Fecha de recepción: 31-agosto-2023 Fecha de aceptación: 10-febrero-2024

AN ETHNOBOTANICAL REVIEW REGARDING THE USE OF MEDICINAL PLANTS IN LOCAL MEDICAL SYSTEMS IN RORAIMA, BRAZIL

Rhilary Herielle Gomes Pereira [1, 2], Carlos Eduardo Gomes [3], Amélia Carlos Tuler [1, 2]

[1]Centro de Ciências da Saúde, Programa de Pós-graduação em Saúde e Biodiversidade, Universidade Federal de Roraima, Campus Paricarana: Avenida Capitão, Ene Garcez, 2413, 69304-000, Boa Vista, Roraima, Brasil.

[2.] Centro de Estudos da Biodiversidade, Universidade Federal de Roraima, Campus Paricarana: Avenida Capitão, Ene Garcez, 2413, 69304-000, Boa Vista, Roraima, Brasil.

[3]Departamento de Economia, Universidade Federal de Roraima. End: Av. Cap. Ene Garcez, 2413, Campus Paricarana, Bloco II - Cadecon, Sala 221 - Bairro Aeroporto - CEP: 69310-000 - Boa Vista, RR, Brasil.

*Email: herieelle@gmail.com

ABSTRACT

The Amazon rainforest is known for harboring the largest tropical forest in the world and for having one of the largest reserves of plant biodiversity on the planet. The indigenous people that inhabit the region have always used its plant biodiversity, mainly for medicinal purposes. In Roraima, there are several scientific and para-scientific studies on medicinal plants, however, there is no consolidated list of species used for this purpose. To address this gap, an ethnobotanical review of the species and the traditional knowledge related to them was conducted. For gathering data on the use of medicinal plants in local medical systems (LMSs) in Roraima, the PubMed (Medline) and Google Scholar databases were utilized. We screened and selected 72 articles and records. Four hundred and forty-four medicinal plant species were identified at the species level, belonging to 101 botanical families. Fabaceae, Lamiaceae and Asteraceae were the most frequent families and of the 444 species included, 282 were classified as native, 108 as cultivated, and 54 as naturalized. The DIP code (Certain infectious and parasitic diseases) was the most cited in LMS in Roraima. Although the results are expressive, the diversity of medicinal species in Roraima is probably greater than what the studies carried out have covered, considering the vast extension of the state and its ethnic diversity. The compilation of a single list of medicinal species can support new research and guide public health policies in Roraima. In addition, the data described here can provide a more general overview for making assertive decisions regarding the conservation of the local flora and practices within LMSs.

KEYWORDS: ethnobiology, list of useful plants, local peoples, traditional knowledge.

UMA REVISÃO ETNOBOTÂNICA SOBRE O USO DE PLANTAS MEDICINAIS EM SISTEMAS MÉDICOS LOCAIS DE RORAIMA, BRASIL

RESUMO

A Floresta Amazônica é conhecida por abrigar a maior floresta tropical do mundo e por possuir uma das maiores reservas de biodiversidade vegetal do planeta. Os povos indígenas que habitam a região sempre utilizaram essa biodiversidade vegetal, principalmente para fins medicinais. Em Roraima, existem diversos estudos científicos e para-científicos sobre plantas medicinais, no entanto, não há uma lista consolidada de espécies utilizadas para esse fim. Para preencher essa lacuna, foi realizada uma revisão etnobotânica das espécies e dos conhecimentos tradicionais relacionados a elas. Para coletar dados sobre o uso de plantas medicinais nos sistemas médicos locais (LMSs) em Roraima, foram utilizados os bancos de dados PubMed (Medline) e Google Scholar. Foram analisados e selecionados 72 artigos e registros. Identificou-se 444 espécies de plantas medicinais no nível de espécie, pertencentes a 101 famílias botânicas. Fabaceae, Lamiaceae e Asteraceae foram as famílias mais frequentes, e das 444 espécies incluídas, 282 foram classificadas como nativas, 108 como cultivadas e 54 como naturalizadas. O código DIP (Certas Doenças Infecciosas e Parasitárias) foi o mais citado no LMSs de Roraima. Embora os resultados sejam expressivos, a diversidade de espécies medicinais em Roraima provavelmente é maior do que a abordada nos estudos realizados, considerando a vasta extensão do Estado e sua diversidade étnica. A compilação de uma única lista de espécies medicinais pode apoiar novas pesquisas e orientar políticas de saúde pública em Roraima. Além disso, os dados aqui descritos podem fornecer uma visão mais geral para a tomada de decisões assertivas em relação à conservação da flora local e práticas nos LMSs.

PALAVRAS-CHAVE: conhecimento tradicional, etnobiologia, lista de plantas úteis, pessoas locais.

INTRODUCTION

In the present ethnobotanical review, we present data on the diversity and uses of medicinal plants in the state of Roraima, in the Brazilian Amazon. Our approach is centered on the knowledge and use of medicinal plants in local medical systems (SMLs). SMLs are understood as complex and dynamic systems that are structured based on people's perceptions about health, and disease, as well as prevention and treatment strategies to deal with illness events (Dunn, 1976; Kleinman, 1978; Henrich & McElreath, 2003). These systems are considered biocultural entities since cultural and biological traits are important for their structuring. In this way, they are important tools or models for our understanding of how populations respond to disease pressures over time (see Ferreira-Júnior & Albuquerque, 2018).

In the Brazilian Amazon, practices, beliefs, and knowledge about the uses of medicinal plants that encompass SMLs play an important role in the prevention, relief, treatment, and cure of diseases among local populations (Frausin *et al.*, 2015; Oliveira & Braga, 2017; Moraes *et al.*, 2019; Milliken, 2021; Lima, 2021). The Amazon is known for harboring the largest expanse of tropical forest and for having the largest hydrographic basin on the planet (Junk & Piedade, 2005; De Paiva *et al.*, 2013; Cardoso *et al.*, 2017). It features one of the largest reservoirs of plant biodiversity in the world, estimated at around 14,000 plant species (Cardoso *et al.*, 2017). In addition to the great biological diversity, the Brazilian Amazon is home to great social and cultural heterogeneity, including 385 indigenous ethnic groups, according to data from the Rede Amazônica de Informação Socioambiental Georreferenciada (RAISG, 2022).

Other traditional communities (ribeirinhos, artisanal fishermen, caboclos from the Amazon, coconut breakers, terreiro people, etc.) also have a history of using medicinal plants to deal with illness events (Milliken & Albert, 1996; Milliken & Albert, 1997; Milliken, 1998; Vandebroek *et al.*, 2004; Frausin *et al.*, 2015; Oliveira & Braga, 2017; Moraes et al., 2019; Lima, 2021; Milliken, 2021), being an essential resource for the subsistence and identity of these local peoples.

The state of Roraima is home to 11 ethnic groups and 32 indigenous lands (Frank & Cirino, 2010), with a history of using medicinal plants. Milliken (2021), for example, cited the use of 52 species for the Ingarikó, Macuxi (Makuxi), Taurepang, Wai-Wai, and Wapishana (Wapixana) ethnic groups. Oliveira *et al.* (2021) cited 33 woody medicinal species belonging to 16 botanical families in the Darora indigenous community (the majority of the population belonging to the Makuxi ethnic group). The use of medicinal species is not restricted to indigenous communities; it has been reported in both rural and urban areas. Ethnobotanical investigations carried out with the local population in the south of the state and in peripheral neighborhoods of the capital showed how knowledge about medicinal plants is part of the routine of Roraima residents (Santos *et al.*, 2013; Araújo *et al.*, 2018).

In addition to the research listed above, several records of the use of medicinal plants are dispersed in scientific and para-scientific productions of various organizations (teaching and research institutions, governmental and non-governmental, religious, and union organizations, among others), which ends up making it difficult to consolidate a list of medicinal plant species used for the state of Roraima.

The unification of these data is extremely important for understanding the role of SMLs for local communities since it is possible to identify culturally important species and provide information on how populations understand diseases and their symbolic meanings and show how populations manage surrounding ecosystems (Heinrich *et al.*, 2009).

Based on these arguments and the gaps in knowledge presented from this review, we intend to answer the following questions: 1) What species of medicinal plants are used and/or known in the state of Roraima, Brazil? 2) What are the therapeutic targets for which medicinal plants are employed? 3) What is the origin and habit of the species? What are the methods of preparation and routes of administration of home remedies based on medicinal plants?

From the unification of data on diversity and use of medicinal plants in the state of Roraima, we hope to contribute to the understanding of SMLs by providing information on how populations understand diseases and their symbolic meanings, as well as prevention and treatment strategies, preserving this knowledge for future generations. Our results may also support studies, research, and policies aimed at public health in the state of Roraima, Brazil.

MATERIAL AND METHODS

Study area. The state of Roraima occupies the northernmost region of the Brazilian Amazon, bordering Guyana and Venezuela internationally. The state occupies an area of 225,116.1 km², representing 4.5% of the legal Amazon. Its vegetation cover includes different forest and non-forest formations, including particular plant formations such as the campinas and campinaranas (a regionalist term for a type of vegetation in the Amazon region, with varied physiognomies, from grassland to forested) concentrated in the south, the tepuis in the north, and the savannas called "Lavrados" (Sette-Silva, 1997; Barbosa *et al.*, 2003).

The state has an estimated population of 652,713 people, according to IBGE data (2021). Its population is made up of ethnic and cultural diversity, consisting mainly of indigenous peoples, with emphasis on the Macuxi, Wapixana, Taurepang, Ingaricó, and Yanomami, among others (Milliken, 1997). In addition to indigenous peoples, the population of Roraima also includes migrants from other regions of Brazil, mainly from the Northeast, and immigrants from neighboring countries such as Venezuela

and Guyana (Barbosa, 1993). The presence of these groups has intensified in recent years, mainly due to the migratory crisis in Venezuela (Niño, 2020).

Bibliographic research and data collection. This research was based on qualitative and quantitative methodology, based on bibliographical research and documental analysis for the survey of knowledge and use of medicinal plants in SMLs in the state of Roraima, Brazil, through screening and selection of ethnobotanical surveys, scientific books, annals, and documents forums, and meetings on medicinal plants, and data made available by research centers, and government organizations.

The searching strategy to retrieve published data on medicinal plants used in the state of Roraima included recognized databases, specifically PubMed (Medline) and Google Scholar. The combinations of keywords used in database searches, covering Portuguese and English languages ("Medicinal plants") AND ("Roraima"), ("Medicinal plants") AND ("Roraima"), ("Etnobotânica") AND ("Roraima"), and ("Ethnobotany") AND ("Roraima") were used. In addition, data from CRIA (SpeciesLink), using the link https://specieslink.net using the terms "Medicine" in the Notes filter and "Roraima" in the State filter. In the Google Scholar database, 1995 publications were identified, and nine in PubMED were filtered. In the CRIA database, 80 records of the use of medicinal plants were identified. Additionally, we included one study shared by personal communication (Doyle 1985). After removing duplicates and exclusion criteria, 78 works (research papers, dissertations, thesis, book chapter and leaflet), and records (CRIA data) were screened and selected.

Inclusion/exclusion criteria. Inclusion criteria were research with data on medicinal plants from the state of Roraima used by traditional medicine for the treatment of diseases, with a focus on records and ethnobotanical data. After reading the title and abstract, there was an exclusion of works that deviated from the theme of the present study, such as data published without location information, locations outside Roraima, and the absence of scientific names of medicinal plants. Studies focusing on pharmacochemistry were also excluded. In order for the scope of the work to be greater, there was no exclusion of data regarding the period of publication.

Taxonomic treatment, habit identification and species origin. The nomenclatural update and checking of possible botanical synonymies were carried out through searches in online databases, including *Flora e Funga do Brasil* (https://floradobrasil.jbrj.gov.br) and Plants of the World Online (POWO, https://powo.science.kew.org). The classification of angiosperm families followed the recommendations of APG IV (2016), except for the Turneraceae and Passifloraceae families. For this botanical families, we adopted the classification of Tokuoka (2012).

All botanical species were classified in relation to habit and origin, using as a primary basis the bibliographies raised in the methodology. When these data were absent in the surveyed bibliographies, we used *Flora e Funga do Brasil* as a data source. Habits were classified as: tree, bush, subshrub, liana/voluble/creeper, and herb. When the species had more than one habit, we chose to select the stage of greatest phenological development. Regarding their origin, the species were classified as native when they occurred naturally in Brazilian territory. Exotic species were classified as naturalized or cultivated, following the *Flora e Funga do Brasil* database.

Classification of therapeutic targets. In the classification of therapeutic targets, the medicinal uses mentioned by the references were classified according to the International Statistical Classification of Diseases and Related Health Problems (ICD 2022) provided by the World Health Organization (WHO), as shown in Table 1. This adoption of the ICD-11 in Table 1 aims to standardize the traditional uses, despite the existence of deficiencies associated with standardization (Staub, 2015). Other studies used, at least in part, the same classification (Leonti, 2011; Baptista *et al.*, 2013; Souza & Hawkins, 2021) In this sense, the uses were grouped into 29 categories

Classification of preparation and administration methods. For the classification of preparation and administration methods, the methodology adapted from Souza & Hawkins

Table 1. Codes used to classify medicinal information of the bibliography.

CODE	WHO ICD 11
DIP	Certain infectious or parasitic diseases
NEO	Neoplasms
DSO	Diseases of the blood or blood-forming organs
DSI	Immune system diseases
ENM	Endocrine, nutritional, or metabolic disorders
MCN	Mental, behavioral, or neurodevelopmental disorders
SVI	Sleep-wake disorders
DSN	Nervous system diseases
DSV	Diseases of the visual system
OPM	Diseases of the ear or mastoid process
DSC	Diseases of the circulatory system
DSR	Diseases of the respiratory system
DSG	Digestive system diseases
DDP	Skin diseases
SMC	Diseases of the musculoskeletal system or connective tissue
DAG	Diseases of the genitourinary system
RSS	Conditions related to sexual health
GPP	Conditions related to pregnancy, childbirth, or puerperium
CPP	Certain conditions originating in the perinatal period
ADD	Developmental anomalies
SSA	Other specified symptoms, signs, or clinical findings, not elsewhere classified
LEC	Other specified injury, poisoning or certain other consequences of external causes
CMM	External causes of morbidity or mortality
FSS	Factors influencing health status or contact with health services
	Special purpose codes
IEG	Inflammation in general
AEN	Agents that primarily affect water and nutritional balance and metabolism
FRT	Fortifying
SHE	Symptoms or signs involving mood or emotion
CON	Contraceptive

Source: World Health Organization (2022). International statistical classification of diseases and related health problems (11th ed.). https://icd.who.int/

(2020), was used, as shown in Table 2. The terms used in publications and records were replaced by "terms used for the classification of preparation methods" for data analysis.

Classification of plant parts. For the classification of plant parts, Table 3 was assembled based on specialized bibliographies on plant morphology.

Table 2. Preparation and administration classification terms.

TERMS USED FOR THE CLASIFICATION OF METHODS OF PREPARATION	TERMS USED IN PUBLICATIONS AND RECORDS
Decoction	Decoction
Infusion	Infusion, tea, with water, with milk, cold infusion
Dye	Wine, alcoholic extraction, extract, bottled
Maceration	Maceration
Topical use	Topical, externally applied, ointment, plaster
Plant juice	Plant juice
Juice	Beverage, juice
Bath	Bath, soap, mouthwash, wash
Gargle	Gargle
Food	Edible, raw, fresh, ingestion, tablet, food
Oil	Oil
Syrup	Syrup, with honey
Powder	Powder/inhalation, snuff
Compresses	Compresses
Cataplasm	Cataplasm
Milling process	Milled, milling process
Scrape	Scrape, scraping
Blessing	Blessing
Gum	Gum
Crushing	Crushing, shredding

Source: Adapted from Souza & Hawkins (2020).

Elaboration of the unique list of medicinal plant species. Species from the consulted databases were included in a single list in Microsoft Excel. Each species was counted only once, even if it had several uses. For all species, the therapeutic target, the part of the plant used, the method of preparation, and the habit cited in the selected research investigation were included. It is important to mention that not all selected works had data on the part used and the method of preparation, but the scientific name was still compiled

.

Table 3. Plant parts classification.

TERMS USED FOR PLANT PART CLASSIFICATION	TERMS USED IN PUBLICATIONS
Leaf	Leaf, Leaves, Dry leaf, Leaf without stem, Bark water (e.g., *Musa* × *paradisiaca*), Bract
Fruit	Fruit, Fruit, Bean, Dry fruit, Dry fruit fiber, Fruit peel, Plant sponges, Pseudofruit
Whole plant	Whole plant
Latex	Latex, Sap
Resin	Resin
Branch	Branch with leaves, branch
Seed	Seed, Grain, Aril
Bulb	Bulb
Bast	Bast
Petiole	Petiole
Oil	Oil
Stem	Stem, Apical part of the plant, Wood, Bark of the wood, Bark, Bark of the stem, Inner bark, Rhizome, Bulbils, Inner bark, Branch, Branches, Water of the vine
Fiber	Fiber, Bark Fiber
Bud	Bud
Root	Root, Root Bark
Flower	Flower, Flower Bud, Stigma

All listed species were classified according to therapeutic target, methods of preparation, and classification of plant parts according to Tables 1, 2, and 3.

Data analysis. The Microsoft Excel software was used to quantify the frequency of species citations, frequency of distribution, habit, part of the plant used, preparation methods, and therapeutic targets. In addition, Python 3.9 software (Anaconda Distribution for Windows) was used for the production of visual graphs.

RESULTS AND DISCUSSION

Data selection. A total of 16 research papers, four mater's dissertations, one doctoral thesis, one brochure, and one book chapter were retrieved from Google Scholar and PUBMed. Additionally, one unpublished study (personal communication) and 54 CRIA records were also included in our analysis (Table 4).

Diversity of medicinal plants in SLMs in Roraima, Brazil. From the selected research investigations and records resulting from this ethnobotanical review, 444 species were identified and classified as medicinal plants belonging to 101 botanical families (Annex 1).

Fabaceae (52 spp.), Lamiaceae (30 spp.), and Asteraceae (28 spp.) were the botanical families that stood out with greater frequency in the research investigations analyzed. The others were represented by less than 20 species (Figure 1).

The predominance of the Fabaceae family for medicinal use has already been similarly reported in the Amazon in a systematic review (Pascoa Júnior & Souza, 2021), in studies in Brazilian Amazonian communities (Sarquis *et al.*, 2019; Pedrollo *et al.*, 2016), and in the Brazilian Cerrado (Penido *et al.*, 2016; Silva *et al.*, 2015; Costa *et al.*, 2017).

In the Amazon and Guyana regions, inventories carried out at several sites attest to the great importance of the Fabaceae family in the floristic composition of different forest and non-forest formations (Salomão *et al.*, 1988; Silva *et al.*, 1992; Almeida *et al.*, 1993; Terborgh & Andresen, 1998; Ferreira & Prance, 1998; Milliken, 1998; Miranda & Absy, 2000; Oliveira, 2000), being invariably among the families with the highest density and diversity in the canopy of primary forests (Nelson & Oliveira, 2001). According to Ter Steege *et al.* (2000), in half of the forest regions studied in the Amazon and Guiana

Table 4. Bibliography used after the selection of research investigations.

Nº	AUTHORS	TITLE	YEAR OF PUBLICATION	TYPE
1	Doyle, M	Contribuição à flora medicinal dos índios Macuxi	1985	Non published
2	Berg M.; Silva M.	Contribuição ao conhecimento da flora medicinal de Roraima	1988	Research paper
3	Milliken, W	Malaria and antimalarial plants in Roraima, Brazil	1997	Research paper
4	Milliken, W	Plantas medicinais, malária e povos indígenas: estudos etnobotânicos no norte da Amazônia	1997	Research paper
5	Milliken, W	The use of medicinal plants by the Yanomami Indians of Brazil, Part II	1997	Research paper
6	Milliken, W	Traditional anti-malarial medicine in Roraima, Brazil	1997	Research paper
7	Luz, F.J.F	Medicinal plants of popular use in Boa Vista, Roraima, Brazil	2001	Research paper
8	Pinto, AAC; Maduro, CB	Produtos e subprodutos da medicina popular comercializados na cidade de Boa Vista, Roraima	2003	Research paper
9	Perez, IU	Uso dos recursos naturais vegetais na comunidade indígena araçá, Roraima	2010	Master's Dissertation
10	Pedrollo, CT	Baixo Jauaperi: da farmacopeia ao sistema de saúde–um estudo etnobotânico em comunidades ribeirinhas	2013	Master's Dissertation
11	Batista, DL; Barbosa, RI	Agrobiodiversidade urbana: composição florística, riqueza e diversidade deplantas nos quintais de Boa Vista, Roraima	2014	Research paper
12	Silva, VDAD; Costa, SA; Silva, FDCF; Silva, ADS; Silva, CEMD	Uso de espécies arbóreas florestais no tratamento medicinal alternativo em Rorainópolis, Roraima	2016	Research paper
13	Falcão, MT	Ambiente e conhecimento tradicional da etnia Ingarikó na Terra Indígena Raposa Serra Do Sol – Roraima: abordagem etnocientífica no estudo do uso da terra	2016	Doctoral Thesis
14	Oliveira, RLC; Scudeller, VV; Barbosa, RI	Use and traditional knowledge of *Byrsonima crassifolia* and *B. coccolobifolia* (Malpighiaceae) in a Makuxi community of the Roraima savanna, northern Brazil	2017	Research paper
15	Araújo, KA; Miranda, IPDA; Camargo, C; Repetto, M	Knowledge of medicinal plants used by residents in two peripheral districts of Boa Vista, Roraima, Northern Brazilian Amazon: Phytotherapy as a new strategy in collective health	2018	Research paper
16	Oliveira, RLC; Almeida, LFPD; Durigan, MFB; Scudeller, VV; Barbosa RI	Conhecimento tradicional e usos de copaíba pela comunidade Makuxi Darora na Savana de Roraima	2019	Research paper
17	Oliveira, RLC; Brito, SOD; Almeida, LFPD; Scudeller, VV; Barbosa RI	Uso e extrativismo do Angico numa comunidade indígena na savana de Roraima, norte da Amazônia brasileira	2019	Research paper
18	Oliveira, RLC; Almeida, LFPD; Scudeller, VV; Barbosa, RI	Traditional botanical knowledge variation between gender and age in a Makuxi community in Roraima savanna, northern Brazilian Amazonia	2020	Research paper
19	Milliken, W	Traditional Medicines Amongst Indigenous Groups in Roraima, Brazil: A Retrospective	2021	Research paper
20	CRIA	**CRIA data (https://specieslink.net)/)**	**2022**	Virtual Herbarium
21	Mojica, JB	Uso de plantas alimentícias e medicinais na Comunidade Indígena Nova Esperança, Terra Indígena São Marcos – Município De Pacaraima/ Roraima	2018	Master's Dissertation

Table 4. Cont.

Nº	AUTHORS	TITLE	YEAR OF PUBLICATION	TYPE
22	Luz, FJF	Plantas medicinais de uso popular no município de São Luís do Anauá, Roraima.	1998	Brochure
23	Oliveira, RLC; Almeida, LFPD; Durigan, MFB; Scudeller, VV; Barbosa RI	Espécies arbóreas de uso múltiplo em uma comunidade makuxi no lavrado de Roraima, Amazônia brasileira	2021	Book chapter
24	Pinho, RCD	Quintais Agroflorestais indígenas em área de savana (Lavrado) na terra indígena Araça, Roraima	2008	Master's Dissertation
25	Rodrigues, T; Souza, AO	Local Knowledge and Botanical Teaching at Campo De Caroebe/Roraima School	2021	Research paper

Elaborated by the authors.

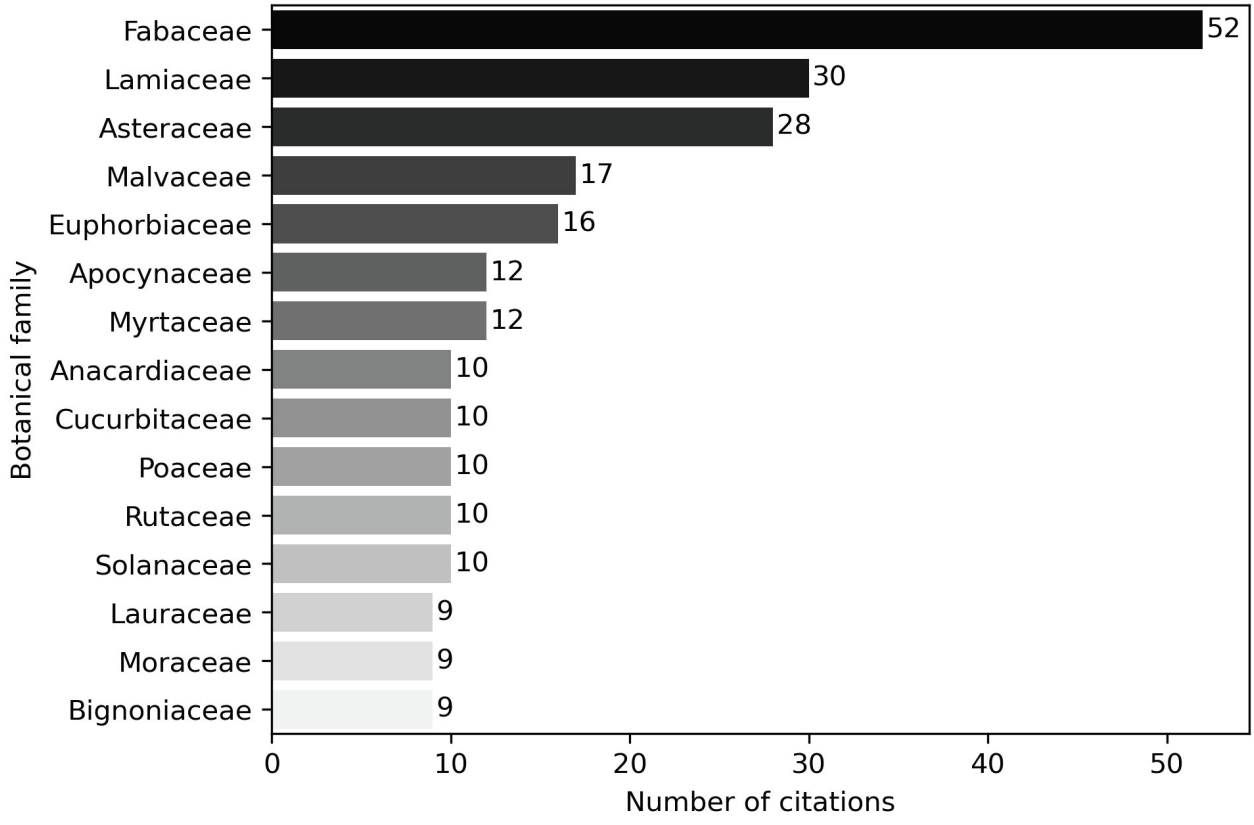

Figure 1. Botanical families with the highest citation frequencies in LMSs in Roraima, Brazil.

Shield, Fabaceae is floristically the most abundant family, representing, on average, 16% of all individuals sampled.

The Lamiaceae family, with about 250 genera and 7825 species (Prakash *et al.*, 2016), includes species of food and medicinal importance, such as alfavaca (*Ocimum* spp.), alecrim (*Rosmarinus* sp.), erva-cravo (*Hypttis* spp.), hortelã-pimenta (*Mentha* spp.), manjericão (*Origanum* spp.), erva-cidreira (*Melissa* spp.), tominho (*Thymus* spp.). Other species are cultivated for ornamentation or for the production of essential oils, such as sálvia (*Salvia* spp.), and alfazema (*Lavandula* spp.) (Porte & Godoy, 2001). Several ethnobotanical studies pointed out Lamiaceae as one of the most frequent families in

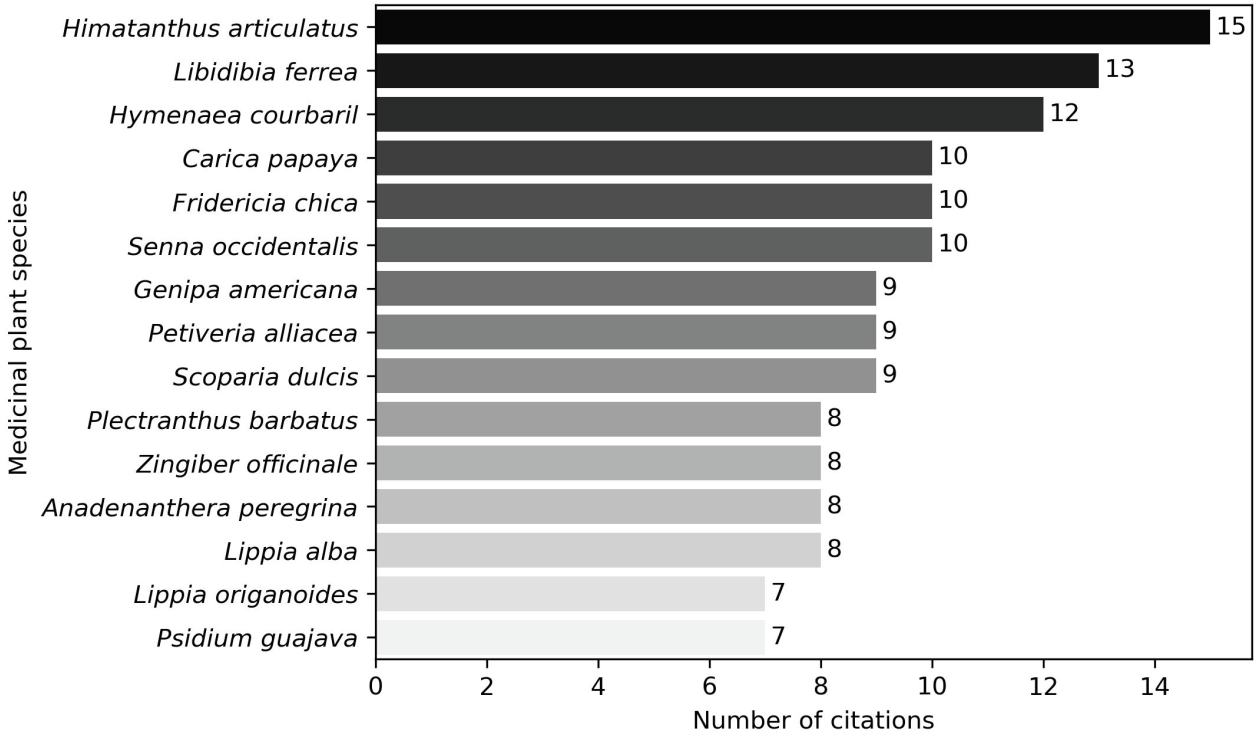

Figure 2. Species with the highest citation frequencies in Roraima, Brazil.

Table 5. Six of the most cited species in this ethnobotanical review are listed, including their vernacular name, medicinal uses, and research investigation or reference.

SCIENTIFIC NAME	VERNACULAR NAME	MEDICINAL USES	RESEARCH INVESTIGATION OR REFERENCE
Carica papaya L.	Mamoeiro, Mamão, mapaya	Liver, stomach, treatment of malaria, flu, antitussive, digestive, laxative, diabetes, asthma, vomiting, indigestion, clean skin, worms, infantile colic, intestine, vomiting, dysentery	Berg e Silva, 1988; Milliken, 1997 (1); Milliken, 1997 (2); Milliken, 1997 (4); Luz, 2001; Perez, 2010; Pedrollo, 2013; Araújo *et al.*, 2018; Milliken, 2021; Mojica, 2018.
Fridericia chica (Bonpl.) L.G.Lohmann	Crajiru, Carajeru, Crejeru, Tipi, Crajirú	Ulcer, uterine inflammation, anemia, anti-inflammatory, healing, external injuries, toothache, infection	Berg e Silva, 1988; Luz, 2001; Perez, 2010; Pedrollo, 2013; Batista e Barbosa, 2014; CRIA: Pedrollo, CT 298, 2012.; CRIA: Oliveira, SKS, UFRR 8528, 2015; Mojica, 2018; Luz, 1998; Rodrigues e Souza, 2021.
Himatanthus articulatus (Vahl) Woodson	Sucuúba, Sucubeira, Pau-de-leite, e'guye, Sucuuba, Sucuba	Inflammation, liver, tuberculosis, malaria treatment, gynecological inflammation, leukemia, cough, hernia, wound, tear, brain, gastritis, wound healing, impinge, kidney stone medicine, spleen disorders, vermifuge, diabetes, stomach pain, infection, kidneys, mouth fungus, contraceptive, cancer, wound washing, menstrual cramps, external injuries, hemorrhoids, flu, menstruation	Berg e Silva, 1988; Milliken, 1997 (2); Milliken, 1997 (4); Luz, 2001; Pinto e Maduro, 2003; Perez, 2010; Pedrollo, 2013; Silva *et al.*, 2016; Oliveira *et al.*, 2019 (3); Milliken, 2021; CRIA: Oliveira, SKS, UFRR 8628, 2015; CRIA: Oliveira, SKS, UFRR 8523, 2015; Mojica, 2018; Luz, 1998; Pinho, 2008.
Hymenaea courbaril L.	Jatobá, Jutaí, Mairirî	Venereal disease, treatment of malaria, flu, cough, catarrh, sequelae of malaria, hemorrhoids, diuretic, tuberculosis, anemia, prostate, inflammation, cancer, myoma, respiratory disorders, bronchitis, wounds that do not heal, cold, inflammation of the uterus, tonic , rheumatism, vaginal inflammation, kidneys	Doyle, M., 1985; Berg e Silva, 1988; Milliken, 1997 (4); Luz, 2001; Pinto e Maduro, 2003; Perez, 2010; Silva *et al.*, 2016; Milliken, 2021; CRIA: Oliveira, SKS, UFRR 8625, 2015; CRIA: Oliveira, SKS, UFRR 8533, 2015; Mojica, 2018; Luz, 1998.

Table 5. Cont.

SCIENTIFIC NAME	VERNACULAR NAME	MEDICINAL USES	RESEARCH INVESTIGATION OR REFERENCE
Libidibia ferrea (Mart. ex Tul.) L.P. Queiroz	Jucarî; Jucá	Antidiarrheal, blood purifier, hemorrhoids, malaria, anti-inflammatory, kidneys, tuberculosis, rheumatism, skin cleansing, inflammation in general, headache, stomach, soothing, kidney inflammation, flu, remedy for bruises, dysentery, vaginal inflammation	Doyle, M., 1985; Berg e Silva, 1988; Milliken, 1997 (4); Luz, 2001; Pinto e Maduro, 2003; Perez, 2010; Pedrollo, 2013; Batista e Barbosa, 2014; Araújo *et al.*, 2018; Milliken, 2021; CRIA: Oliveira, SKS, UFRR 8619, 2015; Luz, 1998; Pinho, 2008.
Senna occidentalis (L.) Link	Scasrîî, Fedegoso, Mangerioba, Mangirioba	Treatment of malaria, whooping cough, thumps, fever, chilblains, liver disorders, hepatitis, diabetes, cancer, inflammation, high blood pressure, heart, hemorrhoids	Doyle, M., 1985; Berg e Silva, 1988; Milliken, 1997 (1); Milliken, 1997 (2); Milliken, 1997 (4); Luz, 2001; Pedrollo, 2013; CRIA: Oliveira, SKS, UFRR 8530, 2015; CRIA: Oliveira, SKS, UFRR 8629, 2015; Luz, 1998.

Elaborated by the authors.Elaborated by the authors.

terms of the number of medicinal plant species (Coutinho *et al.*, 2015; Oliveira & Menini Neto, 2012).

Asteraceae is one of the largest angiosperm families, consisting of approximately 24,000 species and 1,600 genera (Roque *et al.*, 2017), and widely distributed in Brazil in different plant formations. Members of this family synthesize various secondary metabolites, especially sesquiterpene lactones, in addition to volatile oils and terpenoids (Cronquist, 1981). Perhaps these secondary metabolite profiles, together with the large number of species, are the main reasons for the relevance of this family in traditional medicine.

The Fabaceae, Lamiaceae, and Asteraceae together represent about 25% of all species. According to Saslis-Lagoudakis *et al.* (2012), the selection of species for medicinal use does not occur at random. A likely explanation is phylogenetic conservatism, since phylogenetically close species share medicinal properties.

The species with the highest number of citations were *Himatanthus articulatus* (15), *Libidibia ferrea* (13), *Hymenaea courbaril* (12), *Carica papaya*, *Fridericia chica*, and *Senna occidentalis* (10 each) (Figure 2, Table 5).

Himatanthus articulatus was the most frequently cited species in the state of Roraima, indicating great importance in the different SMLs. In this way, the species is widely sold in open-air markets in Boa Vista (Pinto & Maduro, 2002). In addition to the uses listed here, it was cited in the Peruvian Amazon for the treatment of malaria (Kvist *et al.*, 2006) and also in other states of Brazil for the treatment of coughs (Miranda *et al*., 2000), syphilis (Gilber, 2006), and tumors (Van Den Berg, 1982).

Libidibia ferrea, the second species with the highest number of citations, has been reported to have hepatoprotective (Barros *et al.*, 2014), anti-diabetic (Ueda, 2001), anti-inflammatory (Carvalho *et al.*, 1996), and anti-ulcer (Bacchi & Sertié, 1994). *Hymenaea courbaril* is used in traditional medicine to treat anemia, kidney problems, sore throats, and other airway diseases such as bronchitis and asthma (Cartaxo *et al.,* 2010).

Carica papaya is a rich source of proteolytic enzymes, such as papain, wich are used in the treatment of digestive and abdominal disorders, mainly dyspepsia, hyperacidity, dysentery, and constipation (Aravind *et al.*, 2013). *Fridericia chica*, also called crajiru, is known to have anti-inflammatory potential, and its leaves are widely used to treat colic, diarrhea, anemia, inflammation of the uterus, and skin wounds (Behrens *et al.*, 2012; Batalha *et al.*, 2022). *Senna occidentalis* is known to have antibacterial, antifungal, antidiabetic, anti-inflammatory, anticancer, antimutagenic, and hepatoprotective activity (Yadav *et al.*, 2010).

Distribution, form of growth, parts used, and main methods of preparation of medicinal plant species. Regarding origin of the 444 species included in this ethnobotanical review, 282 were classified as native, 108 as cultivated, and 54 as naturalized (Figure 3).

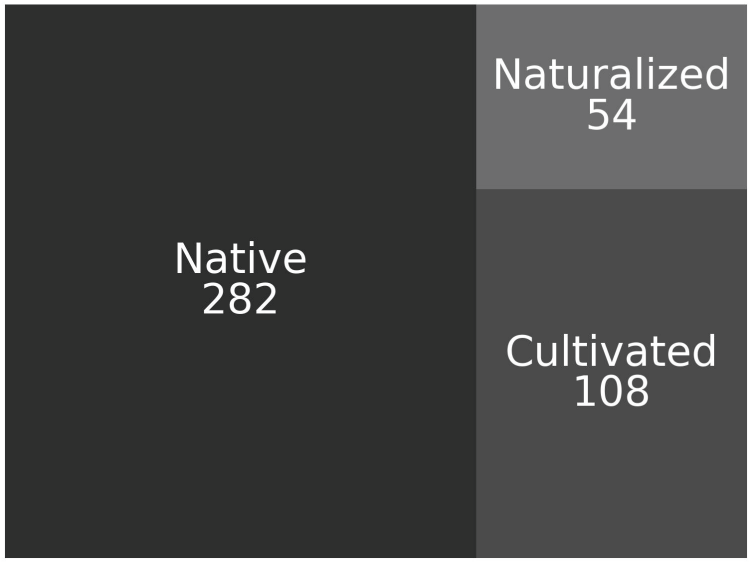

Figure 3. Origin of botanical species documented in Roraima for medicinal use.

Our analyzis showed that almost 65% of the mentioned plants are native. This result suggests that in the state of Roraima, the use of Amazonian flora remains an important resource in primary health care (Pascoa Júnior & Souza, 2021). This resource gains even more importance, considering that the state is home to great ethnic diversity, including 11 ethnic groups and 32 indigenous lands (Frank & Cirino 2010), and some of these communities are considered isolated, having little or no contact with external societies. Native

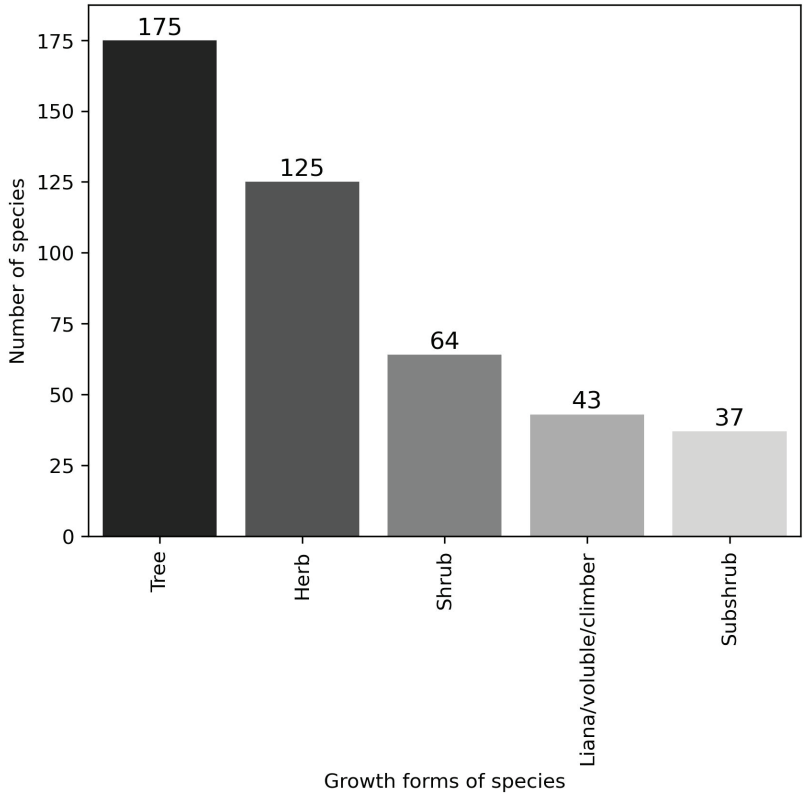

Figure 4. Growth forms of medicinal plant species in LMSs in Roraima, Brazil.

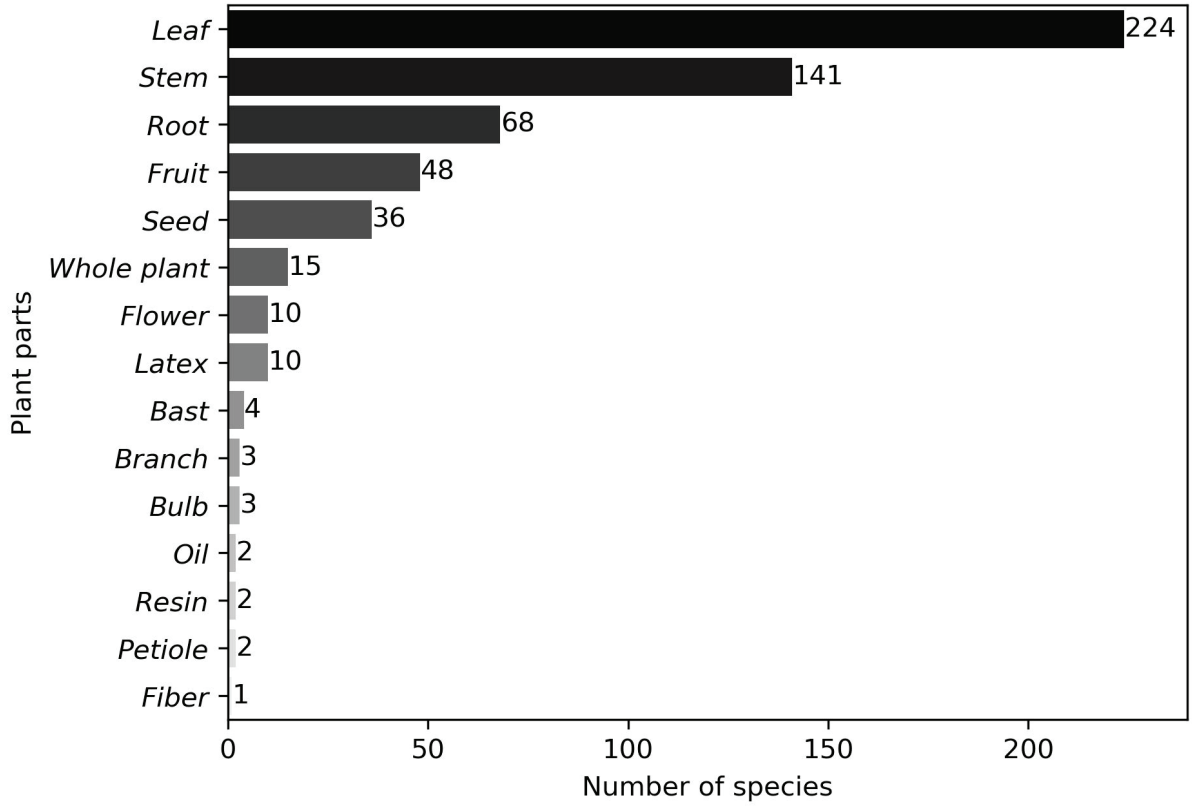

Figure 5. Plant parts utilized for medicinal purposes in LMSs in Roraima, Brazil.

medicinal species are structured an important resource for health care.

Among the botanical species and genera included in the review, the majority (175 spp.) have a tree life form, followed by herb (125 spp.), shrub (64 spp.), liana/voluble/climber (43 spp.), and subshrub (37 spp.) (Figure 4).

The Amazon rainforest has one of the greatest levels of plant biodiversity in the world, estimated at around 14,000 species, of which 6,727 are tree species. According to Coelho *et al.* (2021), many of these are useful tree species, used as fibers, shelter, medicinal use, food use, firewood, construction, poisons, dyes, clothing, and many others for several roles in the subsistence of local peoples. The high rate of use of tree species may be related to their availability. According to Phillips & Gentry (1993), plants with greater abundance, therefore more apparent in the landscape, are the most collected and used for various purposes.

Regarding the plant parts used, the leaf was the most cited part (224), followed by the stem (141), root (68), and fruit (48). The remaining parts (seed, flower, whole plant, latex, branch, bast, oil, resin, bud, bulb, petiole, and fiber) had a count of less than 45 citations (Figure 5).

The greater use of leaves in medical practice has been reported in the ethonobotanical literature (Alves *et al.*, 2008; Oliveira & Menini Neto, 2012; Vásquez *et al.*, 2014). In general, the leaves are collected more easily, in addition to being a resource found practically all year round, unlike flowers, fruits and seeds that are available in specific periods of the year, only in the flowering and fruiting periods, respectively.

On the other way, the high percentage of use of the stem (234) and the root (142) may represent a risk to the species used, since it may reduce the number of individuals in the areas where it is collected, in some cases even culminating in its disappearance, as pointed out by Rodrigues & Carvalho (2001).

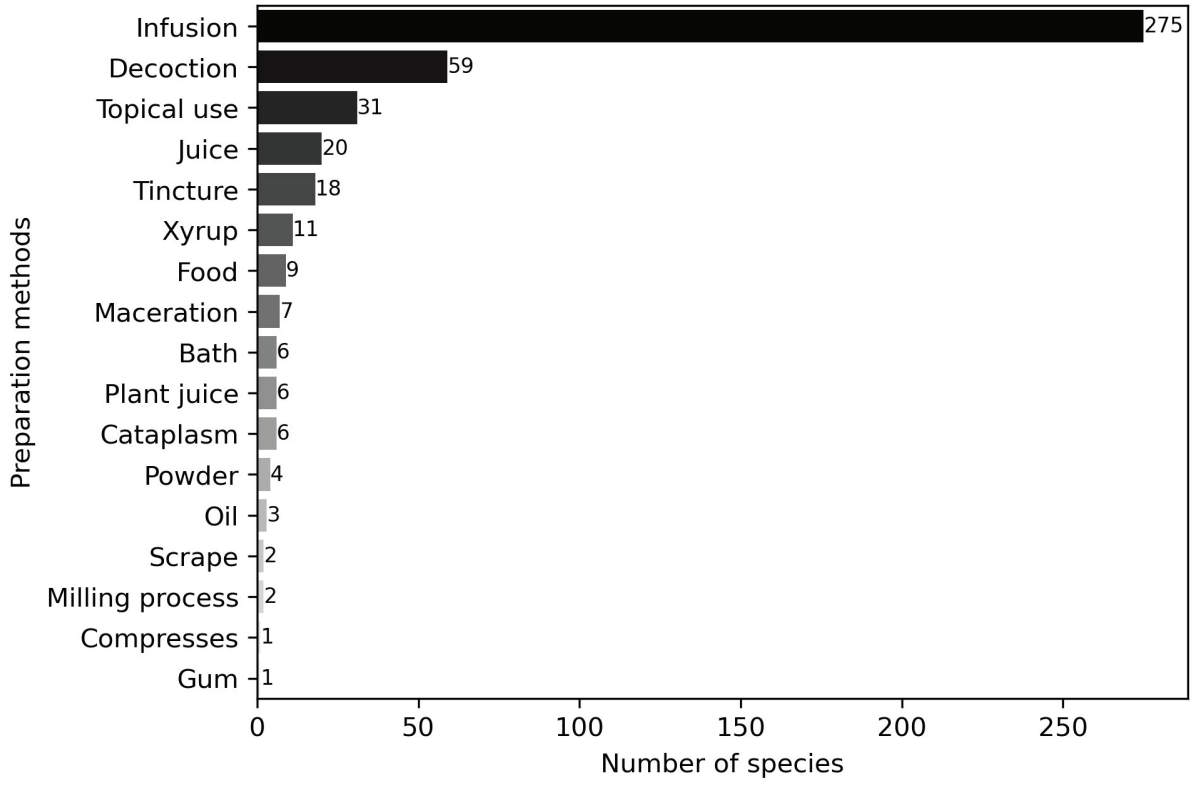

Figure 6. Preparation methods in medicinal practices in LMSs in Roraima, Brazil.

For the preparation methods of medicinal practices (Figure 6), infusion had a significant number, adding up to 275 citations, followed by decoction with 59, topical use with 31, juice with 20, and tincture with 18.

Other research investigations in the Amazon also indicated infusion as the most commonly used form of preparation (Vásquez *et al*., 2014; Bieski *et al.*, 2015; Amaral *et al.*, 2021). The infusion (see Table 2) is indicated for the most tender parts of the plants, reflecting, therefore, the most cited part of the plant, the leaf. The second most cited form of preparation, decoction, is indicated for the hardest parts, such as the stem, the second most cited part of the plant for medicinal purposes in LMSs of Roraima.

Therapeutic targets. The code DIP (certain infectious and parasitic diseases) was mentioned 375 times (Figure 7, Table 1). Symptoms, signs of clinical findings not elsewhere classified (SSA) got 284 citations, and Diseases of the digestive system were cited 173 times. Diseases of the genitourinary system obtained 102 citations, and Inflammation in general (IEG) received 95 citations. All other reasons for use had scores below 85 (Figure 7).

The prevalence of citations of the DIP code (Infectious or parasitic diseases), shows an alarming scenario for the state of Roraima and for the Amazon. In general. 99.5% of malaria records in Brazil come from the Legal Amazon region (PAHO 2017). There are many factors that influence the dynamics of communicable diseases such as malaria in the Amazon, including environmental factors, mainly deforestation (Chaves *et al.*, 2021; Laporta *et al.*, 2021); sociodemographics (migrations and population density); in addition to the biological (life cycle of vectors of infectious agents) and medical-social aspects (immune status of the human population; effectiveness of local health systems and specific disease control programs, etc.) (PAHO, 2017).

Considering the significant increase in deforestation in the Legal Amazon in recent years, as well as the recent

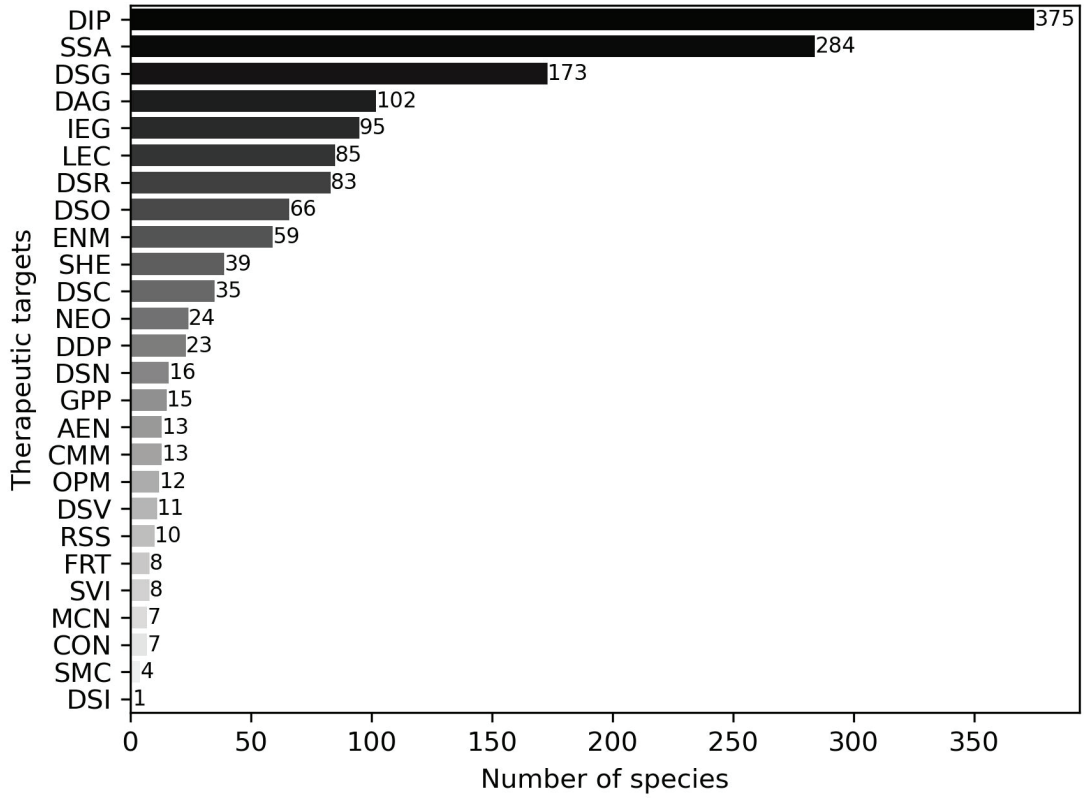

Figure 7. Therapeutic targets. DIP: Certain infectious or parasitic diseases; NEO: Neoplasms; DSO: Diseases of the blood or blood-forming organs; DSI: Immune system diseases; ENM: Endocrine, nutritional or metabolic disorder; MCN: Mental, behavioral, or neurodevelopmental disorders; SVI: Sleep-wake disorders; DSN: Nervous system diseases; VSD: Diseases of the visual system; OPM: Diseases of the ear or mastoid process; DCS: Diseases of the circulatory system; RSD: Diseases of the respiratory system; DSG: Digestive system diseases; DDP: Skin disease; CMS: Diseases of the musculoskeletal system or connective tissue; GAD: Diseases of the genitourinary system; RSS: Conditions related to sexual health; GPP: Conditions related to pregnancy, childbirth or puerperium; CPP: Certain conditions originating in the perinatal period; ADD: Developmental anomalies; SSA: Other specified symptoms, signs or clinical findings, not elsewhere classified; LEC: Other specified injury, poisoning or certain other consequences of external causes; CMM: External causes of morbidity or mortality; FSS: Factors influencing health status or contact with health services; IEG: Inflammation in general; AEN: Agents that primarily affect water and nutritional balance and metabolism; FRT: Fortifying; SHE: Symptoms or signs involving mood or emotion; CON: Contraceptive.

migration scenario of Venezuelans in the state of Roraima, it is likely that these numbers will be even higher in the coming years.

According to Brandão *et al.* (1992), in the Amazon region, where malaria is prevalent, there is a large floristic resource and a local tradition on the use of medicinal plants to treat malaria and fever. Thus, it is likely that the use of medicinal plants for specific therapeutic purposes is linked to epidemiological problems in the region.

In addition to malaria, according to Pithan *et al*. (1991), acute respiratory infections such as tuberculosis and sexually transmitted diseases had already been a problem among the indigenous peoples of the Yanomami ethnic group in Roraima since the 1980s, with a significant increase in the frequency of hospital admissions for patients from areas with greater mining concentration.

CONCLUSION

The results of this ethnobotanical review demonstrate that there is a great diversity of medicinal plants in the state of Roraima and that these resources are of great importance in SMLs. Most medicinal plant species are native and arboreal, which suggests that in the state of Roraima, the use of Amazonian flora remains an important resource in primary health care. The main therapeutic targets mentioned are infectious or parasitic diseases (DIP), mainly malaria, therefore, the use of medicinal plants reflects the epidemiological problems faced in the region. Our effort to register all this diversity as well

as the traditional knowledge associated with these species, in addition to valuing and preserving this knowledge, will allow it to be transmitted to future generations, especially in times of constant threats to this knowledge. Our results can also provide an overview for making more decisive decisions, wich are necessary for the conservation of the local flora, wich is used as a medicinal resource. In this way, our results can be used as subsidies for research and policies aimed at public health in the state of Roraima. Finally, we emphasize that the diversity of medicinal species in the state of Roraima can be infinitely greater since research in this region is still scarce. It is suggested, therefore, that future studies be carried out with different local populations, such as residents of rural settlements, extractivists from other districts of the municipality, and indigenous populations.

ACKNOWLEDGEMENTS

Our sincere gratitude goes to the *Fundo Nacional de Desenvolvimento da Educação* (FNDE) and *Programa de Educação Tutorial* (PET) for the financial support to the first author. We also extend our appreciation to the *Centro de Estudos da Biodiversidade* (CBio – UFRR) and the Federal University of Roraima (UFRR) for providing the necessary infrastructure for this study. Special thanks are due to Dr. William Milliken for his invaluable insights and guidance throughout this research. Additionally, we would like to express our appreciation to Professor Dr. Mariane Bosholn for her valuable insights and guidance at the inception of this research.

LITERATURE CITED

Almeida, S.S., P.L.B. Lisboa and A.S.L. Silva. 1993. Diversidade florística de uma comunidade arbórea na Estação científica "Ferreira Penna", em Caxiuanã (Pará). *Boletim do Museu Paraense Emílio Goeldi* 9(1): 93-128.

Alves, E.O., J.H. Mota, T.S. Soares, M.C. Vieira and C.B. Silva. 2008. Levantamento etnobotânico e caracterização de plantas medicinais em fragmentos florestais de Dourados-MS. *Ciência e Agrotecnologia* 32(2): 651–658. DOI: http://dx.doi.org/10.1590/S1413-70542008000200048

Amaral, R, B. Ribeiro, Q. Tronco and Y. Franco. 2021. Estudo etnobotânico de plantas medicinais na Reserva Extrativista Rio Preto Jacundá, Amazônia Brasileira. *Revista Geográfica Venezolana* 62(2): 468–479. DOI: https://doi.org/10.53766/rgv%2F2021.08

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. DOI: https://doi.org/10.1111/boj.12385

Araújo K.A., I.P.A Miranda, C. Camargo, M. Repetto. 2018. Knowledge of medicinal plants used by residents in two peripheral districts of Boa Vista, Roraima, Northern Brazilian Amazon: Phytotherapy as a New Strategy in Collective Health. *Journal of Medicinal Plants Research* 12(26): 435–547. DOI: http://dx.doi.org/10.5897/JMPR2018.6634

Aravind, G., D. Bhowmik, S. Duraivel and G. Harish. 2013. Traditional and medicinal uses of *Carica papaya*. *Journal of Medicinal Plants Studies* 1(1): 7-15.

Bacchi, E., and J. Sertié. 1994. Antiulcer action of *Styrax camporum* and *Caesalpinia ferrea* in rats. *Planta Medica* 60(2): 118–20. DOI: https://doi.org/10.1055/s-2006-959430

Baptista, M.M., M.A. Ramos, U. P. Albuquerque, G.C. Souza and M.R. Ritter. 2013. Traditional botanical knowledge of artisanal fishers in Southern Brazil. *Journal of Ethnobiology and Ethnomedicine* 9(54): 1-16. DOI: http://dx.doi.org/10.1186/1746-4269-9-54

Barbosa, R.I., M.R. Xaud, G.F.N. Silva and A.C Cattâneo. 2003. Forest fires in Roraima, Brazilian Amazonia. *International Forest Fire News* 28: 51-56.

Barbosa, R.I. 1993. Ocupação humana em Roraima II. Uma revisão do equívoco da recente política de desenvolvimento e o crescimento desordenado. *Boletim do Museu Paraense Emilio Goeldi* 9(2): 177-197.

Barros, A.O., R.S. Souza, E.SP. Aranha, L.M. Costa, T.P. Souza, M.C Vasconcellos and E.S Lima. 2014. Antioxidant and Hepatoprotective Activities of *Libidibia*

ferrea Bark and Fruit Extracts. *International Journal of Pharmacy and Pharmaceutical Sciences* 6(11): 71–76.

Batalha, A.D.S.J, D.C.M Souza, R.D. Ubiera, F.C.M. Chaves, W.M. Monteiro, F.M.A. Silva, H. H. F. Koolen, A.L. Boechat and M.A. Sartim. 2022. Therapeutic Potential of Leaves from *Fridericia chica* (Bonpl.) L. G. Lohmann: Botanical Aspects, Phytochemical and Biological, Anti-Inflammatory, Antioxidant and Healing Action. *Biomolecules* 12(9): 1-22. DOI: https://doi.org/10.3390/biom12091208

Batista, D.L. and R.I. Barbosa. 2014. Agrobiodiversidade urbana: composição florística, riqueza e diversidade de plantas nos quintais de Boa Vista, Roraima. *Revista Brasileira de Agroecologia* 9(2): 130–150.

Behrens, M.D., C.J.M Tellis and M.S. Chagas. 2012. *Arrabidaea chica* (Humb. & Bonpl.) B. Verlot (Bignoniaceae). *Revista Fitos* 7(4): 236–244.

Bieski, I.G.C., M. Leonti, J.T. Arnason, J. Ferrier, M. Rapinski, I.M.P. Violante, S.O. Balogun, J.F.C.A. Pereira, R.C.F. Figueiredo, C.R.A.S. Lopes, D.R. Silva, A. Pacini, U.P. Albuquerque and D.T.O. Martins. 2015. Ethnobotanical Study of Medicinal Plants by Population of Valley of Juruena Region, Legal Amazon, Mato Grosso, Brazil. *Journal of Ethnopharmacology* 173: 383–423. DOI: https://doi.org/10.1016/j.jep.2015.07.025

Brandão, M.G.L, T.S.M. Grandi, E.M.M Rocha, D.R. Sawyer and A.U. Krettli. 1992. Survey of Medicinal Plants Used as Antimalarials in the Amazon. *Journal of Ethnopharmacology* 36(2): 175–182. DOI: https://doi.org/10.1016/0378-8741(92)90018-m

Cardoso, D., T. Särkinen, S. Alexander, A.M. Amorim, V. Bittrich, M. Celis, D.C. Daly, P. Fiaschi, V.A. Funk, L.L. Giacomin, R. Goldenberg, G. Heiden, J. Iganci, C.L. Kelloff, S. Knapp, H. C. Lima, A.F.P. Machado, R.M. Santos, R.M. Silva, F.A. Michelangeli, J. Mitchell, P. Moonlight, P.L.R. Moraes, S.A. Mori, T.S. Nunes, T.D. Pennington, J.R. Pirani, G.T. Prance, L.P. Queiroz, A. Rapini, R. Riina, C.A.V Rincon, N. Roque, G. Shimizu, M. Sobral, J.R. Stehmann, W.D. Stevens, C.M. Taylor, M. Trovó, C. van den Berg, W. van der Werff, P.L. Viana, C.E. Zartman and R.C. Forzza. 2017. Amazon Plant Diversity Revealed by a Taxonomically Verified Species List. *Proceedings of the National Academy of Sciences* 114(40): 10695–10700. DOI: https://doi.org/10.1073/pnas.1706756114

Cartaxo, S.L., M.M.A. Souza and U.P. Albuquerque. 2010. Medicinal plants with bioprospecting potential used in semi-arid northeastern Brazil. *Journal of Ethnopharmacology* 131(2): 326–342. DOI: https://doi.org/10.1016/j.jep.2010.07.003

Carvalho, J.C.T., J.R.M. Teixeira, P.J.C. Souza, J.K. Bastos, D. Santos Filho and S.J. Sarti. 1996. Preliminary Studies of Analgesic and Anti-Inflammatory Properties of *Caesalpinia ferrea* Crude Extract." *Journal of Ethnopharmacology* 53: 175–78. DOI: https://doi.org/10.1016/0378-8741(96)01441-9

Chaves, L.S.M., E.S. Bergo, J.E. Conn, G.Z. Laporta, P.R. Prist and M.A.M. Sallum. 2021. Anthropogenic Landscape Decreases Mosquito Biodiversity and Drives Malaria Vector Proliferation in the Amazon Rainforest. *PLoS ONE* 16(1): 1-25. DOI: https://doi.org/10.1371/journal.pone.0245087

Coelho, S.D., C. Levis, F.B. Baccaro, F.O.G. Figueiredo, A.P. Antunes, H. ter Steege, M. Peña-Claros, C.R. Clement and J. Schietti. 2021. Eighty-Four per Cent of All Amazonian Arboreal Plant Individuals Are Useful to Humans. *PLoS ONE* 16(10): 1-17. DOI: https://doi.org/10.1371/journal.pone.0257875

Costa, I.B.C., F. Bonfim, M.C. Pasa and D. Montero. 2017. Ethnobotanical Survey of Medicinal Flora in the Rural Community Rio Dos Couros, State of Mato Grosso, Brazil. *Latin American and Caribbean Bulletin of Medicinal and Aromatic Plants* 16(1): 53–67.

Coutinho, P.C., Z.A. Soares, E.C. Ferreira, D.V. Souza, R.S. Oliveira and R.F.P. Lucena. 2015. Knowledge and use of medicinal plants in the Semiarid Region of Brazil. *Brazilian Journal of Biological Sciences* 2(3):51-74.

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York, USA.

Doyle, M. 1985. Contribuição à flora medicinal dos índios Macuxi. Manaus, Amazonas: Centro de Ciências Biológicas, UFAM.

Dunn, F. 1976. Traditional Asian medicine and cosmopolitan medicine as adaptive systems. In:

LESLIE C. (Org.). Asian medical systems: a comparative study. University California Press, California, USA.

Falcão, M.T. 2016. Ambiente e conhecimento tradicional da etnia Ingarikó na Terra Indígena Raposa Serra Do Sol – Roraima: abordagem etnocientífica no estudo do uso da terra. PhD thesis, Museu Paraense Emílio Goeldi, Brazil.

Ferreira Júnior, W.S. and U.P. Albuquerque. 2018. A theoretical review on the origin of medicinal practices in humans: echoes from evolution. *Ethnobiology and Conservation* 7: 1-7. DOI: http://dx.doi.org/10.15451/ec2018-02-7.03-1-7

Ferreira, LV and G.T. Prance. 1998. Species richness and floristic composition in four hectares in the Jaú National Park in upland forests in Central Amazonia. *Biodiversity & Conservation* 7: 1349-1364. DOI: https://doi.org/10.1023/A:1008899900654

Flora e Funga do Brasil. 2023. Jardim Botânico do Rio de Janeiro. Available in: http://floradobrasil.jbrj.gov.br. (verified in 05/01/2023).

Frank, E.H. and C.A. Cirino. 2010. Des-Territorialização E Re-Territorialização Dos Indígenas de Roraima: Uma Revisão Crítica. In: Barbosa RI, Melo VF. Roraima: Homem, Ambiente e Ecologia. FEMACT, Boa Vista, Roraima, Brazil.

Frausin, G, A.F. Hidalgo, R.B.S. Lima, V.F. Kinupp, L.C. Ming, A.M. Pohlit and W. Milliken. 2015. An Ethnobotanical Study of Anti-Malarial Plants among Indigenous People on the Upper Negro River in the Brazilian Amazon. *Journal of Ethnopharmacology* 174: 238–252. DOI: https://doi.org/10.1016/j.jep.2015.07.033

Gilbert, B. 2006. Produtos Naturais Industrializáveis Da Amazônia. *Revista Fitos* 2: 30–38.

Henrich, J. and R. Mcelreath. 2003. The evolution of cultural evolution. *Evolutionary Anthropology: Issues, News, and Reviews* 12: 123-135. DOI: https://doi.org/10.1002/evan.10110

Instituto Brasileiro de Geografia e Estatística (IBGE). 2012. População estimada [2021]. Available in: https://cidades.ibge.gov.br/brasil/rr/panorama. (Verified in 01/05/2023).

Kleinman, A. 1978. Concepts and a model for the comparison of medical systems as cultural systems. Social Science & Medicine. Part. B. *Medical Anthropology* 12(2B): 85- 93. DOI: https://doi.org/10.1016/0160-7987(78)90014-5

Kvist L.P., S.B. Christensen, H.B. Rasmussen, K. Mejia and A. Gonzalez. 2006. Identification and Evaluation of Peruvian Plants Used to Treat Malaria and Leishmaniasis. *Journal of Ethnopharmacology* 106(3): 390–402. DOI: https://doi.org/10.1016/j.jep.2006.01.020

Laporta, G.Z., R.C. Ilacqua, E.S. Bergo, L.S.M Chaves, S.R. Rodovalho, G.G. Moresco, E.A.G. Figueira, E. Massad, T.M.P. Oliveira, S.A. Bickersmith, J.E. Conn and M.A.M. Sallum. 2021. Malaria e Transmission in Landscapes with Varying Deforestation Levels and Timelines in the Amazon: A Longitudinal Spatiotemporal Study. *Scientific Reports* 11(6477): 1-14. DOI: https://doi.org/10.1038/s41598-021-85890-3

Lima, P.A.V. 2021. Manejo da Dor em Comunidade Ribeirinhas na Amazônia Brasileira. Master dissertation. Universidade Federal do Amazonas, UFAM, Brazil.

Luz, F.J.F. 1998. Plantas medicinais de uso popular no municipio de Sao Luis do Anauá, Roraima. Roraima: EMBRAPA-CPAF.

Luz, F.J.F. 2001. Plantas medicinais de uso popular em Boa Vista, Roraima, Brasil. Horticultura Brasileira 19: 88–96.

Milliken, W and B. Albert. The Use of Medicinal Plants by the Yanomami Indians of Brazil. 1996. *Economic Botany* 50(1): 10–25.

Milliken W, Albert B. The Use of Medicinal Plants by the Yanomami Indians of Brazil, Part II. 1997. *Economic Botany* 51(3): 264–278.

Milliken, W. 1997. Malaria and Antimalarial Plants in Roraima, Brazil. *Tropical Doctor* 27: 20–25. DOI: https://doi.org/10.1177/004947559702701S1

Milliken, W. 1997. Traditional anti-malarial medicine in Roraima, Brazil. *Economic Botany* 51: 212–237.

Milliken W. 1998. Plantas Medicinais, Malária e Povos Indígenas: Estudos Etnobotânicos No Norte Da Amazônia. *Boletim Do Museu Integrado de Roraima (Online)* 4(1): 23–30. DOI: https://doi.org/10.24979/bolmirr.v4i01.727

Milliken, W. 1998. Structure and composition of one hectare of central amazonian terra firme for-

est. *Biotropica* 30(4): 530-537. DOI: http://dx.doi.org/10.1111/j.1744-7429.1998.tb00093.x

Milliken, W. 2021. "Traditional Medicines amongst Indigenous Groups in Roraima, Brazil: A Retrospective." *Ethnoscientia - Brazilian Journal of Ethnobiology and Ethnoecology* 6(3): 116-138. DOI: http://dx.doi.org/10.18542/ethnoscientia.v6i3.10503

Miranda, A., J. Silva, C. Rezende, J. Neves, S. Parrini, M. Pinheiro, M. Cordeiro, E. Tamborini and A. Pinto. 2000. Anti-Inflammatory and Analgesic Activities of the Latex Containing Triterpenes from *Himatanthus sucuuba*. *Planta Medica* 66(3): 284–86. DOI: https://doi.org/10.1055/s-2000-8572

Miranda, I.S. and M.L. Absy. 2000. Fisionomia das savanas de Roraima, Brasil. *Acta Amazonica* 30(3): 423-423. DOI: https://doi.org/10.1590/1809-43922000303440

Mojica, J.B. 2018. Uso de plantas alimentícias e medicinais na Comunidade Indígena Nova Esperança, Terra Indígena São Marcos – Município De Pacaraima/ Roraima. Master dissertation. Universidade Federal de Roraima, UFRR, Brazil.

Moraes, L.L.C., J.L. Freitas, J.R. Matos Filho, R.B.L. Silva, C.H.A. Borges and A.C. Santos. A Ethno-Knowledge of Medicinal Plants in a Community in the Eastern Amazon. 2019. *Revista de Ciências Agrárias* 42(2): 565–573. DOI: https://doi.org/10.19084/rca.15625

Nelson, B.W. and A.A. Oliveira. Área Botânica. 2001. In: Capobianco, JPR. Biodiversidade na Amazônia Brasileira. Editora Estação Liberdade/Instituto Socioambiental, São Paulo, Brazil, Pp. 132–176.

Niño, E.A.L. 2020. Migração, Cidades e Fronteiras: a Migração Venezuelana nas Cidades Fronteiriças do Brasil e da Colômbia. *Espaço Aberto* 10(1): 51-67. DOI: https://doi.org/10.36403/espacoaberto.2020.29956

Oliveira, E.R. and L. Menini Neto. 2012. Levantamento etnobotânico de plantas medicinais utilizadas pelos moradores do povoado de Manejo, Lima Duarte - MG. *Revista Brasileira de Plantas Medicinais* 14(2): 311-320. DOI: https://doi.org/10.1590/S1516-05722012000200010

Oliveira, P.C. and J. Braga. 2017. Ethnobotany of Borari-Arapiuns Indigenous People, Amazon, Brazil. *Journal of Medicinal Plants Studies* 5(1): 164–170.

Oliveira, R.L.C., L.F.P. Almeida, V.V. Scudeller and R.I. Barbosa. 2021. Conservation Priorities for Woody Medicinal Plants in an Indigenous Community in a Savanna Area of the Northern Brazilian Amazon. *Ambiente: Gestão e Desenvolvimento* 14(3) 38–44. DOI: https://doi.org/10.24979/ambiente.v14i3.953

Oliveira, R.L.C., L.F.P.D. Almeida, M.F.B. Durigan, V.V. Scudeller and R.I. Barbosa. 2019. Conhecimento tradicional e usos de copaíba pela comunidade Makuxi Darora na Savana de Roraima. *Gaia Scientia* 13(2): 64-72. DOI: https://doi.org/10.22478/ufpb.1981-1268.2019v13n2.46242

Oliveira, R.L.C., L.F.P.D. Almeida, M.F.B. Durigan, V.V. Scudeller and R.I. Barbosa. 2021. Espécies arbóreas de uso múltiplo em uma comunidade makuxi no lavrado de Roraima, Amazônia brasileira. In: Falcão MT, Gomide PHO. Sociobiodiversidade Amazônica: Saberes, olhares e práticas agroecológicas. UERR Edições, Roraima, Brazil.

Oliveira, R.L.C., L.F.P.D. Almeida, V.V. Scudeller and R.I. Barbosa. 2020. Traditional botanical knowledge variation between gender and age in a Makuxi community in Roraima savanna, Northern Brazilian Amazonia. *Ethnoscientia - Brazilian Journal of Ethnobiology and Ethnoecology* 5(1): 1-12. DOI: http://dx.doi.org/10.18542/ethnoscientia.v5i1.10295

Oliveira, R.L.C., S.O.D. Brito, L.F.P.D. Almeida, V.V. Scudeller and R.I. Barbosa. 2019. Uso e extrativismo do angico numa comunidade indígena na savana de Roraima, norte da Amazônia Brasileira. *Ambiente: Gestão e Desenvolvimento* 12(1): 47–52. DOI: https://doi.org/10.24979/193

Oliveira, R.L.C., V.V. Scudeller and R.I. Barbosa. 2017. Use and traditional knowledge of *Byrsonima crassifolia* and *B. coccolobifolia* (Malpighiaceae) in a Makuxi community of the Roraima savanna, northern Brazil. *Acta Amazonica* 47(2): 133–140. DOI: https://doi.org/10.1590/1809-4392201600796

Pan American Health Organization (PAHO). Interactive Malaria Statistics. Pan American Health Organization, Washington. 2017. Available in: http://ais.paho.org/phip/viz/malaria_surv_API_popup.asp. (Verified in 05/01/2021).

Pascoa Júnior, J.G. and I.L.L. Souza. 2021. Medicinal Plants Used in the Amazon Region: A Systematic Review. *Research, Society and Development* 10(14): 1-16. DOI: https://doi.org/10.33448/rsd-v10i14.19965

Pedrollo, C.T., C.F. Kinupp, G. Shepard and M. Heinrich. 2016. Medicinal Plants at Rio Jauaperi, Brazilian Amazon: Ethnobotanical Survey and Environmental Conservation. *Journal of Ethnopharmacology* 186: 111–124. DOI: https://doi.org/10.1016/j.jep.2016.03.055

Pedrollo, C.T. 2013. Baixo Jauaperi: da farmacopeia ao sistema de saúde–um estudo etnobotânico em comunidades ribeirinhas. 2013. Master dissertation, Instituto Nacional de Pesquisas da Amazônia, INPA, Brazil.

Penido, A.B., S.M. Morais, A.B. Ribeiro and A.Z. Silva. 2016. Ethnobotanical Study of Medicinal Plants in Imperatriz, State of Maranhão, Northeastern Brazil. *Acta Amazonica* 46(4): 345–354. DOI: https://doi.org/10.1590/1809-4392201600584

Perez, I.U. 2010. Uso dos recursos naturais vegetais na Comunidade Indígena Araçá, Roraima. Master thesis, Universidade Federal de Roraima, UFRR, Brazil.

Phillips, O.L. and A.H. Gentry. 1993. The useful plants of Tambopata, Peru. II: Additional hypothesis testing in quantitative ethnobotany. *Economic Botany* 47: 33-43. DOI: https://doi.org/10.1007/BF02862204

Pinho, R.C. 2008. Quintais agroflorestais indígenas em área de savana (lavrado) na terra indígena araçá, Roraima. Master dissertation. Instituto Nacional de Pesquisas da Amazônia, INPA, Brazil.

Pinto, A.A.C. and C.B. Maduro. 2003. Produtos e subprodutos da medicina popular comercializados na cidade de Boa Vista, Roraima. *Acta Amazonica* 33(2): 281–290. DOI: https://doi.org/10.1590/1809-4392200332290

Pithan, O.A., U.E.C. Confalonieri and A.F. Morgado. 1991. A Situação de Saúde Dos Índios Yanomámi: Diagnóstico a Partir Da Casa Do Índio de Boa Vista, Roraima, 1987 - 1989. *Cadernos de Saúde Pública* 7(4): 563–580.

Porte, A. and R.L. Godoy. 2001. Alecrim (*Rosmarinus officinalis* L.): propriedades antimicrobiana e química do óleo essencial. *Boletim do Centro de Pesquisa e Processamento de Alimentos* 19(2): 193-210.

POWO. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. 2023. http://www.plantsoftheworldonline.org/. (Accessed 05/01/2023).

Prakash, O., M. Chandra, A.K. Pant and D.S. Rawat. 2016. Chapter 64 - Mint (*Mentha spicata* L.) Oils. In: Preedy, V.R. Essential Oils in Food Preservation, Flavor and Safety. Academic Press.

Rede Amazônica de Informação Socioambiental Georreferenciada (RAISG). Pressões e Ameaças. 2020. https://www.amazoniasocioambiental.org/pt-br/mapas/. (Accessed 01/02/2020).

Rodrigues, T. and A.O. Souza. 2021. Local Knowledge and Botanical Teaching at Campo De Caroebe/Roraima School. *Journal of Earth and Environmental Sciences Research* 3(5): 1-7. DOI: http://dx.doi.org/10.47363/JEESR/2021(3)156

Rodrigues, V.E.G. and D.A. Carvalho. 2007. Levantamento etnobotânico de plantas medicinais no domínio do cerrado na região do Alto Rio Grande – Minas Gerais. *Revista Brasileira de Plantas Medicinais* 9(2): 17-35.

Roque, N., A.M. Teles and J.N. Nakajima. 2017. A família Asteraceae no Brasil: classificação e diversidade. EDUFBA, Salvador, Brazil.

Salomão, R.P., M.F.F. Silva and N.A. Rosa. 1988. Inventário Ecológico Em Floresta Pluvial Tropical de Terra Firme, Serra Norte, Carajás, Pará. *Boletim Do Museu Paraense Emílio Goeldi* 4(1): 1–46.

Santos, R.A., C.P. Oliveira, G.A. Oliveira and A.G. Rosário. 2013. Use of Medicinal Plants as Coping Strategies of the Most Common Diseases in the southern State of Roraima. *Cadernos de Agroecologia* 8(2): 1-5.

Sarquis, R.S., I. Sarquis, C.P. Fernandes, G.A. Silva, R.B.L. Silva, M.A.G. Jardim, B.L. Sánchez-Ortíz and J.C.T. Carvalho. 2019. The Use of Medicinal Plants in the Riverside Community of the Mazagão River in the Brazilian Amazon, Amapá, Brazil: Ethnobotanical and Ethnopharmacological Studies. *Evidence-Based Complementary and Alternative Medicine* 2019: 1–25. DOI: https://doi.org/10.1155/2019/6087509

Saslis-Lagoudakis, C.H., V. Savolainen, E.M. Williamson, F. Forest, S.J. Wagstaff, S.R. Baral, M.F. Watson, C.A. Pendry and J.A. Hawkins. 2012. Phylogenies reveal predictive power of traditional medicine in bioprospecting. *Proceedings of the National Academy of Sciences of the United States of America* 109(39): 15835-15840. DOI: https://doi.org/10.1073/pnas.1202242109

Sette-Silva, E.L. 1997. A vegetação de Roraima. In: Barbosa RI, Ferreira EJG, Castellón EG (eds). Homem ambiente e ecologia no Estado de Roraima. INPA, Manaus, Amazonas, Brazil.

Silva, A.S.L., S.S. Almeida and P.L.B. Lisboa. 1993. Diversidade Florística de Uma Comunidade Arbórea Na Estação Científica 'Ferreira Penna', Em Caxiuanã (Pará). *Boletim Do Museu Paraense Emilio Goeldi* 9(1): 93–188.

Silva, J.D.A., M.G.P. Nascimento, L.G. Grazina, K.N.C. Castro, S.J. Mayo and I.M. Andrade. 2015. Ethnobotanical Survey of Medicinal Plants Used by the Community of Sobradinho, Lus Correia, Piau, Brazil. *Journal of Medicinal Plants Research* 9(32): 872–883. DOI: 10.5897/JMPR2015.5881

Silva, V.D.A.D, S.A. Costa, F.D.C.F Silva, A.D.S. Silva and C.E.M.D. Silva. 2016. Uso de espécies arbóreas florestais no tratamento medicinal alternativo em Rorainópolis, Roraima. *Revista Eletrônica Ambiente* 8: 122-128.

Souza, E.N.F. and J.A. Hawkins. 2020. Ewé: A Web-Based Ethnobotanical Database for Storing and Analysing Data. *Database* 2020: 1-9. DOI: https://doi.org/10.1093/database/baz144

Staub, P.O., M.S. Geck, C.S. Weckerle, L. Casu and M. Leonti. 2015. Classifying Diseases and Remedies in Ethnomedicine and Ethnopharmacology. *Journal of Ethnopharmacology* 174: 514–519. DOI: https://doi.org/10.1016/j.jep.2015.08.051

Ter Steege, H., D. Sabatier, H. Castellanos, T. van Andel, J. Duivenvoorden, A.A. Oliveira, R.E.R Lilwah, P. Maas and S. Mori. 2000. An Analysis of the Floristic Composition and Diversity of Amazonian Forests Including Those of the Guiana Shield. *Journal of Tropical Ecology* 16: 801. DOI: https://doi.org/10.1017/S0266467400001735

Terborgh, J. and E. Andresen. 1988. The composition of Amazonian forests: patterns at local and regional scales. *Journal of Tropical Ecology* 14(5): 645-664. DOI: https://doi.org/10.1017/S0266467498000455

Tokuoka, T. 2012. Molecular phylogenetic analysis of Passifloraceae sensu lato (Malpighiales) based on plastid and nuclear DNA sequences. *Journal of Plant Research* 125(4): 489-497. DOI: https://doi.org/10.1007/s10265-011-0472-4

UEDA, H. 2001. Aldose Reductase Inhibitors from the Fruits of Mart. *Phytomedicine* 8(5): 377–81. DOI: https://doi.org/10.1078/0944-7113-00043

van den Berg, M.E. 1982. Plantas medicinais na Amazônia: contribuição ao seu conhecimento sistemático. CNPq/PRU/MPEG, Belém, Pará, Brasil.

van den Berg, M.E. and M.H.L Silva. 1988. Contribuição ao conhecimento da flora medicinal de Roraima. *Acta Amazonica* 18: 23–35. DOI: https://doi.org/10.1590/1809-43921988185035

Vandebroek, I., J.B. Calewaert, S. De, S. Sanca, L. Semo, P. Damme, L. Puyvelde and N.D. Kimpe. 2004. Use of Medicinal Plants and Pharmaceuticals by Indigenous Communities in the Bolivian Andes and Amazon. *Bulletin of the World Health Organization* 82(4): 243–250.

Vásquez, S.P.F., M.S. Mendonça and S.N. Noda. 2014. Etnobotânica de Plantas Medicinais Em Comunidades Ribeirinhas Do Município de Manacapuru, Amazonas, Brasil. *Acta Amazonica* 44(4): 457–472. DOI: https://doi.org/10.1590/1809-4392201400423

World Health Organization. International statistical classification of diseases and related health problems (11th ed.). 2022. Available in: https://icd.who.int/. (Verified in 08/01/2021).

Yadav J.P., V. Arya, S. Yadav, M. Panghal, S. Kumar and S. Dhankhar. 2010. *Cassia occidentalis* L.: A Review on Its Ethnobotany, Phytochemical and Pharmacological Profile. *Fitoterapia* 81: 223–230. DOI: https://doi.org/10.1016/j.fitote.2009.09.008