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Original article

Does total tannin content explain the use value of spontaneous medicinal plants from the Brazilian semi-arid region?

*Julio M. Monteiro**, João S.N. de Souza, Ernani M.F. Lins Neto, Keli Scopel, Elzineide F. Trindade*

Departamento de Biologia, Universidade Federal do Piauí, Campus Profa. Cinobelina Elvas, Planalto Horizonte, Bom Jesus, PI, Brazil

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ABSTRACT

Due to the current predatory exploitation and consequent extinction of native medicinal plants around the world, strategies have been proposed aiming at the sustainable use of these resources. Accordingly, this study aims at verifying the differences in tannin compounds content in the bark of eleven species with high use value (UV) and also relating the amounts of tannins with their therapeutic indications. To quantify the total phenolic content in the samples the Folin-Ciocalteu reagent was used, and for total tannins chemical casein precipitation was applied. The amount of tannins ranged intra-specifically and the greater variation was found for *Anadenanthera colubrina* (angico) that displayed between 157.57 and 107.39 mg/g. The lowest variation occurred in *Lafoensia replicata* (mangabeira) with values ranging between 76.55 and 68.96 mg/g. There were significant differences between several of the eleven species and according to the simple regression analysis, the quantities of tannins found failed to justify their UV. Thus, it was not possible to establish whether the amount of total tannins influenced to a greater or lesser degree in the accumulation of knowledge. Moreover, this is the first study to investigate the relationship between the amount of total tannins and local botanical knowledge expressed by the UV.

Introduction

Many studies have highlighted the great importance of plants with therapeutic use for traditional communities, whose daily practice lead to an impressive accumulation of knowledge (Almeida and Albuquerque, 2002; Morais et al., 2005; Monteiro et al., 2006a; Albuquerque et al., 2007; Mendes and Carlini, 2007; Araújo et al., 2008; Giraldi and Hanazaki, 2010; Monteiro et al., 2012). Hence, there is a need to expand the studies on medicinal plants to enable future strategies for knowledge and new compounds, or even drugs, acquisition. In Brazil, there are studies focusing on elucidating species or groups of medicinal plants with both pharmacological and phytochemical properties, studying classes of secondary metabolites with biological activities (Trugillho et al., 1997; Viana et al., 1997; Allain et al., 1998; Queiroz et al., 2002; Trevisan and Macedo, 2003; Paes et al., 2006; Souza et al., 2007; Leal et al., 2008; Silva et al., 2009; 2010a; Melo et al., 2011a,b; Almeida et al., 2012;

* *Corresponding author.*
E-mail: juliommonteiro@ufpi.edu.br (J.M. Monteiro).
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Siqueira et al., 2012) or through an ethnobotanical approach (Monteiro et al., 2006a; Albuquerque et al., 2007; Agra, et al. 2007; David et al., 2007; Mendes and Carlini, 2007; Giraldi and Hanazaki, 2010; Monteiro et al., 2011; Soldati and Albuquerque, 2012; Lucena et al., 2012; Zank and Hanazaki, 2012), accessing the knowledge and local use of these resources. For example, Monteiro et al. (2006a) found higher amount of total tannins in the stem bark than in leaves of *Anadenanthera colubrina* (Vell.) Brenan (angico) in Pernambuco, northeastern Brazil. However, the leaves of *M. urundeuva* Allemão (aroeira) had a higher concentration of tannins than the bark, contradicting the local knowledge that pointed the bark of this plant as the most efficient part for medicine manufacture.

Specifically in Piauí, Brazil; ethnobotanical, pharmacological or phytochemical studies on medicinal plants are still scarce and the vegetation is poorly sampled. Moreover, the flora richness of Piauí, characteristic of the transitional areas between the southern regions of Caatinga and Cerrado, provides a unique opportunity for research development covering the wide range of plant biodiversity associated with their traditional knowledge (Farias, 2003).

Given this panorama, one central question guided this study: does the content of tannin content in the bark of eleven species explain their use value? This study aims at evaluating the amount of tannins in eleven spontaneous tree species and relating them to their therapeutic indications (use value). This proposal was based on the premise that plants with astringent, healing and/or anti-inflammatory uses have tannins as the components responsible for such therapeutic activity (Mello and Santos, 2001; Monteiro et al., 2006a,b). Thus, it is expected that plants with higher use value carry a higher tannin content. Moreover, these phenolic compounds have the ability to form water-insoluble complexes with proteins; due to this property tannins have a number of biological activities, including astringency, anti-inflammatory and healing activities (Bruneton, 1991; Chung et al., 1998; Mello and Santos, 2001; Monteiro et al., 2005).

Materials and methods

The ethnobotanical research, selection, collection and study site of eleven spontaneous tree species

The collection area corresponds to a fragment of hypoxerophytic vegetation bordering the Santo Antonio Village, formerly called 'Boca da Caatinga', belonging to the municipality of Currais, located on the southern part of the state of Piauí in the Médio Gurguéia region. This area is limited to the north by the city of Palmeira, to the south with the municipality of Bom Jesus, to the east with Santa Luz and to the west with Baixa Grande do Ribeiro; and the approximate population is 4722 inhabitants (IBGE, 2008). The climate in this region is semiarid with a well-defined dry season during the summer and concentrated rains in the winter. The predominant features of the Caatinga vegetation consists of trees and of dense, low, gnarled and dry-looking shrubs during the summer, with small and outdated leaves, with deep and thick roots (Rodal and Sampaio, 2002). This vegetation component does not form a homogeneous structural and floristic set, but varies depending on factors such as soil, xerothermal index, physiognomy and characteristic plant families: Myrtaceae and Fabaceae (Lemos and Rodal, 2002).

The ethnobotanical research started with informal visits to the Santo Antonio Village establishing a relationship of trust with the locals and the recognition of the study area. For a small community (34 families) all those responsible for residences were invited to participate, totaling 32 interviews, two residents declined participation. After a brief explanation of the objectives of the study all participants were invited to sign a consent form. The access to local knowledge was through semi-structured interviews (Albuquerque et al., 2010), divided into two steps: collecting socioeconomic data of respondents and their knowledge about medicinal plants, the main question was about medicinal plants with anti-inflammatory and healing indications and the part of the plant used.

Ten individuals were selected of the eleven trees and spontaneous species with anti-inflammatory and healing described activities by fitting the following criteria: high use value, portrayed here by their local relevance (good knowledge and use by the aforementioned community) and whose products are obtained by strongly destructive actions (stem bark).

The Use Value (UV) calculated for the eleven species was based on the proposal of Rossato et al. (1999), which is the ratio between citated number of uses of the species mentioned per each interviewee and the total number of interviewees. After calculation, the eleven native species with higher UV were: amburana (*Amburana cearensis* (Allemao) A.C. Sm., Fabaceae); mangabeira (*Lafoensia replicata* Pohl, Lythraceae), aroeira (*Myracrodruon urundeuva* Allemão, Anacardiaceae), pau-d'óleo (*Copaifera langsdorffii* Desf., Fabaceae), catinga-de-porco (*Terminalia brasiliensis* (Cambess. ex A. St.-Hil.) Eichler, Combretaceae), jatobá (*Hymenaea stigonocarpa* var. *pubescens* Benth., Fabaceae), pau-de-rato (*Caesalpinia bracteosa* Tul., Fabaceae), angico (*Anadenanthera falcata* (Benth.) Speg., Fabaceae), inharé (*Brosimum gaudichaudii* Trecul, Moraceae), ameixa (*Ximenia americana* L., Ximeniaceae) and folha-de-carne (Casearia *sylvestris* var. *angustifolia* Uittien, Salicaceae).

A data collection guided tour (Albuquerque et al., 2010) to obtain the stem bark of plants, consisted of walking with informants in a scrub fragment next to the local community to identify and collect the samples from ten individuals of each species. All samples were deposited to the Herbarium Graziela Barroso (TEPB) at the Universidade Federal do Piauí.

This paper was submitted to the Ethics Committee in Research of the Universidade Federal do Piauí and accepted under the Registration Number: 0191.0.045.000-11.

Determination of total tannins in the stem bark of eleven medicinal species selected

Stem bark of ten individuals of each species were collected, stored in paper bags and taken to the Laboratory of Organic Chemistry, UFPI, Campus Prof. Cinobelina Elvas in Bom Jesus, PI for analysis of total tannins. The Folin-Ciocalteu assay and the chemical casein precipitation were used to quantify the total phenolic content in the samples by using tannic acid as standard for total tannins (Folin and Ciocalteu, 1927; Hagerman and Butler, 1989; Mueller-Harvey, 2001; Schofield et al., 2001; Verza et al., 2007; Bueno et al., 2012; Blainski et al., 2013).

Samples were dried under forced-air circulation at 50°C (Nova Etica, model 400/1ND) for three days and grounded using a Willy mill with vertical knives and sieved, yielding a particle size of 16 Mesh. The methanol extracts (80% v/v) were made from 500 mg of material to 50 ml of solvent. The 80% methanol 80% was chosen and the ratio of 1:100 used, since it is the most recommended methodology in the literature (Monteiro et al., 2006a,b; Araújo et al., 2008). Five successive extractions were carried out under heating, filtered using qualitative filter paper Whatman nº 2. All extractions were performed in triplicate. From the extracts, the total phenol content was analyzed using the Folin-Ciocalteu reagent and total tannins content was measured by casein precipitation method (Folin and Ciocalteu, 1927; Mueller-Harvey, 2001; Monteiro et al., 2006a; Verza et al., 2007; Bueno et al., 2012; Blainski et al., 2013). The Folin-Ciocalteu assay employed in the study to verify phenol content consists of adding aliquots (0.25-1.0 ml) of extract to 75 ml of distilled water, 5 ml of Folin-Ciocalteu reagent (10% aqueous solution, v/v), 10 ml sodium carbonate solution (0.75%, m/v), supplemented with distilled water for a final volume of 100 ml. The solution was kept at rest for 30 min and the absorbance observed at 760 nm wavelength in the spectrophotometer. The extent of absorption was calibrated from a control solution of tannic acid (the usual standard) at the following concentrations: 0.0001, 0.0005, 0.001, 0.0025 and 0.000375 $mg.ml^{-1}$. The tannins were determined by the casein precipitation method that comprises adding 1 g of casein to 6 ml of the sample extract diluted with 12 ml of distilled water. After the resulting solution, it was stirred for 3 h at room temperature (25°C) and subsequently filtered through a filter paper Whatman 9 cm and the filtrate was measured with distilled water to a final volume of 25 ml. Aliquots (8-12 ml) of this solution were tested for residual phenolic content using the Folin-Ciocalteu method. The amount of tannins corresponded to differences in absorbance of the samples precipitated with casein and those obtained by analysis of total phenols. The total tannin amounts were expressed in mg/g of dry material (Monteiro et al., 2006a,b).

Data analysis

Differences in the production of tannins from different species were tested by the Kruskal-Wallis test. The use value and amounts of total tannins were correlated by the Pearson correlation test and the simple regression analysis was used to verify if the high use value explains the amount of tannins. The software BioStat 5.0 was used for all statistical analyses (Ayres et al., 2007).

Results and discussion

Total tannin content of selected medicinal species.

The amount of total tannins of eleven local species is described in Table 1. The amount of tannins varied intra-specifically. The greatest variation, between 157.57 and 107.39 mg/g, was found for angico (*A. falcata*). The lowest rate was found in mangabeira (*L. replicata*), between 76.55 and 68.96 mg/g (Table 1). All selected individuals of the same species were adults, close to each other, avoiding changes due to the environment. Variations in specimens' size (similar height and thickness) and signs of herbivory at the time of collection were also avoided. This type of variation is commonly found in some studies. Teixeira et al. (1990) found intraspecific variation in populations of *Stryphnodendron adstingens* (Mart.) Coville. Monteiro et al. (2006a) studied three Caatinga arboreal species and found higher intraspecific variation between 107.98 and 57.59 mg/g in tannins from barks of *A. colubrina*. Intraspecific variations found in the current study support the explanation that individual genetic changes are influencing the results, since no local factor (soil, shading, distance between individuals, age, temperature or presence of watercourses) seemed to explain such differences. However, studies monitoring for periods of time longer than one year biometric, biotic and abiotic factors are interesting to clarify the strategies for synthesis and deposition of tannins (Mello and Santos, 2001; Monteiro et al., 2005; Gobbo-Neto and Lopes, 2007). Given the management purposes for the species studied, future research is needed to identify the "genotypes" suitable for breeding, domestication and propagation through ecological interactions of the plant/environment (Gobbo-Neto and Lopes, 2007).

There were significant interspecific differences in the tannin content among certain species (Table 2). The angico (*A. falcata*) had the highest amount of tannins (132.97 mg/g) however it was not significantly different from mangabeira (*L. replicata*), catinga-de-porco (*T. brasiliensis*), jatobá (*H. stigonocarpa* var. *pubescens*) and ameixa (*X. americana*). There are some studies in the literature indicating the considerable tannin content of some species of the genus *Anadenanthera*, the plants known as angico (Paes et al., 2006). Monteiro et al. (2006a) reported a yield of about 10% of tannin content in the stem bark and they were significantly higher than those in the *M. urundeuva* in the dry season in Caatinga, a semi-arid area of Pernambuco. Similar values to the ones cited above were found by Paes et al. (2006) for the same species (*A. colubrina*) in the city of Patos, Paraíba, locally known as yellow angico. The author also showed that this species has great importance to the northeast from the use in leather tanning. In research focused on the Cerrado of Minas Gerais, Trugillho et al. (1997) found 10.6% of condensed tannins in the stem bark of *A. macrocarpa*. Belonging to the same family of angico, jatobá (*Hymenaea stigonocarpa* var. pubescens) showed no distinction in tannin content. However, Allain et al. (1998) found on average 262.5 mg/g of tannins in the leaves of jatobá (*Hymenaea* sp.). Importantly, the present study quantified only the stem bark for all species.

There is a trend to find higher amounts of high molecular weight compounds, such as polyphenols, in arboreal plants, typical of dry forests as Caatinga (Albuquerque et al., 2012). The authors suggested the existence of a 'metabolic specialization', since a prioritization in the accumulation of phenolic compounds in the case of Caatinga due to the ecogeographic variations was percieved (Albuquerque et al., 2012). This work supports the high values of tannins found in some species in this study (Tables 1 and 2). It should be noted that the investment in the production of certain secondary metabolites is determined by a multitude of factors, and among the main ones, the botanical taxon to which it belongs (Mole, 1993).

Three species analyzed in this study had lower amounts of tannins; pau-d'óleo (*C. langsdorffii*), pau-de-rato (*C. bracteosa*) and inharé (*B. gaudichaudii*) and there were no significant differences between them (Table 2). Probably, the three aforementioned species showed not only an effect on targeted indications of the study (healing and anti-inflammatory) but also over: coughing, influenza, asthma, epilepsy, migraine and bone fracture (pau-d'óleo); tonic, depurative, cancer, for general pain treatment, mosquito bite allergy (inharé) and kidney infection, liver, hypertension, intestinal colic, indigestion and appease children's teething (pau-de-rato). This variability in the indications may explain the low amount of tannins, because there is another metabolite of greater expressiveness in the plant, supporting such statements.

Silva et al. (2009), in a guided study in the Caatinga-Cerrado transition area, north of Minas Gerais, found on average 3.0 mg/g of total tannins for *Copaifera langsdorffii*, values much lower than those found in this work, about 33.0 mg/g (Tables 1 and 2). Studies have shown that such variations can be a result of collection site, seasonality (distinct collection periods) or even variations between parts of the same plant. Fernández De Simón et al. (1999) found differences in the concentration of polyphenols in the wood extracts of species from the genus *Quercus* over a year. Monteiro et al. (2006a) found higher amounts of total tannins in the stem bark than on leaves for *A. colubrina*. However, the leaves of *M. urundeuva* concentrated more tannins than bark, contradicting the local knowledge, which scored the barks of this plant as the most efficient part for the manufacture of medicines. The aforementioned authors stated that the dry season prevails and barks are the constantly offered resources in the Caatinga where this study was conducted. Thus, local communities guided exploitation of bark based on their temporal availability, regardless of the biological response (therapeutic activity). A study directed to relate the amount of phenolic compounds in *L. pacari* leaves to seasonal variations of temperature revealed higher concentrations of these compounds in months of lower temperatures, probably due to decreased photosynthesis (Sampaio et al., 2011). The authors concluded that these compounds were greatly influenced by temperature and foliar micronutrients (Sampaio et al., 2011).

There were no reports in the literature on the amounts of tannins for mangabeira (*L. replicata*), catinga-de-porco (*T. brasiliensis*), jatobá (*H. stigonocarpa* var. *pubescens*), ameixa (*X. americana*), folha-de-carne (*Casecaria sylvestris* var. *angustifolia*) or inharé (*Brosimum gaudichaudii*).

Table 1
Mean amounts of total tannins with standard deviation and Use Value (UV), along with their therapeutic use, of eleven medicinal tree species collected in the municipality of Currais, southern Piauí.

	Popular name (*Scientific name*) Voucher	Therapeutic use	Use value	Total tannins (mg/g)
1	Amburana (*Amburana cearensis* (Allemao) A. C. Sm) 29.625	Intestinal colic, influenza, stomach pain, snakebite, diarrhea, migraine, emesis, headache, joint pain, dizzy spells, fever, constipation, depurative, diuretic, kidney infection.	1.59	42.42 ± 23.10
2	Mangabeira (*Lafoensia replicata* Pohl.) 29.623	Wounds, kidney infection, genitourinary infection in women, diabetes, hypertension, influenza, mosquito bite, general inflammation, ulcers, pains in general, healing, prostate, intestinal disorders.	1.34	72.75 ± 03.79
3	Aroeira (*Myracrodruon urundeuva* Allemao) 29.602	Genitourinary infection in women, wound healing, bone fractures, kidney disorders, diarrhea, anemia, body ache, ear infection, intestine, stomach pain, depurative.	0.88	66.75 ± 10.77
4	Catinga-de-porco (*Terminalia brasiliensis* Camb) 29.604	Genitourinary infection in women, diarrhea, wounds, stomach pain, indigestion, teeth extraction, intestinal infections, ulcer, intestinal colic, constipation.	0.84	85.29 ± 18.75
5	Pau-de-rato (*Caesalpinia bracteosa* Tul.) 29.599	Kidney infection, liver, gastritis, hypertension, diarrhea, intestinal infection in adults and children, intestinal colic, indigestion, children's teething	0.81	29.85 ± 05.78
6	Jatobá (*Hymenaea stigonocarpa var. pubescens* Benth) 29.601	Anemia, influenza, depurative, constipation, general pain, intestinal colic, ulcers, conjunctivitis, fortifying, indigestion, genitourinary infection in women.	0.78	74.30 ± 08.74
7	Pau-d'óleo (*Copaifera langsdorffii* Desf.) 29.600	Coughing, influenza, asthma, infection of genitourinary, scarring, throat inflammation, body aches, epilepsy, migraine, bone fracture.	0.75	32.98 ± 04.23
8	Angico (*Anadenanthera falcata* (Benth.) Speg.) 29.605	Depurative, wounds, colds, coughing, burns, boils, colic.	0.69	132.97 ± 25.57
9	Inharé (*Brosimum gaudichaudii* Trecul.) 29.624	Tonic, depurative, wounds, cancer, inflammation, pain in general, mosquito bite allergy, blood circulation.	0.66	17.50 ± 06.76
10	Ameixa (*Ximenia americana* L.) 29.603	Female genitourinary tract infection, constipation, diabetes, liver, kidney infection.	0.59	70.84 ± 07.66
11	Folha-de-carne (*Casecaria sylvestris var.angustifolia* Uittien) 29.598	Constipation, stomach pain, coughing.	0.53	68.56 ± 04.85

Table 2
Variance matrix of 11 spontaneous medicinal species for Kruskal-Wallis test at 95% confidence. Diagonal averages of total tannins followed by the standard deviation (SD).

Total Tannins (mg/g) ± SD	1	2	3	4	5	6	7	8	9	10	11
1	42.42 ± 23.10	ns	Ns	ns	ns	ns	ns	$p < 0.005$	$p < 0.005$	ns	ns
2		72.75 ± 03.79	Ns	ns	$p < 0.005$	ns	$p < 0.005$	ns	$p < 0.005$	ns	ns
3			66.75 ± 10.77	ns	ns	ns	ns	$p < 0.005$	$p < 0.005$	ns	ns
4				85.29 ± 18.75	$p < 0.005$	ns	p<0.005	ns	$p < 0.005$	ns	ns
5					29.85 ± 05.78	$p < 0.005$	ns	$p < 0.005$	ns	$p < 0.005$	ns
6						74.30 ± 08.74	$p < 0.005$	ns	$p < 0.005$	ns	ns
7							32.98 ± 04.23	$p < 0.005$	ns	ns	ns
8								132.97 ± 25.57	$p < 0.005$	ns	$p < 0.005$
9									17.50 ± 06.76	$p < 0.005$	$p < 0.005$
10										70.84 ± 07.66	ns
11											68.56 ± 04.85

1, Amburana (*Amburana cearensis*); 2, Mangabeira (*Lafoensia replicata*); 3, Aroeira (*Myracrodruon urundeuva*); 4, Catinga-de-porco (*Terminalia brasiliensis*); 5, Pau-de-rato (*Caesalpinia bracteosa*); 6, Jatobá (*Hymenaea stigonocarpa* var. *pubescens*); 7, Pau-d'óleo (*Copaifera langsdorffii*), 8, Angico (*Anadenanthera falcata*); 9, Inharé (*Brosimum gaudichaudii*); 10, Ameixa (*Ximenia americana*); 11, Folha-de-carne (*Casecaria sylvestris* var,*angustifolia*).

Total tannins × use value (UV)

According to the simple regression analysis, the amounts of tannins found in the studied species did not explain its use value (UV) (F = 0.0003, p = 0.98). The plant with highest amount of tannins, angico (*A. falcata*), ranked eighth in use value (VU - 0.66) (Table 1). The species with highest UV, amburana (*Amburana cearensis*), had one of the lowest total tannin content (Table 1). Thus, it was not possible to establish whether the amount of total tannins (responsible for the therapeutic activity) influenced to a greater or lesser degree the accumulation of knowledge due to local relevance (UV). Initially proposed by Phillips and Gentry (1993a,b), the UV is an index widely used to 'quantify' the traditional knowledge and, some authors have already made use of this proposal in their studies with different goals (Rossato et al., 1999; La Torres-Cuadros and Islebe, 2003; Lucena et al., 2007; Silva et al., 2010b). This index is sensitive to the number of uses of a given plant according to a given set of respondents (Silva et al., 2010b). Thus, the UV does not capture the real or effective use, it only quantifies the knowledge and assesses the real local use, and so one has to use collecting methods in situ or counts of plant material (Ramos et al., 2008; Nascimento et al., 2009; Ramos and Albuquerque, 2012).

Lucena et al. (2007) found that phytosociological parameters explained the use value in one of the sampled areas in Caruaru, Pernambuco. La Torres-Cuadros and Islebe (2003), in Southeastern Mexico, found a weak relationship between UV and availability of useful plants (phytosociological parameters). Ferraz et al. (2006) found no significant relationships between UV and the availability of surveyed species in a study conducted in the interior of Pernambuco. However, they realized that plants with high UV may indicate mechanisms of appropriation of these plants resulting in the change of the local vegetation component.

There was also no correlation between UV and total tannins (rs = 0.24, p = 0.46) (Fig. 1). Some studies have correlated the levels of tannins to other variables (Monteiro et al., 2006a,b).

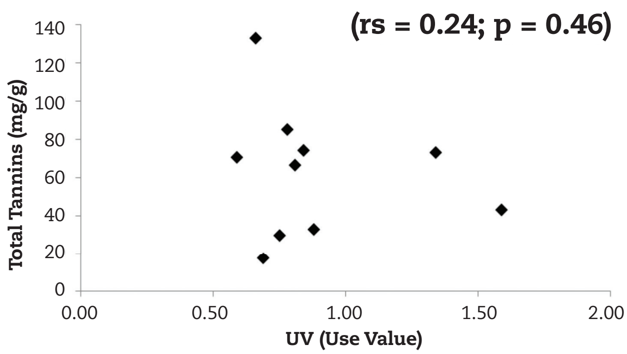

Figure 1 - Relationship between the amount of total tannins and their Use Values (UV), of eleven medicinal tree species collected in the municipality of Currais, southern Piauí.

Monteiro et al. (2006b) found no correlation between biometric characteristics (height and diameter) of three tree species, aroeira (*M. urundeuva*), angico (*A. colubrina*) and catingueira (*C. pyramidalis*) with tannin levels in the stem bark. However, the Caatinga seasonality characterized by well-defined seasons - a lasting dry season and a short rainy season - influenced the tannin contents for angico (*A. colubrina*) and aroeira (*M. urundeuva*), whose stem barks totalized more tannins in the dry season (Monteiro et al., 2006b). Some studies have shown the high use of vegetative parts, such as bark and roots for the Brazilian semi-arid region (Albuquerque and Andrade, 2002; Albuquerque, 2006; Monteiro et al., 2006a). This finding is justified on account of the ephemerality of herbaceous plants of the Caatinga, in contrast to the availability of tree resources, due to the marked rainfall seasonality.

Final remarks

In this study there was no relationship between the UV and tannin contents in the studied species. Thus, it was not possible to establish whether the amount of total tannins influenced to a greater or lesser extent the accumulation of knowledge of particular species (UV). Probably, such knowledge may reflect the local needs. It is noteworthy also that the tool used here to quantify the knowledge was selected for its practicality and ease of use fitting the concept of techniques called "informants" consensus' (Philips, 1996; Silva et al., 2010b), but it is not able to estimate the effective use of plant species (Silva et al., 2010b).

It was also assumed that the therapeutic activities cited are assigned to the concentrations of tannins in the bark, since there are several studies in the literature supporting such a statement (Bruneton, 1991; Chung et al., 1998; Mello and Santos, 2001; Monteiro et al., 2006a). Future studies are needed to associate the tannins with anti-inflammatory activity because there are several causes for the onset of an inflammatory process, and healing processes are distinct among bodily organs as documented by Ferreira Junior et al. (2011).

Moreover, this is the first study to investigate the relationship between the amount of total tannins and local botanical knowledge expressed by the UV for this region. Adding to the complexity of Piauí flora, distinguished by its areas of transition between Caatinga and Cerrado in the southern region, providing extensive fieldworks involving people/plants interaction. Such studies may favor the implementation of projects and future management proposals suitable for the area, marked by gaps in knowledge.

Authors' contributions

JMM, JSNS and EMFLN designed the study, supervised the laboratory work and contributed to critical reading of the manuscript. KS and EFT contributed in collecting plant sample and identification, confection of herbarium, running the laboratory work, analysis of the data and drafted the paper. All the authors have read the final manuscript and approved the submission.

Conflicts of interest

The authors declare no conflicts of interest.

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