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# Ethnobotany of Medicinal Plants in Communities of the Arari Itacoatiara Region - Brazilian Amazon

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**Abstract:** ***Ethnobotany links cultural and environmental factors with conceptions regarding plants and the uses that are made of them. A study was made in nine communities in the Arari region of the Itacoatiara municipality of Amazonas State, Brazil, using semi-structured interviews and participant observation to identify the medicinal plants, what they were used for and the age groups of holders of such knowledge. Holders of traditional knowledge were mostly women aged 55 or older (70%). During the survey, 384 references were obtained, involving 105 species from 40 botanical families. Leaves were the most commonly used plant part, most commonly in the form of a tea. Illness symptoms were distinguished using the DATA-SUS classification. Stomach and throat ailments were the most cited. Plants were also used in the pursuit of mental well-being, as in combating the ´evil eye´. Some prominent species received ten or more references, and indices of Fidelity (0.8) and Order Significance (0.64) placing aloe (Aloe vera (L.) Burm. F.) in first place, followed by West Indian goosefoot (Chenopodium ambrosioides L.) (0.72 and 0.51) and mojito mint (Mentha villosa Huds) (0.66 and 0.43). Despite the existence of a large number of medicinal species and their widespread use among older people, few young people held medicinal plant knowledge. Some way of introducing traditional knowledge to this age group is needed.***

**Keywords:** traditional knowledge, economic botanic, fitoterapia, Itacoatiara

## 1. Introduction

The Amazon forest has high biological diversity and its natural resources have formed the basis of the wealth of societies that have existed for centuries in these ecosystems. According to Diegues (1996), the use of plant resources is firmly embedded in the popular culture of traditional populations and is transmitted from parents to children.Ethnobotany contributes to the systematic organization of botanical knowledge about the use of plant resources in the various biomes. In Brazil, ethnobotanical research on medicinal plant use has occurred throughout the country, but has been especially strong in the northeast and southeast of the country. Knowledge and use of medicinal plants are found even in urban areas of Amazonia. Silveiro et al., (2012), studying urban backyards of Rio Branco city (Acre State), recorded 109 species of medicinal use. In the municipality of Manacapuru-AM the use of medicinal plants also remains an important tool in maintaining the health of rural communities. Vasquez et al., (2015) reported the use of 171 species, while (CASSINO, 2010) (found 103 and 140 species in use in different communities in this municipality.

The populations classified as "traditional" are those whose space occupation model and use of natural resources focus mainly on subsistence, with weak links to commercial markets. Ethnobotanical studies can reveal the presence or absence of traditional knowledge related to information transfer regarding medicinal plants. Many authors (GOMES et al., 2014; LEITE et al., 2015; LIMA, 2015)have identified oral transmission as the main form by which knowledge of medical plant use is transferred in such populations. This process occurs informally in day-to-day living. Most often, parents, grandparents or older members of the family pass on such knowledge within the domestic group. This paper presents a survey of the medicinal plants used by rural communities along the Arari River, Itacoatiara, Amazonas state, Brazil. The uses of medicinal plants were investigated via recorded statements of the plant part employed, the form of preparation of homemade medicines and the age of knowledge-holder groups, allowing an analysis of the extent of traditional knowledge of medicinal plants.

## 2. Material and Methods

### Study Area

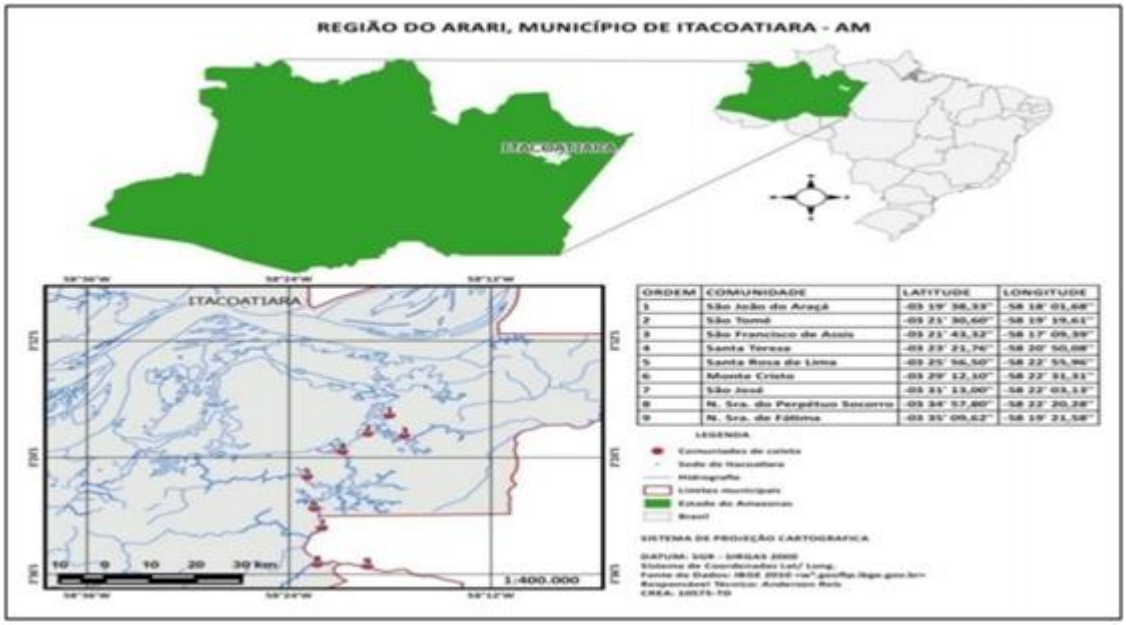


**Figure 1:** Study area location within the State of Amazonas, Brazil (Datum: Sirgas 2014)

**Obtaining secondary data**

The Itacoatiara Municipal Secretariat of the Interior provided geographic coordinates, socioeconomic data, number of households and the most recent population estimates for communities in the Arari River area.

**Selection of respondents and sample composition**

Sampling was conducted using the non-probabalistic (snowball) method. Respondents who had been raised locally and also made use of medicinal plants were interviewed and then asked to identify other local residents as being holders of traditional knowledge concerning such plants. Communities' visits were determined at random.

Data collection occurred from September 2014 to May 2015. Consent of all participants was obtained in all communities, with the signing of a formal agreement form. This form and the study itself, were both approved by the Research Ethics Committee of the Federal University of Amazonas (Protocol No. 745 524, of 06.08.2014).

## 3. Interviews with Contributors, Collection and Identification of Plant Species

Interviews were conducted individually and took place mostly in the morning (and never later than 14:00). They comprised questions relating to socio-economic aspects of the respondents (age, gender, education, origin, marital status, number of residents in the house, activities undertaken and benefits received), knowledge of plant resources in the region and their respective local customs. Contact with informants was maintained for an extended period, allowing observation of the participants to confirm their uses of plants in everyday life. This allowed the study to reach well beyond detailed description of situational components, and enter into an identification of the meaning, orientation and dynamics of each moment (SPRADLEY, 1980).

Fertile botanical voucher specimens were collected after interviews with the respondent indicating the location in the community area of a particular plant. These are housed in the herbarium of the Center for Advanced Studies, Itacoatiara/ University of Amazonas (CESIT/UEA), with numbers Hitam 4300- 4349. If sterile (lacking flower or fruit) plants were recorded only with photographs.

Identifications were made using local floras, comparison with species cited in scientific articles and the help of experts. Scientific names were checked using the Tropicos database (http://www.tropicos.org) and List of Species of the Flora of Brazil. The taxon order follows APG III.

Diseases mentioned by respondents were classified according to ICD-10, International Statistical Classification of Diseases and Related Health Problems (WHO, 2000).

### 3.1 Data analysis

We used Excel to categorize plants by respondent groups, to track frequency of plant species citations and to characterize informants based on socioeconomic information. A Loyalty Index (LI) was calculated for each plant, based on the agreement between different informant´s responses as to that plant's main therapeutic property (FRIEDMAN et al., 1986). Priority Ordering (PO) was also obtained for each plant, combining data from the LI and the Relative Popularity Index (RPI) (ALBUQUERQUE; ANDRADE 2002; AMARAL, 2008)

The Statistical Program *PAST*, Ward's method was used to obtain pairwise similarities between the lists of medicinal plant species from each communities sampled on the Arari River, to obtain a cluster diagram. Similarity is calculated by the formula:

$$D_{ij} = \frac{ninj}{ni+nj} * d^2(Gi, Gj)$$

ni = number of elements of cluster i;
nj = number of elements of cluster j;
Gi = center of gravity of cluster i;

Gj = center of gravity of cluster j;
$d^2(Gi, Gj)$ = Euclidian square of distance between Gi and Gj.

The Ward method is also called the "Minimum Variance" (MINGOTI, 2005). Groups are formed in the cluster diagram by maximizing within-group homogeneity, based on the within-group sum of squares.

Shannon Wiener diversity index and evenness index were calculated for each plant list of each community to allow comparisons between the diversity of ethnobotanical knowledge of different communities and to characterize the diversity of knowledge across the area as a whole. The formula used to calculate the Shannon-Wiener diversity index is:

$$S.H = -\sum_{i=1}^{S} pi * log2 * pi$$
$$pi = \frac{ni}{N}$$

where:
S = number of species;
ni= number of records per specie i;
N = total number of records;
Pi = sample of total proportion that belongs to specie i;
H '= Evenness index.
All other collected information was analyzed descriptively.

## 4. Results and Discussion

All 36 research participants were female. Average age was 54 years, ranging 19 to 78 years. The two oldest age classes, 55-78 years, held 69% of respondents. The identification of women as prime possessors of medicinal plant knowledge is not uncommon in ethnobotanical studies. This is generally attributed to their spending more time at home and being responsible for taking care of the family and household environment, including cultivation of medicinal plants (SILVA et al., 2015; VÁSQUEZ et al., 2015; LEITE et al., 2015; OLIVEIRA;MENINI, 2012; LIPORACCI; SIMAO 2013; VENDRUSCOLO; MENTZ, 2006; CARVALHO et al., 2013). However, this may no longer be the case, as most respondents reported obtaining pertinent knowledge from their mothers and grandmothers. This may well be because of the increased contact of older women with younger in household chores that will include caring for plants that grow in their yards, and preparing teas, baths and other uses of these plants. The great majority of people interviewed originate from the Arari region and have remained there, favoring transfer of herbal knowledge from one generation to the next.

With regard to age, (LEITE et al., 2015) conducted an ethnobotanical survey in rural Amazonian communities that gave an age range very close to that recorded in the current study.

The cultivation of plants in the region occurs both for the respondent´s own use and for exchange with neighbors and relatives. Preparation of some of the more elaborate remedies such as syrups and potions is more restricted, and the holders of such knowledge are generally older (69% of respondents being 55-78 years).

Most respondents (61%) were retired. The remainder worked in a variety of activities: housewife (8%), rural agriculturalists (19%), fisherfolk (3%), health workers (6%) and cooks (3%). The incomes of these women showed little variation. Most received benefits amounting to a minimum wage (67%) that included retirement payment and other salaries. Fourteen percent of respondents received only financial aid from federal income transfer programs (e.g., Bolsa Família, Bolsa Escola) and 19% had income of two minimum salaries resulting from the sum of the salary paid by their professional activities and/or her husband's retirement and pension.

Similar results have been found in many ethnobotanical studies in both rural and urban areas of Brazil. In study of the use of medicinal plants São Luis (Maranhão state), (GOMES et al. 2014) found that the great majority of informants were residents with low economic status and low levels of state education. Souza and Pasa ( 2013) reported similar results in rural Rondonópolis (Mato Grosso state, Brazil) in terms of respondents' formal education: 50% of respondents had not finished elementary school and only 8% had done so.

At the localities studied on the Arari most informants grew-up either in the communities where they now reside or in the immediate Arari region (72%). The remainder were from other municipalities of Amazonas or the neighboring state of Pará (Table 2). Most are married (58%) and Catholicism is the predominant religion (92%). For 83% of respondents ´incomplete primary´ was highest level of education attained. Only one informant had a high school education (Table 2).

That the great majority of informants originated either in the communities where they now live or in some part of the Arari region should facilitate their access to knowledge of many species of medicinal use and acquisition of that knowledge. Similar patterns of birth and residence for informants and holders of traditional knowledge has been commonly found (SIVIERO et al. 2012; GOMES, 2014; CRUZ et al. 2011). In contrast, in communities in the city of Montes Claros (Minas Gerais state), it found that more than 50% of respondents do not have their origin in their current location (PIRES et al. 2014).

In the Arari region most medicinal plants are grown in household backyards (89%) (Table 2). Many authors highlight gardens and yards as predominant areas for the cultivation of such plant species (SIVIERO et al. 2012; SOUZA et al., 2010; SILVA et al., 2015).

**Table 2:** Socioeconomic characteristics of interviewees in the Arari River region, Itacoatiara municipality, Amazonas state, Brazil

| Classes | Number of interviewees | (%) |
|---|---|---|
| **Occupation** | | |
| Retired | 22 | 61.1 |
| Rural agriculturalist | 7 | 19.4 |
| Home maker | 3 | 8.4 |
| Heath agent | 2 | 5.6 |
| Cook | 1 | 2.8 |
| Fisherwomen | 1 | 2.8 |

| | | |
|---|---|---|
| **Income** | | |
| One minimum salary | 24 | 66.7 |
| Two minimum salaries | 7 | 19.4 |
| Grants/Assistance from Government Programs | 6 | 13.9 |
| **Civil status** | | |
| Single | 6 | 16.7 |
| Married | 21 | 58.3 |
| Widowed | 8 | 22.2 |
| Civil partnership | 1 | 2.8 |
| **Origin** | | |
| Arari (AM) | 26 | 72.2 |
| Itacoatiara (city)(AM) | 1 | 2.8 |
| Maués (AM) | 3 | 8.4 |
| Manaus (AM) | 2 | 5.5 |
| Urucurituba (AM) | 2 | 5.5 |
| Rio Urubu (AM) | 1 | 2.8 |
| Santarém (PA) | 1 | 2.8 |
| **Level of education** | | |
| None | 3 | 8.3 |
| Incomplete primary education | 30 | 83.3 |
| Complete primary education | 0 | 0 |
| Incomplete highschool education | 2 | 5.6 |
| Complete highschool education | 1 | 2.8 |
| **Plant cultivation location** | | |
| House | 32 | 88.9 |
| Community | 1 | 2.8 |
| Both | 3 | 8.3 |
| Note: Each box contains all 36 respondents | | |

The ethnobotanical survey obtained 384 reports linked to 104 species of medicinal plants, of which 91 were identified botanically (Table 3). They belonged to 47 botanical families. The family with the highest number of species was Lamiaceae (13 species), then Rutaceae (5) and Asteraceae (5), followed by Rubiaceae, Euphorbiaceae (4), Acanthaceae, Solanaceae, Verbenaceae, Bignoniaceae, Annonaceae (3), Zingiberaceae, Crassulaceae , Poaceae, Piperaceae, Fabaceae (2) and others (1) (Figure 2).

**Table 3:** Herbal species reported by nine communities from the Arari river region, Itacoatiara municipality, Amazonas state, Brazil

| *Family* | *Species* | *Common English name* | *Parte used* | *Illness treated* |
|---|---|---|---|---|
| Lamiaceae | ***Mentha villosa* Huds** | Mojito mint | Leaf | Sore throat |
| | ***Mentha pulegium* L.** | Pennyroyal | Leaf | Children's sickness |
| | ***Ocimum minimum* L.** | Greek basil | Leaf | Evil eye |
| | **Aeollanthus suaveolens D. Don** | Macassa | Leaf | Pain/calmer |
| | ***Scutellaria spicatus* A. St. Hil. ex Benth** | Spiked snake's beard | Leaf | Ear ache/scrapes |
| | ***Rosmarinus officinalis L.*** | Rosemary | Leaf | Preventitive-strenghtener /body cleansing |
| | ***Leonotis nepetifolia* (L.) R. Br.** | Lion's Tail | Seed | Urinary pain |
| | ***Plectranthus barbatus* Andrews** | Indian coleus | Leaf | Stomach pains |
| | ***Ocimum gratissimum* L.** | Clove (African) basil | Root | Bleeding |
| | ***Pogostemon patchouli Pallet.*** | True patchouli | Leaf | Heart/pressure |
| | ***Mentha arvensis* L.** | Field mint | Leaf | Sinusitus |
| | ***Plectranthus amboinicus* (Lour.) Spreng** | Mexican mint | Leaf | Ashma/lung pain |
| | ***Plectranthus* sp.** | False Mexican mint | Leaf | Stomach |
| Asteraceae | ***Vernonia condensata* Baker** | Boldo | Leaf | Stomach |
| | ***Egletes viscosa* (L.) Less** | Tropic daisy | Leaf | Stomach |
| | ***Spillanthes acmella (L.) L*** | Paracress | Leaf | Stomach |
| | ***Eupatorium ayapana Vent*** | White snakeroot, Water hemp | Leaf | Head ache |
| | ***Syzygium aromaticum (L.) Meer & L.M. Perry*** | Clove | Leaf | Sinusius/bath |
| Acanthaceae | ***Justicia calycina* (Nees) V. A.W. Graham** | Flame flower | Leaf | Various illnesses |
| | ***Justicia pectoralis* Jacq.** | Water willow | Leaf | Bleeding |
| Zingiberaceae | ***Zingiber officinale* Roscoe** | Ginger | Root | Throat |
| | ***Alpinia speciosa* (Blume) D. Dietr.** | Shell flower | Leaf | A bath for headache |
| Euphorbiaceae | ***Jatropha curcas* L.** | Jatropha | Leaf | Mouth wounds |
| | ***Croton sacaquinha* Croizat** | Sacaquinha | Leaf | Bath/evil eye |
| | ***Jatropha gossypiifolia* L.** | Black physicnut, Cotton-leaf physicnut | Leaf | A bath for children |
| | **Euphorbia tirucalli L.** | Pencil cactus | Stem/Leaf | warts/whitlows |
| Crassulaceae | ***Kalanchoe pinnata (Lam.) Pers*** | Cathedral bells, Miracle leaf, | Leaf | Anti-inflamatory |
| | ***Kalanchoe brasiliensis* Cambess** | Fortune leaf | Leaf | Cancer |
| Poaceae | ***Cymbopogon citratus* (DC.) Stapf** | Lemon grass | Leaf | Stomach |
| Piperaceae | ***Piper callosum* Ruiz&Pav** | Bush piper | Leaf | Muscle pain |
| | ***Piper marginatum Jacq.*** | Cake bush | Leaf | Stomach pain |
| Amaranthaceae | ***Chenopodium ambrosioides* L.** | Indian goosefoot | Leaf | Pneumonia |
| | ***Pfaffia glomerata (Spreng.) Pedersen*** | Brazilian ginseng | Leaf | Bone regeneration |
| | ***Alternanthera brasiliana* (L.) Kuntze** | Purple joyweed | Leaf | Wash wounds/ fever |
| Rhaminaceae | ***Ampelozizyphus amazonicus* Ducke** | ? | Bark | Diarrea, nerves, liver. |
| Solanaceae | ***Solanum sessiliflorum* Dunal** | Peach tomatoe | Fruto | Diabetes |
| | ***Physalis angulata* L.** | Balloon cherry, Cutleaf ground cherry | Root | Diabetes |
| Rutaceae | ***Ruta graveolens* L.** | Rue | Leaf | Headache, Evil eye |
| | ***Citrus sinensis* Osbeck** | Orange, Sweet Orange | Leaf | Stomach ache |

| | | | | |
|---|---|---|---|---|
| | ***Citrus aurantium* L.** | Bitter orange, Seville orange | Leaf | Heart |
| | ***Citrus limon (l.) Osbeck*** | Lemon | Leaf/fruit | Fever/Headache |
| | ***Citrus aurantium* L.** | Bitter orange, Seville orange | Leaf | Sinusitus |
| Fabaceae | ***Hymenaea courbaril* L.** | Courbaril, Jatoba | Bark | Inflammation |
| | ***Libidibia ferrea* (Mart.) L.P. Queiroz** | Brazilian ironwood, Leopard tree | Bark/Fruit | Inflammation |
| | ***Dipteryx odorata Willd*** | Cumaru, Tonka bean | Seed | Headache |
| Arecaceae | ***Euterpe oleracea* Mart.** | Asai | Root | Anaemia |
| Verbenaceae | ***Stachytarpheta cayennensis* (Rich.) Vahl** | Blue snakeweed | Leaf | Blows, kideys, infections |
| | ***Lippia origanoides* Kunth** | False orengano | Leaf | Stomach |
| | ***Lippia alba (Mill.) N.E.Br.ex Britton & P. Wilson*** | Bushy matgrass | Leaf | Stress |
| Pedaliaceae | ***Sesamum indicum L.*** | Sesame | Leaf | Throat |
| Portulacaceae | ***Portulaca pilosa* L.** | Hairy pigweed | Leaf | Inflammation/infection |
| Anacardiaceae | ***Anacardium occidentale*L.** | Cashew | Bark | Diarrea /Inflammation |
| | **Anacardium sp.** | ? | Fruto | Internal inflammation |
| | ***Mangifera indica L.*** | Mango | Bark | Cough |
| Humiriaceae | ***Endopleura uchi (Huber) Cuatrec*** | Uxi, Amazon hog plum | Bark | Cleansing uro-genital wash |
| Rubiaceae | ***Uncaria guianensis* (Aubl.) J.F.Gmel** | Cat's claw | Bark/Root | Anti-inflamatory |
| | ***Morinda citrifolia* L** | Noni, Indian mulberry, Cheesefruit | Leaf/fruit | Cancer |
| | ***Genipa americana L.*** | Genipapo, Huito | Fruit | Anaemia/Kidney stones |
| | ***Coffea arábica* L.** | Coffee | Leaf | To promote quick walking in children |
| Annonaceae | ***Annona muricata L.*** | Graviola, Soursop. Hairy sourspo | Leaf | Insomnia/Sleeping draught |
| | **Annona mucosa Jacq.** | Biribar | Leaf | Amoeba/nematodes |
| | ***Annona coriacea Mart.*** | Melted soursop | Leaf | Body pains/Bath |
| Rosaceae | ***Rosa sp.*** | Rose | Flower 'heart' (androecium, gynoecium, and calyx combined) | Heart |
| Costaceae | ***Costus spicatus (Jacq.) SW.*** | Costus | Leaf | Kidney infections |
| Bignoniaceae | ***Fridericia chica (Bonpl.) L. G. Lohamann*** | Cricket-vine | Leaf | Anaemia |
| | ***Mansoa alliaceae (Lam.) A. H.Gentry*** | Garlic vine | Leaf | Bath |
| | ***Crescentia cujete L.*** | Calabash tree | Bark | Throat |
| Convolvulaceae | ***Bonamia ferruginea (Choisy) Hallier f.*** | ? | Leaf | Anaemia |
| Loranthaceae | ***Struthanthus flexicaulis Mart.*** | Mistletoe | Leaf | Cancer/infection |
| Moraceae | ***Morus alba* L.** | White mulberry | Leaf | Diabetes/high *blood* pressure/Hormone imbalance |
| Myrtaceae | ***Eugenia uniflora L.*** | Suriname cherry | Leaf | Diarrea/high fever |
| Apocynaceae | ***Himatanthus sucuuba (Spruce ex Miill. Arg) Woodson*** | Sucuuba | Bark | Inflammation |
| Meliaceae | ***Carapa guianensis Aubl.*** | Andiroba | Bark | Bath/Rheumatic pain |
| Bixaceae | ***Bixa orellana L.*** | Achiote | Seed | Heart |
| Cyperaceae | ***Cyperus luzulae* (L.) Rottb. ex Retz** | Sedge | Root | Diarrea |
| Lauraceae | ***Persea americana* Mill** | Avocado | Leaf | Anaemia |
| Malvaceae | ***Gossypium hirsutum* L.** | Mexican cotton | Leaf | Migrane |
| Liliaceae | ***Aloe vera* L.** | Aloe vera | Leaf | Wounds/Hair loss |
| Phytolaccaceae | ***Petiveria alliacea* L.** | Guinea hen weed, Gully root, Taintweed | Leaf/Root | Bleeding/Fever |
| Caprifoliaceae | ***Sambucus nigra* L.** | Elderberry | Leaf | Measels/ Chickenpox |
| Phyllanthaceae | ***Phyllanthus minutulus Mill. Arg.*** | Fairy steps | Leaf | Kidneys |
| Aristolochiaceae | ***Aristolochia triloba L.*** | Pipe vine | Leaf | Stomach pains |
| Simaroubaceae | ***Simarouba amara Aubl.*** | Simaroupa, Bitter Ash | Under ground storage organ | Diarrea |
| Commelinaceae | ***Tripogandra glandulosa (Seub.) Rohw.*** | Flagflower | Leaf | Diarrea |
| Musaceae | ***Musa paradisiaca* L.** | Banana | Flower/fruit | Throat |
| Brassicaceae | **Brassica oleracea L.** | Cabbage | Leaf | Anaemia |
| Marantaceae | **Myrosma cannifolia L.f.** | Cannaleaf myrosma | Leaf | Evil eye |
| Monimiaceae | **Siparuna guianensis Aubl.** | Siparuna | Leaf | Triglyceride urinary infection |

Among the families of medicinal plants reported by community members in the Arari region, the Lamiaceae and Asteraceae stand out as the most commonly used. Similar results were reported by Liporacci and Simon (2013) and Alves and Povh (2013) in surveys conducted in the Ituiutaba region of Minas Gerais state. Most of the medicinal plants used in Latin America and belonging to the Lamiaceae and Asteraceae families are characterized by having a high number of rich in essential oils (FERRAO et al., 2014, CUNHA; BORTOLOTT, 2011; BRITO et al., 2015).

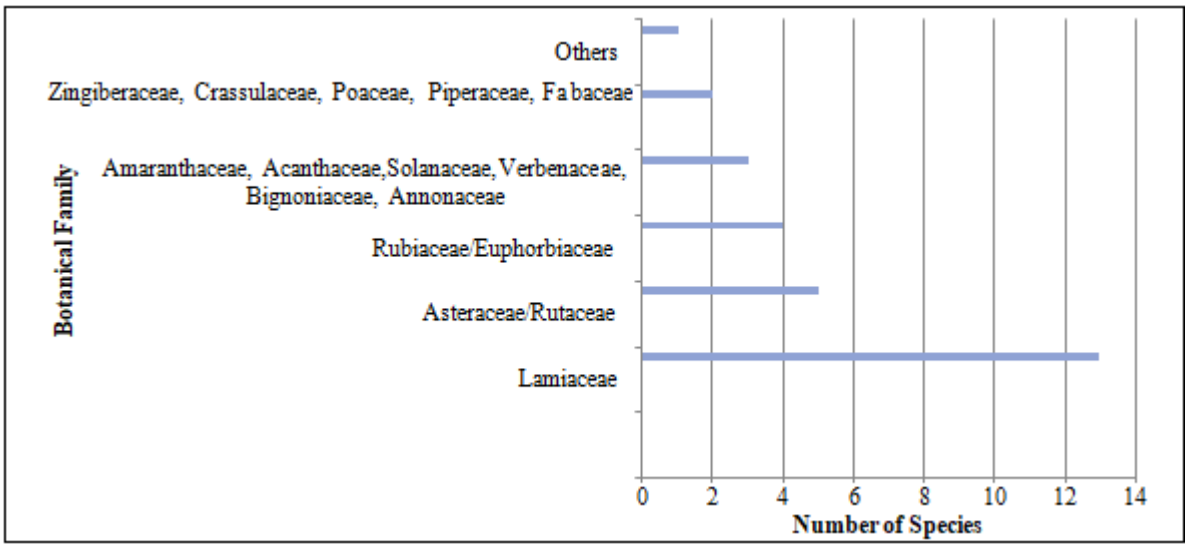


**Figure 2:** Number of medicinal species by botanical families

The leaf was the part used by 84% of respondents (322 records) when preparating medicinal products (mostly teas). Other parts used where the bark (20 records), root (18) and fruit (18) (Figure 3). It is common for leaves to be recorded as the plant part most frequently used in the preperation of herbal medicines (LIMA, 2015; TEXEIRA; MELO 2006). Baldo and Spagnuolo (2009) attribute the more frequent use of this part of the plant for their greater availability during every month of the year.

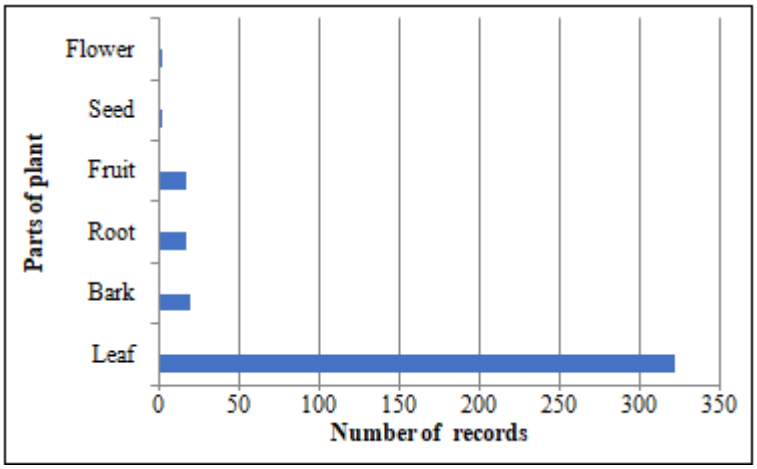


**Figure 3:** Number of reports per part of medicinal plant used by interviewees

The use of leaf-derived teas is method by which herbal medicines are most commonly administered in the Arari region, and this form of preparation is the one most reported in other studies (CRUZ et al. 2011; ARAUJO; LEMOS, 2015). The common use of teas was also found in a study conducted in Pitimbu municipality, some 60 km from the capital João Pessoa, Paraíba state, Brazil (BRITO et al., 2015). This was followed, in order of requency, by preperations made by: making a heated infusion with sugar (*lambedor*); steeping in alcohol, water or wine; leaf maceration; juicing; applying fresh; applying as a bath; potions; toasting leaves.

In the communities studied, a large number of respondents also used the leaves to prepare baths with intent to cure ills attributed to such spiritual aspects as "evil eye", "bad body" and "brokenness". In studies conducted in Paraíba many species, including *Ruta graveolens* and *Jatropha gossypifolia* are used to cure the such physical and spiritual malaises afflicting members of populations which have been analyzed (OLIVEIRA; TROVAO, 2009).

The plants most cited were highlighted with records of more than 10 citations during interviews. Among these stands out *Ruta graveolens* (21), followed by *Mentha pulegium* (18), *Justicia calycina* (Nees) V. A.W. Graham (13), *Mentha*

*villosa* (12), *Kalanchoe pinnata* (11), *Portulaca pilosa* (11), *Gossypium hirsutum* (11), *Chenopodium ambrosioides* (11) , *Aloe vera* (10), and *Vernonia condensata* (10) (Figure 4).These plants are often cited as medicinals (OLIVEIRA; MENINI, 2012; LIPORACCI; SIMAO, 2013; FERREIRA et al., 2015; NEGRELLE; FORNAZZALI 2007). *Ruta graveolens* was the most cited plant among informants, which explains extensive traditional knowledge regarding the use of this plant among people over 50 years old (Table 4).

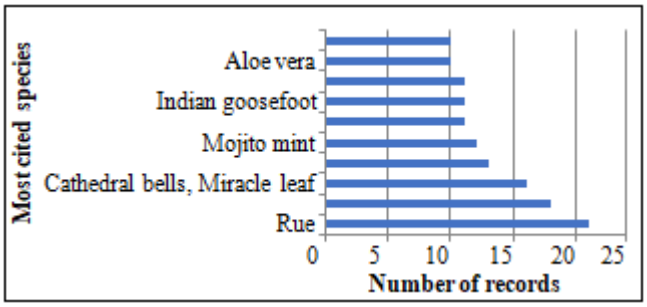


**Figure 4:** Number ofspecies reported (with 10 or more reports) in communities on the Arari River, Amazonian Brazil

**Table 4:** Distribution between informant age classes of knowledge of the most reported medicinal plant species

| Know the plamts | Informants ≥50 anos | Informants < 50 anos | Total |
|---|---|---|---|
| Yes | 17 | 4 | 21 |
| No | 10 | 5 | 15 |
| Total | 27 | 9 | 36 |

The plants ´tampão´ (*Cyperus luzulae* (L.) Rottb.ex Retz) and ´tapacu´ (*Tripogandra* glandulosa (Seub.) Rohw were found being used medicinally in two Arari communities. This was the first time any ethnobotanical study has recorded the use of these as medicinal species. They are used to treat diarrhea, in the communities São João do Araçá and Nossa Senhora de Fatima, respectively.

**Table 5:** Classification and distribution of symptoms and illnesses cited by Arari region informants, arranged according to the CID 10 - DATA-SUS grouping for medical disorders and illnesses

| Illness grouping | Reported symptoms |
|---|---|
| Some infectious diseases and paraites | Stomach pain, infection, worms, amoeba, snake bite, conjuntivitus, measles, chicken pox |
| Neoplasias [tumors] | Cancer |
| Blood, blood forming organs and certain immune disorders | inflamation, body pain, fever, rheumatic pain |
| Endocrine, nutritional and metabolic diseases | diabetes, liver, hormonal problems, high triglycerides, blood imbalance, |
| Mental and behavioral disorders | muscular pains |
| Nervous system disorders | nerve disease, headache, muscle aches, bumps, soothing, tinnitus, 'bad body' |
| Circulatory system diseases | Heart, stroke, hemorrhage, blood pressure, anemia, swelling |
| Respiratorysystem diseases | throat, cough, pneumonia, influenza, sinusitis, catarrh, ear pain, asthma, lung infection |
| Digestivesystem diseases | stomach pain, diarrhea, gastritis, vomiting, headache, constipation, nausea, toothache |
| Skin and subcutaneous tissue diseases | Mouth wounds, sores, wounds, hair loss leishmaniasis, scarring, burning |
| Diseases of the urogenital system | menstrual cramps, inflammation of the prostate, urination pain, inflammation of the uterus, urinary tract infection, kidney, kidney stones |

| Community | Illness/symptom | Number of records |
|---|---|---|
| Santa Tereza | Stomach | 6 |
| | Throat | 6 |
| Santa Rosa | Stomach | 7 |
| | Headache | 6 |
| Monte Cristo | Stomach | 12 |
| | Receiving evil eye | 10 |
| | Inflammation | 9 |
| | Urinary infection | 5 |
| São João do Araçá | Inflamação | 14 |
| | Stomach | 10 |
| | Urinary infection | 7 |
| São Tomé | Stomach pain | 12 |
| | Receiving evil eye | 11 |
| | Headache | 10 |
| | Cough | 7 |
| São Francisco | Stomach | 3 |
| | Receiving evil eye | 2 |
| São José | Stomach | 13 |
| | Receiving evil eye | 12 |
| | Headache | 3 |
| Nossa Senhora de Fátima | Receiving evil eye | 11 |
| | Stomach | 10 |
| | Inflammation | 6 |
| | Headache | 6 |
| Nossa Senhora do Perpétuo Socorro | Stomach | 2 |
| | Inflammation | 2 |

There are among those interviewed discrimination between symptoms and diseases mentioned in each community (Table 6). Overall, the quotes that stood out were the diseases of the stomach followed by "evil eye", which though not physical illness, is considered by the informants as being the reason for the beginning of many evils that affect the community. In rural communities of the Atlantic the most cited diseases and symptoms that can be treated from medicinal plants are involving the digestive system and is the symptom most often cited a stomach ache (PINTO et al., 2006).

**Table 6:** Number of notable diseases/symptoms reported in the communities of Arari Region, Itacoatiara municipality, Amazonas, Brazil

| Community | Illness/symptom | Number of records |
|---|---|---|
| Santa Tereza | Stomach | 6 |
| | Throat | 6 |
| Santa Rosa | Stomach | 7 |
| | Headache | 6 |
| Monte Cristo | Stomach | 12 |
| | Receiving evil eye | 10 |
| | Inflammation | 9 |
| | Urinary infection | 5 |
| São João do Araçá | Inflamação | 14 |
| | Stomach | 10 |
| | Urinary infection | 7 |
| São Tomé | Stomach pain | 12 |

| | | |
|---|---|---|
| | Receiving evil eye | 11 |
| | Headache | 10 |
| | Cough | 7 |
| São Francisco | Stomach | 3 |
| | Receiving evil eye | 2 |
| São José | Stomach | 13 |
| | Receiving evil eye | 12 |
| | Headache | 3 |
| Nossa Senhora de Fátima | Receiving evil eye | 11 |
| | Stomach | 10 |
| | Inflammation | 6 |
| | Headache | 6 |
| Nossa Senhora do Perpétuo Socorro | Stomach | 2 |
| | Inflammation | 2 |

The indices for Loyalty (LI) and Ordenation Priority (OPI) were calculated only for the 11 species that received more than 10 citations. Among these, the one with highest FI and OPI was *Aloe vera* with values of 0.8 and 0.64 respectively, followed by *Chenopodium ambrosioides* with 0.72 and 0.51, and *Mentha villosa* with 0.66 and 0 43 (Table 7).

**Table 7:** Indeces of Loyalty (LI) and Ordenation Priority (OPI) for the species most reported by Community of Arari region (> 10 citations)

| Species | Number of records | Symptom/ illness | Localty Index (LI) | Ordenation Priority Index (OPI)- |
|---|---|---|---|---|
| *Ruta graveolens* | 21 | Headache | 0.38 | 0.14 |
| *Mentha pulegium* | 18 | Childen's illness | 0.38 | 0.14 |
| *Kalanchoe pinnata* | 16 | Inflamation | 0.37 | 0,13 |
| *Justicia calycina* | 13 | Various illnesses | 0.46 | 0.21 |
| *Mentha villosa* | 12 | Throat | 0.66 | 0.43 |
| *Portulaca pilosa* | 11 | Inflammation | 0.63 | 0.39 |
| *Gossypium hirsutum* | 11 | Throat | 0.63 | 0.39 |
| *Chenopodium ambrosioides* | 11 | Stomach | 0.72 | 0.51 |
| *Vernonia condensata* | 10 | Stomach | 0.6 | 0.36 |
| *Aloe vera* | 10 | Skin wounds | 0.8 | 0.64 |

When assigning the symptoms and diseases it was essential to make the analysis of loyalty levels and priority order to dsiciover how well the species was known in comparison to the overall knowledge of that species. Importance considers informant consensus at two levels - distribution of knowledge that is most important for the social group and distribution of knowledge about particular species within the social group (ALBUQUERQUE et al., 2010).

*Aloe vera* showed the highest loyalty index and priority order, followed by *Chenopodium ambrosioides* (0.72 and 0.51), and the *Mentha villosa*. In studies conducted by Pasa et al (PASA, 2011) in the community Bom Jardim (Mato Grosso state) among the species with the highest rate are 'guaco' (*Mikania glomerata* Spreng., Asteraceae), followed by *Rosmarinus officinalis* and 'caapeba' or 'pariparoba' (*Pothomorphe umbellata* C.DC, Piperaceae)In rural areas of Piracicaba the level of fidelity was high for all the medicinal plants with high citation levels, including *Cymbopogon citratus* (lemon grass), *Matricaria recutita* L. (chamomile), *Melissa officinalis* L. (lemon balm), indicating that the popular knowledge is transmitted faithfully by its holders (ZAMBON; AGOSTINI, 2015).

A survey of fatal diseases in the municipality of Itacoatiara (ICD-10 - DATA-SUS Management Report of the municipality of Itacoatiara, 2014) the diseases that most lead to death were those related to the circulatory system. Among survey, respondents plants mentioned for the treatment of associated diseases included: *Pogostemon patchouli* Pallet - 6 citations, *Bixa orellana L.* - 1, *Ruta graveolensL.* - 1, *Rosa* sp. - 2, for heart disease; *Cymbopogon citratus* (DC.) Stapf - 1; *Aristolochia ligulata* L. - 1, *Rubus* sp. - 1, *Croton sacaquinha* Croizat -1, and *Bertholletia excelsa* Humb. & Bonpl. - 1, for high blood pressure and *Sesamum indicum* L. -1, and *Jatropha gossypiifolia* L.-1, for stroke.

The Ward Similarity Index For the number of medicinal plants in the various communities was 0.85, indicating there were strong similarities between them in terms of the medicial plants used. Subsequently, the sample was seperated into five large groups thay brought together those with the greatest similarity in the use of the aforementioned species. Secondly, the communities were split into two groups, whereby the sets of plants mentioned as being used by the communities had subtle diferences. These seperations reflected geographical proximity and kinship relations. The existence of the overall similarity may be due to the even distribution of such plants between the gardens and the fact that most medicial plants in the nine studied communities are herbaceous (Figure 5), facilitating transference via inter-user exchanges. Another reason for the strong correlation between the studied areas in Arari region and species surveyed, is the use of both native plants and cultivated species.

Gomilde et al (2006) studied the relations of medical species in different physiognomic environments, andidentified possible degrees of similarity or dissimilarity, but without mentioning measurement of distance, making it difficult to quantify levels of florístic similarity. Using the Sorensen Similarity Index, Barata-Silva et al., (2005) found a high level of overlap in the use of tree for medicinal purposes by traditional communities in the state of Rio Grande do Sul which was considered to be explained by their colonial origin.

For communities on the islands of Cardoso (São Paulo state) and Santa Catarina (Santa Catarina state), (MIRANDA; HANAZAKI, 2008) calculated similarity indices based on the number of plants cited by respondents from different districts. Based on plant relative frequency, the communities could be seperated initially into two broad groups, one of which was then further subdividable into subgroups, while the other showed greater homogenaity due to the absence of a clear separation between different neighborhoods Miranda (2008).

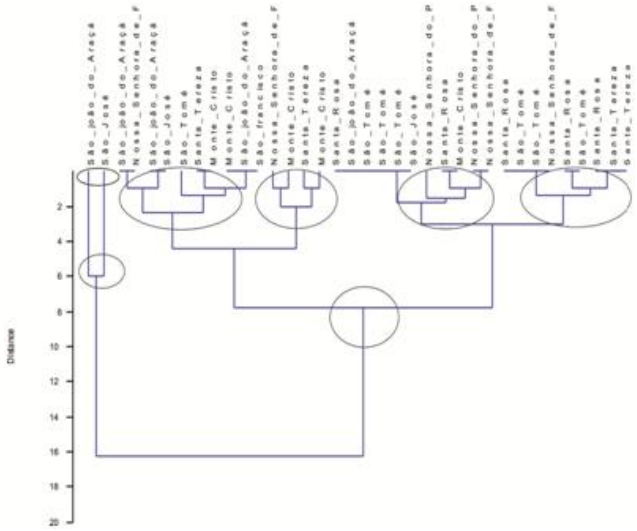

**Figure 5:** SimilarityDendrogram for the number of medical plant species species recorded from nine communities in the Arari region of Amazonian Brazil

The Shannon-Wiener Diversity Index value, 4.1734, confirming the high diversity of medicinal herb assemblages and indicating a pattern similar to that of the Amazon. The diversity index, widely used in ecology, has been used more recently in ethnobotanical work in order to assess the diversity of ethnobotanical knowledge Zeni and Bosio (2011).

Studies in backyards in Boa Vista (Roraima state) found highest diversity index non-woody plants, indicating the relationships the relationship between species richness and number of individuals representing species may be a complex one Batista and Barbosa (2014).

That the sample size was adequate was shown by a data accumulation curve which reached an asymptote with 36 interviews. This parallels the results of Silva and Bindchen (2011) where the curve stabilized with 40 respondents. Thus the number of interviews can be considered satisfactory.

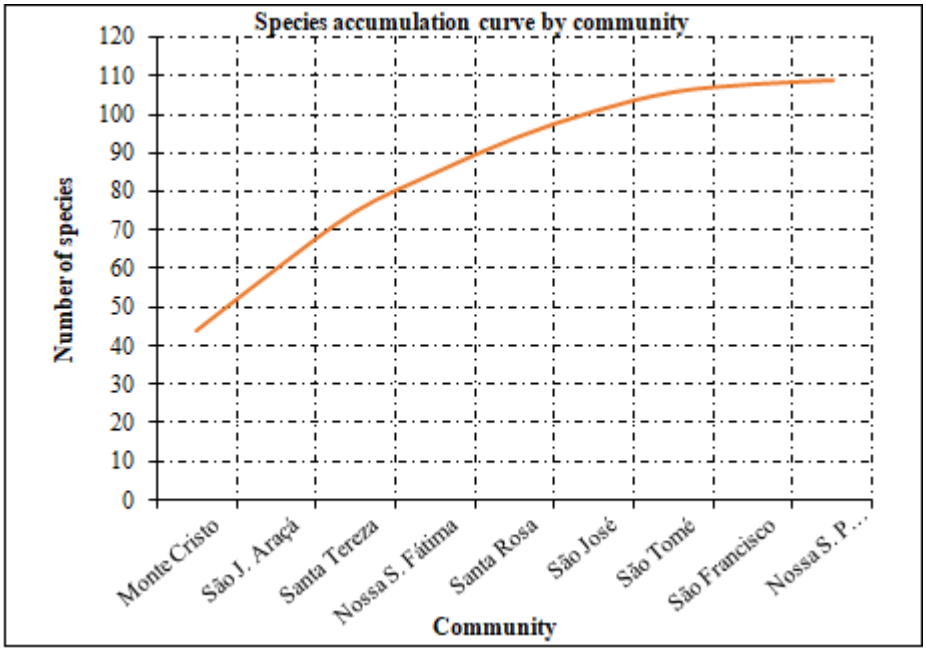


**Figure 6:** Species accumulation curve showing increase in number of medicial plant species recorded with increase in sampling effort. Arari River, Amazonas, Brazil

Traditional knowledge of the use of medicinal plants is present in the communities of Arari region. This knowledge is concentrated in women aged 35 to > 65 years (96.4%). When asked where they acquired their knowledge of medicinal plants, 86.1% of respondents said they had learnt everything they from their grandmothers or mother. Only 13.9% said they had acquired such information from sources external to the community (such as migrants incomers or through information transmitted via radio or TV).

The prevalence of women as holders of knowledge relatibg to the use of medicinal plants is commonly recorded in ethnobotanical studies, though men are also identified. The ways in which knowledge is acquired is very diverse in the literature. For example, in a survey conducted by Silva et al (2015) in the municipality of Milages (Ceará state), most respondents said they had obtained their knowledge of medicinal plant use from parents (74%), while the rest reported gaining such information from uncles, neighbors and even younger children. In São Luís do Maranhão a study of medicinal plants useful against hypoglycemia found that 45% of the interviewees has acquired what they knew from individuals known for their medicinal plant knowledge, 28% from their parents, 11% frrom pharmacists, 7% from grandparents, 6% from friends and 3% mentioned the Internet as a source (GOMES et al., 2014).

During participant observation, it was possible to notice that this cultural heritage is currently being lost. Though most interviewees have confirmed that the current use of medicinal plants has been passed down from preceeding generations, during conversations with the informants, children when present, regardless of sex, showed no showed in the subject. Additionally, many young people from the community have moved to the municipal capital in search of better educational and living conditions. Another factor that

should be emphasized are the recente floods devastated crops for three years. Participants who had few medicinal plants when interviewed, always mention the fact that they lost many plants as a result of the river rises, which demotivated them to continue medicianl plant cultivation. Some mentioned that "We didn't spend much energy planting again, because the river will simply come and take it all".

Studies by Silva et al., (2015) of medicinal plants in the region Matinhos in Paraná, most of the respondents addressed began to notice and make use of medicinal plants before they were twenty years old, having learned in childhood, usually watching their parents. Ferrão et al., (2014) conducted research on the importance of traditional knowledge in the use of medicinal plants in Buritis (Minas Gerais state, Brazil), and found that among respondents with knowledge of medicinal plants, only 4% were young (0 – 20 years),pointing to a possible break in transfer mechanism of such traditional knowledge. It this ciontunues this may, in the near future, lead to the extinction of this practice, and swiftly, the loss of unique and valuable knowledge.

In the Arari region traditional knowledge clearly still exists, with the 55-64 years age-group possessing deep and appropriate knowledge of the plants in their backyards and medicinal uses to which they can be put. There is a significant number of medicinal species (104) currently in use, all from plant families commonly cited in ethnobotanical studies, There is a manifest interest in their use among the older inhabitants.

## 5. Conclusion

However, the low percentage of young respondents (3.6%) may pose a threat in the maintenance of traditional medicinal plant knowledge in the region. During interview visits the youngest community members showed no interest in mastering the safe use of these plants. This, the recente spate of river-based floods that has kill many medicinal plants, and the relatively easy access to city center, its public health service and manufactured drugs, are cause for concern and demonstrate the need to implement strategies to rescue the knowledge on the use of medicinal plants from the older generation and incentivise its promulgation and use among the younger.

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