The use and diversity of medicinal flora sold at the open market in the city of Oeiras, semiarid region of Piauí, Brazil

Francisca Carla Silva de Oliveira, Fábio José Vieira, Alexandre Nojoza Amorim and Roseli Farias Melo de Barros

Correspondence

Francisca Carla Silva de Oliveira[1], Fábio José Vieira[2], Alexandre Nojoza Amorim[3] and Roseli Farias Melo de Barros[4]

[1]Federal University of Piauí, Department of Teaching Methods and Techniques, Piauí, Brazil.
[2]State University of Piauí, Picos, Piauí, Brazil.
[3]Federal Institute of Maranhão, Maranhão, Brazil.
[4]Federal University of Piauí, Herbarium Graziela Barroso, Piauí, Brazil

[*]Corresponding Author: carlaoliveira@ufpi.edu.br

Ethnobotany Research & Applications 22:21 (2021)

Research

Abstract

Background: Medicinal plants are important resources in people's health care. In urban areas, they are commercialized in open markets. The goal of this paper is to know the medicinal plants marketed in the Oeiras/PI free trade fair and the associated knowledge attached to it.

Methods: Interviews were carried out with the seven licensees who traded medical ethnospecies at the free trade fair of the municipality, through the application of semi structured forms. Species similarity and richness were calculated using the Shannon-Wiener and Jaccard index. For the informant's consensus Factor, the Loyalty Level was calculated.

Results: We identified 60 species, belonging to 34 botanical families, with greater representativity for *Fabaceae* (16 ssp.). The most used plant organs were leaves (29,9%) and stems (20,8%) and the predominant preparation method of herbal medicine was tea (decoction and infusion, 26,9% and 20,8%, respectively). *Ximenia americana* L. showed greater use and *Amburana cearensis* (Allemão) AC Sm. was the most versatile species. The most usual citation was for the treatment of symptoms of the respiratory and genitourinary systems disorders. It was verified that the fair is an important space for maintenance, (re) construction and diffusion of the local culture on the use of medicinal plants.

Conclusions: Public policies should include these spaces in the establishment of standards and specific guidelines that guarantee the permanence of sellers and the safe and sustainable use of flora resources.

Keywords: herbal plants merchants, ethnobotany, ethnomedicine, market.

Manuscript received: 25/07/2021 – Revised manuscript received: 13/09/2021 - Published: 22/09/2021
http://dx.doi.org/10.32859/era.22.21:1-19

Background

Historically, plants are considered reliable natural therapeutic sources for the restoration of physical and spiritual health. The permanence of species within the medicinal repertoire suggests the existence of empirically proven healing properties, through a process of cultural validation, which is commonly involved by characteristic mysticisms, dynamics and symbology (Albuquerque 2005, Araújo *et al.* 2014, Lorenzi & Matos 2002, Medeiros *et al.* 2010).

Ethnobotany is a science that includes studies referring to the affinity relationship established over time between human populations and plants, thus enabling an analysis between the symbolic, the natural (botanical) and the cultural. This process can lead to the discovery of natural chemical compounds of interest, new applicability for substances already studied, the recognition of locally important species, documentation of knowledge associated with the plant world and the development of programs for adequate management practices, among others (Agra 1996, Albuquerque 2005, Amorozo 1996, Bastos *et al.* 2020, Cotton 1996, Santos 2020, Santos *et al.* 2019, Soldati 2013, Woff *et al.* 2008).

The vast repertoire of flora species used for therapeutic purposes by urban populations, both naive and cultivated, is attributed to the process of cultural syncretism of indigenous peoples with African and European people (Agra 1996, Amorozo 1996, Ferreira Júnior 2015, Rocha 2015, Rocha *et al.* 2013). In Brazil, as in other countries, the use of medicinal plants was limited to traditional and rural populations until population density and the creation of cities favored the emergence of alternative forms of access and commercialization of plant species, becoming an economic activity in urban areas (Arenas *et al.* 2015, Pasa *et al.* 2005, Pieroni & Vandebroek 2007).

As a place of purchase and sale, the open market is a place where specific socio-cultural practices are established, characterized, above all, as a space for the maintenance and dissemination of knowledge and, therefore, for the (re)production of cultures based on experiences lived by the people within the environment. The commercialization of plant species involves not only the economic dimension, but geographical, cultural, structural, psychological and social dimensions as well (Carvalheiro 2010).

In this context, on the commercialization of plant species used in therapy (ethnospecies) in open fairs, the studies developed in Brazil in fairs and markets by Alves *et al.* (2016), Araújo *et al.* (2015), Bastos *et al.* (2020), Bochner *et al.* (2012), Conceição *et al.* (2011), Costa Lima *et al.* (2014), Freitas *et al.* (2012), Linhares *et al.* (2014), Monteiro *et al.* (2010a, 2010b), Rocha *et al.* (2013), Rocha (2015) and Santos *et al.* (2015) and in Piauí by Conceição *et al.* (2011), Oliveira and Barros (2018), Santos (2020) and Santos *et al.* (2013, 2020) can be highlighted.

In order to contribute to research on medicinal plants sold in open markets, and, above all, given the relevance of plant species in ethnomedicine, the aim of this article was to do an inventory of medicinal plants and knowledge associated with ethnospecies sold in open markets in Oeiras, Piauí.

Materials and Methods

Characterization of the study area

Oeiras is considered the oldest population center in Piauí. Founded in 1696, in 1758 it became the first capital of the state of Piauí (Freitas 1984). With the move of the capital to Teresina in 1852, numerous families moved to the new headquarters, when their trade went through a period of great decline. In 1930, the exploration of **carnaúba** wax (*Copernicia prunifera* (Mill) H.E. Moore) boosted productive activities and economic growth in the municipality was resumed (Moura 1986, Soares 1973). Oeiras is about 300km from Teresina (Fig. 1), has an estimated population of 35,646 and a territorial extension of 2,702.5km² (Ibge 2010).

It has a remarkable cultural richness, with historic mansions, religious festivities, squares with gardens and well-developed commerce, being included in the tourist itinerary of the State. The vegetation is characterized by the Cerrado (a tropical savanna ecoregion)/Caatinga (a semi-arid scrub forest) transition, with the shrubby-arboreal Caatinga prevailing (Oliveira *et al.* 2010).

The research was carried out with seven traders (hereinafter also referred to as market vendors, sellers, herbalists, traders, informants and interviewees, identified by adding the numbers 1, 2, 3, 4, 5, 6 and 7 as a way to preserve identity), that sell medicinal plants in the open market in Oeiras. For this study, the term free fair refers to the permanent place, located in the Historical Center of the city until 2018, where medicinal plant species were sold. The term ethnospecies is in accordance with the one proposed by Hanazaki *et al.* (2000).

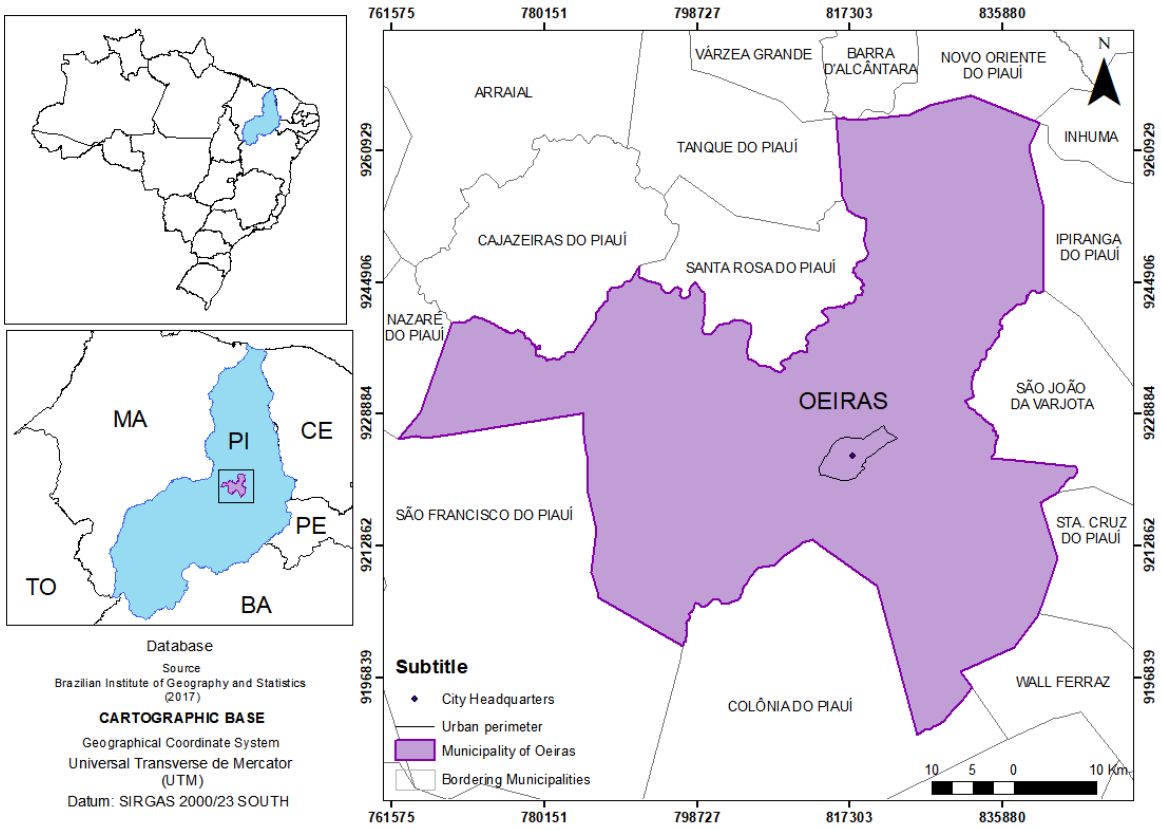

Figure 1. Location of the municipality of Oeiras, Piauí, Northeast Brazil.
Source: Ibge (2010), adapted by Karoline Veloso (2018).

Ethnobotanical data collection

The work was initially presented to the local municipal authority to inform the research intentions. Subsequently, the project was submitted and approved by the Ethics and Research Committee (CEP, in Portuguese) of the Federal University of Piauí (UFPI, in Portuguese), through the process No. 886195 and also registered in the National System of Genetic Heritage and Traditional Knowledge Management Associate (SISGEN, in Portuguese) under the number A7B0C2B. Subsequently, we proceeded with the explanation about the research objectives and its stages for the fair sellers, using the Rapport technique (Bernard 2006).

At the open fair in Oeiras, eight licensees were identified who sell plant species for medicinal uses. Of these, seven agreed to participate by signing the Informed Consent Form (ICF), which were then interviewed by applying semi-structured forms (Albuquerque *et al.* 2014, Martin 1995) to obtain information about the medicinal species sold, therapeutic indication and productive/extractive chain.

Data were transcribed and analyzed at the Herbarium Graziela Barroso (TEPB, in Portuguese) at the Federal University of Piauí (UFPI, in Portuguese). The continuous and frequent commercialization of medicinal plants, exclusively or associated with other products, with a period of at least one year, was considered as an inclusion criterion. The biogeographic origin of plant species was also analyzed (Moro *et al.* 2012). To verify the spelling of the names, they were consulted on the official websites: Flora do Brasil and Mobot (2021). The identification of the species sold, due to the quality of the material in the open market, occurred through the articulation of information: use of photographic records, comparisons of the plant parts acquired in the open market with those deposited at the TEPB, sending photos to specialists, consulting the specialized bibliography, and organized as proposed by the Angiosperm Phylogeny Group (APG 2016).

Shannon-Wiener Similarity and Diversity were calculated by Jaccard Index (Magurran 1989) and Species Wealth using Biostat 5.0 software (Ayres *et al.* 2007). To verify the agreement between the respondents' answers for the main therapeutic indication, the Loyalty Level (Friedman *et al.* 1986) was calculated using the formula:

$FCI=(nur-n_t)/(n_{ur}-1)$

where FCI= consensus factor of informants; nur= the number of citations of uses in each subcategory; nt= number of species used in this subcategory.

Results and Discussion

A wide range of vegetable products was available at the open market in Oeiras. In the research, 62 species were identified (Table 1), of which 64.5% were native and 35.5% were exotic, distributed in 34 families, with *Fabaceae* being the most representative family (16 ssp). Probably due to the fact that it is one of the largest families of angiosperms in semi-arid environments, such as the Caatinga, according to a study developed by Roque *et al.* (2010).

Table 1. Medicinal plants sold at the open market in the city of Oeiras, Piauí, Northeastern Brazil. Abbreviations:VN= Vernacular Name; TI=Therapeutic Indication; PU=Part Used RI=Relative Importance; PM= Preparation Mode O= Origin (N= native E= exotic) TEPB= registration number at the Graziela Barroso/UFPI Herbarium; ip.= identified in the place.

Family/ Scientific name (TEPB)	VN	TI	PU	PM	O
Adoxaceae					
Sambucus nigra L. (il.)	**sabugueira**	measles; infant colic; tooth eruption; chickenpox; inflammations; flu; fever	flower leaf	decoction infusion licker inhalation	E
Amaranthaceae					
Dysphania ambrosioides L. Mosyakin & Clemants (23.388)	**mastruz**	vermifuge	leaf	juice	E
Amaryllidaceae					
Allium cepa L. (il.)	**cebola cebola-branca**	measles; flu; asthma; gases.	bulb	inhalation	E
Allium sativum L. (il.)	**alho**	measles; heart problems; vermifuge; high blood pressure.	bulb	*in natura* seasoning infusion	E
Asparagaceae					
Aloe vera (L.) Burm. f. (il.)	**babosa**	flu; expectorant; sinusitis; uterine problems; bronchitis; toothache.	leaf	juice syrup topical use	E
Anacardiaceae					
Astronum urundeuva (M. Allemão) Engl. (23.496)	**aroeira**	female inflammations	bark	infusion	N
Apiaceae					
Anethum graveolens L. (il.)	**endro**	constipation; diuretic.	seed	decoction	E
Pimpinella anisum L. (il.)	**erva-doce**	soothing	seed	decoction	E
Arecaceae					
Cocos nucifera L. (il.)	**coco**	rash	oil	*in natura*	E

Mauritia flexuosa L.f. (il.)	**buriti**	snake bite; insect bites; tarantula spider bite.	bark oil leaf	smoothie *in natura* topical use decoction infusion	E
Aristolochiaceae					
Aristolochia acutifolia Duch. (23.456)	**jarrinha**	female inflammations	flower	infusion	N
Asteraceae					
Acanthospermum hispidum DC . (23.480)	**cabeça-chata**	pneumonia; gallstones.	leaf	decoction	N
Helianthus annuus L. (*il.)*	**girassol**	headache	seed	decoction	E
Matricaria chamomilla L. (il.)	**camomila**	soothing	flower	infusion	E
Pectis oligocephala var. *affinis* (Gardner) Baker (23.481)	**alecrim**	soothing; urinary infection.	leaf	decoction	N
Boraginaceae					
Varronia leucocephala (Moric.) J. S. Mill.	**moleque-duro**	childwalk	leaf	decoction	N
Heliotropium curassavicum L. (23.877)	**crista-de-galo**	newborn diseases; inflammations; diarrhea.	leaf flower root	decoction	N
Brassicaceae					
Sinapis alba L. (il.)	**mostarda**	stroke	seed	decoction	E
Cactaceae					
Nopalea cochenillifera (L.) Salm-Dyck (23.449)	**palma-santa**	healing	leaf	topical use	E
Cleomaceae					
Tarenaya spinosa (Jacq.) Raf. (23.455)	**mussambê**	evil eye; flu	leaf	blessing syrup	N
Caryocaraceae					
Caryocar coriaceum Wittm. (il.)	**pequi**	the flu; bone pain	oil fruit	*in natura*	N
Combretaceae					
Combretum leprosum Mart. (23.469)	**mufumbo**	flu	flower	syrup	N
Convolvulaceae					
Operculina macrocarpa (L.) Urb. (23.900)	**batata-de-purga**	measles; flu; expectorant; vermifuge; skin clearing; intestinal problems.	tubercle	decoction infusion	N
Cucurbitaceae					
Luffa operculata Cogn. (23.913)	**buchinha** **buchinha-paulista**	female inflammations; abortive; flu	fruit	inhalation	N

Euphorbiaceae					
Cnidoscolus urens var. *neglectus* (Pohl) Lourteig (23.397)	**cansanção** **cansanção-branco**	appendicitis; toothache	root latex	topical use	N
Croton betaceus Baill. (23.398)	**velaminho**	fever; flu	root leaf	syrup decoction	N
Jatropha gossypiifolia L. (23.395)	**pinhão-roxo**	avoid evil eye	whole plant	*in natura*	N
Ricinus communis L. (23.408)	**mamona**	vermifuge; cleansing the lungs; hair loss; constipation	oil	*in natura*	E
Fabaceae					
Amburana cearensis (Allemão) A.C.Sm. (23.920)	**imburana** **imburana-de-cheiro**	chickenpox; infantile colic; inflammation in general; tooth eruptions; flu; antipyretic; expectorant	bark seed	shower decoction syrup	N
Anadenanthera colubrina var. *colubrina* (Vell.) Brenan (23.490)	**angico**	chickenpox; flu; depurative; dysentery; abdominal pain	bark	juice	N
Bauhinia acuruana Moric. (23.488)	**miroró-branco**	stroke	bark	decoction smoothie	N
Bauhinia dubia G. Don (23.533)	**pata-de-vaca**	weight gain; gastritis; diabetes; inflammations	bark leaf	decoction	N
Copaifera langsdorffii Desf. var. *langsdorffii* (il.)	**copaíba**	pain in general	oil	*in natura*	N
Copaifera martii Hayne (23.544)	**podói** **podóia** **pau-d'oil**	pain in general; menstrual regulator	latex bark	topical use juice	N
Dimorphandra gardneriana Tul. (23.492)	**podói** **podóia** **pau-d'oil**	pain in general; menstrual regulator	latex bark	topical use juice	N
Dioclea violacea Mart. Ex Benth.(23.935)	**mucunã-de-chapada** **mucunã**	the flu; expectorant	bark	juice	N
Hymenaea courbaril L. (23.642)	**jatobá** **jatobá-preto**	depurative; anemia; gastritis	bark	juice	N
Hymenaea eriogyne Benth. (23.491)	**jatobá**	anemia	bark	juice	N
Libidibia ferrea (Mart. Ex Tul.) L.P. Queiroz (23.621)	**jucá** **pau-ferro**	flu; expectorant; diarrhea; intestinal cramps	bark	syrup smoothie decoction	N
Mimosa caesalpiniifolia Benth. (24.029)	**sabiá**	stroke	seed	infusion	N

Mimosa tenuiflora Poir. (23.860)	**jurema-preta**	abdominal pain	bark	infusion smoothie	N
Poincianella pyramidalis (Tul.) L. P. Queiroz (23.493)	**pau-de-rato**	abdominal distension; dysentery	flower bark fruit	decoction smoothie	N
Senna spectabilis (DC.) HS Irwin & Barneby (23.494)	**cana-fliche**	constipation; vermifuge; flu; wounds	leaf	decoction	N
Swartzia flaemingii var.*psilonema* (Harms) R. S. Cowan(23.501)	**jacarandá**	liver problems; gastric problems; diabetes; vomiting; diarrhea	leaf seed	decoction infusion	N
Lamiaceae					
Mesosphaerum suaveolens (L.) Kuntze (23.603)	**bambural**	the flu; sinusitis	leaf	syrup infusion	N
Plectranthus barbatus Andrews (23.919)	**boldo**	gastric problems; indigestion; diarrhea; abortive	leaf	juice	E
Rosmarinus officinalis L. (24.003)	**alecrim alecrim-de-passos; alecrim-de-bom-jesus**	the flu; expectorant	bark	infusion decoction	E
Linaceae					
Linum usitatissimum L. (il.)	**linhaça**	food supplement; constipation; inflammation in general	seed	juice	E
Loganiaceae					
Strychnos sp (23.598)	**quina**	female inflammations	bark	juice	N
Malpighiaceae					
Malpighia emarginata DC. (23.959)	**acerola**	flu; expectorant	fruit	juice *in natura*	E
Myristicaceae					
Myristica fragrans Houtt. (il.)	**noz-moscada**	stroke	seed	infusion	E
Myrtaceae					
Campomanesia velutina (Cambess.) O. Berg (23.922)	**guabiraba**	sorethroat	seed	infusion	N
Eucalyptus globulus Labill. (il.)	**erva-mate**	weight loss; flu	leaf	inhalation defumador	E
Olacaceae					
Ximenia americana L. (23.894)	**ameixa**	female inflammations; uterine bleeding; healing	bark	juice smoothie topical use (powder) infusion	N

Passifloraceae					
Passiflora cincinnata Mastro. (24.008)	**maracujá maracujá-bravo maracujá-do-mato**	soothing	seed	juice	N
Piperaceae					
Piper nigrum L. (il.)	**pimenta-do-reino**	sore throat; heart problems; vermifuge; high blood pressure; hoarseness	seed	infusion seasoning	E
Poaceae					
Cymbopogon citratus (DC.) Stapf (23.916)	**capim-de-cheiro folha-santa**	high blood pressure	leaf	decoction	E
Rhamnaceae					
Ziziphus joazeiro Mart. (23.890)	**juá**	diabetes; cholesterol; flu; Parkinson's disease.	leaf	decoction	N
Rubiaceae					
Tocoyena selloana K. Schum. (23.690)	**jenipapinho**	high blood pressure; cholesterol; diabetes	leaf	decoction	N
Solanaceae					
Solanum americanum Mill. (23.853)	**maria-preta**	colic; pain in general.	leaf	decoction	N
Verbenaceae					
Lippia alba (Mill.) N.E.Br. ex P. Wilson (23.931)	**erva-cidreira**	high blood pressure; infectionss; indigestion; soothing; convulsions.	leaf flower	decoction	N
Vochysiaceae					
Callisthene fasciculata Mart. (23.986)	**capitão-de-campo**	newborn diseases	leaf	infusion	N

Source:Field Research.

As for the vernacular name of the species sold, different names were registered for the same species, as well as a single name for different species, causing possible erroneous therapeutic uses. This process, according to Kool *et al.* (2012), can have several implications:r Source:Field Research.
emoval, by mistake, of rare or endangered species; overexploitation of species in high demand; and consumer health risks from the introduction of potentially toxic species. Bussmann *et al.* (2015), when carrying out a comparative study of the plants commercialized in the markets of La Paz, Bolivia and Trujillo and Chiclayo in northern Peru, they found that two species were sold as "Cola de Caballo", which, for the authors, may represent risks for consumers due to already documented side effects, which requires greater attention in identification by suppliers for species used as medicinal.

The transmission of knowledge associated with the therapeutic properties of known and commercialized ethnospecies among the interviewees was done on conversations. Furthermore, the permit holders revealed that the permanence of this knowledge in the family environment is threatened by the lack of time, lack of interest

and/or distancing from their children, as when constituting their families they seek work opportunities or professional training in other cities. In these terms, it is noteworthy that learning by oral speech transmission, according to Soldati *et al.* (2011), may be compromised by the impossibility of family experiences (hunting, collecting vegetables, walks, etc.) which, historically, were constituted as a way of transmitting this information. According to Cheng *et al.* (2020), popular taxonomy or parataxonomy encompasses morphological, sensory, ecological and cultural mechanisms for recording information about organisms, and can be considered as a classification system as consistent as scientific taxonomy, however, it is poorly registered and is threatened with extinction.

Of the total species identified in the Oeiras open market (62 ssp.), five (*Allium sativum* L., *Eucalyptus globulus* Labill., *Matricaria chamomilla* L., *Pimpinella anisum* L. and *Sambucus nigra* L.) are included in the list of simplified registration traditional products of herbal medicines by the National Health Surveillance Agency (Anvisa 2014). In addition to these, **alho** (*Allium sativum*), **babosa** (*Aloe vera* Burm.f.), **camomila** (*Matricaria chamomilla*) and **pinhão-roxo** (*Jatropha gossypiifolia* L.) are included in the National List of Medicinal Plants of Interest to the Unified Health System/RENISUS (Brasil 2009).

The medicinal use of **ameixa** (*Ximenia americana* L.) stands out for its anti-inflammatory properties, referenced to the treatment of female genitourinary diseases, uterine bleeding and healing. The **ameixa** had, among all respondents, mentions of similar use, varying only the indication of the form of preparation. Data that corroborate what was found by Linhares *et al.* (2014) in São Luís/MA, in which this species had the highest use agreement among respondents, for use as an anti-inflammatory. The antimicrobial and antiviral activity against the HIV-1 virus in the plant extract was described by Santana (2006). Chaves *et al.* (2014) point out that although this species is versatile, known and widely used for therapeutic purposes worldwide, care must be taken in the administration of the preparations, to avoid hepatotoxic effects.

The **imburana** (*Amburana cearensis (*Allemão) A.C.Sm.) was the most versatile species, whose barks (stem) and seeds were indicated for the treatment of seven diseases (chickenpox, infantile colic, inflammation in general, tooth eruptions, the flu, antipyretic and expectorant), with scientifically proven uses, as stated by Canuto (2008). Silva *et al.* (2020) state that coumarins, a chemical constituent naturally present in various parts of the plant, known pharmacologically as antioxidants and anti-inflammatory drugs, also have a neuroprotective function, due to their ability to reduce oxidative stress, inflammation and neuronal death. Agra (1996) also adds that it is threatened with extinction in areas of Caatinga, due to exploitation for timber purposes in the region of Cariris Velhos/CE. Martineli *et al.* (2013) mention that the species is of interest for research and conservation and also has a high economic value, however, it is in decline. Which may be related, according to Santos *et al.* (2019), to the unsustainable exploitation, suggesting the awareness of extractivists to avoid ringing, which leads to the death of the plant.

The **aroeira** (*Astronium urundeuva*) has been recommended by vendors for the treatment of female inflammations. In analyzing the phytochemical profile and biological activity, Morais *et al.* (1999) and Viana *et al.* (2003) found that bark (stem) extract has antidiarrheal, antioxidant and anti-inflammatory activity. As for the conservation measures of plants and commercialized parts, for this research, it was found that dehydration is prevalent and that the vegetables or parts of them are exposed to room temperature in the open market. Santos *et al.* (2015) confirmed that this form is suitable, as there will be no loss of therapeutic properties, since the content, refractive index and chemical composition of the essential oil of the fresh plant will not change.

For the treatment of measles, sellers indicated a mixture of barks (stem) of **imburana** (*Amburana cearensis*) and **angico** (*Anadenanthera colubrina* var. cebil (Vell.) Brenan); tubercle of the **batata-de-purga** (*Operculina macrocarpa* (L.) Urb.), the bulbs of **alho** (*Allium sativum*) and **cebola-branca** (*Allium cepa* L.).The **pau-ferro** (*Libidibia ferrea* (Mart. ex Tul.) L. P. Queiroz) was indicated for the treatment of the flu/expectorant, diarrhea and intestinal colic. For this species, Oliveira *et al.* (2010) recorded its use as healing, in combating the flu and kidney inflammation. Silva *et al.* (2015) found that residents of Caatinga areas in Milagres/CE, use bark (stem) and fruit, prepared in the form of tea, syrup, to combat the flu, kidney inflammation, as well as soothing and to diminish cough.

Mussambê (*Tarenaya spinosa* (Jacq.) Raf.) and **mufumbo** (*Combretum leprosum* Mart.) had as main indication the treatment of the flu. In Piauí, Emperaire (1989) found that the tea of the barks (stem), leafs and fruits of **mufumbo** was attributed antiophidic and antiasthmatic activity and the aqueous suspension of the lyophilized hydroalcoholic

extract was mentioned by Alves *et al.* (2015) as possessing calcium-dependent bioactive compounds capable of causing prolonged production of endothelial cell relaxing factors.

According to all respondents, the greatest demand from customers is for species used to treat symptoms and/or diseases of the respiratory system, especially after the rainy season, when the flu and allergic reactions are common. Although it was open every day of the week, on Saturdays and Sundays there was an increase in the flow of people at the Oeiras fair, especially those living in the rural area of

the municipality and in other surrounding cities. It is noteworthy, in this dynamic, that there was a relevant increase in sales on payment days for municipal, state and social assistance workers. On these busiest days, merchants stayed in their stalls, and it was common to travel to open markets in nearby cities on other days of the week, when they left the space under the care and supervision of a family member or a trusted person.

In Oeiras, various forms of commercialization of ethnospecies were registered: products benefited in the form of oils, syrup, smoothies and plants, or part of them dehydrated. The association of **noz-moscada** (*Myristica fragrans* Houtt.) and **mostarda** (*Sinapis alba* L.), for example, is used to prevent stroke. As transcribed below:

(...) *a client had a stroke and had one side of her face completely paralyzed, she didn't move at all. She came here looking for medicine and then I told her to mix* ***noz-moscada*** *and* ***mostarda*** *and drink the tea. When she used both of them together it worked, she got better. You need to see it with your own eyes. There was no defect* (*A. erveiro*).

There was the sale of **pequi** (*Caryocar coriaceum* Wittm.), **buriti** (*Mauritia flexuosa* L.f.) and **mamona** oil (*Ricinus communis* L.) oils, indicated to combat the flu, insect bites and as vermifuge, respectively, by all the sellers. These products are stored in reused glass bottles with a capacity of 50ml and 1L. As for the form of preparation, it was identified that teas (decoction and infusion, 26.9% and 18.3%, respectively) (Fig. 2), are the most common form of use, as also evidenced by Parente and Rosa (2001) and Polat *et al.* (2013).

The syrup of the bark (stem) of the **imburana** (*Amburana cearensis*) was indicated for the treatment of the flu with expectorant function. According to the interviewees, the preparation before use requires exposure to moonlight for three days in a row. After this period, the bath or syrup is prepared, in association with flowers of **fava-d'anta** (*Dimorphandra gardneriana* Tul.) and **pau-ferro** (*Libididia ferrea*) flowers. Pimentel and Guerra (2015) mention that in addition to entrebark and seeds, **imburana** roots are also used in the preparation of syrup, as they are rich in coumarin, an active ingredient with anti-inflammatory and bronchodilating action.

To combat the flu, **babosa** leafs (*Aloe vera*) are prepared in association with barks of **angico** (*Anadenanthera colubrina* var. cebil), **juá** (*Ziziphus joazeiro* Mart.), **pau-ferro** (*Libidibia ferrea*), **imburana** (*Amburana cearensis*) and **batata-de-purga** (*Operculina macrocarpa*). Another species used for the same purpose is the **velaminho** (*Croton betaceus* Baill), whose leafs, in addition to being used as an anti-flu medicine, are indicated as an antipyretic. In addition to therapeutic use, the leafs of **babosa** and **mamona** (*Ricinus communis*) were also referenced for cosmetic and veterinary use, respectively. These data corroborate those presented in the studies developed by Mattos *et al.* (2015), in Monte Claros/MG; Amadu and Sanchez (2014) in Sierra Leone (Africa); Freitas *et al.* (2012) in São Miguel/RN; and Oliveira *et al.* (2010) in Oeiras/PI, in which leaf had more indications of use than other vegetable parts, according to the people interviewed. In this last area, Jenrich (1989) documented the occurrence of 15 species used as medicine, in which the bark (stem) was the part used with 75% of citations.

The preparation of the **podói** (*Copaifera martii* Hayne), according to the herbalists, used as a menstrual regulator in the form of juice, requires scraping the bark (stem) from the bottom to the top, so that it does not lose its therapeutic properties, similar to behavior observed in a study by Oliveira *et al.* (2010). Thus, it is reiterated that the permanence of the species in the repertoire in a given location may indicate that this plant is potentially effective.

The aerial part (leafs, floweres, stem) of **alecrim-dos-passos** (*Rosmarinus officinalis* L.) is used in the decoration of homes, to bring "good omens" and during religious festivities such as the Holy Week, being flaunted by people in walks and religious events. Similarly, Dantas and Ferreira (2013), recorded the uses of this plant as smoke, baths, fluids and perfumes used to ward off evil spirits and negative energies in Belém/PA. For Albuquerque (2005),

interactions between people and plants permeate medical or therapeutic use, as, in some cases, a magical-religious relationship is established, with visions of the spiritual world, which causes well-being by repelling bad luck.

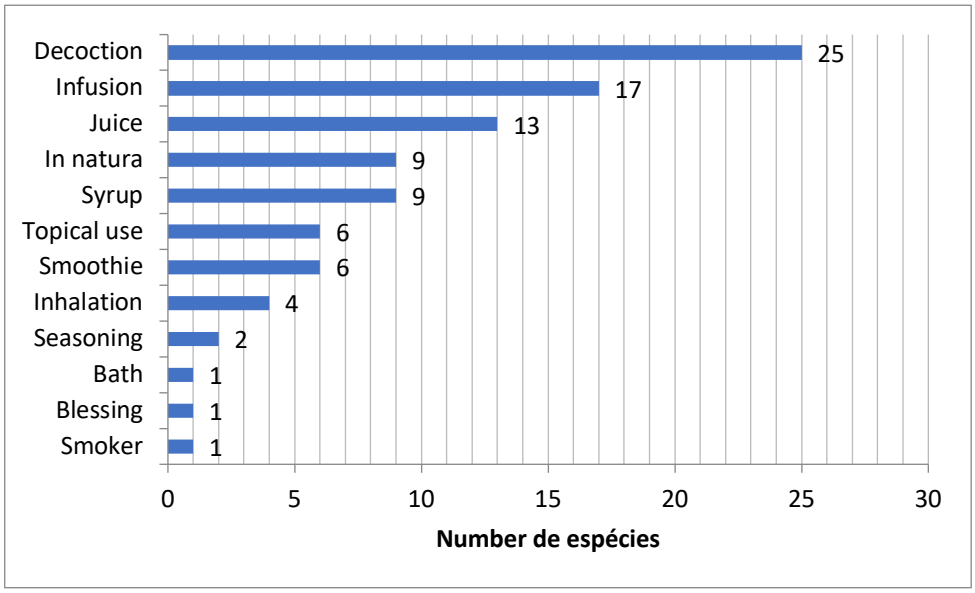

Figure 2. Methods of preparation of ethnospecies sold for medicinal use in the open market in the municipality of Oeiras, Piauí, Northeastern Brazil.
Source:Field Research.

In this context, there are smoothies and syrup, identified in this study for the treatment of problems in the genitourinary or respiratory systems. They are medicinal preparations constituted by the combination of several species and with the addition of alcohol or thickened with sugar, respectively. Another identification in this study is that syrup should be sweetened with honey, stored in a refrigerator and consumed daily, as prescribed. According to the interviewees' reports, orders are placed in advance and preparation requires caution and selection of components. The study by Agra (1996) in the region of Cariris Velhos/PE is highlighted, in which syrup was defined as homemade syrup, usually used to treat childhood illnesses, and smoothie, a type of alcoholate, commonly referenced to combat sexual dysfunctions.

The most mentioned plant parts for use in medicinal preparations were the leafs (30.2%), followed by the stem (22.3%) (Fig. 3).

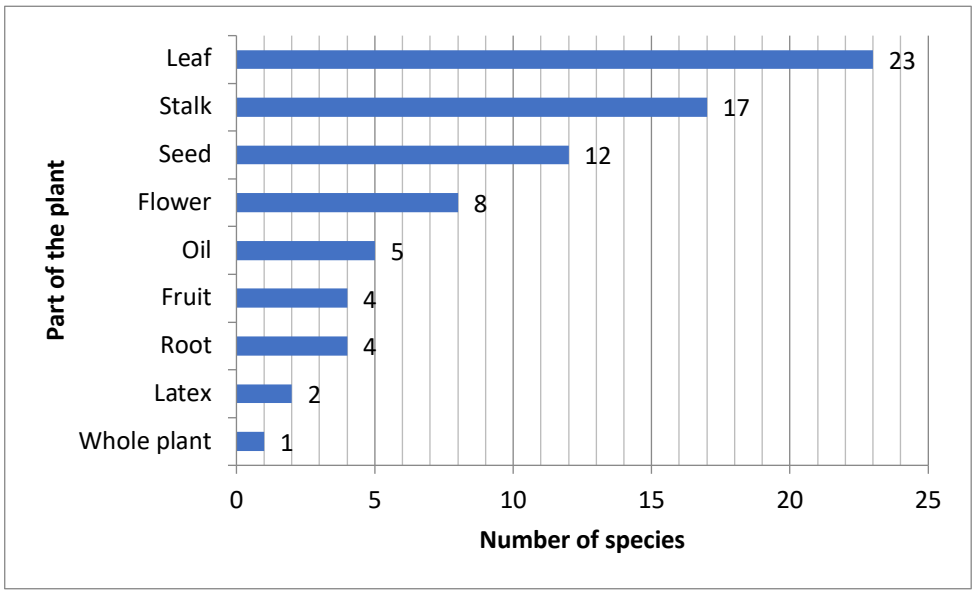

Figure 3. Vegetable parts sold for medicinal use in the municipality of Oeiras, Piauí, Northeastern Brazil.
Source: Field Research.

The leafs of **babosa** (*Aloe vera*) and the barks (stem) of the **imburana** (*Amburana cearensis*) were indicated to combat the flu, in the form of syrup and presenting an expectorant function. **Velaminho** (*Croton betaceus*), whose leafs are collected from the local vegetation, is sold by prior order, as, according to the interviewees, it must be used fresh and soon after removal from the natural environment, so as not to lose its therapeutic properties.

The **buchinha-paulista** (*Luffa operculata* Cogn.), mentioned by all the interviewees, is indicated for the treatment of the flu and, for this, it must be roasted and grounded to be administered by inhalation. Interviewees highlighted that the fruit contains a large concentration of active principle, which they designated as "offensive", requiring the use of only 25% of the fruit in each dose. Although they mentioned that "what is natural is not bad" (J., seller), 57.1% of respondents highlighted that pregnant woman cannot use it, because it is abortive and that use during pregnancy puts the life of the mother and the child at risk; in addition, aspiration can cause nasal bleeding. As transcribed below:

*"I don't like selling the **buchinha-paulista**. It's very mousy. It's used for the flu, but it's too strong. The woman takes it to abort when the husband does not want children. It is dangerous. If you take this medicine, it risks your life and the unborn child's life as well" (J., marketer).*

Respondents to this survey revealed that the prices of some plants or parts of them at the open-air fair in Oeiras fluctuate throughout the year, either due to a shortage in supply or an increase in demand, influenced by the drought. Price increases also occur in periods of the year when some diseases, especially those affecting the respiratory system, are more common, which increases demand and, as a result, there is a reduction in supply. However, there is no significant variation in prices between the stalls, but throughout the day, and this finding is similar to that shown by Delang (2005) in Sapa and Hanoi, Asia.

For all interviewees, the use of medicinal plants for the maintenance and restoration of health represents a situation of access to health quickly and effectively.

The concomitant use of allopathic medicines and medicinal plants was cited as something common by sellers. Parente and Rosa (2001) found that in Rio de Janeiro, the choice for the use of herbal medicines, over allopathic ones, occurs because the home remedies have a lower price, added to the belief that they are a natural treatment option and thus healthier. Contrary to the above, in research carried out in the city of Goiânia and neighboring cities, Tresvenzol *et al.* (2006) highlighted some factors that can put the health of consumers at risk when using plant species in therapy, such as: insufficient knowledge about commercialized plants, counterfeits, lack of quality control of plant material and the use of plant mixtures without considering the interactions between species.

Also, at the Oeiras open-air fair, the products are displayed outdoors or hanging on the sides and/or coverings of the stands. The transport and storage of the plant parts are done using plastic or straw deposits, the barks (stem) and leafs are regularly exposed to the sun, to prevent the proliferation of microorganisms.

In this scenario, in Oeiras, there is no regulation for the trade of medicinal plants in the open market, although the functions occupied by each person in the commercial activity have been informally defined. The system for registering sellers only made it possible for the municipal government to register the seller, in which it is specified the type of product to be sold. Once the space of equal size is assigned to all merchants, a monthly fee is paid for maintenance and cleaning of the place. In this way, everyone works on equal terms, characterizing themselves as small traders. There are no companies or service outsourcing, they make use of empathy with customers and the diversity of products offered.

The commercialization of medicinal plants in the open market in Oeiras involves several people: collectors, middlemen, sellers and consumers. Collectors are the individuals who collect plant species in the natural environment, selling them to middlemen and/or sellers. The middlemen, in turn, are people who acquire the species from the collectors and mediate the sale to the merchants, traveling to the open market. The purchase of medicinal plants by market traders is made in Oeiras/PI, Juazeiro/BA, Juazeiro/CE, Petrolina/PE, Santa Rosa/PI and Teresina/PI and the middlemen distribute them in several municipalities, with Oeiras being in this commercialization route. In addition to these shopping points, another purchase location is Picos/PI, but with a specificity, as sellers travel to purchase medicinal plants directly from collectors, people who collect plant material and/or local specialists.

When asked about the extraction of plants in the municipality and their use in commerce, market vendors claimed difficulty in accessing places where the species naturally occurs, such as stony and high-altitude plateaus; absence of middlemen to mediate and transfer plant material, following guidelines from local experts, and also difficulties in finding people who work for marketers in the sale of species. In a study in plateau areas in the city of Oeiras, Jenrich (1989) highlighted the uses associated with native tree and shrub species by the local population and the importance of their conservation for therapeutic uses.

Thus, it was recorded that in the marketing chain, the products traded at the Oeiras open market are purchased from middlemen, except for **imburana** (*Amburana cearensis*), **mussambê** (*Tarenaya spinosa*) and **fava-d'anta** (*Dimorphandra gardneriana*), that are collected by stallholders, similar to that shown by Linhares *et al.* (2014), who found in their study that the most common way to obtain the plants was through third parties (76%) and only 24% were cultivated and collected directly by sellers. Likewise, Santos *et al.* (2019) and Bastos *et al.* (2020), showed that the vegetable parts sold in the markets of Parnaíba and Teresina, respectively, are predominantly acquired from third parties.

From the dissimilarity analysis (Fig. 4), the formation of two groups with different characteristics was observed. The sellers of medicinal plants 2, 4, 5 and 6, aged 65, 72, 66 and 60 years old, respectively, constituted by the informants of the highest age group, form the group that referred the largest number of medicinal ethnospecies.

Informant 4 had a greater variety of citations, a fact that can be explained by the older age within the group. A second group, formed by data from informants 1, 3 and 7, younger, aged 50, 48 and 48, respectively, and with great similarity between the information recorded for 3 and 7, and a little less similar to the data cited by the informant 1 to the group.

Thus, the data showed a set of information about medicinal plants that are more disseminated or common (group of informants 2, 4, 5 and 6) in relation to another group whose data are more restricted (group of informants 1, 3 and 7) and that, in this same group, there was greater similarity between 3 and 7 in relation to 1, a fact that can be explained by the geographic origin, as it is the only informant who comes from another Northeastern state, different from the others, who were born in Piauí municipalities. The influence of age on the knowledge and uses of native plants in an area of Caatinga was identified by Arévalo-Marin *et al.* (2015), noting that older people know a greater number of species used in therapy than younger people.

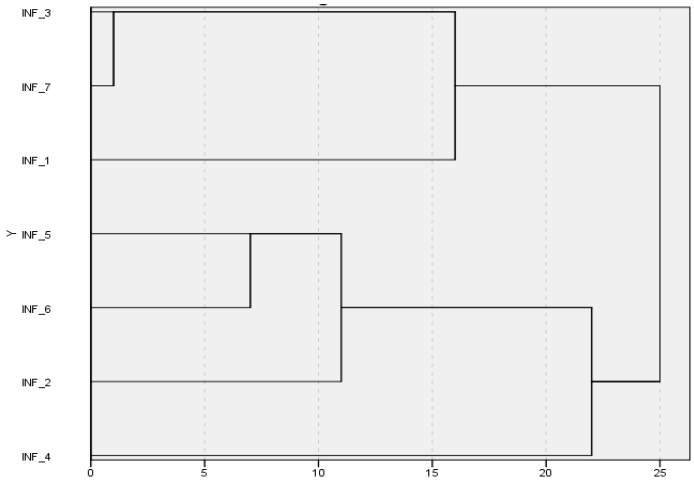

Figure 4. Dendrogram of grouping analysis of seven informants, from the open market in Oeiras/PI, obtained through quantitative analysis**. INF = Informant**
Source: Field Research.

Considering the body systems (Table 2), it is observed that there was significant agreement between the sellers, with regard to the indications for use for the treatment of skin diseases/related structures (mucosa) (ICF = 0.5) and sensory functions and pain (ICF = 0.5).

Table 2. Informant Consensus Factor (ICF) values registered among medicinal plant traders in Oeiras, Piauí, Northeastern Brazil. Abbreviation:NUR=the number of citations of uses in each subcategory; NT= number of species used in this subcategory. ICF= Informers' Consensus Factor

Body Systems	NUR	NT	**ICF**
Skin Functions and Related Structures	3	2	**0,50**
Functions of the cardiovascular, hematological, immune and respiratory systems	39	28	**0,29**
Digestive, metabolic and endocrine system functions	16	12	**0,27**
Genitourinary and reproductive functions	10	7	**0,33**
Mental functions	11	9	**0,20**
Sensory and pain functions	5	3	**0,50**

Source:Field Research.

The various uses listed for the cardiovascular and related systems are due to the great demand for blood purifying remedies to control blood pressure and inflammatory processes.

The rarefaction curve (Fig. 5), calculated for the set of citations based on the Shannon diversity index (H'), showed that the diversity of citations did not fluctuate much among the informants, varying in a spectrum of 0.5 to 1.5.

This variation reflects the diversity of the set of plants with medicinal indications sold, as also evidenced by Amorozo (2002) in Mato Grosso and by Pinto *et al.* (2006) in Bahia.

Final considerations

The open market in Oeiras, Piauí is an important space for (re)production and maintenance of the culture of use of medicinal plant species by the local population and neighboring cities, and for the treatment of physical and/or spiritual illnesses. The sale of medicinal plants is a commercial activity carried out by a small number of traders, which represents a risk of associated knowledge, due to the difficulty of inter-generational transfer. The activity requires planning by the government, in the sense of authorizing and inspecting phyto-sanitary conditions, so that it is safe and viable over time.

There was greater consensus between information for skin treatment, sensory functions and pain; tea is a prevalent form of preparation, and leafs are the most used plant part in medicinal preparations, followed by stems, which gives rise to concerns about the ways of extraction.

The open market is a space where medicinal plants from different origins converge and which, in addition to the economic importance for sellers, the commercialization of ethnospecies presents a relevant socio-environmental contribution to the population of the municipality of Oeiras/PI.

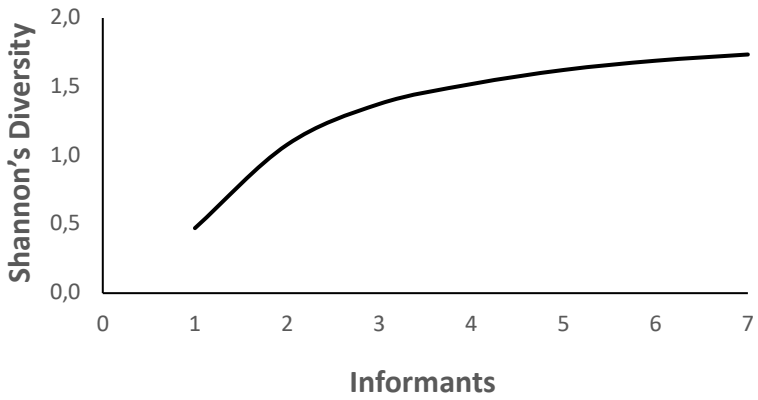

Figure 5. Rarefaction curve calculated from the Shannon-Wiener diversity index for the plants mentioned.
Source: Field Research.

Declarations

List of abbreviations: CEP: Ethics and Research Committee; TEPB: Herbarium Graziela Barroso; SISGEN: National System of Genetic Heritage and Traditional Knowledge Management Associate; UFPI: Federal University of Piauí.
Approval and consent to participate: The work was initially presented to the local municipal authority to inform the research intentions. Subsequently, the project was submitted and approved by the Ethics and Research Committee of the Federal University of Piauí, through the process number 886195 and also registered in the National System of Genetic Heritage and Traditional Knowledge Management Associate under the number A7B0C2B. Subsequently, we proceeded with the explanation about the research objectives and its stages for the fair sellers.
Consent for publication: Not applicable.
Availability of data and material: Data were transcribed and analyzed at the Herbarium Graziela Barroso at the Federal University of Piauí.
Competing interests: The authors declared no conflicting interests.
Funding: We declare that we received financial support only for the translation of the article text of the Graduate Support Program.
Author's contributions: FCSO carried out fieldwork, data analysis and drafted the manuscript. FJV, ANA and RFMB configured the research project, supervised the work, and improved the manuscript. All the authors read, reviewed, and approved the final version of the manuscript.

Acknowledgments

To the traders of medicinal plants at the open market in Oeiras/PI, for sharing stories and knowledge.

Literature cited

Agra, MF. 1996. Plantas da medicina popular dos Cariris Velhos, Paraíba, Brasil: espécies mais comuns. 1. ed. Editora União, Recife, BR.

Albuquerque UP, Cruz LVF, Lucena, RFP, Alves, RRN. 2014. Methods and techniques used to collect ethnobiological. In: Albuquerque UP, Cunha LVFC, Lucena RFP. (Eds.). Methods and techniques in ethnobiology and ethnoecology, New York: Springer Science, p. 15-37, EUA.

Albuquerque UPA. 2005. Introdução à etnobotânica. 2. ed. Interciência, Rio de Janeiro, BR.

Alves CAB, Silva S, Belarmino NALA, Souza RS, Silva DR, Alves PRR, Nunes GM. 2016. Comercialização de plantas medicinais: um estudo etnobotânico na feira livre de Guarabira, Pernambuco, Nordeste do Brasil. Gaia Scientia 10:390-407.

Alves Filho FC, Cavalcanti PMS, Passaglia RCAT, Ballejo G. 2015. Extrato de *Combretum leprosum* causa relaxamento dependente de endotélio de longa duração em artérias isoladas. Einstein 13:395-403.

Amadu A, Sanchez AC. 2014. Medicinal plant trade in Sierra Leone: threats and opportunities for conservation. EconomicBotany68:16-29.

Amorozo MCM. 1996. A abordagem etnobotânica da pesquisa de plantas medicinais. In: Di Stasi LC Plantas medicinais:arte e ciência. Um guia de estudo interdisciplinar. São Paulo: Unesp, p. 47-68.

Amorozo MCM. 2002. Uso e diversidade de plantas medicinais em Santo Antônio do Leverger, MT, Brasil. Acta Botanica Brasilica 16:189-203.

Anvisa. 2014. Agência Nacional de Vigilância Sanitária. Instrução Normativa n. 2, de 13 de maio de 2014. Publica a "lista de medicamentos fitoterápicos de registro simplificado" e a "lista de produtos tradicionais fitoterápicos de registro simplificado", 2014. Available at: www.anvisa.gov.br(acessed on: 20/02/2020).

APG IV. 2016. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnean Society 181:1-20.

Araújo CRF, Oliveira JOD, Resende JC, Bezerra MGP, Costa EP, Coutinho MS. 2014. Raizeiros e raizeiras enquanto multiplicadores do conhecimento popular: um resgate da literatura. Revista Saúde e Ciência OnLine 3:34-42.

Araújo IFM, Souza LF, Guarçon EAE, Firmo WCA. 2015. O comércio de plantas com propriedades medicinais na cidade de Bacabal, Maranhão, Brasil. Natureza OnLine 13:111-116.

Arenas PM, Doumecq MB, Puentes JP, Hurrell JA. 2015. Algas y plantas comercializadas como adelgazantes en el área metropolitana de Buenos Aires, Argentina. Gaia Scientia9:32-40.

Arévalo-Marín E, Lima J, Palma A, Lucena R, Cruz D. 2015. Traditional knowledge in a rural community in the semi-arid region of Brazil. Ethnobotany Research & Applications 14:331-344.

Ayres M, Ayres Júnior M, Ayres DL, Santos AD. 2007. Bioestat 5.0 - Aplicações estatísticas nas áreas das ciências biomédicas. Belém:ONG, Mamirauá, BR.

Bastos EM, Schiavetti A, Monteiro JM, Barros RFM. 2020. Características sociodemográficas dos permissionários de produtos da sociobiodiversidade em mercados públicos do nordeste brasileiro. Brazilian Journal of Development 6:19553-19574.

Bernard HR. 2006. Research methods in cultural anthropology. Newbury Park:SAGE Publication, EUA.

Bochner RI, Fiszon JT, Assis MA, Avelar KES. 2012. Problemas associados ao uso de plantas medicinais comercializadas no Mercadão de Madureira, município do Rio de Janeiro, Brasil. Revista Brasileira de Plantas Medicinais 14:537-547.

Brasil. 2009. Ministério da Saúde. Renisus:relação nacional de plantas medicinais de Interesse ao SUS. Espécies vegetais. DAF/SCTIE/MS - RENISUS - 2009. Available at: http://portal.saude.gov.br/portal/arquivos/pdf/RENISUS.pdf (accessed on:12/01/2018).

Bussmann RW, Paniagua-Zambrana NY, Moya Huanca AL. 2015. Dangerous Confusion - "Cola de Caballo" — Horsetail, in the Markets of La Paz, Bolivia. Economy Botanic 69:89-93.

Canuto KM. 2008. Aspectos Químicos do Estudo Interdisciplinar (Química-Agronomia Farmacologia) de *Amburana cearensis* A.C. Smith. 313f. Tese (Doutorado em Química Orgânica) - Universidade Federal do Ceará, Fortaleza.

Carvalheiro EM. 2010. A construção social de mercados para os produtos da agroindústria familiar. 215f. Tese (Doutorado em Desenvolvimento Rural) - Faculdade de Ciências Econômicas, Universidade Federal do Rio Grande do Sul, Porto Alegre.

Chaves EMF, Chaves EBF, Coelho-de-Souza G, Figueiredo LS, Barros RFM, Kubo R. 2014. Um olhar sobre *Ximenia americana* L. e suas potencialidades. Acta Tecnológica9:70-77.

Cheng Z, Hang Shu H, Zhang S, Luo B, Gu R, Zhang R, Ji Y, Li F, Long C. 2020. From Folk Taxonomy to Species Confirmation of Acorus (Acoraceae): evidence based on phylogenetic and metabolomic analyses. Frontiers in Plant Science 24:1-10

Conceição GM, Ruggieri AC, Araújo MFV, Conceição TMM, Conceição MAMM. 2011. Plantas do cerrado: comercialização, uso e indicação terapêutica fornecida pelos raizeiros e vendedores, Teresina, Piauí. Scientia Plena7:1-6.

Costa Lima PG, Coelho-Ferreira M, Santos RS. 2014. A floresta na feira: plantas medicinais do município de Itaituba, Pará, Brasil. Fragmentos de Cultura 24:285-301.

Cotton CM. 1996. Ethnobotany: principles and applications. New York: J. Wiley, EUA.

Dantas CFN, Ferreira RS. 2013. Os conhecimentos tradicionais dos (as) erveiros (as) da Feira do Ver-o-Peso (Belém, Pará, Brasil):um olhar sob a ótica da ciência da informação. Perspectivas em Ciência da Informação 18:105-125.

Delang CO. 2005. The market for medicinal plants in Sapa and Hanoi, Vietnam. Economic Botany 59:377-385.

Emperaire L. 1989.Vegetation et gestion des resources naturelles dans la caatinga du su-est du Piauí (Brésil). 319f. Tese (Doutoratd'Etat ès Sciences Naturalles) - Universitè Pierre et Marie Curie, Paris.

Ferreira Júnior WS. 2015. Seleção de plantas medicinais: um estudo sobre a estrutura e funcionalidade de sistemas médicos locais. 122f. Tese (Doutorado em Botânica) - Universidade Federal Rural de Pernambuco, Departamento de Biologia, Recife.

Flora do Brasil 2020. Jardim Botânico do Rio de Janeiro. Available at: http://floradobrasil.jbrj.gov.br/ (accessed on: 03/02/2020).

Freitas AVL, Coelho MFB, Azevedo RAB, Maia SSS. 2012. Os erveiros e a comercialização de plantas medicinais em São Miguel, Rio Grande do Norte, Brasil. Revista Brasileira de Biociências 10:147-156.

Freitas F. 1984. Oeiras: sinopse histórica. Revista do Instituto Histórico e Geográfico de Oeiras 8:73-74.

Friedman J, Yaniv Z, Dafni A, Palewitch D. 1986. A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of ethnopharmacological field survey among bedouins in the Negev desert, Israel. Journal of Ethnopharmacology 16:275-287.

Hanazaki N, Tamashiro JY, Leitão Filho HF, Begossi A. 2000. Diversity of plant use in two caiçara communities from the atlantic Forest Coast, Brazil. Biodiversity and Conservation 9:597-615.

Ibge. 2010. Instituto Brasileiro de Geografia e Estatística. (2010). *Cidades.* 2010. Available at http://cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=220700&search=piaui/oeiras (accessed on 25/01/2015).

Jenrich H. 1989.Vegetação arbórea e arbustiva nos altiplanos das chapadas do Piauí Central: características, ocorrência, empregos. 1. ed. Eschborn: BMZ/GTZ, BR.

Kool M, Fierens K, Lambrecht BN. 2012. Alum adjuvant: some of the tricks of the oldest adjuvant. Journal of Medical Microbiology61:927-934.

Linhares JFP, Hortegal EV, Rodrigues MIA, Silva PSS. 2014. Ethnobotany of the main medicinal plants commercialized in fairs and markets of São Luis, Maranhão State, Brazil. Revista Pan-Amazônica de Saúde 5:39-46.

Lorenzi H, Matos FJA.2002. Plantas medicinais do Brasil: nativas e exóticas cultivadas. Nova Odessa: Instituto Plantarum, BR.

Magurran A E .1989. Diversidad ecológica y su medición. Barcelona: Edições Vedra, ES.

Martin GL. 1995. Ethnobotany. A people and plants conservation manual. London: Chapman & Hall, GB.

Martinelli G, Messina T, Santos Filho L. 2013. (Eds.). *Livro vermelho da flora do Brasil-Plantas raras do Cerrado*. Trad. Anderson F.& Hieatt C. ed. Rio de Janeiro: Andrea Jackson Instituto de Pesquisas Jardim Botânico, BR.

Mattos AA, Morais RB, Sampaio JB, Lacerda GA, Ramos DMB, Carreiro DL. 2015. Levantamento de plantas medicinais comercializadas por raizeiros do mercado municipal central de Montes Claros-MG. Revista Brasileira de Pesquisa em Ciências da Saúde 2:11-17.

Medeiros MFT, Andreata RHP, Valle LS. 2010. Identificação de termos oitocentistas relacionados às plantas medicinais usadas no Mosteiro de São Bento do Rio de Janeiro, Brasil. Acta Botanica Brasilica 24:780-789.

Mobot. 2021.Tropicos. Available at: http://www.tropicos.org (accessed on:04/01/2021).

Monteiro JM, Ramos MA, Araújo EL, Amorim ELC, Albuquerque UP. 2010a. Local markets and medicinal plant commerce: a review with emphasis on Brazil. EconomicBotany64:352-366.

Monteiro JM, Ramos MA, Araújo EL, Amorim ELC, Albuquerque UP. 2010b. Dynamics of medicinal plants knowledge and commerce in an urban ecosystem (Pernambuco, Northeast Brazil). Environmental Monitoring and Assessment 178:179-202.

Morais SAL, Nascimento, EA, Queiroz CRAA, Piló-Velloso D, Drumond MG. 1999. Studies on polyphenols and lignina of *Astronium urundeva* wood. Journal of the Brazilian Chemical Society 10:447-452.

Moro MF, Souza VC, Oliveira-Filho AT, Queiroz LP, Fraga CN, Rodal MJN, Araújo FS, Martins FR. 2012. Alienígenas na sala: o que fazer com espécies exóticas em trabalhos de taxonomia, florística e fitossociologia? Acta Botanica Brasilica 26:991-999.

Moura C. 1986. Oeiras e seu instituto histórico. Revista do Instituto Histórico e Geográfico de Oeiras8:91-94.

Oliveira FCS, Barros RFM, Moita Neto JM. 2010. Plantas medicinais utilizadas em comunidades rurais de Oeiras, semiárido piauiense. Revista Brasileira de Plantas Medicinais12:282-301.

Oliveira FCS, Barros RFM. 2018. Aspectos sociodemográficos dos comerciantes de plantas medicinais da feira de Oeiras, Piauí. Educação Ambiental em Ação 63:1-12.

Parente CET, Rosa MMT. 2001. Plantas comercializadas como medicinais no município Barra do Piraí, RJ. Rodriguésia 52:47-59.

Pasa MC, Soares JJ, Guarim-Neto G. 2005. Estudo etnobotânico na comunidade de Conceição-Açu (Alto da Bacia do rio Aricá Açu, MT, Brasil). Acta Botanica Brasilica 19:195-207.

Pieroni A, Vandebroek I. 2007.Traveling cultures and plants: the ethnobiology and ethnopharmacy of migrations. Studies in environmental anthropology and ethnobiology.7. ed. Berghahn Books, EUA.

Pimente JVF, Guerra HOC. 2015. Crescimento inicial de *Amburana cearensis* (Allem. A. C. Smith) em sistema agroflorestal no semiárido brasileiro. Ciência Florestal25:771-780.

Pinto EPP, Amorozo MCM, Furlan A. 2006. Conhecimento popular sobre plantas medicinais em comunidades rurais de mata atlântica - Itacaré, BA, Brasil. Acta Botanica Brasilica 20:751-762.

Polat R, Cakilcioglub U, Satilc F. 2013. Traditional uses of medicinal plants in Solhan (Bingöl-Turkey) 148:951-963.

Rocha F, Araújo L, Lima T, Silva E, Silva P, Gundim M, Araújo M, Leão-Costa N. 2013. Características do comércio informal de plantas medicinais no município de Lagoa Nova/RN. Holos 5:264-281.

Rocha FAG. 2015. Diagnóstico da comercialização de produtos da medicina popular em feiras livres do semiárido do Rio Grande do Norte: avaliações socioeconômicas e sanitárias, com proposta de legislação específica. 237f. Tese (Doutorado - Área de Concentração Desenvolvimento e Meio Ambiente) - Universidade Federal do Rio Grande do Norte, Natal.

Roque AA, Rocha RM, Loiola MIB. 2010. Uso e diversidade de plantas medicinais da Caatinga na comunidade rural de Laginhas, município de Caicó, Rio Grande do Norte (nordeste do Brasil). Revista Brasileira de Plantas Medicinais12:31-42.

Santana AEG. 2006. Olacaceae. In: Lucchese, AM (Ed.). Instituto do Milênio do Semi-árido. Plantas da Caatinga: perfil botânico, fitoquímica e atividade biológica. Associação de Plantas do Nordeste 4:377-379.

Santos A, Dutra K, Dutra M, Silva F, Maranhão C, Navarro D, Frutuoso M, Brandão, S. 2015. Plantas medicinais comercializadas em mercados públicos de Casa Amarela, Recife, Pernambuco: influência do modo de conservação na composição do óleo essencial. Holos1:36-48.

Santos MHB, Farias JC, Vieira IR, Barros RFM. 2020. Tratando doenças da alma: etnobotânica urbana. Revista Etnobiologia 18:3-23.

Santos MHB. 2020.Mercados públicos municipais de Parnaíba como difusores etnobotânicos no Piauí. 157f. Dissertação (Mestrado - Área de Concentração Desenvolvimento e Meio Ambiente) - Universidade Federal do Piauí.

Santos MV, Vieira IR, Silva, MFS, Andrade, IM. 2019. Comercialização de plantas medicinais nos mercados públicos do município de Parnaíba, Piauí, Brasil. Espacios 40:1-13.

Santos RL, Nobre MSC, Guimarães GP, Dantas TB, Vieira KVM, Felismino DC. 2013. Contaminação fúngica de plantas medicinais utilizadas em chás. Revista de Ciências Farmacêutica Básica e Aplicada 34:289-293.

Silva CG, Marinho MGV, Lucena MFA, Costa JGM. 2015. Levantamento etnobotânico de plantas medicinais em área de Caatinga na comunidade do Sítio Nazaré, município de Milagres, Ceará, Brasil. Revista Brasileira de Plantas Medicinais17:133-142.

Silva JHC, Ferreira RS, Pereira EP, Braga-de-Souza S, Almeida MMA, Santos CC, Butt AM, Caiazzo E, Capasso R, Silva VDA, Costa SL. 2020. *Amburana cearensis*: pharmacological and neuroprotective effects of its compounds. Molecules 25:3394-3410.

Soares S. 1973. Enciclopédia dos municípios piauienses. 1. ed. Fortaleza: Escola Gráfica Santo Antônio, BR.

Soldati GT, Duque-Brasil R, Silva TC, Coelho FMG, Albuquerque UP. 2011. Conhecimento botânico e representações ambientais em uma comunidade rural no Domínio Atlântico: bases para conservação local. Sitientibus Série Ciências Biológicas11:265-278.

Soldati GT. 2013. Transmissão de conhecimento: origem social das informações e evolução cultural. In: Albuquerque UP. (Orgs.) Etnobiologia: bases ecológicas e evolutivas. Recife, PE: NUPEEA, p. 37-61, BR.

Tresvenzol LM, Paula JR, Ricardo AF, Ferreira HD, Zatta DT. 2006. Estudo sobre o comércio informal de plantas medicinais em Goiânia e cidades vizinhas. Revista Eletrônica de Farmácia3:23-28.

Viana GSB, Bandeira MAM, Matos FJA. 2003. Analgesic and anti-inflammatory effects of chalcones isolated from *Myracrodruon urundeuva* Fr All. Phytoterapy Research 10:189-195.

Woff LF, Nascimento MPSB, Oliveira ME. 2008. Conhecimento popular no uso das plantas. In: Nascimento MPSB. (Org.). Plantas do semi-árido: conhecimentos e usos no assentamento Marrecas. Teresina: Embrapa Meio-Norte, BR.