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Comparing ethnobotanical knowledge of medicinal plants between community health workers and local experts in the "Mata da Paraíba" zone, northeastern Brazil

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Abstract. *Paiva Maia AC, da Costa Ferreira E, Marques de Lucena C, dos Santos Souza A, Dias da Cruz D, Paiva de Lucena RF. 2021. Comparing ethnobotanical knowledge of medicinal plants between community health workers and local experts in the "Mata da Paraíba" zone, northeastern Brazil. Biodiversitas 22: 5606-5616.* The use of medicinal plants is an old practice in a society that has been transmitted to this day, with local experts recognized in many communities and being encouraged through public policies. In Brazil, Community Health Agents (CHWs) can be important for the dissemination of this practice, due to their work with the Health System and the community. This study aimed to compare the knowledge of medicinal plants between CHWs and local experts in the community of Timbó, the municipality of Jacaraú (Paraíba, northeastern Brazil). Semi-structured interviews were conducted addressing local names of plants, their indications, parts used, and preparation methods. The data on the species local importance were analyzed through the use value (UV) and relative importance (RI) methods. Local experts cited more species than CHWs. There was great local importance of some species both among local specialists and among CHWs. However, some species were highlighted exclusively among local specialists. Decoction and infusion stood out among the preparation methods and leaf, flower, and seed were the most prominent parts used. The diseases treated with plants are mainly related to the respiratory and digestive systems. Our findings show a correspondence between the CHWs' knowledge and local experts' knowledge, which leads us to believe that experts and CHWs may be sharing the same local knowledge in the study community.

Keywords: Atlantic Forest, district of Timbó, ethnobotany, local knowledge, phytotherapy

INTRODUCTION

The use of plants for therapeutic purposes, in addition to being an ancient practice, is related to human evolution (Ferreira Júnior et al. 2013). People have been experimenting with the available resources and generating their knowledge from mistakes and successes through the use of plants over time (Mahomoodally 2013). This experimental understanding played an important role because from these observations many discoveries were made about the useful and harmful properties of plants. This acquired knowledge of the use of medicinal plants has been transmitted, mainly, orally from generation to generation, ensuring the survival and sustainability of human groups (Nascimento et al. 2018; Vandebroek et al. 2011).

Cultural plurality is the main characteristic of traditional groups or communities that use plant resources. Understanding their cultural perception of medicinal plants is important. The use of plant resources by these people can provide useful information for pharmacological studies; thus, research can be planned based on local knowledge, often celebrated by continuous use, which will be scientifically tested (Araújo et al. 2016). In this perspective, the empirical basis of traditional knowledge, evidenced by the scientific community, caused a growing interest in applying medicinal plants to modern society (Helmstädter and Staiger 2014). From this advancement, the role of traditional medicine was recognized by the World Health Organization (WHO) in 1978 (Chaudhary and Singh 2011). Since then, WHO started to encourage the implementation of public policies for the use of Traditional and Complementary Medicine in the health systems of Member States (Brasil, 2006). In some communities, especially in rural areas, access to Basic Health Units is difficult because of the distance, lack of transportation, and lack of money to pay for the trip, among other reasons, which lead these communities' residents to use plants for therapeutic purposes in an empirical way, as shown in ethnobotanical studies on the use of medicinal plants in rural communities in the Atlantic Forest (Beltreschi et al. 2018; Brito et al. 2015; Santana et al. 2016; Silva et al. 2018). Nonetheless, despite this demand for the use of medicinal plants, their use is not significant in Primary Health Care (PHC), due to the lack of information and professionals specialized in this practice (Oliveira et al. 2006). Health professionals should know the properties of plants used for medicinal purposes to provide effective assistance, including the preparation methods, indications, care, and dosages, always considering the cultural bases of the local population, as well as knowing how the community

understands the health/disease process (Alonso-Castro et al. 2017).

Among the professionals of the multidisciplinary PHC team, community health workers (CHWs) deserve more attention on the guidance on the correct use of medicinal plants, as they are in daily contact with the community. Moreover, the Ministry of Health recognizes the importance of these professionals for the use of medicinal plants and, through the Department of Primary Care (DPC), offers courses preferably to CHWs, providing information on the cultivation of medicinal plant species and even guidelines on how to prepare and use home remedies. These professionals are people from the community who work in prevention and health promotion and in educational health actions in the community, making monthly visits to each household, identifying and monitoring the basic health needs of each family (Ministério da Saúde 2001), on the other hand, local specialists are understood as community residents who have a great deal of knowledge about medicinal plants and their use. Therefore, it is important to have a balance of knowledge between CHWs and the local community, regarding the pharmacological activities and contraindications of medicinal plants. CHWs must always consider the customs, traditions, and socio-educational conditions of the population, especially in their residential areas, since they are always in contact with the communities. This study aimed to compare the knowledge of medicinal plants between local experts and community health workers, recording the plant species known and/or used by them and assessing their knowledge based on the hypothesis that local experts have greater knowledge than CHWs.

MATERIALS AND METHODS

Study area

This research was conducted in the district of Timbó, municipality of Jacaraú, being the first study of its kind carried out in this municipality. Jacaraú is located in the "Zona da Mata da Paraíba" (Paraíba Forest Zone), covers approximately 253,028 km², and is located about 96 km from the state capital, João Pessoa (Figure 1), and has a population of about 13,942 inhabitants. The region comprises two ecosystems: the Caatinga and the Atlantic Forest (IBGE 2010).

The region has a rainy tropical climate with dry summer (CPRM 2005). The district of Timbó is located 6 km from downtown Jacaraú. Timbó is subdivided into some areas as follow: Salvador Gomes de Baixo, Salvador Gomes de Cima, Várzea, Macedo, Catigereba, Gavião, Nacença, Jaracatia, Lagoa Seca, Tarama, and Jardim. In addition to these areas, two settlements are part of this territory: Novo Salvador and Boa Esperança. The district has a population of 3,236 inhabitants distributed in 1,017 families. Most of these people make a living from agriculture and small poultry and swine farms.

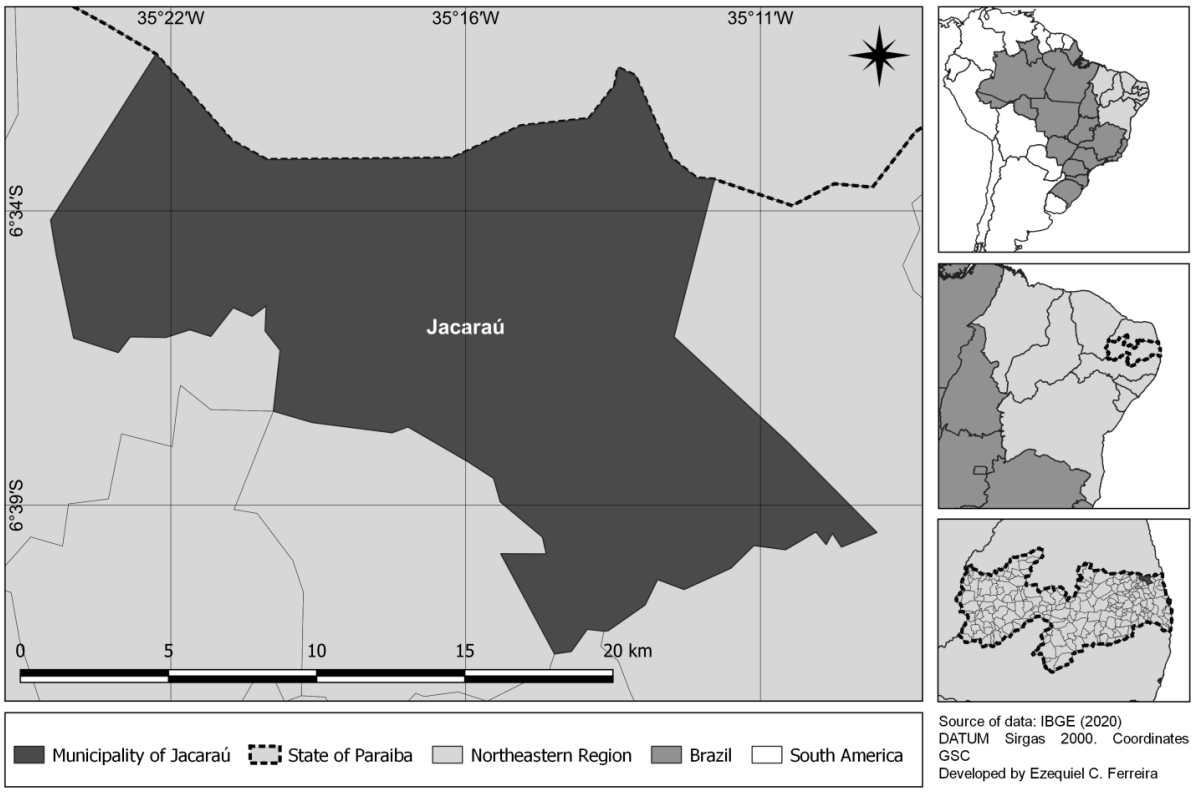

Figure 1. Map of the study area in the municipality of Jacaraú, Paraíba, northeastern Brazil

Jacaraú has a low Municipal Human Development Index (MHDI) and in 2010 it ranked 5,081st in the national HDI among 5,565 Brazilian municipalities, in which 5,080 (91.28%) municipalities are in a better situation and 485 (8.72%) are in the same or worse situation. The life expectancy at birth increased from 53.2 years in 1991 to 61.3 years in 2000, and 68.2 years in 2010. Concerning the average per capita income, Jacaraú had an increase of 161.29% in the last two decades, going from R$ 95.97 in 1991 to R$ 141.23 in 2000, and R$ 250.76 in 2010 (Atlas de Desenvolvimento Humano, 2013).

Ethnobotanical data collection

Semi-structured interviews (Albuquerque et al. 2014) were conducted with local experts and community health workers (CHWs). The local experts were selected using purposive sampling through the snowball method (Bailey 1982). When the first contact with the community was conducted, a local expert was indicated, who then indicated the second one, and so on, until the indications were repeated, demonstrating that all the experts recognized by the community were interviewed.

Before starting each interview, the objectives of the study were explained and the informants, who agreed to participate in the research, were asked to sign the Informed Consent Form, required by the Research Ethics Committee of the Health Sciences Center (CEP/CCS) of the Federal University of Paraíba, which approved the present research (Protocol No. 2.506.499 and No. 2.695.066).

The questionnaire sought information on species known and used by local experts and CHWs, recording the vernacular names of each species, parts used, preparation methods, and therapeutic indications. Samples of all species cited by the informants were collected, created the herbarium, and deposited in the "Jaime Coelho de Morais" herbarium (EAN) of the Center for Agricultural Sciences (CCA) of the Federal University of Paraíba (UFPB). In the case of some species unavailable for collection, the informants were asked to identify them through photographs in Lorenzi and Matos (2008).

Data analysis

The Use Value was calculated according to the proposal by Philips and Gentry (1993a, 1993b), adapted by Rossato et al. (1999), using the following equation:

$$UV = \sum Ui/n,$$

Where; Ui = number of citations given by the informants; n = number of informants.

To analyze species versatility, the relative importance (RI) was calculated for the local experts and community health workers, based on the proposal by Bennett and Prance (2000), using the following equation:

$$RI = BS+PH,$$

Where; BS refers to the number of body systems and PH refers to the number of pharmacological properties. The BS is obtained by the following calculation:

$$BS=BSS/BSVS,$$

Which; corresponds to the division of the number of body systems treated by a given species (BSS) by the total number of body systems treated by the most versatile species (BSVS), in which the most versatile species is assigned to the highest number of body systems. The NP is determined by the following equation:

$$PH=PHS/PHVS,$$

Which; corresponds to the division of the number of properties attributed to a given species (PHS) by the number of properties attributed to the most versatile species (PHVS), in which the most versatile species has the highest number of properties.

This method classifies the species according to their versatility, i.e., diversity of uses. The maximum value obtained by the relative importance method is 2, and the closer to this value, the higher the species versatility (Silva et al. 2014).

The therapeutic properties were adapted according to the World Health Organization (ICD 2010), in 13 categories (body systems), as follow: ear diseases, blood and hematopoietic organ diseases, cardiovascular system diseases, digestive system diseases, genitourinary system diseases, nervous system diseases, osteomuscular and connective tissue diseases, respiratory system diseases, endocrine, nutritional and metabolic diseases, infectious and parasitic diseases, injuries from external causes, neoplasia, and undefined symptoms and signs.

RESULTS AND DISCUSSION

Eighty-nine medicinal plant species were recorded, 16 of which were cited exclusively by the CHWs, 46 exclusively by the local experts, and 27 species were cited by both groups (Table 1). Among the 89 plant species recorded, 71 were identified, 61 of which at the species level, 9 at the genus level, and 1 at the family level; the other 18 species were not identified (Table 1). The identified species were distributed in 66 genera and 42 families. Fabaceae (9 spp.), Lamiaceae and Asteraceae (5 spp. each), and Euphorbiaceae and Myrtaceae (4 spp. each) were the most representative families regarding the number of species.

Differences in the number of species can be observed in several studies around the world when compared to the number of species found in our study. Some studies have recorded a higher number of species, such as in China (264 spp.) (Li and Xing 2016), Bangladesh (159 spp.) (Faruque et al. 2018), India (117 spp.) (Parkash 2021), the Philippines (108 spp.) (Cordero and Alejandro 2021) and Mexico (158 spp.) (Estrada-Castillón et al. 2021). While other studies have recorded a smaller number of species, such as in Algeria (58 spp.) (Boudjelal et al. 2013), Turkey (59 spp.) (Paksoy et al. 2016), Kenya (62 spp.) (Nankaya et al. 2019), and Indonesia (36 spp.) (Ramadhani et al. 2021). These differences in the number of species in local

pharmacopoeias may occur due to several factors related to the environment and culture, which influence both knowledge and local biodiversity (Randriamiharisoa et al. 2015).

Dysphania ambrosioides (L.) Mosyakin & Clements ("mastruz"; UV = 1.38), *Mentha arvensis* L. (Japanese mint), *Lippia alba* (Mill.) N.E.Br. ex P. Wilson (Licorice Verbena; 1.25), *Sambucus australis* Cham. & Schltdl. ("sabugueira"; 1.25), and *Pimpinella anisum* L. (anise; 1.13) had the highest use values among the CHWs (Table 1). Meanwhile, *S. australis* (4.2), *Eucalyptus* sp. (eucalyptus) and *D. ambrosioides* (2 each), Non-Id. 6 ("espriteira"; 1.6) and *L. alba* (1.2) had the highest use values among the local experts (Table 1).

Regarding the relative importance (RI), *S. australis* and *P. anisum* (RI = 2 each), *L. alba* and *M. arvensis* (1.75 each), and *D. ambrosioides* (1.55) stood out among the CHWs (Table 1). *D. ambrosioides* (2.0), *Rosmarinus officinalis* L. and *Eugenia* sp. (Brazilian red berry) (1.05 each) stood out among the local experts (Table 1).

Some species had great local importance among the CHWs and the local experts, both by the UV and the RI, such as *D. ambrosioides, M. arvensis, L. alba, S. australis,* and *P. anisum*, which had wide local use and high versatility. The wide use and versatility of these species have been recorded in several ethnobotanical studies in different regions of Brazil, evidencing their distribution and importance in different local pharmacopoeias (Beltreschi et al. 2018; Magalhães et al. 2019; Medeiros et al. 2013; Ribeiro et al. 2017). However, it is worth mentioning that, in general, these species are exotic and herbaceous, which contributes to disseminating their use. According to Albuquerque et al. (2009), the versatility of uses can be a useful factor to indirectly assess the pressure of use on a given species in the environment. Species popularity is another important characteristic that can also be considered in studies involving hypothesis testing and versatility. In this case, popularity is verified by the number of people who cite the plant species; the more people cite the species, the more popular it is, see Santoro et al. (2015).

There are several records in the literature on the medicinal use of the most prominent species in the present study, many of them citing uses similar to those observed here. *D. ambrosioides* is cited in the literature for sputum, cough, bruises, flu, tuberculosis, urinary diseases, scarring and pain in the body (Cock et al. 2021; Farias et al. 2019, Magalhães et al. 2019). M. arvensis is seen in the treatment of abdominal pain (diarrhea), gastric and intestinal problems, stomach acidity, earache and respiratory problems, menstrual pain and anxiety (Khan et al. 2021; Magalhães et al. 2019; Rehman et al. 2017). *L. alba* is used in the treatment of digestive and respiratory diseases, hypertension, headache, skin diseases, injuries, insomnia, colic, heart and liver diseases, lack of appetite, diarrhea, tonic, dizziness, worms (Hennebelle et al. 2008; Magalhães et al. 2019; Medeiros et al. 2013). *S. australis* is used for allergy, chickenpox, mumps, measles, diabetes, ear and sore throat, fever, injuries, and cardiovascular disease (Magalhães et al. 2019; Medeiros et al. 2013). *P. anisum* is used for gastric and intestinal problems, nervousness, anxiety, kidney cramps, respiratory diseases, abdominal pain, poor appetite, anthrax, menopause, diarrhea, worms, insomnia (AbouZid1 and Mohamed 2011; Ahmed 2016; Magalhães et al. 2019).

Regarding the parts used, the leaf was the most cited part by the CHWs (95 citations), followed by seed (20) and flower (18) (Figure 2A). Leaf was also the part most cited by the local experts (111 citations), followed by flower (23) and bark (15) (Figure 2B). In general, a greater use of leaves (206 citations), flowers (41 citations), and seeds (27 citations) were recorded (Figure 2C).

Greater use of leaves is common in Atlantic Forest areas, as has been recorded in several studies (Bolson et al. 2015; Beltreschi et al. 2019; Sauini et al. 2020; Yazbek et al. 2019). This predominance can be explained by the seasonality hypothesis, which states that the greater use of leaves in humid areas is due to their constant availability and ease of collection (Albuquerque et al. 2019; Gaoue et al. 2017; Medeiros et al. 2013). As the people would have a greater variety of resources available for most of the year, it is believed that they may have had a longer time interval for experimenting with the available resources, giving some surveyed species a high versatility in these more humid environments. However, most studies have shown that dry environments stand out in this perspective, with high versatility, mainly due to lower richness of species, in comparison with more humid areas, which results in a higher diversity of uses, since there are no species to fulfill redundant functions in the system (Medeiros et al. 2013).

Concerning the forms of use, infusion (75) was the most cited by the CHWs, followed by decoction (30) and maceration (10) (Figure 3A). Among the local experts, decoction (123), infusion (31), and juice (5) stood out (Figure 3B). Considering the total number of citations, decoction (153), infusion (106), and juice (13) were the most prominent forms of use (Figure 3C).

The preparation of teas by infusion and decoction are quite common methods and widespread in traditional medicine around the world, possibly due to the ease of preparation and effectiveness in extracting the active ingredients. Decoction and infusion preparation methods stood out in studies in Iraq (Ahmed 2016), Algeria (Boudjelal et al. 2013), China (Li and Xing 2016) and Pakistan (Ahmad et al. 2018), Italy (Vitalini et al. 2013), and Nepal (Kunwar et al. 2013). This may be related to the most diverse culture referring to the use of tea, both for medicinal purposes and for social and cultural purposes (Van Wyk and Gorelik 2017).

Table 1. General data on the use of medicinal plants in the district of Timbó, municipality of Jacaraú (Paraíba, northeastern Brazil)

Family/scientific name	Vernacular name	Part used	Forms of use	Indications	UV		RI	
					CHWs	LEx	CHWs	LEx
Alliaceae								
Allium sativum L.	Garlic	Bb	Dc / If / Mc	Tiredness / The flu / Pneumonia / Worms	0.25	0.4	0.9	0.45
Amaranthaceae								
Alternanthera dentata (Moench) Stuchlik ex R. E. Fr	"Terramicina"	Lf	Dc / In	Erysipelas / Inflammation	-	0.6	-	0.7
Dysphania ambrosioides (L.) Mosyakin & Clements	"Mastruz"	Lf	Dc / If / Mc / Ju / Pju	Heartburn / Bronchitis / Tiredness / Colic / Diarrhea / Secretion decrease	1.38	2	1.45	2
Anacardiaceae								
Anacardium ocidentale L.	Cashew	Sd / Bk	Pd / Dc	Stroke / Inflammation	0.25	0.2	0.45	0.35
Schinus terebinthifolia Raddi	Aroeira	Lf	In	Healing	-	0.2	-	0.35
Mangifera indica L.	Mango	Lf	Dc	Fever	-	0.2	-	0.35
Annonaceae								
Annona muricata L.	Graviola	Lf	If	Diabetes / Cancer	0.25	-	0.9	-
Apiaceae								
Pimpinella anisum L.	Anise	Sd	Dc / If	Tranquilizer / Baby colic / Menstrual cramps	1.13	0.6	2	0.7
Arecaceae								
Cocus nucifera L.	Coconut	Fb	If	Diarrhea	-	0.2	-	0.35
Asphodelaceae								
Aloe vera (L.) Brum. f.	Aloe	Lf	Pju / In / Lb	Healing / Improve digestion / Improve immunity / Pinworms	0.38	0.2	1.35	0.35
Asteraceae								
Acanthospermum hispidum DC.	"Espinho-de-cigano" (Gypsy-Thorn)	Ro	Dc	The flu	-	0.2	-	0.35
Helianthus annuus L.	Sunflower	Sd	Pd / If	Stroke	0.25	-	0.45	-
Matricaria chamomilla L.	Chamomile	Fl	Dc / If	Tranquilizer / Baby colic	0.88	0.2	0.9	0.35
Solidago chilensis Meyen	Brazilian arnica	Lf	If	Blows	-	0.2	-	0.35
Sphagneticola trilobata (L.) Prusk.	Calendula	Fl	Dc	Antiallergic	-	0.2	-	0.35
Boraginaceae								
Boraginaceae[1]	"Macassá"	Lf	Pju	Ear pain / stroke	-	0.4	-	0.7
Brasssicaceae								
Brassica juncea (L.) Coss.	Mustard	Sd	Pd	Stroke	0.13	-	0.45	-
Brassica oleracea var. *botrytis*	Cauliflower	Lf	Dc	Stomach ache / Heartburn	-	0.4	-	0.45
Caricaceae								
Carica papaya L.	Papaya	Fl	Dc	Nausea / Vomiting	0.13	-	0.45	-
Caryophyllaceae								
Dianthus caryophyllus L.	White carnation	Fl	Dc	Tranquilizer / Heart disease	0.13	0.2	0.45	0.35
Cleomaceae								
Tarenaya spinosa (Jacq.) Raf.	"Mussambê"	Fl / Ro	Dc	The flu	-	0.4	-	0.35
Convolvulaceae								
Ipomoea sp.	Sweet potato	Lf	Dc	Healing	-	0.2	-	0.35
Costaceae	"Cana do brejo"							
Costus sp.	(Swamp sugarcane)	Lf	If	Kidney stone	-	0.2	-	0.35
Crassulaceae								
Kalanchoe crenata (Andrews) Haw.	"Saião"	Lf	Dc / Lb / Pju	Antibiotic / Heartburn / Secretion decrease / Stomach pain / The flu	0.38	0.6	0.65	0.8
Cucurbitaceae								
Sechium edule (Jacq.) Sw.	Chayote	Fr	If / Ju	Hypertension	0.38	-	0.45	-
Euphorbiaceae								
Cnidosculus sp.	White nettle	Ro	Dc	Uterus problems	-	0.8	-	0.35
Euphorbia tirucalli L.	Aveloz	Lf	Dc	Antibiotic	-	0.2	-	0.35

Jatropha gossypiifolia L.	Purple Pinion	Lt	In	Healing	-	0.2	-	0.35
Manihot esculenta Crantz	Cassava	Lf	Dc	Blood problems	-	0.2	-	0.35
Fabaceae								
Abarema cochliacarpos (Gomes) Barneby & J.W.Grimes	"Barbatimão"	Bk	Dc / If	Diarrhea / Inflammation	-	0.4	-	0.7
Anadenanthera colubrina (Vell) Brenan	"Angico"	Bk	Dc	The flu	-	0.2	-	0.35
Amburana cearensis (Allemão) A. C.Sm	"Cumarú"	Bk	Dc	The flu	-	0.2	-	0.35
Bowdichia virgiliodes Kunth	"Sucupira"	Sd	Mc	Backache	-	0.2	-	0.35
Crotalaria juncea L.	Sunn hemp	Sd	Pd / If	Stroke	0.38	-	0.45	-
Erythrina velutina Willd	"Mulungú"	Bk	Dc	Anxiety / Tranquilizer / Depression / Insomnia	-	1	-	0.65
Hymenaea courbaril L.	"Jatobá"	Bk	If	Tiredness / Inflammation / Pneumonia	-	0.6	-	0.8
Libidibia ferrea (Mart. ex Tul.) L.P.Queiroz var. *ferrea*	"Jucá"	Bk	If	Inflammation	-	0.2	-	0.35
Senna occidentalis (L) Link	"Fedegoso"	Sd	Dc	Stroke	-	0.2	-	0.35
Geraniaceae								
Pelargonium graveolens L'Hér. ex Aiton	Rose-scented geranium	Lf	Dc / If	Antibiotic / Flu / Cough	0.25	0.6	0.65	0.7
Lamiaceae								
Mentha arvensis L.	Japanese mint	Lf	Dc / If / In / Pju	Amoeba / Diarrhea / Flu / Infection in general / Constipation / Worms	1.25	0.8	1.75	0.7
Mentha sp.	"Vick"	Lf	If	The flu	-	0.4	-	0.35
Plectranthus amboinicus (Lour.) Spreng	Indian borage	Lf	Dc / If / In / Lb	Headache / Chilblains / Flu / Lung secretion / Cough	0.63	0.6	1.3	0.8
Plectranthus barbatus Andrewes	"Boldo"	Lf	Dc / If	Constipation / The flu / Poor digestion	0.25	0.4	0.9	0.35
Rosmarinus officinalis L.	Rosemary	Lf	Dc / If	Tranquilizer / Flatulence / Heart problems	0.5	0.6	1.1	1.05
Lauraceae								
Persea americana Mill.	Avocado	Lf	Dc	Weight loss / Kidney stones / Prevent prostate diseases	0.25	0.2	0.9	0.35
Lythraceae								
Punica granatum L.	Pomegranate	Fr / Sd	Dc / If	Conjunctivitis / Sore throat	0.38	0.2	0.9	0.35
Malvaceae								
Gossypium hirsutum L.	Cotton	Lf	If	Antibiotic	-	0.2	-	0.35
Meliaceae								
Cedrela sp.	Cedar	Bk	If	Inflammation	-	0.2	-	0.35
Moraceae								
Morus sp.	Blackberry	Lf	Dc	Rheumatism	-	0.2	-	0.35
Musaceae								
Musa paradisiaca L.	Banana	Fr	Mc	Worms	0.13	-	0.45	-
Myrtaceae								
Eucalyptus sp.	Eucalyptus	Lf	Dc / If	Nasal allergy / Fever / The flu / Breathing problems / Sinusitis	0.5	2	0.45	0.8
Eugenia sp.	"Pitangueira"	Lf	If	Diarrhea / The flu / Poor digestion / Prostate	0.38	0.6	0.9	1.05
Psidium guayava L.	Guava	Lf	Dc / If	Tranquilizer / Diarrhea / Poor digestion	0.38	0.4	0.45	0.7
Syzygium cumini (L.) Skeels	Jamun	Lf	Dc	Tranquilizer / Hypertension	-	0.4	-	0.7
Nephrolepidaceae								
Nephrolepis exaltata (L.) Schott	Fern	Lf	If	Inflammation	-	0.2	-	0.35
Oxalidaceae								
Averrhoa carambola L.	Carambola / Starfruit	Lf	If	Infection in general	0.13	-	0.45	-
Passifloraceae								
Passiflora edulis Sims	Passion fruit	Lf	Dc	Tranquilizer / Insomnia	-	0.4	-	0.45
Phyllanthaceae								
Phyllanthus tenellus Roxb.	Stonebreaker	Lf	If	Kidney stone	-	0.2	-	0.35
Plantaginaceae								
Plantago major L.	"Tansagem"	Lf	Dc	Sore throat	-	0.2	-	0.35
Poaceae								

Cymbopogon citratus (DC.) Stapf	Lemongrass	Lf	Dc / If	Tranquilizer / Fever / The flu / Prevent heart problems	1	0.6	1.35	0.7
Rubiaceae								
Borreria verticillata (L.) G. Mey.	"Vassoura de botão" (Button broom)	Lf	Dc	Inflammation in general	-	0.2	-	0.35
Morinda citrifolia L.	Noni	Fr			0.13	0.2	0.45	0.35
Rutaceae								
Citrus aurantifolia Swingle	Lemon	Fr	Ju	The flu	0.13	-	0.45	-
Citrus sinensis (L.) Osbeck	Orange	Lf	Dc / If	Tranquilizer / Insomnia	0.5	0.2	0.65	0.35
Ruta graveolens L.	Rue	Lf	Dc / If / Pju	Conjunctivitis / Headache / Pain in general / Inflammation of injuries / Ear inflammation	0.38	0.6	1.35	0.7
Solanaceae								
Solanum paniculatum L.	"Jurubeba"	Lf / Sd	Dc	Diabetes	-	0.4	-	0.35
Urticaceae								
Cecropia sp.	"Capeira branca"	Lf	Dc / If	Hypertension	0.25	-	0.45	-
Verbenaceae								
Lippia alba (Mill.) N.E.Br. ex P. Wilson	Licorice Verbena	Fl / Sd	Dc / If / Pju	Tranquilizer / Belly pain / Fever / Hypertension / Insomnia / Poor digestion	1.25	1.2	1.75	0.8
Viburnaceae								
Sambucus australis Cham. & Schltdl.	"Sabugueira"	Fl / Lf / Ro	Dc / If	Tranquilizer / Headache / Fever / The flu / Hypertension / Infection in general / Cold	1.25	4.2	2	0.9
Vitaceae								
Cissus verticillata (L.) Nicolsons C. E. Jarvis	"Insulina"	Lf	Dc / If	Diabetes	0.25	-	0.9	-
Zingiberaceae								
Alpinia zerumbet (Pers.) Roscoe	"Colônia"	Fl / Lf	Dc / If / Mc	Erysipelas / Fever / The flu / Hypertension	0.63	0.4	0.9	0.7
Non-identified								
Non-Id. 1	"Acôndio"	Lf	If	Fever	0.13	-	0.45	-
Non-Id. 2	Red Angico	Bk	Dc	Phlegm in the lungs	0.13	-	0.45	-
Non-Id. 3	Mugwort	Lf / Fl	Dc	Menstrual cramps	-	0.8	-	0.35
Non-Id. 4	Avenca	Lf	Dc	The flu / Hoarseness / Cough	-	0.6	-	0.55
Non-Id. 5	"Espinheira santa"	Lf	Dc / In	Antibiotic / The flu	-	0.4	-	0.7
Non-Id. 6	"Espriteira"	Fl / Lf	Dc / In / Mc	Fever / The flu	0.25	1.6	0.45	0.7
Non-Id. 7	Guandu bean	Lf	Dc	Antibiotic	-	0.2	-	0.35
Non-Id. 8	Guaco	Lf	Dc	The flu	-	0.2	-	0.35
Non-Id. 9	Jasmine	Lf	Pju	"Seal" the bone	-	0.2	-	0.35
Non-Id. 10	Lilac liamba	Lf	Dc	Reduces menopause effects	-	0.2	-	0.35
Non-Id. 11	Lime	Lf	Dc	Labyrinthitis	-	0.2	-	0.35
Non-Id. 12	"Língua de vaca" (Cow tongue)	Lf	Dc	Inflammation	0.13	-	0.45	-
Non-Id. 13	"Louro"	Lf	If	Baby colic / Poor digestion	0.13	0.2	0.45	0.35
Non-Id. 14	"Marcela"	Sd	If	Contraceptive	0.13	-	0.45	-
Non-Id. 15	"Parietaria"	Lf	Dc	Kidney stone	-	0.2	-	0.35
Non-Id. 16	"Perpétua branca"	Sd	Pd	Stroke	0.13	-	0.45	-
Non-Id. 17	"Picão de carrapicho de agulha"	Lf	Dc	Diabetes	-	0.2	-	0.35
Non-Id. 18	"Urinanã"	Lf / Ro	Dc	Cramps	-	0.4	-	0.35

Note: Parts Used: Bb: Bulb; Ro: Root; Fb: Fiber; Lf: Leaf; Sd: Seed; Fr: Fruit; Fl: Flower; Bk: Bark; L: Latex. Forms of use: If: Infusion; Mc: Maceration; In: In natura; Dc: Decoction; Lb: "Lambedor" (homemade syrup); Pju: Peel juice; Ju: Juice; Pd: Powder. UV: use value; RI: relative importance. CHWs: community health workers; LEx: Local experts

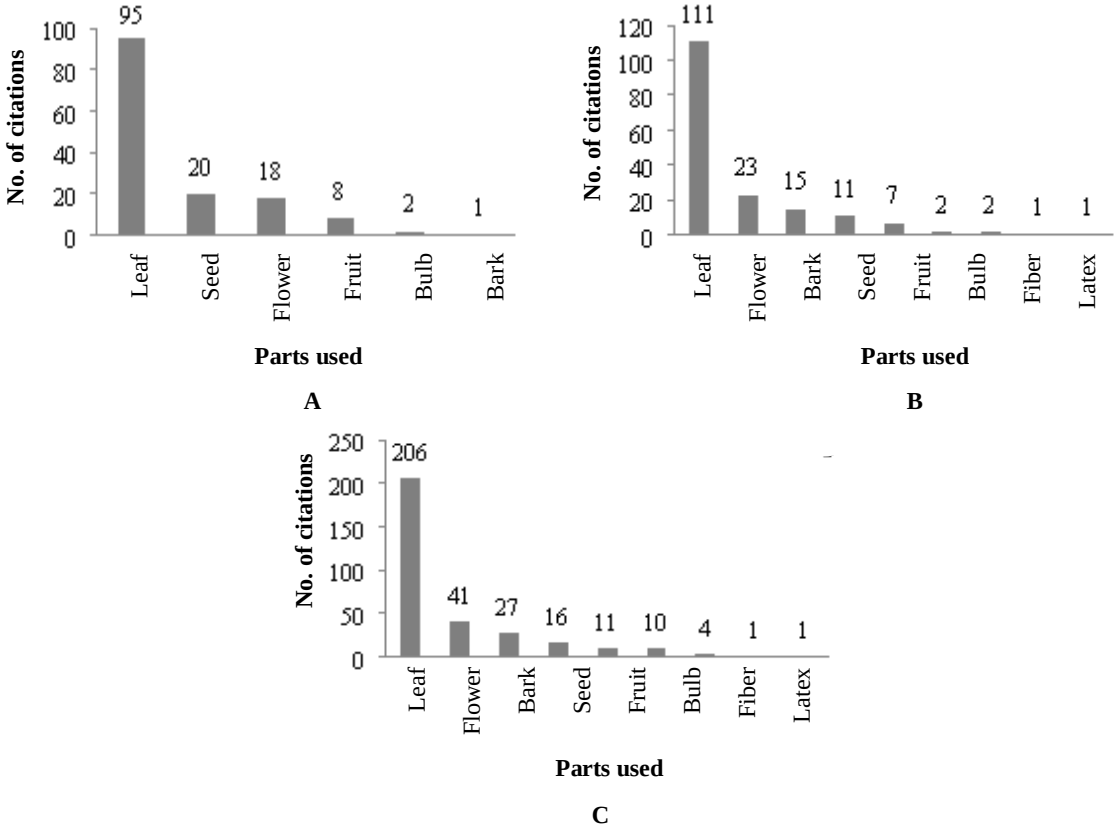

Figure 2. The number of citations for the parts of medicinal plants used in the District of Timbó, municipality of Jacaraú (Paraíba, northeastern Brazil). A: Citations from community health workers; B: Citations from local experts; C: Total number of citations.

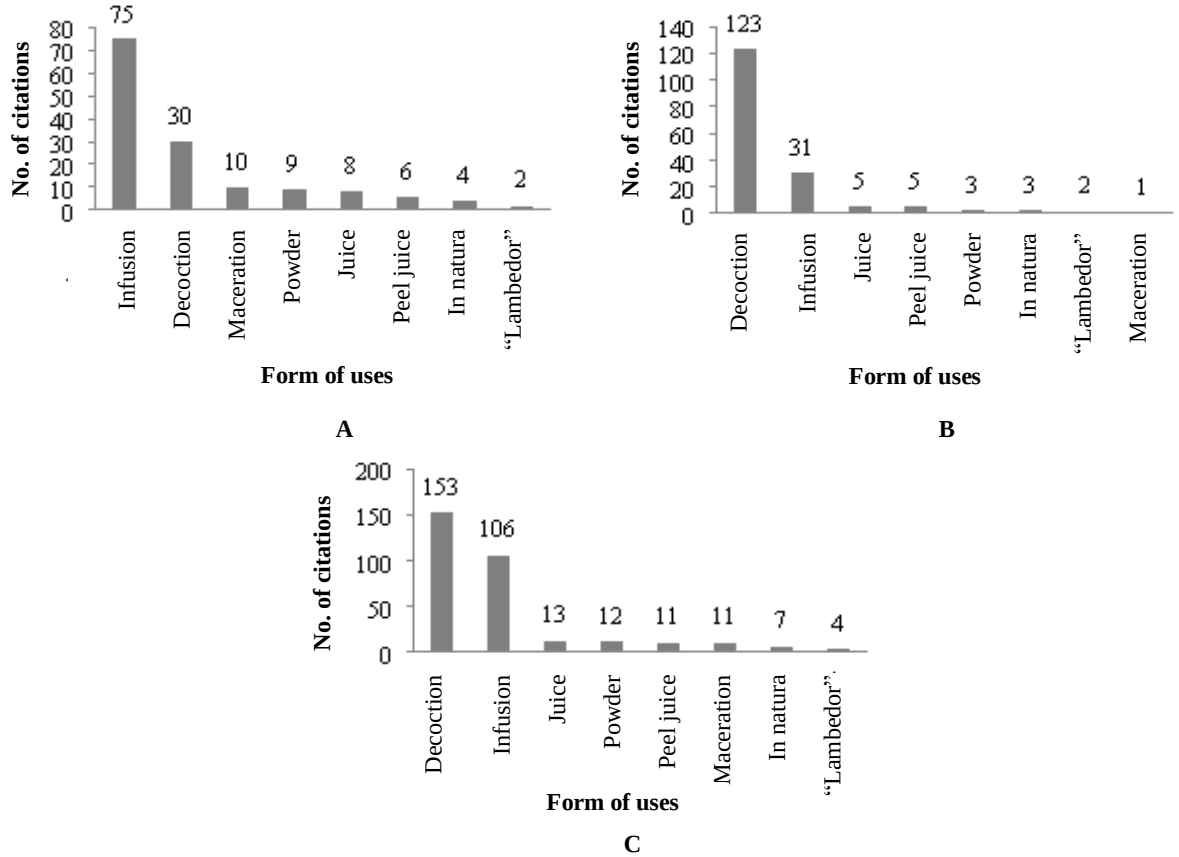

Figure 3. The number of citations of forms of use of medicinal plants used in the District of Timbó, municipality of Jacaraú (Paraíba, northeastern Brazil). A: Citations from community health workers; B: Citations from local experts; C: Total number of citations

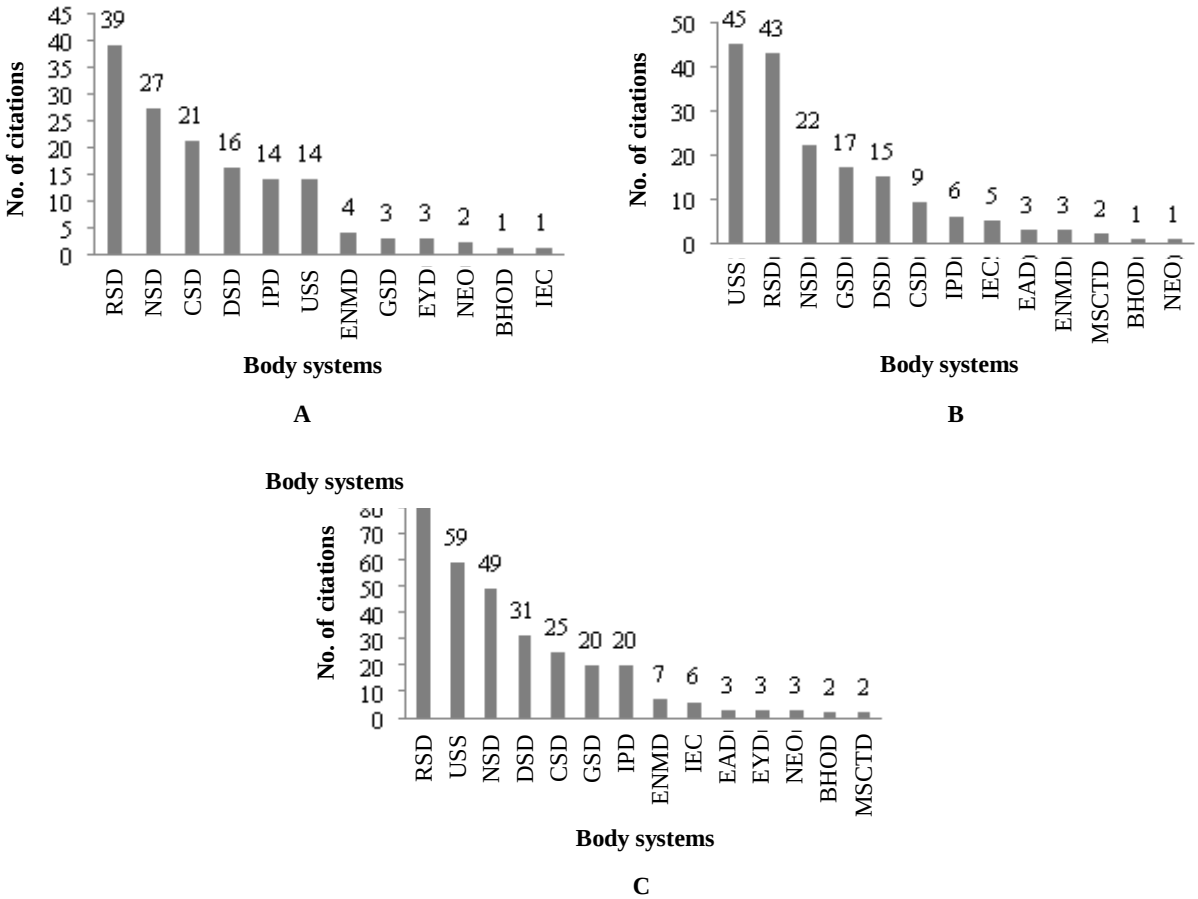

Figure 4. The number of citations for each body system considered for therapeutic purposes using medicinal plants in the District of Timbó, municipality of Jacaraú (Paraíba, northeastern Brazil). A: Citations from community health workers; B: Citations from local experts; C: Total number of citations. BHOD: blood and hematopoietic organ diseases; CSD: cardiovascular system diseases; DSD: digestive system diseases; EAD: ear diseases; ENMD: endocrine, nutritional and metabolic diseases; EYD: eyes diseases; GSD: genitourinary system diseases; IEC: injuries from external causes; IPD: infectious and parasitic diseases; MSCTD: musculoskeletal system and connective tissue diseases; NEO: neoplasia; NSD: nervous system diseases; RSD: respiratory system diseases; USS: undefined symptoms and signs

Regarding the body systems, respiratory system (39), nervous system (27) and cardiovascular system (21) diseases were the most cited by the CHWs (Figure 4A). Undefined symptoms and signs (45) and respiratory system (43) and nervous system (22) diseases stood out among the local experts (Figure 4B). In general, respiratory system diseases (82), undefined symptoms and signs (59), and nervous system diseases (49) were the most prominent (Figure 4C).

The predominance in the use of medicinal plants to treat digestive system and respiratory system diseases is a trend in ethnobotanical studies (Ahmed 2016; Juárez-Vázquez et al. 2013; Santana et al. 2016; Torres-Avilez et al. 2016), which may be justified by the fact these systems are related to more common diseases, which affect the human population more frequently, and because they would be easier to treat using medicinal plants (Quiroga et al. 2012).

To conclude, the community of Timbó has a high diversity of medicinal plants used in the treatment of various diseases. There is a certain correspondence between the most used and most versatile species highlighted by the community health workers and those highlighted by the local experts, indicating that the knowledge has probably spread uniformly in the study area. Moreover, knowledge has been possibly shared between the CHWs and the local experts. The wide use of leaves and preparation of infusion and decoction is supported by the literature, which may indicate that the study area has characteristics of humid forest environments, where the deciduousness phenomenon occurs to a lesser extent, or is even absent. The high versatility of some species, evidenced by the relative importance index, leads us to believe that these species may be under greater pressure from collection than the others; thus, conservation efforts must be directed towards these species. However, it should be verified whether these species belong to the local and native flora or whether they are exotic and even invasive. This information is of great relevance for a better understanding of the conditions of the local ecosystem, considering that if a high presence of invasive species is observed, for example, this could indicate a possible decline in native vegetation due to the dispute for resources and loss of habitat, and consequent availability of native species, which would lead to greater

use of exotic species due to the unavailability of native species. In this sense, conservation actions would be recommended to native species. It is suggested that future studies can individually assess each species cited as highly versatile, relating their data to those found in other studies, carried out in different areas, and analyzing more deeply the socio-cultural context that involves the use of a particular species in the local pharmacopoeia.

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