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Ethnobotanical inventory of medicinal plants used by specialists in the treatment and cure of diseases in riverside communities in the amazon

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Abstract
The research aimed to learn about the socioeconomic profile and medicinal plants used by local specialists from three riverside communities in the municipality of Porto de Moz, Pará, Brazil. The data was collected with 10 specialists through a semi-structured questionnaire. Local specialists are mostly women (80%), with low income and a low education level. 83 medicinal ethnospecies were identified. The Lamiaceae and Fabaceae families were the most representative in the study area with 9 and 10 species, respectively. The *Dysphania ambrosioides* (18%) species was the most referenced one. Most of the recommendations regarding use of the medication are related to unclassified signs and symptoms, with 48 references. The young members in the communities exhibit low interest in medicinal plants. The precariousness of local public health services enhances the use of medicinal plants. The medicinal knowledge of local specialists assists in the prevention, treatment and cure of illnesses based on traditional medicine empiricism.

Keywords: health, traditional medicine, traditional people, phytotherapy, forest

Introduction
For millennia, humans have used medicinal plants or concoctions of them for prevention, treatment and cure of diseases [1]. Populations, through their healers and through autonomous use, accumulated experiences and vast knowledge regarding medicinal plants [2]. This knowledge proved to be safe and effective enough to treat/cure several illnesses faced by those who constructed it. However, scientific and technologic advancements incorporated to medicine over the last few decades have led to widespread discredit of other practices and knowledge considered to be traditional [3]. Although modern medicine is highly developed across most parts of the world, use of medicinal plants by ethnic groups and communities is still very common. For these social groups, many times, plants symbolize the only option to cure their pathologies. Factors such as effectiveness, accessibility and low cost contribute to the use of medicinal plants [4]. It is found that about 85% of developing countries' populations use medicinal plants or concoctions of them for their basic healthcare [5]. Thus, comprehending the perceptions of people regarding the benefits arising from the use of medicinal plants may provide important adventitious ideas about human-plants interaction. This, in turn, may contribute toward the identification of useful species capable of interfering in the health-disease process of family units.
In Brazil, the practice of using medicinal plants is very ancient, originating in indigenous culture, later compounded by African and European culture [6]. This tradition of domestic and community use of medicinal plant was perpetuated until current times through oral, intergenerational transmission throughout different communities. As a result of this intercultural fusion, traditional pharmacopeia was born, based on medicinal plants native, with the introduction of exotic species by colonizers and slaves. Currently, this traditional pharmacopeia, used by traditional people and communities across the Brazilian territory, congregates theoretical and practical knowledge and beliefs involving health, disease, social actors, plants and medicinal animals [7]. Amorozo [8] observes that traditional pharmacopeia is, thus, a dynamics process, through which both acquisition and loss of species may occur.

In the Amazon, indigenous peoples actively participate in the elaboration of the Amazon pharmacopeia, followed by riverside communities, fishermen, extractivist people and quilombolas. In turn, these social groups developed a vast knowledge regarding the useful or harmful properties of plants, especially riverside communities, who possess practical knowledge regarding local flora and fauna which they use to their advantage [9]. Within these communities, specialists stand out, as they are capable of identifying medicinal plants, collecting the medicinal parts of plants, diagnosing diseases, preparing and storing medication, as well as prescribing homemade medicine. In spite of this, few studies have investigated these local specialists' knowledge regarding the use of medicinal plants. In these circumstances, it seems assertive to prospect ethnobotanical information from the knowledge of these local specialists. Indeed, ethnobotany focuses on the direct inter-relation between people and plants, including all forms of perception and appropriation of plant resources [10]. Furthermore, ethnobotanical approaches may provide important answers both to problems of biological conservation and to issues pertaining to local development [11]. It also facilitates the selection of indicated species based on local knowledge, focused on their application within their health-disease systems [10]. In this sense, comprehending the knowledge of local specialists is very useful as a strategic source of "hints" regarding the effectiveness or toxicity of medicinal plants.

Based on these premises, the research aimed to learn about the socioeconomic profile and medicinal plants used by local specialists of three riverside communities in the municipality of Porto de Moz, Pará, Brazil. Additionally, it is expected that this study may serve as a subsidy for carrying out studies in a detailed scale, in the context of the Resex Verde para Sempre communities. Finally, sensitize health workers and managers to structure phytotherapy projects, focused on primary attention to family health in the municipality of Porto de Moz.

Material and Methods

Characterization of the study area

The municipality of Porto de Moz is part of the Low Amazon mesoregion and is situated within the Almeirim microregion, in the state of Pará, Brazil (Figure 1). The surface area is of 17,423.017 km^{2,} corresponding to approximately 1.4% of the state of Pará. The municipality's population is estimated at 41,801 inhabitants, with 45% of the population settled in urban areas and 55% in rural areas [12].

Porto de Moz has an Am equatorial climate, with an average temperature of 26 ºC and rainfalls of 1969 mm/year. The Xingu River is the main access way of the local population to the urban centers of the states of Pará and Amapá. The natural landscape is predominantly composed of Dense Ombrophilous Forest. In the municipality, the dominant soil is of sedimentary origin, represented, mainly, by the Oxisol and Argisol classes, which occupy, respectively, 50% and 18% of the total area [13].

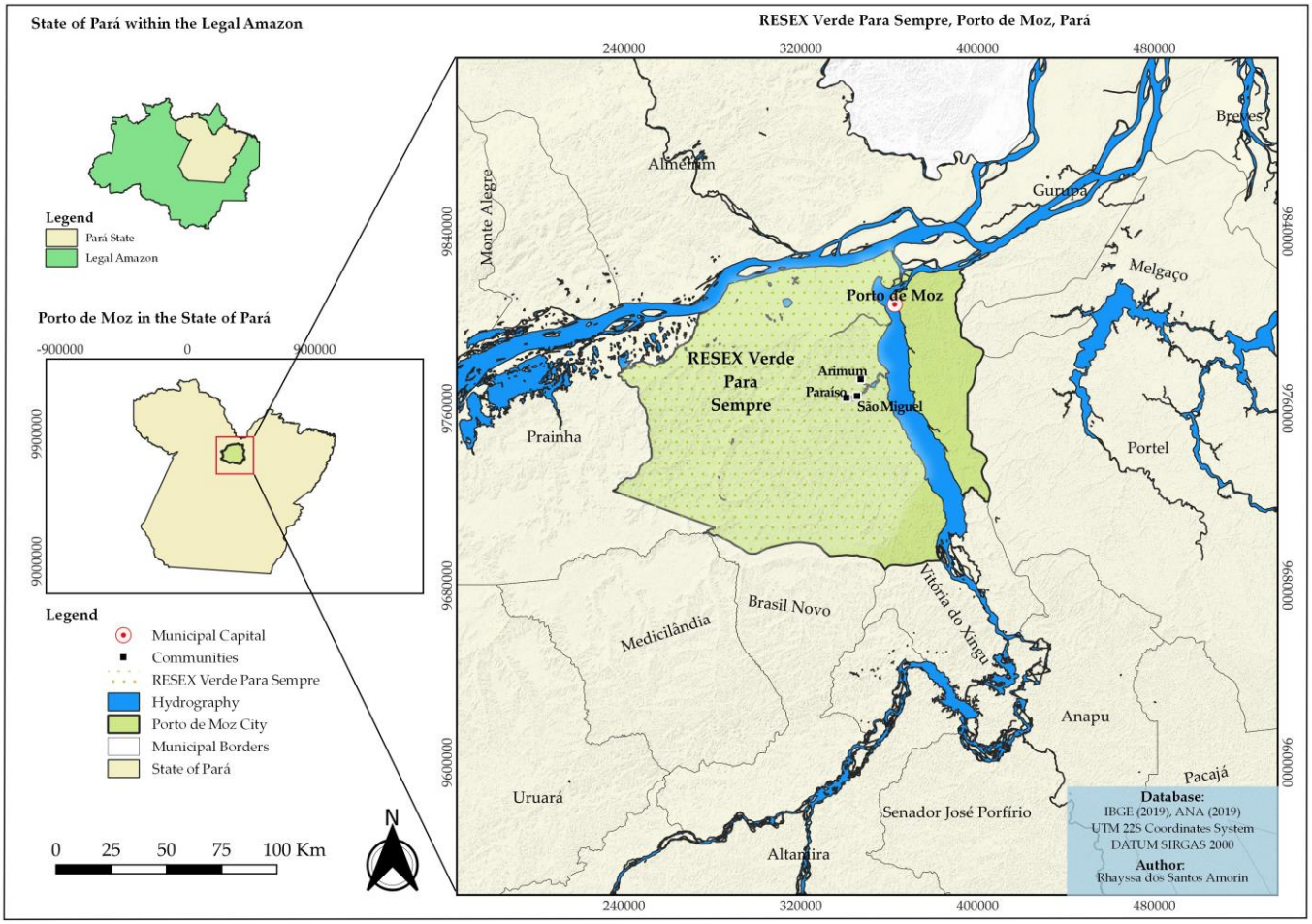

Fig 1: Study area in the Verde para Sempre Extractivist Reserve, Municipality of Porto de Moz, Pará, Brazil.

The population of the municipality of Porto de Moz is formed basically by riverside dwellers. The main economic activities in the municipality are: farming and services provision. Another rapidly growing economic activity is tourism, with attractions such as beaches, seaside resorts, lakes and ecological tours in the forest.

In the municipality of Porto de Moz is the largest extractive reserve (Resex) for sustainable use in Brazil, named Verde para Sempre, created by Federal decree on November 8, 2004 (Figure 1). It has an area of around 12,958 km^2, equivalent to 74% of the municipality's total area. Resex Verde para Sempre has around 10,000 inhabitants, distributed over 58 communities and 31 localities, concentrated irregularly among the floodplain and dry land environments[13].

In this work, three dry land communities were chosen (Figure 1): the Perpétuo Socorro Community from the Arimum river (henceforth Arimum), São Miguel and Paraíso, with 60, 90 and 40 families, respectively. Subsistence agriculture, artisanal fishing and small animal husbandry are the basis of these communities' support and survival. The agricultural production system of these communities is characterized by not being diversified, exhibiting a low technological level and being made possible through family labor in small properties. Another rising activity that has contributed to work generation and local income is Community Forest Management. This activity makes rational use of forest resources in a small scale, in line with environmental conservation. Other sources such as retirement, Bolsa Família (social welfare program) and unemployment insurance have contributed toward increasing the income of the families in these rural communities.

The São Miguel community has a Basic Health Unit (UBS) and a health agent who sees to other communities. Additionally, it was observed that the Paraíso community has an elementary school that sees to other communities. As is the case with most municipalities in the state of Pará, there is no basic sanitation. Water is obtained directly from the river or from wells for the purposes of hygiene and consumption (boiled or with added hypoclorite). Electric energy is obtained through solar panels (data collected by the author).

Methodological procedures

This is a qualitative, exploratory and descriptive study. The study was assessed by the Biodiversity Information Authorization System (SISBio), who granted authorization to carry out the research in Resex Verde para Sempre (nº 75047-1). The research was approved by the Ethics Committee of the Health Science Institute of the Federal University of Pará (CAAE 47237721.9.0000.0018). All the people who participated in the research signed the Free and Informed Consent Term (FICT), which guaranteed the anonymity of the information.

The criteria for eligibility for this primary sample included: age ≥ 30 years for the interviewee, with a time of residence ≥ 20 years and who is a local specialist recognized by the community. The selection of informants was made through a snowball technique [14]. 10 medicinal plant specialists were selected. Due to the reduced number of constituent elements in the universe being studied, sampling was intentionally non-random [15].

Data collection

The data was collected from January to March 2020. The collection consisted of semi-structured interviews with local specialists. The interviews were carried out individually in the residence of each interviewee. The standardized forms were composed of the following elements: socioeconomic profile (place of birth, sex, age, religion, education level, occupation, income and time of residence) and questions regarding the plant resources used. Guided tours were carried out, aided additionally by a field diary and direct observation [15]. The species were identified based on comparisons with specimens deposited in the MG Herbarium of the Emílio Goeldi Pará Museum. We also consulted specialized literature and, when necessary, consulted specialists. The spelling of the scientific names was verified using the Tropicos database, available at http://www.tropicos.org. For taxa listing, we followed Angiosperm Phylogeny Group III [16]. For each referenced species, we registered the popular name, its origin, its habit, provenance, part used, form of preparation and recommended use.

Data analysis

The data was analyzed in a qualitative manner, using the program Microsoft *Excel*® 2010. The synthesis of the information obtained in the interviews is disposed in tables and graphs. The diseases and symptoms mentioned by local specialists were categorized according to the International Classification of Diseased and health-related problems (ICD-10).

Results and Discussion

Socioeconomic profile of the local specialists

Regarding the specialists' place of birth, it was observed that 60% of them are from Porto de Moz. Another 40% came from other cities in the state of Pará, such as Portel, Altamira, Monte Alegre and Santarém. This data reveals the strong cabocla influence on medicinal plant knowledge, passed down from generation to generation.

Women represent 80% of the investigated sample. Evidence of the intense feminization in the practice of traditional medicine is very common in many ethnobotanical studies [17, 18]. Feminine predominance is due to the sexual division of labor that occurs in the rural environment [19]. This is because traditional communities are quintessentially divided in these two groups, with their own distribution of rights and duties, their own forms of coexistence, their own authority systems and their own internal institutional framework [19]. Thus, the men in the communities are connected to the activities of wood extraction, residence building, opening farms, fishing and hunting. Within this logic of sexual division of labor, women are responsible for several domestic and extra-domestic activities, as observed in other works in academic literature [20, 21]. Among these domestic activities is the task of caring for the family's health. As a result, the woman concentrates a lot of traditional knowledge, with a wide domain of the repertoires of medical complaints and associated cure practices (Praça e Gualda, 2000). As such, the woman manipulates, preserves and disseminates the curative potential of medicinal plants, becoming a reference in the field of family and community care [17]. In this way, the woman, even with all her other attributions, also takes on her historical role as provider of family healthcare, which reduces free time and has implications on social life [22].

The age of the local specialists varied between 38 and 81 years, with an average age of 54.3 years (standard deviation ±14.42). This is an important factor regarding accumulated knowledge of therapeutic plant use, as, in this context, advanced age may indicate greater experience with regards to the benefits of homemade medicine [23]. As such, the implementation of educational practices that disseminate knowledge, centered on the elderly, are welcome, with the goal of avoiding the erosion of this knowledge. Other research identified the elderly as those who detain greater knowledge related to the therapeutic properties of medicinal plants [17, 21, 24].

60% of local specialists are Catholic, concentrated in the Arimum river and São Miguel communities. Another 20% are declared Evangelicals and live in Paraíso community, and 20% did not reply. These results diverge from those reported on a national scale (32% Evangelicals and 50% Catholics) [25]. The predominance of Catholicism is a historical inheritance of the old "settlers", who were knowledgeable regarding plants in Brazil and were followers of the Catholic faith [26]. However, in the context of the Amazon, there is an effective rise of the Evangelical religion in many of the communities, which has weakened Catholic churches in the region and caused many conflicts and divisions in the community sphere [9]. In any case, there is a connection between traditional medicine knowledge regarding the use of medicinal plants and religious beliefs [27]. Two local Evangelical specialists claimed they do not use nor recommend homemade medicine in the form of tinctures and also do not believe in the magical-religious power of plants.

This study also points to the fact that the degree of education of local specialists is low. It was observed that 30% of local specialists are illiterate, 40% have not concluded elementary school and 30%

have not completed high school. The age group between the infancy and adolescence of these specialists calls back to times in which access to formal education was more difficult, and people from low income families were faced with the imperious necessity of contributing toward the domestic budget or, sometimes, with the necessity of ensuring their own subsistence. This situation of premature transformation of children into adults and their subsequent incorporation into the universe of work denied them the right to an educational and professional training that afforded them better opportunities for insertion into society [28]. For the female sex, access to education was more restrictive due to the impediment imposed by parents [18]. In this study, educational level was not an influencing factor in the use of medicinal plants, as the different specialists demonstrated similar knowledge, both regarding use and treatment. However, other studies have indicated that the lower the level of education, the more intense the use and knowledge regarding medicinal species [24].

The specialists are considered to be of low income, as their monthly income varies between 1 and 1.5 minimum wages. This income includes the citizen benefits offered by the Federal Government (Bolsa Família, rural retirement and unemployment insurance), the sale of forest products (*andiroba* and *copaiba* resin-oil), flour and fish. Thus, it is observed that their income is not enough to ensure food security or quality healthcare and education.

The time of residence interval among the interviewees varied between 20 and 57 years, with an average time of residence in the location of 35.6 years (standard deviation ±13.69). This average reflects a considerable time of residence in the same location, which contributes toward greater knowledge regarding the local flora. Ming [29], when studying the time of residence of the inhabitants of the Chico Mendes Extractivist Reserve, observed that the fact that the inhabitants lived for more years in the communities reflected a greater knowledge regarding regional flora. In summation, the time of residence in a given location is an important factor for the creation of a popular identity connected to the place in question, in this case a stronger connection regarding the forest and its waters.

Diversity of the medicinal species referenced in the Resex communities

83 ethnospecies were identified, belonging to 74 genera and 39 families, as displayed in Table 1.

Table 1: Use of plant resources by specialists of the Arimum, São Miguel and Paraíso Communities, Resex Verde para Sempre, Brazilian Amazon.

Family/species	Ethnospecies	O	H	P	UP	FP	Recommended use
Acanthaceae							
Justicia calycina (Nees) V.A.W. Graham	Sara-tudo	N	bus	cult	Le	in	Inflammation
Adosyceae							
Sambucus nigra L.	Sabugueiro	E	bus	cult	le, fl	in	Measles, chicken pox and e dengue
Amaranthaceae							
Hebanthe eriantha (Poir.) Pedersen	Paratudo	N	sub	cult	ba, ro	dc	Tiredness, stress, stomach pain, anemia, low immunity
Dysphania ambrosioides (L.) Mosyakin & Clemants	Mastruz	N	herb	cult	Le	ju, in	Flu, bronchitis, asthma, expectorant, cough, bone fracture, scarring, vermifuge
Alternanthera brasiliana (L.) Kuntze	Terramicina	N	herb	cult	Le	in	Inflammation, flu, urinary infection
Amaryllidaceae							
Allium sativum L.	Alho	E	herb	cult	Bu	in, sy	Flu, cough, high blood pressure, stomach pain, headache
Allium cepa L.	Cebola	E	herb	cult	Bu	in, sy	Expectorant, flu, cough
Anacardiaceae							
Anacardium occidentale L.	Cajueiro	N	tre	cult	le, ba	in, dc	Diarrhea, flu
Anacardium spruceanum Benth. ex Engl.	Cajuí	N	tre	for	Le	in	Gastritis
Mangifera indica L.	Mangueira	E	tre	cult	Le	in	Diarrhea
Annonaceae							
Ephedranthus amazonicus R.E. Fr	Envira-taia	N	tre	for	Ba	dc, al	Inflammation, rheumatism
Apocynaceae							
Parahancornia fasciculata (Poir.) Benoist.	Amapá-amargoso	N	tre	for	Ex	dw	Gastritis, Cancer, vermifuge
Himatanthus sucuuba (Spruce ex Mull. Arg.) Woodson	Sucuúba	N	tre	for	ba	dc	Menstruation, stomach pain, urinary infection
Catharanthus roseus (L.) G. Don	Vinca	E	herb	cult	le	in	Cancer
Arecaceae							

Cocos nucifera L.	Coco	E	pal	cult	Ác	*in*	Dehydration
Euterpe oleracea Mart.	Açaí	N	pal	cult/for	fr, ro	*in*, dc	Anemia, toothache
Attalea maripa (Aubl.) Mart.	Inajá	N	pal	for	Ro	in	Amoeba
Asphodelaceae							
Aloe vera (L.) Burm. f.	Babosa	E	herb	cult	Le	in, dr	Inflammation, scarring, gastritis, capillary hydration
Asteraceae							
Acmella oleracea (L.) R. K. Jansen	Jambu	N	herb	cult	Le	in	Stomach pain
Ayapana triplinervis (Vahl) R. M. King & H. Rob.	Japana	N	herb	cult	Le	in	Kidney stones
Cichorium intybus L.	Chicória	E	herb	cult	Ro	dc	Stomach swelling
Bignoniaceae							
Handroanthus impetiginosus (Mart. ex DC.) Mattos	Ipê-roxo	N	tre	for	Ba	dc	Inflammation
Fridericia chica (Bonpl.) L. G. Lohmann	Pariri	N	bus	cult	Le	in	Anemia, inflammation, kidneys
Bisyceae							
Bisy orellana L.	Urucum	N	bus	cult	Se	in	Scarring
Brassicaceae							
Brassica oleracea L.	Couve	E	herb	cult	Le	ju	Stomach pain
Costaceae							
Costus spicatus (Jacq.) Sw.	Canarana	N	herb	cult/for	le, ro	in, dc	Kidneys, diabetes, urinary infection, diuretic
Crassulaceae							
Bryophyllum pinnatum (Lam.) Oken	Saião	E	herb	cult	Le	in, sy, dr	Pain, boils, inflammation, gastritis, cough, flu, chilblains
Kalanchoe daigremontiana Raym-Hamet. & H. Perrier	Aranto	E	herb	cult	Le	in	Cancer, inflammation
Kalanchoe laciniata (L.) DC.	Coirama	E	herb	cult	le	in	Inflammation
Euphorbiaceae							
Euphorbia tirucalli L.	Avelós	E	bus	cult	Ex	*in*	Cancer, skin disease
Hura crepitans L.	Assacu	N	tre	for	Ba, ex	dc, *in*	Rheumatism, cancer
Jatropha curcas L.	Pinhão-manso	N	bus	cult	Le	in	Inflammation, flu
Jatropha gossypiifolia L.	Pinhão-roxo	E	bus	cult	le, ex	in, *in*	Flu, gastritis
Fabaceae							
Vouacapua americana Aubl.	Acapu	N	tre	for	Ba	dc	Inflammation
Pterogyne nitens Tul.	Amendoim-bravo	N	tre	for	Le	in	Úlcers
Bauhinia variegata L.	Pata-de-vaca	E	tre	cult	Le	in	Kidneys
Stryphnodendron adstringens (Mart.) Coville	Barbatimão	N	tre	cult	Ba	dc	Inflammation, scarring, diarrhea, gastritis
Dipteryx odorata (Aubl.) Forsyth f.	Cumaru	N	tre	for	Se	sy, dc	Flu, pneumonia, inflammation
Copaifera langsdorffii Desf.	Copaíba	N	tre	for	ba, ex	oi, dc	Scarring, inflammation
Hymenaea courbaril L.	Jatobá	N	tre	for	ba, ex	dc, sy	Gastritis, cough
Dalbergia monetária L. f.	Verônica-vermelha	N	li	for	Ba	dc	Inflammation
Libidibia ferrea (Mart. ex Tul.) L.P. Queiroz	Jucá	N	tre	for	le, ba	in, dc	Flu, kidneys
Humiriaceae							
Endopleura uchi (Huber) Cuatrec	Uxi-amarelo	N	tre	for	Ba	dc	Inflammation
Iridaceae							
Eleutherine bulbosa (Mill.) Urb.	Marupazinho	N	herb	cult	Rhi	dc	Diarrhea, vermifuge
Lamiaceae							
Lavandula angustifólia Mill.	Alfazema	E	bus	cult	Le	in	Flu, sedative
Rosmarinus officinalis L.	Alecrim	E	bus	cult	Le	in	Flu
Ocimum gratissimum L.	Alfavacão	E	sub	cult	Wp	in, ju	Flu, inflammation
Mentha arvensis L.	Vique	E	herb	cult	Le	in, ju, sy	Flu, cough, throat pain, amoeba
Mentha x *vilosa* Huds.	Hortelã	E	herb	cult	Le	in	Flu
Aeollanthus suaveolens Mart. ex Spreng.	Catinga-de-mulata	E	herb	cult	Le	in	Headache
Pogostemon cablin (Blanco) Benth.	Patchouli	E	herb	cult	Le	in	Inflammation
Plectranthus barbatus Andrews	Falso-boldo	E	sub	cult	Le	in, ju	Stomach pain, liver pain, flu
Plectranthus amboinicus (Lour.) Spreng.	Hortelã-folha-grossa	E	herb	cult	Le	in, sy	Flu
Ocimum basilicum L.	Manjericão	E	sub	cult	Le	in	Pain
Lauraceae							
Aniba canelilla (Kunth) Mez	Casca-preciosa	N	tre	for	ba, le	dc, in	Pain, diarrhea, candidiasis, rheumatism, diabetes
Cinnamomum verum J. Presl	Canela	E	tre	cult	ba, le	dc, in	Sedative, stomach pain
Loranthaceae							
Struthanthus sp.	Erva-de-passarinho	N	bus	spo	Le	in	Lung disease
Malpighiaceae							
Byrsonima crassifolia (L.) Kunth	Murici-do-mato	N	tre	cult/for	Ba	dc	Inflammation

Malvaceae							
Gossypium hirsutum L.	Algodão	N	bus	cult	Le	in	Flu, inflammation
Theobroma grandiforrum (Willd. ex Spreng.) K. Schum.	Cupuaçu	N	tre	cult	Le	in	Flu
Meliaceae							
Carapa guianensis Aubl.	Andiroba	N	tre	for	ex, ba	dc, sy, oi	Inflammation, scarring
Myrtaceae							
Syzygium cumini (L.) Skeels	Jambolão	E	tre	cult	Le	in	Diabetes, Inflammation
Psidium guajava L.	Goiabeira	N	tre	cult	le, ba	in, dc	Diarrhea, urinary infection
Phyllanthaceae							
Phyllanthus niruri L.	Quebra-pedra	N	herb	spo	Wp	in	Kidney stones
Phytolaccaceae							
Petiveria alliacea L.	Mucuracaá	N	sub	cult	Le	in	Headache, arthritis
Piperaceae							
Peperomia pellucida (L.) Kunth	Erva-de-jaboti	N	herb	spo	Wp	in	High blood pressure, cholesterol
Piper alatipetiolatum Yunck.	Pau-de-angola	N	bus	cult	Le	in	Headache
Piper callosum Ruiz & Pav.	Elixir-paregórico	N	sub	cult	Le	in	Diarrhea, pain
Poaceae							
Cymbopogon citratus (DC.) Stapf	Capim-santo	E	herb	cult	Le	in	Sedative, colic, insomnia
Portulacaceae							
Portulaca pilosa L.	Amor-crescido	N	herb	cult	Le	in	Inflammation, hair loss, liver pain
Rhamnaceae							
Ampelozizyphus amazonicus Ducke	Saracura-mirá	N	li	for	Ba	dc	Inflammation
Rubiaceae							
Coutarea hexandra (Jacq.) K. Schum.	Quina-quina	N	tre	for	Ba	dc	Inflammation, scarring, stomach pain
Morinda citrifolia L.	Noni	E	bus	cult	Fr	dc	Inflammation
Uncaria guianensis (Aubl.) J. F. Gmel.	Unha-de-gato	N	li	for	Ba	dc	Inflammation
Rutaceae							
Citrus limom (L.) Osbeck	Limão	E	tre	cult	Le	in	Flu
Citrus sp.	Laranja	E	tre	cult	Le	in	Flu
Ruta graveolens L.	Arruda	E	herb	cult	Le	in, al	Cysts, muscle pain
Simaroubaceae							
Quassia amara L.	Quina	N	bus	for	ba	dc	Inflammation, scarring, stomach pain
Simarouba amara Aubl.	Marupá	N	tre	for	ba	dc	Diarrhea
Smilacaceae							
Smilax japicanga Griseb.	Japecanga	N	sub	for	Ro	dc	Inflammation, stomach pain, diarrhea
Verbenaceae							
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	Erva-cidreira	N	sub	cult	Le	in	Flu, sedative, insomnia
Winteraceae							
Drimys brasiliensis Miers	Casca-d'anta	N	tre	for	ba	dc	Bleeding, inflammation
Zingiberaceae							
Zingiber officinale Roscoe	Gingibre	E	herb	cult	Rhi	dc	Inflammation, gastritis

O – Origin (N – native; E – exotic); H – Habit (tre – tree; li – liana; bus – bush; pal – palm ; herb – herbaceous; sub – subshrub); P – Provenance (cult – cultivated; for – forest; spo – spontaneous); UP – Used part of the plant (ba – bark; le – leaf; fr – fruit; ro – root; ex – exudate; se – seed; fl – flowers; bu – bulb, rhi – rhizome; wp – whole plant); FP – form of preparation (in – infusion; dc – decoction; sy – syrup; dr – dressing; ju – juice; al – alcoholature; *in* – *in natura*; oi – oil; dw – diluted in water; cw – coconut water).

The botanical families Lamiaceae, Fabaceae e Euphorbiaceae, contribute 28% of referenced medicinal species, a percentage similar to other studies carried in the Amazon [30].

The Lamiaceae family contains many species that are rich in essential oils with different biological activities and several therapeutic applications around the world [31, 32], which justifies the greater use of species from this family observed in several ethnobotanical survey studies carried out in the Amazon [33] an in other regions in Brazil [34].

The Fabaceae family is the third largest Family in the angiosperm group with regards to species variety on a global scale, and the largest family in Brazil in that respect [35]. This wealth of species contributes to its great morphological and chemical diversity, which elevates the multiple usage derived from this family [36]. The large species diversity, as well as the quantity and distribution of its individuals in the environment, are factors that elevate the probability of usage by human populations [37]. The fact is that it is a very common Family in ethnobotanical studies carried out in Brazil, where Fabaceae leads in number of species [30, 38].

Euphorbiaceae is one of the largest, most complex and diversified families of the Magnoliopsida [39]. Additionally, it plays a prominent role in economic activity, through human nutrition and traditional medicine [40].

The collection of plant material for medicinal use occurred in two environments: forest (primary and secondary) and garden (cultivated and spontaneous). The predominant habits of the medicinal species were tree and herbaceous, with 35% and 31%, respectively (Table 1). The predominance of trees may be related to the fact that local specialists reside near forests with a low level of anthropization. A study [30] carried out in the Norte Araguaia microregion, in the state of Mato Grosso, found that species used medicinally are mainly trees and herbaceous, at 38.8% and 32.2%, respectively. On the other hand, Vasques *et al*. [41] found that 82.7% of species cultivated in gardens were herbaceous (52.2%), followed by arboreal (24.7%). These differences occur due to the study area, as verified in the aforementioned works. Ribeiro *et al*. [30] explored the knowledge of experienced local specialists in a transition area between both biomes (Amazonian and

savanna) with great biologic diversity and a predominance of native trees. Conversely, Vasques *et al*. [41] explored the knowledge of informants who mainly use medicinal plants cultivated in gardens, which are mostly herbaceous. Thus, the prevalence of a habit depends on many factors, such as geographical area, the type of informant and their sex, among others.

As for the origin of the referenced medicinal species, 33 are exotic and 50 are native. Although other ethnobotanical studies carried out in the Amazonian biome reveal a numeric superiority of native species, the opposite effect is also observed [30, 42]. The superiority of native species presented in this study can be explained by the fact that specialists reside near forests. Consequently, they possess more knowledge regarding the resources of the local flora, among them the species for medicinal use.

The species used for the preparation of homemade medication are mainly those cultivated in gardens (64%). The specialists cultivate the plants, especially those that are smaller and more frequently used. The culture of cultivation and use of medicinal plants constitutes an important local resource for health and sustainability in the rural environment [24]. Surprisingly, we found that 46% of native species are cultivated in gardens (Table 1). One possible explanation is the fact that the use of medicinal plants is predominant among the female specialists in these communities. They do not enter the forest to collect native plants, due to their advanced age or for fear of being stung by venomous animals that are common in that location. Pinto *et al*. [43] claim that the ease of cultivating plants around houses, along with their greater use by women, may set a pattern of preferential exploitation of plants, in this case, specifically native cultivated plants.

Part of the plant used in the preparation of traditional medicine

Leaves were the most used plant parts in the preparation of traditional medicine (49%), followed by bark (25%) (Table 1). Other parts, such as extractive products, roots, bulb, rhizome, seeds, fruit, flowers and the entire plant constitute 26%. Extractive products correspond to resin, sap, latex and oil-resin. In some species, more than one resource is used, as is the case of copaiba (bark and oil-resin); cinnamon (leaf and bark) and jatobá (bark and resin). The use of leaves and bark is predominant in the community, due do the wide availability of plant material, added to the ease of access and collection. Other works carried out in rural communities also report the importance of leaves as the most use part of plants for medicinal purposes [38, 41]. The selection of the plant part for medicinal purposes depends on factors such as: availability, ease of collection and the organ with the greatest concentration of active substances [44]. Additionally, the illness being seen to is another factor that must guide the choice of the plant part being used during treatment [38].

Preparation methods of traditional medicine

The most expressive form of homemade preparation was infusion (49%), followed by decoction (28%) of the referenced species (Table 1). In the former process, hot water (boiled) is poured over selected parts of the plant and kept in a closed recipient for some minutes. Infusion is recommended when using parts of plants such as leaves and flowers. In the decoction preparation method, part of the plant is heated (boiled) with water, and their active ingredients are released. Decoction is applicable to the harder parts, such as bark, roots and stems. As such, the obtainment of the beverage known as tea depends on the part of the plant being used. These tea preparation methods have also been reported by other researchers [41, 42]. Other preparation methods of homemade medicine such as syrups, dressings, alcoholatures, and juice were referenced by local specialists. It was verified that most of the medicinal preparations involve the use of a single plant species or a single plant part.

Traditional therapeutic recommendations

The therapeutic recommendations of the referenced medicinal plants were grouped into 13 categories of symptoms/diseases according to ICD-10. Among the main categories, the most expressive ones were those related to unclassified signs and symptoms (UCS, 48 references), respiratory system diseases (RSD, 28 references) and digestive system diseases (DSD, 22 references) (Figure 2). Similar results were reported in other studies carried out in Brazil [33, 41]. The greatest number of referenced medicinal species related to unclassified signs and symptoms (43 species; respiratory system diseases (23 species) and digestive system diseases (21 species) (Figure 2). As such, one may infer that plant diversity is also associated to chemical diversity, and consequently, to a greater number of active ingredients, which expands the therapeutic action spectrum.

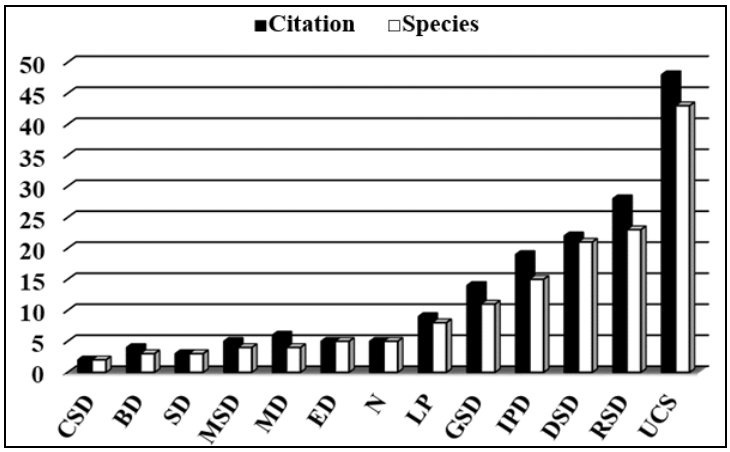

Fig 2: Number of references and number of species referenced by specialists from the Arimum, São Miguel and Paraíso communities for different types of disorders within the body systems recognized by the World Health Organization (WHO, 2009). CSD: Circulatory system diseases; BD: Blood diseases; SD: Skin diseases; MSD: Musculoskeletal diseases; MD: Mental disorders; ED: Endocrine diseases; N: Neoplasms; LP: Lesions and poisoning; GSD: Genitourinary system diseases; IPD: Infectious and parasitic diseases; DSD: Digestive system diseases; RSD: Respiratory system diseases; UCS: Unclassified Symptoms. Total references: 173.

In the UCS category, inflammatory processes (31%) are the most referenced symptoms (Figure 3). Due to the practice of manual labor, exercised daily by residents of the Resex, it is very common for inflammatory processes caused by sprains, fractures and dislocations to occur. Within the RSD category, the flu (22%) is the most referenced disease. The flu is caused by the sudden change in the weather, which is very common in the Amazonian region, which favors the emergence of diseases related to the respiratory system [24]. Lastly, stomach pain (10%) and gastritis (8%) are the prevalent illnesses in the DSD category (Figure 3). Almeida *et al*. [45] also observed a greater use of phytomedicines for inflammatory processes and flu symptoms. Marques *et al*. [33] showed that a greater number of plants are used to treat headaches, inflammation, coughs, diarrhea and the flu in riverside communities in Pará.

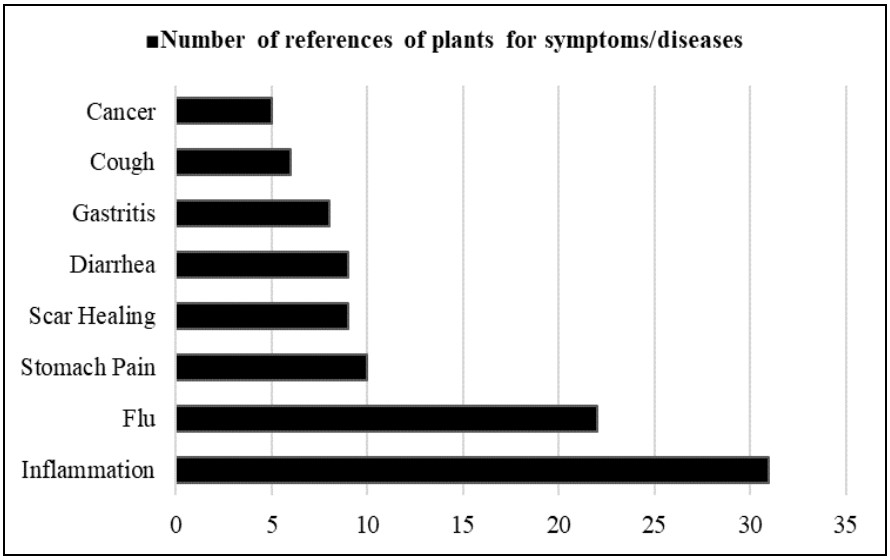

Fig 3: Number of references of species for symptoms/diseases recommended by specialists of the Arimum, São Miguel and Paraíso communities

Despite recent improvements, the communities visited in the Resex still exhibit precariousness in public sanitation and health services. This situation favors a greater incidence of the aforementioned illnesses. Gois *et al*. [46] also point out that the sanitary problems and the precariousness of conventional medical assistance contribute to the increase in gastrointestinal pathologies in riverside communities.

Main medicinal species with greater therapeutic use and their importance for local health

Of the 83 referenced species, 36 (43.4%) were mentioned for a single health problem, while most of the medicinal plants, 47 species (56.6%) had more than one therapeutic recommendation, with some of them being used for many health problems (Table 1). From these, the species with the greatest number of therapeutic recommendations were *Dysphania ambrosioides* (L.) Mosyakin & Clemants (*mastruz*, 18%), *Bryophyllum pinnatum* (Lam.) Oken (miracle leaf, 14%), *Pfaffia paniculata* (Mart.) Kuntze, *Allium sativum* L., *Aniba canelilla* (Kunth) Mez, with 10% each. These species, with the exception of *D. ambrosioides*, are common in other ethnobotanical works, although they are not among those most referenced.

D. ambrosioides (Mastruz) is an aromatic species, native to tropical America and originating in Mexico, with a vast distribution across the world. It is a plant that is cultivated due to the therapeutic effects attributed to it in traditional medicine. The traditional use of *D. ambrosioides* against helminthic diseases and other infectious illnesses has been reported in many pharmacological and biological essays [30]. Although therapeutic recommendations are not always the same, this species is one of the most referenced in other ethnobotanical studies [21, 42]. Its widespread use is due to the presence of high levels of ascaridole in the seeds, leaves and the stem (its essential oil contains between 60-80% ascaridole) [47]. Local specialists use *D. ambrosioides* preferentially for the treatment of parasitic worms and respiratory system diseases.

Bryophyllum pinnatum (Miracle leaf) is a herbaceous plant that originating in Madagascar and distributed across Tropical America, China, India and Australia. *B. pinnatum* is cultivated across all of the Amazon and is frequently used for various treatments, especially inflammations [48]. The traditional use of *B. pinnatum* for treating infectious diseases is supported by research that indicates that the plant's leaves possess anti-bacterial, antiviral and antifungal activities [49]. However, despite the widespread use of *B. pinnatum*, more studies must be carried out in order to identify the specific compounds responsible for the pharmacologic activities attributed to the species [49].

Hebanthe eriantha (Poir.) Pedersen (Paratudo) is a plant native to South America, traditionally used to treat fatigue, stress, inflammation and low immunity, in addition to displaying proven intestinal anti-inflammatory action [50]. Brazil is the greatest collection center of this species, whose root contains pfaffic acid, which exhibits anticancer activity [51].

Allium sativum (garlic) is a plant native to central Asia, cultivated around the world. Garlic is used in a large scale in global cuisine, as well as in traditional medicine. Some of garlic's pharmacological properties are well established, such as its antibacterial, antifungal, antioxidant, anticoagulant and anti-hypertensive action [52].

Aniba canelilla, known as precious-bark, is an aromatic plant that is abundant in the Amazon. In traditional medicine, it is recommended for treating a wide variety of diseases, including digestive, respiratory, inflammatory and central nervous system disorders. It is mainly administered as tea. Its essential oil is a natural antioxidant for preserving food and controlling disease, displaying great potential for use in the

cosmetics, perfumery and pharmaceutical products sectors [53]. Rural populations, such as those in the Resex communities, in the face of diseases, initially use medicinal plants in primary health care. To this end, they require knowledge regarding the therapeutic properties of the plants being used. In this study, the local specialists demonstrated knowledge regarding 83 species, 25 of which were published in the National List of Medicinal Plants of Interest to the SUS (RENISUS) [54]. In this context, ethnobotanical and ethnopharmacological studies are important, as they may reaffirm medicinal plants that are already known and used by many populational groups, with a therapeutic potential for insertion into public health systems. Furthermore, ethnobotanics may contribute toward the discovery of new medicinal species, thus increasing the chemical diversity of products with multiple activities, such as, for example, antitumor and antioxidant activities, among others.

The number of plants referenced by local specialists is considered to be relatively high (83 ethnospecies). This result is partly due to the elevated number of native species encountered in the study area, which demonstrates the knowledge of these species detained by local specialists. This knowledge is a reflection of traditional customs inherited mainly from secular indigenous peoples in this region.

Knowledge, transmission and the importance of medicinal plants for local health

The knowledge system of traditional populations is complex and dynamics, as both actions change over time as well as the environment itself which is acted upon. In this context, specialists continuously reinvent themselves, not restricting themselves to a single repertoire or consisting of a mere listing of medicinal plants. In truth, they comprehend the sophisticated formulas, the prescriptions and the respective procedures required to carry out the desired transformation [55]. As such, the information used by local specialists for the prescription of medicinal plants is truly important in the prevention of diseases and the promotion of local health.

Local specialists obtained knowledge regarding medicinal plants and their utilities, mainly, from their mothers. In rural communities, it is common for children to accompany, from a young age, adults in the field's daily tasks. As such, they become habituated to planting and rarely lose such skills, even when migrating to urban areas [8]. Thus, traditional medicine is transmitted in an essentially oral and gestural manner, and is acquired through relatives and neighbors [5].

According to local specialists, the youth in the communities display little interest in learning, and, consequently, possess little knowledge regarding medicinal plants. Additionally, many of them have left the communities in search of professional qualification and paid work. Similarly to what occurs in other regions, influences associated with modernity, access do industrialized medication and cultural influence have also effectively contributed toward reducing interest of the youth in the communities [43, 56]. According to Araújo *et al.* [26], the lack of interest from the youth represents risk of loss of valuable information regarding the medicinal plant resources of Brazilian flora.

Local specialists believe in the essentiality of medicinal plants for local healthcare. Due to the precariousness of local public health services, medicinal plants are frequently used to treat more common diseases that exist among the residents of the communities. This insufficiency of public health services is a problem that is spread across most Amazonian cities. The dearth of resources is a limiting factor for both hiring health professionals and also buying medication. This precariousness is manifested in the movement of the communities' residents to the city capital in search of these services. As such, medicinal plants, according to local specialists, are very important for promoting health among the Verde para Sempre residents. Other factors have also contributed toward the increase of usage of these resources, among them the high cost of industrialized medication and the difficult access of the population to medical assistance [21]. For many people who do not have access to health services, medicinal plants are the main options for treating and curing illnesses [57].

Final considerations

The Research showed aspects of the knowledge and practices related to therapeutic use of plants by local specialists in the riverside communities of Verde para Sempre. The universe of local specialists of medicinal plants is mostly composed of women. They possess a wide and diverse knowledge regarding the most varied uses of medicinal plants. Local specialists are observed to be low income Catholics with a low level of education.

According to local specialists, the young members of the communities display little interest regarding medicinal plants. In fact, many of them are seeking better opportunities regarding studies and employment, mainly in urban centers. This situation is, in a way, dangerous, as it may contribute toward the intergenerational rupture in transmission of knowledge regarding the use of medicinal plants.

The precariousness of public health services, according to local specialists, also contributes toward the use of medicinal plants. For many people, especially those who have low income, medicinal plants are the main options for treating their illnesses.

Thus, it becomes evident that the establishment of public policies is an urgent necessity in Porto de Moz, with the goal of organizing not only health, but especially other fundamental sectors regarding the development of the rural environment and the local population. The present article is not exhausted here, due to the elevated amount of data collected in the field, as well as the wide scope of the theme being studied.

Dialogue with local specialists from the riverside communities of the Baixo Xingu shows hoe the study of this arrangement of medicinal knowledge assists in the prevention, treatment and cure of illnesses. The results, although restricted to a local scale, point to a perspective that requires a greater creative and critical reflection regarding the use of medicinal plants in the contemporary Amazon. Therefore, we highlight the importance of new research and further development of those that already exist regarding the use of medicinal plants by the Amazon's traditional populations, as this is a subject of both social and scientific interest.

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