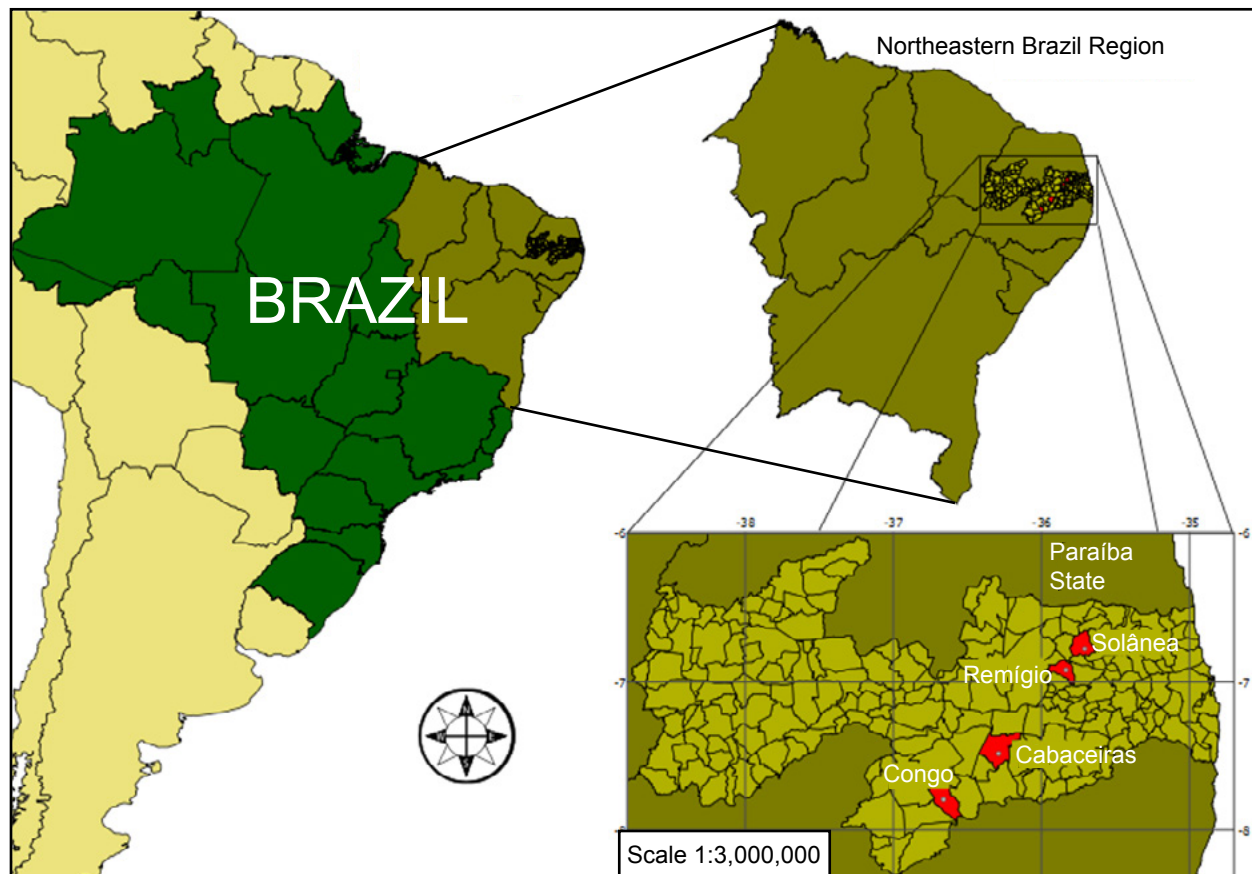


Figure 1. Study area in four rural communities: Capivara (municipality of Solânea), Coelho (municipality of Remígio), São Francisco (municipality of Cabaceiras), and Santa Rita (municipality of Congo) located in two regions of Paraíba State, northeastern Brazil.

2010) and a population of 26,689 inhabitants, of which 7357 are residents in rural areas. It borders the municipalities of Casserengue, Serraria, Dona Inês, Remígio, Arara, Barra de Santa Rosa, Borborema, Bananeiras, and Cacimba de Dentro (IBGE 2010). The Capivara community is about 15 km away from the urban center and is subdivided into three locations: Capivara I, II, and III. Its economy is based on family farming, especially beans and corn cultivation, in addition to cattle, goat, and sheep breeding (Ribeiro *et al.* 2014, Soares *et al.* 2013).

The municipality of Remígio is located in the Agreste mesoregion and Curimataú Oriental microregion of Paraíba State (Figure 1) between coordinates 06°54'10"S and 35°50'02"W. It is at an approximate altitude of 593 m and is 157 km away from the state capital. Its main access is through highways BR 230, BR 041, and PB 105. It borders the municipalities of Esperança, Pocinhos, Barra de Santa Rosa, and Areia. It has a total population of 17,581 inhabitants (4630 in rural areas and 12,951 in urban areas) and a territorial area of 178 km² (IBGE 2010). The Coelho community is approximately 7 km away from the

municipality urban center. The dominant economy is also subsistence agriculture, with an emphasis on rain-fed agriculture; the main products are corn and beans. Cattle breeding is the main community livestock activity; there is also goat and sheep breeding (Coutinho 2013).

The municipality of Cabaceiras is located in the Borborema mesoregion and Cariri Oriental microregion, delimited by coordinates 07°29'20"S and 36°17'14"W (Figure 1), with a mean altitude of about 500 m. It is 180 km away from the state capital, with a territorial area of 453 km² and a total population of 5035 inhabitants, of whom 2217 live in the urban area and 2818 in rural areas (IBGE 2010). It borders the municipalities of Barra de São Miguel, São Domingos, São João do Cariri, Boa Vista, and Boqueirão (IBGE 2010). The São Francisco community is located about 15 km from the urban area, consisting of five different locations: Caruatá de Dentro, Alto Fechado, Jerimum, Rio Direito, and Malhada Comprida. Its economy is based on subsistence agropastoral activities, especially goat, sheep, and cattle breeding and the cultivation of

bean, corn, forage cactus, etc. (Lucena *et al.* 2013, Silva *et al.* 2014).

The municipality of Congo is located in the Borborema mesoregion and Cariri Ocidental microregion (Figure 1), at an approximate altitude of 480 m, between coordinates 7°47'41"S and 36°39'42"W, about 212 km away from the state capital, João Pessoa. It borders the municipalities of Brejo de Santa Cruz (Pernambuco State) and Monteiro, Sumé, Serra Branca, Camalaú, Coxixola, and Caraúbas in Paraíba State, with a total population of 4692 inhabitants (1748 in rural areas and 2944 in urban areas) and a territorial area of 333,469 km², with a population density of 14 inhabitants/km² (IBGE 2010). Santa Rita is approximately 8 km away from the urban center. Its economy is based on subsistence agriculture, especially the cultivation of corn and beans. Goat and sheep breeding is the main community livestock activity; there is also cattle breeding.

Ethnobotanical inventory

Ethnobotanical data collection was performed from April 2011 to July 2012. All the inhabited residences of each community were visited. Semi-structured forms (Albuquerque *et al.* 2010) containing specific questions about the use of *S. obtusifolium* were distributed to the householders (men and women) of each residence to compare different conceptions between genders. Before obtaining ethnobotanical information, we clarified the research objective to each householder, who then, in agreement, signed the Free and Transparent Consent form of the National Health Council through the Committee of Ethics in Research (resolution 196/96). This study was developed with the approval of the Committee of Ethics in Research with Human Beings (CEP) of the Lauro Wanderley Hospital from the Federal University of Paraíba, registered in protocol CEP/HULW No. 297/11.

The information obtained was confirmed using complementary techniques including direct observation and guided tours, which is a step carried out with interviewees who were willing to go through the community, so as to facilitate visualization of the uses mentioned in the interviews and the places where the species is present in the locality (Albuquerque *et al.* 2010).

The use citations were organized in use categories according to the ethnobotany literature (Lucena *et al.* 2007a), namely: construction, food, forage, fuel, medicinal, technology, and others.

In order to better specify the types of medicinal uses in the communities studied, the therapeutic indications cited were classified into 16 pre-set categories by the World Health Organization (OMS 2000) as follows: undefined diseases or undefined pains; physical or mental weakness; lesions on the skin and subcutaneous tissue; endo-

crine gland diseases; nutrition and metabolism problems; blood and blood-forming organ diseases; musculoskeletal system and connective tissue diseases; infectious and parasitic diseases; sexual inappetence; neoplasms; and respiratory, sensory (eyes, ears), cardiovascular, genitourinary, nervous, and digestive system disorders. The medicinal use of *S. obtusifolium* was also categorized according to specific ailments/diseases, and information about its preparation in medicinal forms was collected.

A voucher specimen was collected in the field and deposited in EAN, and processed, identified, and incorporated (EAN No. 17,625) into the Jaime Coêlho de Moraes Herbarium (EAN) of the Federal University of Paraíba, in the Agricultural Science Center.

Data analysis

Since the data were not normally distributed according to a Shapiro-Wilk test, we tested the differences in knowledge by use category and between men and women, and within the regions studied using a non-parametric Mann-Whitney test for two independent samples. To compare knowledge between communities, we used a Kruskal-Wallis test.

Due to the large volume of information generated in the medicinal category, we attempted to conduct a more detailed analysis of knowledge about this use category between the regions. To evaluate the differences in medicinal uses reported for *S. obtusifolium* among the four communities studied, we used the one-way ANOSIM permutation test, using the Bray-Curtis distance and 9999 permutations. The one-way ANOSIM test assumes that the distances are greater among elements of different groups than within the same group (Clarke 1993). This test produces an R value that varies in amplitude from -1 to +1, where R values equal to +1 are obtained only when all replicates within the groups are more similar to each other than to any replicate in a different group. The percentage of similarities procedure (SIMPER) was used to assess which diseases are most responsible for the differences observed among the groups of samples. The program used for the analysis was Past 2.17 (Hammer 2013).

Results

Knowledge and species use

We interviewed 370 people: 112 in Capivara (59 women and 53 men), 37 in Coelho (13 women and 24 men), 107 in São Francisco (55 women and 52 men), and 98 in Santa Rita (57 women and 41 men). However, the analyses were carried out only with information from informants who said they knew *S. obtusifolium*. Thus, we included information from 41 interviewees in Capivara (25 men and 16 women), 15 interviewees in Coelho (6 men and 9 women), 106 in São Francisco (52 men and 54 women),

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Table 1. Distribution of traditional knowledge about *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. in four communities in the semi-arid region of Paraíba State, northeastern Brazil. Equal letters in the same column indicate the absence of significant differences using the Kruskal-Wallis test ($p < 0.05$).

Regions	Communities	Uses $\chi \pm SD$	Citations $\chi \pm SD$
Cariri	São Francisco	4.03 ± 2.97 ^a	2.25 ± 1.29 ^a
	Santa Rita	4.45 ± 2.69 ^{ac}	2.75 ± 1.36 ^a
Curimataú	Coelho	3.13 ± 2.32 ^{bc}	1.86 ± 1.24 ^{ab}
	Capivara	2.54 ± 1.61 ^b	1.59 ± 2.93 ^b

and 82 in Santa Rita (38 men and 44 women) in the data analyses. Therefore, we used data from 244 interviewees who said they knew the species studied.

There are similarities both in relation to the number of uses and in relation to the number of *S. obtusifolium* citations between the cities of each region (Table 1). In general, the Cariri communities (São Francisco and Santa Rita) had greater knowledge about *S. obtusifolium* than the Curimataú communities (Coelho and Capivara) (Table 1). However, we can identify similarities between communities in different regions such as Santa Rita (Cariri), in which the number of uses is similar to the Curimataú region; and Coelho (Curimataú), in which the number of citations is similar to the Cariri region (Table 1). The number of uses recorded in the community of São Francisco is significantly different from those recorded in the Coelho and Capivara communities (Curimataú region) ($M = 40.46$, $P < 0.001$). Concerning the number of citations, the test showed significant differences between Capivara (Curimataú) and the Cariri communities (São Francisco and Santa Rita) ($M = 20.91$, $P = 0.0001$; Table 1).

Reported uses for *S. obtusifolium* were included in eight categories; the medicinal category received the greatest number of citations, followed by the forage category

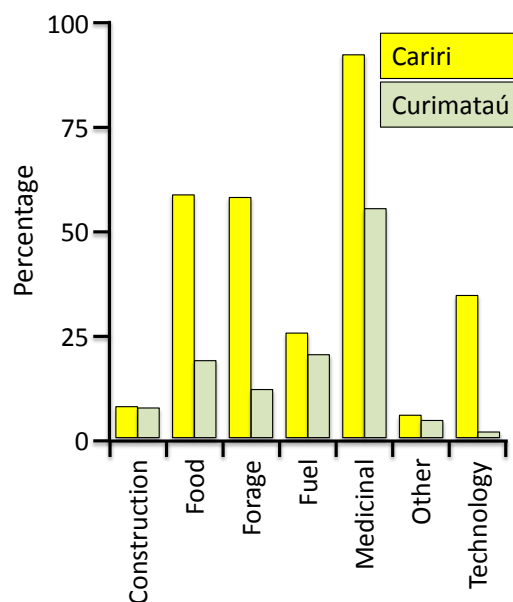


Figure 2. Distribution of traditional knowledge about *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. in two semi-arid regions (Cariri and Curimataú) of Paraíba State, northeastern Brazil.

Table 2. Distribution of traditional knowledge about *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. by use category, showing mean ± standard deviation ($\chi \pm SD$) of citations and uses, in two semi-arid regions (Cariri and Curimataú) of Paraíba State, northeastern Brazil. Different letters in the same row indicate significant differences between the regions using the Mann-Whitney test ($p < 0.05$). Different letters in the same row indicate significant differences among communities using the Kruskal-Wallis test ($p < 0.05$).

	Overall mean of uses $\chi \pm SD$		Overall mean of citations $\chi \pm SD$	
	Cariri	Curimataú	Cariri	Curimataú
Food	0.61 ± 0.48 ^a	0.19 ± 0.39 ^b	0.64 ± 0.55 ^a	0.19 ± 0.39 ^b
Fuel	0.26 ± 0.44 ^a	0.21 ± 0.41 ^a	0.43 ± 0.76 ^a	0.33 ± 0.69 ^a
Construction	0.06 ± 0.25 ^a	0.07 ± 0.25 ^a	0.12 ± 0.49 ^a	0.10 ± 0.40 ^a
Forage	0.59 ± 0.49 ^a	0.12 ± 0.33 ^b	0.93 ± 0.87 ^a	0.14 ± 0.39 ^b
Medicinal	0.87 ± 0.33 ^a	0.96 ± 0.18 ^b	1.33 ± 0.95 ^a	1.75 ± 1.03 ^b
Others	0.05 ± 0.23 ^a	0.05 ± 0.22 ^a	0.59 ± 0.23 ^a	0.07 ± 0.31 ^a
Technology	0.31 ± 0.46 ^a	0.05 ± 0.22 ^b	0.62 ± 1.08 ^a	0.08 ± 0.43 ^b
Veterinary	0.48 ± 0.21 ^a	0.01 ± 0.13 ^a	0.04 ± 0.21 ^a	0.01 ± 0.13 ^a

Table 3. Distribution of traditional knowledge about *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. by use category, demonstrating mean \pm standard deviation ($\bar{x} \pm SD$) of uses and citations in four rural communities in the semi-arid region of Paraíba, northeastern Brazil. Different lowercase letters in the same column for each region indicate significant differences using the Mann-Whitney test ($p < 0.05$).

	Overall mean of uses ($\bar{x} \pm SD$)				Overall mean of citations ($\bar{x} \pm SD$)			
	São Francisco	Santa Rita	Coelho	Capivara	Sao Francisco	Santa Rita	Coelho	Capivara
Food	0.74 $\pm 0.44^a$	0.62 $\pm 0.50^b$	0.20 $\pm 0.41^b$	0.19 $\pm 0.40^b$	0.76 $\pm 0.49^a$	0.50 $\pm 0.50^b$	0.20 $\pm 0.41^b$	0.19 $\pm 0.40^b$
Fuel	0.26 $\pm 0.44^a$	0.28 $\pm 0.46^a$	0.20 $\pm 0.41^a$	0.21 $\pm 0.42^a$	0.39 $\pm 0.70^a$	0.50 $\pm 0.84^a$	0.27 $\pm 0.59^a$	0.36 $\pm 0.73^a$
Construction	0.08 $\pm 0.27^a$	0.08 $\pm 0.26^a$	0.20 $\pm 0.41^a$	0.02 $\pm 0.15^a$	0.09 $\pm 0.35^a$	0.17 $\pm 0.62^a$	0.33 $\pm 0.72^a$	0.02 $\pm 0.15^a$
Forage	0.67 $\pm 0.47^a$	0.60 $\pm 0.50^{ac}$	0.20 $\pm 0.41^{bc}$	0.10 $\pm 0.30^b$	1.06 $\pm 0.86^a$	0.77 $\pm 0.86^{ab}$	0.20 $\pm 0.41^b$	0.12 $\pm 0.40^b$
Medicinal	0.86 $\pm 0.35^a$	0.87 $\pm 0.31^a$	0.93 $\pm 0.26^a$	0.98 $\pm 0.15^a$	1.10 $\pm 0.66^a$	1.63 $\pm 1.17^b$	1.87 $\pm 1.36^{ab}$	1.71 $\pm 0.92^b$
Others	0.03 $\pm 0.17^a$	0.06 $\pm 0.31^a$	0.07 $\pm 0.26^a$	0.05 $\pm 0.22^a$	0.03 $\pm 0.17^a$	0.12 $\pm 0.36^a$	0.07 $\pm 0.26^a$	0.07 $\pm 0.34^a$
Technology	0.29 \pm 0.46 ^a	0.32 \pm 0.48 ^{ab}	0.07 \pm 0.26 ^{ab}	0.05 \pm 0.22 ^b	0.58 \pm 1.04 ^{ab}	0.68 \pm 1.13 ^a	0.20 \pm 0.77 ^{ab}	0.05 \pm 0.22 ^b
Veterinary	0.03 \pm 0.17 ^a	0.05 \pm 0.26 ^a	0 \pm 0	0.02 \pm 0.15 ^a	0.03 \pm 0.17 ^a	0.07 \pm 0.26 ^a	0 \pm 0	0.02 \pm 0.15 ^a

(Table 2, Figure 2). People from the Curimataú communities showed a greater knowledge of uses (citations) in the medicinal category for *S. obtusifolium* than the communities of Cariri; while in the food, forage, and technology categories we observed the opposite (Table 2). This same trend continued when an analysis was done considering the overall mean uses (Table 2, Figure 2). In the technology category, all the cited uses were for the manufacture of tool handles—such as hoe, sickle, hammer, pick, and ax—because the plant has a hard and durable wood. In the construction category, there was an equivalent number of citations between the communities of both regions. The wood is used to build fences (stakes, poles,

and fence posts) from branches that have peculiar measures and characteristics.

In a more detailed analysis, considering the use categories, all the communities had similar uses and citations for the fuel, construction, other, and veterinary categories ($p > 0.05$; Table 3). The community of São Francisco showed the greatest difference in relation to the other communities: in terms of uses ($H = 45.06$, $P < 0.001$) and citations ($H = 44.51$, $P < 0.001$) there was a significant difference from all the other communities in the food category (Table 3); there were differences between the Coelho and Capivara communities in the forage category in relation to the

Table 4. *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. used parts by communities in the regions of Curimataú (communities of Capivara and Coelho) and Cariri (communities of São Francisco and Santa Rita) in Paraíba, northeastern Brazil.

Communities	Used parts (%)						
	Wood	Bark	Fruit	Leaf	Branch	Root	Complete plant
Capivara	19.35	65.61	12	1.07	-	-	1.07
Coelho	27.65	59.57	10.63	2.12	-	-	-
São Francisco	26.99	28.16	30.51	13.14	-	0.23	-
Santa Rita	30.18	36.38	21.02	6.19	0.26	-	2.42
Total	39	352	230	81	1	1	4

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number of uses (M = 44.80, P < 0.001) and citations (M = 45.21, P < 0.001) (Table 3); and there was also a significant difference in the community of Santa Rita in the medicinal category in relation to the number of citations (M = 21.67, P = 0.001) (Table 3). In the technology category, there was also a difference in the number of uses and citations between the Santa Rita and Capivara communities (M = 17.12, P < 0.05; H = 16.98, P < 0.05, respectively) (Table 3).

Use of all parts of the plant was recorded, such as bark, fruit, leaf, root, and the whole plant (Table 4). Although *S. obtusifolium* seems to be a versatile species, in the communities studied people prefer to use the bark due to its

medicinal potential. Timber uses were also registered in rural construction, the development of technological artifacts, and use as firewood and/or charcoal. The fruit is used as human food consumed fresh and as forage for animals. Other parts such as the leaf and root are used in the production of certain medicines, the branches are used to build fences and as whips because of their thorns, and the whole plant is used as shade.

Distribution of knowledge according to gender

In both regions studied (Cariri and Curimataú), there were no significant differences regarding the number of uses and citations between men and women (Table 5). How-

Table 5. Distribution of traditional knowledge about *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. by gender within and between two regions of Paraíba, northeastern Brazil. Different lowercase letters in the same column for each region indicate significant differences using the Mann-Whitney test (p < 0.05). Different capital letters in the same column indicate significant differences between regions using the Mann-Whitney test (p < 0.05).

	Uses $\bar{x} \pm SD$	Citations $\bar{x} \pm SD$
Cariri		
Women	2.73 ± 1.28 ^{aA}	4.05 ± 2.33 ^{aA}
Men	2.96 ± 1.38 ^{aA}	4.38 ± 2.59 ^{aA}
Curimataú		
Women	1.72 ± 1.17 ^{aB}	3.08 ± 2.13 ^{aB}
Men	1.62 ± 0.90 ^{aB}	2.40 ± 1.49 ^{aB}

Table 6. Body systems and diseases included in each system and treatment preparation method using the bark of *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. in the regions of Curimataú (communities of Capivara and Coelho) and Cariri (communities of São Francisco and Santa Rita), in the semi-arid region of Paraíba (Northeast Brazil). A: sauce; B: decoction; C: infusion; D: topical use; E: **lambedor**; F: sitz bath; G: **garrafada**.

Body systems & diseases	Community prep methods			
	Capivara	Coelho	São Francisco	Santa Rita
Undefined diseases or undefined pains				
Blow (mechanical shock)	A, B, D, E	A, B	A, B	A, B, D
General inflammation	A, B, D, E	A, G	A, B, D	A, B, D, F
Hangover	-	-	-	G
Infections	B, E	-	A, B	-
Malaise	-	B	-	G
Pain	A	A, B, G	A	A
Ulcer	-	B	-	G
Physical and mental weakness				
Lack of appetite	-	E	-	E
Blood and blood-forming organs diseases				
Kidney problems	A, B, E	A	-	A
Kidneys	-	A	-	A
Liver	-	G	-	G

Body systems & diseases	Community prep methods			
	Capivara	Coelho	São Francisco	Santa Rita
Musculoskeletal system and connective tissue diseases				
Bruises	-	A	-	A
Injury	-	-	-	-
Muscle pain	-	A	-	A
Rheumatism	A	-	A, B	-
Spine pain	A, B	A, B	A, G	A, B
Skin and subcutaneous tissue lesions				
Caroço	-	-	-	F
Injury	A, D	A, D	A, D	A, D
Lump	-	F	-	-
Digestive system disorders				
Arrested intestine (constipation)	-	B	-	-
Diarrhea	A	-	-	-
Gases	-	B	-	-
Gastritis	A, B	-	-	-
Sore throat	-	-	B	D
Stomach pain	-	-	-	A
Toothache	-	-	A, B	-
Genitourinary system disorders				
Kidney problems	A	-	-	-
Ovary inflammation	-	-	A, F	-
Prostate	-	-	-	A
Urethra inflammation	-	C	-	-
Urinary inflammation	-	-	A, F	-
Uterus inflammation	A	-	F	A, F
Respiratory system disorders				
Cough	-	-	B, E	A, F
Flu	-	-	G	A
Lung	-	-	-	A

ever, when this analysis was made for the same sex between the two regions, we identified differences in both the number of uses and citations of *S. obtusifolium* (Table 5). The men in the Cariri region make greater use of this species for food (U = 756.50, p < 0.001), forage (U = 654.0, p < 0.001), and technology (U = 951.00, p < 0.001) while women have more knowledge in the food (U = 757.00, p < 0.001), forage (U = 678.00, p < 0.001), and technology (U = 969.00, p < 0.05) categories. In relation to the number of citations in each category, the test revealed that men from Cariri have greater knowledge of uses than men from Curimataú, especially in the food (U = 776.00, p < 0.001), forage (U = 685.00, p < 0.001), and technology (U = 973.00, p < 0.001) categories; the same results were found for women in the two regions in the food (U =

760.00, p < 0.001), forage (U = 737.50, p < 0.001), and technology (U = 960.00, p < 0.05) categories. However, women from Curimataú showed greater knowledge about medicinal uses (U = 851.00 p < 0.01).

***Sideroxylon obtusifolium* for medical purposes: Therapeutic indications and preparation**

Thirty diseases treated by *S. obtusifolium* were registered and distributed in 8 bodily systems (Table 6). The following systems/disease classes were not cited: endocrine glands, nutrition and metabolism, infectious and parasitic, sexual inappetence, neoplasms, sensory system (eyes, ears), and nervous system disorders.

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Table 7. Results for the analysis of ANOSIM pairwise comparing therapeutic use citations of *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. among four semi-arid communities of Paraíba, northeastern Brazil.

	Coelho		São Francisco		Santa Rita	
São Francisco	R = 0.069	p = 0.088				
Santa Rita	R = 0.124	p < 0.01	R = 0.010	p = 0.132		
Capivara	R = 0.125	p < 0.05	R = -0.030	p = 0.885	R = 0.001	p = 0.411

For the preparation of medicines seven different methods were reported:

1. "Sauce"—part of the plant is put in water for a certain time, then the water is drunk.
2. Tea decoction—part of the plant is boiled in water.
3. Tea infusion—part of the plant is added to already boiling water (an infusion is made with less water than boiling).
4. Topical use—part of the plant or water from the sauce intended for external use, such as washing injuries.
5. **Lambedor** (homemade syrup)—part of the plant is cooked with sugar until it has a consistency similar to honey, and other plants may or may not be added in the mixture.
6. Sitz bath—water from the sauce or tea decoction is used to bathe the pelvic and genital regions.
7. **Garrafada**—soak part of the plant in water with other plants with medicinal properties listed for the same disease.

The most cited disease was general inflammation, and the bark was the most indicated part used in preparing medicines by the communities.

The results obtained using the ANOSIM test indicated that the similarity hypothesis for citation use in the medicinal category among the four studied communities must be accepted (R = 0.012; p < 0.17). According to pairwise comparison, the total use citations in Capivara differed statistically from the citations in the São Francisco and Santa Rita communities (Table 7).

The results obtained from SIMPER analysis to determine the types of diseases contributing to differences and similarities demonstrated that general inflammation, blow (mechanical shock), and general pain are the main types of diseases responsible for similarity (Table 8) and dissimilarity (Table 9) between communities in the use of *S. obtusifolium* for therapeutic purposes.

Discussion

Knowledge and use of *Sideroxylon obtusifolium*: Comparing Cariri and Curimataú regions

Knowledge about *S. obtusifolium* was similar both in terms of the number of citations and the number of uses

Table 8. Contribution of the types of diseases treated with *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. to the similarity among four semi-arid communities of Paraíba, northeastern Brazil.

Group similarity (%)	Coelho (13.06)	Capivara (32.09)	São Francisco (24.64)	Santa Rita (22.93)
General inflammation	67.33	83.81	69.66	50.10
General pain	25.64	-	-	37.02
Blow	-	6.75	21.59	-
Accumulated %	92.97	90.56	91.25	87.12

Table 9. Contribution of the main types of diseases treated with *Sideroxylon obtusifolium* (Roem. & Schult.) T.D.Penn. to the dissimilarity among four communities in the semi-arid region of Paraíba, northeastern Brazil. SF = São Francisco; SR = Santa Rita.

Dissimilarity among groups (%)	Coelho vs. SF (78.26)	Coelho vs. SR (81.42)	Coelho vs. Capivara (72.20)	SF vs. SR (84.60)	SF vs. Capivara (74.67)	SR vs. Capivara (76.95)
General inflammation	23.78	19.25	26.11	26.33	33.1	27.94
Blow	15.42	17.24	12	20.93	17.55	18.47
General pain	16.28	12.47	14.5	-	10.41	11.17
Accumulated %	40.06	48.96	52.61	47.26	61.06	57.58

between the municipalities of the Cariri and Curimataú regions; however, the communities present in Cariri have greater knowledge in comparison to the Curimataú region. The Cariri communities are far from the municipality's urban area, thus necessitating greater use of natural resources due to poor accessibility, while the Curimataú communities, which are located near the urban center, have greater access to relevant facilities, and there is no need to exploit plant resources, which may explain the use disparity between the two regions. Similar results have been found in communities in the littoral region in Pernambuco State, northeastern Brazil (Silva & Andrade 2005), and in two regions of São Paulo State and in Santa Catarina, Brazil (Miranda & Hanazaki 2008).

The Curimataú and Cariri communities have a higher use frequency for *S. obtusifolium* in the medicinal category, as observed in other studies (Agra *et al.* 2007, Albuquerque & Andrade 2002a, Almeida *et al.* 2005, Garrido *et al.* 2007, Marques 2008, Pedrosa *et al.* 2012, Roque *et al.* 2010, Silva & Albuquerque 2005); however, the Curimataú communities must be highlighted in relation to the number of use and citations in comparison to Cariri with regard to the number of citations and uses by women, both of which are larger in the Curimataú region.

Due to the characteristic climate of the Northeast and consequent lack of non-timber resources that supply forage needs for animal breeding, native species such as the **xiquexique** (*Pilosocereus gounellei* (F.A.C.Weber ex K.Schum.) Byles & G.D.Rowley) and **mandacaru** (*Cereus jamacaru* DC.) are used as emergency food (Braga 1976). The same was found in this study, where *S. obtusifolium* fruit and leaves are used as important forage in animal feed in São Francisco (Cariri). This community stood out in the food category and its fruit, called **quixaba**, is consumed fresh during the winter (Garrido *et al.* 2007, Roque 2009). In the other communities there were significant differences in food uses. The interviewees showed little interest in or appreciation of the fruit (Lucena *et al.* 2007b) because, according to them, the latex contained in the fruit gives it an aspect of gum when the fruit is chewed, which adheres to the teeth, making its consumption infrequent; the same was recorded by Nascimento *et al.* (2009).

In this study, all parts of the plant were cited as useful (fruits, roots, wood, leaves, and bark) when intended for non-timber and timber categories, especially the bark, because it is effective for medicinal uses and is available throughout the year (Alves & Nascimento 2010, Baldauf *et al.* 2009, Marinho *et al.* 2011). When it comes to timber uses, *S. obtusifolium* was shown to be relevant in all communities both for the manufacture of artifacts such as tool handles and in rural constructions such as fences built from the branches, because this species presents a rigid and durable wood (Ferraz *et al.* 2005, Lorenzi 1999, 2002).

Comparing knowledge between genders

We found that *S. obtusifolium* is recognized by the inhabitants of the communities studied. However, there were differences in knowledge between men and women, from the same community, and all informants said they were aware of the medicinal powers of the species, but women stood out, citing these utilities more often than men in the Curimataú region. Lawrence *et al.* (2005), Ceolin *et al.* (2011), and Voeks (2007) confirmed this trend in their studies and claim it occurs because during women's lives they accumulate knowledge on making homemade medicines, unlike men who recognize the species' medicinal use but do not have an interest in learning how to produce the medicines because, in most cases, they already have the task of collecting the useful parts for medicine preparation. However, in the forage category there was a variance in knowledge; comparing women's and men's citations, women had the majority of citations, unlike what has been reported by Colaço (2006), who identified only male citations for forage uses.

Regarding timber use, we determined that both men and women have knowledge, but in some communities women had a greater knowledge in the fuel category, which may be directly related to the maintenance they must do in food preparation; the same was also concluded by Pedrosa *et al.* (2012); these results demonstrate that not only men have knowledge about timber (Hanazaki *et al.* 2000, Luoga *et al.* 2000).

In general, men and women from Cariri have greater knowledge about forage, food, and technology than men and women from the Curimataú region. The communities studied in Cariri have a major economic resource based on breeding sheep and domestic goats (Araújo *et al.* 2010); these animals feed on the species' fruit and leaves, which is why people from Cariri (São Francisco community) have greater knowledge about forage use and show differences in various categories.

***Sideroxylon obtusifolium* for medical purposes: Therapeutic indications and preparation**

The use of plants to treat diseases is associated with several factors, such as local availability and socioeconomic conditions that the regions provide for local populations (Oliveira 2010, Roque *et al.* 2009). According to Dantas *et al.* (2008) and Marques (2008), and supported by the results of this study, the types of uses are related to a community's needs. The bark, for example, may be added to a solvent (water, **aguardente**—name given to a traditional Brazilian alcoholic drink made from sugar cane and/or wine) for a sauce or used in a tea decoction or infusion. Therefore, medicine is prepared according to the treatment required.

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Preference for sauces was also recorded in a study conducted in Mocó community in the municipality of Monteiro, Paraíba (Junior-Pereira 2010). However, other studies have also recorded other ways of preparing medicines, such as teas (Alves *et al.* 2007, Carvalho *et al.* 2013, Silva & Freire 2010). This is worrisome because it indicates an intense extraction to meet the population's needs, which causes negative consequences for the physiological flux of the plant (Trovão *et al.* 2004). However, in this study, besides the bark, there was a citation for medicinal use from leaf and root. In a survey conducted in Rio de Janeiro (Southwest Brazil), Oliveira *et al.* (2007) claimed that there are active metabolites in dry and macerated *S. obtusifolium* leaves; this discovery should be conveyed to traditional communities that use this species as it will probably decrease over-use of the bark.

Concerning bodily systems, we identified eight types of diseases that can be treated with *S. obtusifolium*. A similar result was recorded in the municipality of Arapiraca, Alagoa State, northeast Brazil (Lós *et al.* 2012). In this study, the most mentioned bodily system was "undefined diseases or undefined pains" due to the number of citations for diseases such as pain, infections, general inflammation, blow, ulcers, and hangover (malaise due to drinking alcohol). The treatment for these ailments/diseases has also been reported in other studies (Almeida *et al.* 2005, Alves *et al.* 2007, Gomes & Bandeira 2012, Leandro *et al.* 2013, Lopes *et al.* 2012, Marinho *et al.* 2011, Marques 2008, Roque *et al.* 2010).

Thirty types of therapeutic indications were listed, which is a larger number than what was found by Monteiro *et al.* (2010), who recorded twelve indications; by Pedrosa *et al.* (2012), who obtained seventeen indications; and by Roque *et al.* (2010), who identified three types of diseases. When it came to treated diseases, there were similarities between regions and communities, especially for general inflammation, blow (mechanical shock), and general pain, as identified in other regions (Desmarchelier *et al.* 2003, Guerra *et al.* 2012, Oliveira *et al.* 2007, Pedrosa *et al.* 2012).

Conclusions

We observed that knowledge about *S. obtusifolium* is distributed in a similar way in the studied regions, and in general there were no significant differences between genders. We found that the way a community determines uses and/or citations is often related to its needs, whereby communities located near urban areas rely less on natural resources than those that are far from urban centers.

Among all use categories identified, the medicinal category stood out in all communities, due to the medical applications for several bodily systems and its reliance on bark, the main plant part available throughout the year.

Due to the great emphasis on using the species' bark and the risks this engenders for the plants, studies that provide ecological data about species with high potential utility such as *S. obtusifolium* should be subsidized for more detailed control of plant populations and to assist in future management plans aimed at resource prospecting.

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