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Original Article

Plants Used to Treat Malaria in the Regions of Rio Branco-Acre State and Southern Amazonas State – Brazil

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Abstract

Malaria is a parasitic disease caused by organisms of the genus *Plasmodium*. The present study examined wild and cultivated plants used to treat malaria and associated symptoms by riparian communities in the Municipalities of Pauini and Xapuri in Amazonas and Acre states, respectively. During the year 2013 86 persons were interviewed in 9 rural communities in Pauini and Xapuri that were known for their knowledge and use of medicinal plants, After each interview, walks were made (walk in the woods), with the main informant of the family, for identification of plants and to collect the samples of the species indicated. A total of 86 plant species were indicated by *seringueiros* and *ribeirinhos* for the treatment of malaria and for associated symptoms, while 26 species were indicated exclusively for the treatment of malaria, of which 2 had no previous indication of use for that purpose. Among the plants mentioned in the survey, we highlight the 10 most cited and used by respondents living in the 2 regions. They are: quina-quina–*Stenostomum acreanum* (40), carapanaúba–*Aspidosperma nitidum* (39), Picão ou carrapicho-agulha–*Bidens pilosa* (29), Copaíba–*Copaifera* sp. (21), melão-de-são-caetano–*Momordica charantia* (19), quina-quina–*Geissospermum reticulatum* (16), Paracanaúba/carapanúba–*Aspidosperma megaphyllum* (14), Amor-Crescido/Alecrim–*Portulaca pilosa* (11) *species in test 2* (8) and picão-plantado–*Leonotis nepetifolia* (7). The regions of Pauini and Xapuri have an important flora to prospect promising plants for new antimalarial drug, communities studied have a great knowledge about the forest and their members have used medicinal plants for malaria and its symptoms.
Keywords: Amazonia, Medicinal plants, Traditional communities, Tropical diseases

Introduction

Malaria is a parasitic disease, caused by *Plasmodium*. Approximately 400 *Anopheles* species were described, of which 60 involved in the transmission of malaria in different parts of the globe.[1]

Anopheles darlingi is the species of greatest epidemiological importance, the abundance, the wide distribution in the country, the high degree of anthropophily and endophagy and the ability to transmit different species of *Plasmodium*. It has as preferred local of breeding places with clean water, warm, shaded and low-flow, very common situation in the Amazon region.[2]

There are four recognized as etiological agents causing infection in humans (*Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malarie* e *Plasmodium ovale*), although some authors discuss the role of other species genetically similar to *P. malariae* and *P. vivax* as potential human parasites.[3]

Malaria can be accidentally transmitted by blood transfusion (blood contaminated with *Plasmodium*), by needle sharing (in illicit drug users) or by accident with needles and/or contaminated lancets. There is also the possibility of transmitting neonatal.[4]

The main transmitting agent is the female mosquito, which, by biting the vertebrate host to perform the blood meal for the maturation of eggs, inoculates sporozoites to go via circulatory invade human hepatocytes.[5]

The life cycle lasts on average 30 days. The longevity for different species can achieve between 60 and 100 days. This lifetime can vary greatly as factors such as temperature and humidity mainly. On the other hand, the male *Anopheles* live by a much smaller time than female, and often, for a few days. It is important to remember that, at birth, the female mosquitoes are unable to transmit any disease. This will only occur if, after a few days, to be fed with the blood of an animal or a human being, they also ingest viable forms of parasites.[6]

The maintenance and resurgence of vector-borne diseases

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are related to several factors, such as ecological changes that favor increased vector density or host-vector interactions, among other factors. There were significant increases in the magnitude of the problem of vector-borne diseases as a result of urbanization, deforestation, globalization, economic development.[7]

Malaria is a worldwide public health problem that affects the population of different tropical and subtropical regions of the globe, and is therefore one of the parasitic diseases the world's leading. In the Amazon, is a regional endemic, significantly contributing records high rates of disease.[8]

The main problem, however, is the complexity of the immune response to the parasite. There is no safe and effective vaccine against protozoa, which are infinitely more complex organisms that viruses and bacteria. The *Plasmodium* have more than 5 thousand genes, as against five or 10 in most viruses.[9]

Therefore, the discovery of new substances with antimalarial properties is essential for disease treatment. Given this fact, it is emphasized that much of the population of developing countries use medicinal plants to treat malaria. Faced with the prospect of finding the rich biodiversity of Acre and Amazonas plant species that can generate effective products to treat malaria, the work has the purpose of performing a study of medicinal plants used as antimalarial by traditional communities of these states. The Acre is situated entirely in the Amazon basin with 93% of the territory covered with rainforest. The State of Amazonas has 95% of its forest cover intact, these states have important socio-environmental characteristics to develop ethnobotanical research directed to the search for plants for the treatment of malaria and its associated symptoms. In the Acre and Purus basins, *ribeirinhos* communities make use of many plant species to treat malaria and its symptoms. These informations, in most cases, are restricted to people who live in these regions, far from cities. This knowledge is in orality.

The objective of this study was to know the wild and cultivated plants used for the treatment of malaria and its associated symptoms by *ribeirinhos* and *seringueiros* communities in the municipalities of Pauini and Xapuri in the states of Amazonas and Acre, respectively.

Materials and Methods

The field survey was conducted in the municipalities of Pauini and Xapuri in the states of Amazonas and Acre - Brazil, respectively. The selection of the municipalities of Xapuri (AC) and Pauini (AM) as study sites was based on its strong history, either in the present or past and cases of malaria among its population. The participants consisted mainly of people living in the forest. The survey was conducted during the year 2013.

At the beginning of the field research sampling technique called "snowball,"[10] were used, which was to talk to *ribeirinhos* and *seringueiros* of the given communities and, from these, other possible respondents were indicated. All respondents must have experience and knowledge with the use of plants for the treatment of malaria.

The selection of communities was made by indications of Pastoral of Health, Municipal Health Departments, the National Health Foundation (FUNASA) and neighborhood associations. 86 people were interviewed.

The survey of information about the knowledge of plants used for the treatment of malaria, was conducted through semi-structured and structured interviews, based on a predefined questionnaire. Photographic record was made and the interviews were recorded, both with the prior consent of the informants. After each interview walks were made (walk in the woods),[11] with the main informant of the family, to identify and describe the occurrence of local plants.

The plants indicated for the treatment of malaria with no use similar reference in other works already published had their names omitted, in order to make antimalarial activity studies and testing of toxicity, which can prove whether or not the indication of its popular use in the treatment of malaria. These species are represented here by an acronym.

The data obtained through semi-structured and structured interviews were transcribed and stored in a database formatted using Microsoft Excel® computer program. The bank covered the fields of the form of interviews, which were submitted to statistical techniques descriptive and qualitative analysis.

Results and Discussion

The age of respondents covers wide range for both sexes, ranging from 24 to 74 years. The most frequent age groups were 35-45 years, with 19 participants (34%), 46-56 years, with 19 participants (34%), 24-34 years with 15 participants (17%), and 68-74 years, with 13 participants (15%). Of the 86 respondents, 40 were female (47%) and 46 males (53%). The gender distribution was balanced. This result may have been influenced by the applied methodology, since the interviews were conducted with people who were in the house, which had been mentioned by the snowball technique and who were willing to participate in the study, with no selection and no gender preference. The age of the individual is an often factor involved in the study of ethnobotany and in the case of medicinal plants, also has a tendency to greater knowledge by older individuals.

Among the plants mentioned in the survey (Table 1), was highlighted the ten most cited and used by respondents living in the two communities: quina-quina - *Stenostomum acreanum* (K. Krause) Achille & Delprete (40), carapanaúba - *Aspidosperma nitidum* Benth. ex Müll.Arg. (39), Picão ou carrapicho-agulha - *Bidens pilosa* L. (29), copaíba - *Copaifera* L. sp. (21), melão-de-são-caetano - *Momordica charantia* L. (19), quina-quina - *Geissospermum reticulatum* A.H.Gentry (16), paracanaúba/carapanúba - *Aspidosperma megaphyllum* Woodson (14), amor-crescido/alecrim - *Portulaca pilosa* L. (11), Species in testing 2 (8) e picão-plantado - *Leonotis nepetifolia* (L.) R.Br. (7).

A research found in the Reserva Extrativista Chico Mendes, in Xapuri, about raising medicinal plants, plants

Table 1. Identification and Use of Medicinal Plants Indicated for the Treatment of Malaria and Its Associated Symptoms in Pauini and Xapuri, Amazonas and Acre States, Brazil, 2014

No.	Common Name	Scientific Name	Botanical Family	Use	Part Used	Method of Administration
1	Abacate	*Persea americana* Mill.	Lauraceae	Liver	Leaf	Infusion
2	Açaí	*Euterpe precatoria* Mart.	Arecaceae	Malaria/liver	Root	Decoction
3	Alfavaca	*Ocimum gratissimum* L.	Lamiaceae	Liver	Leaf	Infusion
4	Alho	*Allium sativum* L.	Liliaceae	Malaria	Bulb	Decoction
5	Amor- crescido/	*Portulaca pilosa* L.	Portulacaceae	Malaria/liver	Whole plant	Decoction
6	Andiroba	*Carapa guianensis* Aublet.	Meliaceae	Liver	Bark	Decoction
7	Angico	*Parkia pendula* (Willd.) Benth. ex Walp.	Fabaceae	Malaria	Bark	Decoction
8	Arruda	*Ruta graveolens* L.	Rutaceae	Liver	Leaf	Infusion
9	Algodão- branco/ roxo	*Gossypium hirsutum* L.	Malvaceae	Liver	Leaf	Infusion
10	Anador	*Artemisia verlotorum* Lamotte	Asteraceae	Headache/ Fever	Leaf	Infusion
11	Assa- flor	*Curcuma longa L.*	Zingiberaceae	Liver	Rhizome	Decoction
12	Assa-peixe	*Vernonia albifila* Gleason	Asteraceae	Liver/fever	Flower/new leaf	Infusion
13	Boldo	*Plectranthus barbatus* Andrews	Lamiaceae	Liver	Leaf	Infusion
14	Bota	*Abuta grandifolia* (Mart.) Sandwith	Menispermaceae	Malaria	Bark	Decoction
15	Bordão-de-velho	*Samanea tubulosa* (Benth.) Barneby & J.W.Grimes	Fabaceae	Fever/liver	Leaf	Infusion
16	Breu	*Tetragastris altissima* (Aubl.) Swart	Burseraceae	Liver	Bark	Decoction
17	Cajá	*Spondias mombin* L.	Anacardiaceae	Vomit	Bark	Decoction
18	Canapum	*Physalis angulata* L.	Solanaceae	Liver	Bark/root	Decoction
19	Canarana- dura	*Echinochloa polystachya* (Kunth) Hitchc.	Poaceae	Malaria/liver	New Leaf	Infusion
20	Capim- santo	*Cymbopogon citratus* (DC.)Stapf	Poaceae	Fever/liver	Leaf	Infusion
21	Capurana	*Campsiandra laurifolia* Benth.	Fabaceae	Liver	bark	Decoction
22	Camará	*Lantana camara* L.	Verbenaceae	Fever	Leaf	Infusion
23	Capeba	*Pothomorphe umbellata* (L.) Miq.	Piperaceae	Liver	Whole plant	Infusion
24	Carapanaúba/ preta/amarela	*Aspidosperma nitidum* Benth. ex Müll. Arg.	Apocynaceae	Malaria/liver/ fever	Bark	Decoction
25	Castanheira	*Bertholletia excelsa* Bonpl.	Lecythidaceae	Liver	Resin/bast	Decoction
26	Catuaba	*Qualea tessmannii* Mildbr.	Vochysiaceae	Liver	Bark	Decoction
27	Species in testing 1.	Species in testing 1.	Moraceae	Malaria	Seed	Decoction
28	Cedro	*Cedrela odorata* L.	Meliaceae	Malaria/liver/ fever	Bark	Decoction/ garrafada
29	Chicória	*Eryngium foetidum* L.	Apiaceae	Malaria	Leaf	Infusion
30	Cidreira/ Carmelitana	*Lippia alba* (Mill.) N. E. Br.	Verbenaceae	Fever	Leaf	Infusion
31	Copaíba	*Copaifera* spp.	Fabaceae	Malaria/liver	Bark	Decoction/ garrafada
32	Conabi	*Aegiphila* Jacq.	Verbenaceae	Fever	Leaf	Infusion
33	Corama	*Kalanchoe pinnata* (Lam.) Pers.	Crassulaceae	Liver	Leaf	Decoction
34	Crajiru	*Fridericia chica* (Bonpl.) L.G.Lohmann	Bignoniaceae	Liver	Leaf	Infusion
35	Cumaru-de-cheiro	*Torresea acreana* Ducke	Fabaceae	Liver	Bark	Decoction
36	Dipirona			Headache/ fever	Leaf	Infusion
37	Eucalipto	*Eucalyptus* sp.	Myrtaceae	Liver	Leaf	Infusion
38	Fruta-Pão	*Artocarpus altilis* (Parkinson) Fosberg var. seminifera	Moraceae	Liver	Leaf	Infusion
39	Graviola	*Annona muricata* L.	Annonaceae	Liver	Leaf	Infusion
40	Hortelã-vick	*Mentha* sp.	Lamiaceae	Fever	Leaf	Infusion
41	Jambú/Agrião	*Spilanthes acmella* (L.) L.	Asteraceae	Liver	Leaf	Infusion
42	Jatobá	*Hymenaea courbaril* L.	Fabaceae	Liver/fever/ anemia	Bark	Decoction
43	Jucá	*Caesalpinia ferrea* Mart. ex Tul.	Fabaceae	Liver/leeding	Bark	Decoction

Table 1. Continued

44	João-brandin	*Piper piscatorum* Trel. & Yunck.	Piperaceae	Malaria/liver/ fever	Whole plant	Infusion
45	Jurubeba	*Solanum* sp.	Solanaceae	Liver/fever	Root	Decoction
46	Laranja	*Citrus* sp.	Rutaceae	Liver	Bark/leaf	Decoction/ infusion
47	Lima	*Citrus limetta* Ant.	Rutaceae	Fever	Leaf	Infusion
48	Limão	*Citrus* X *limon* (L.) Osbeck	Rutaceae	Liver	Root	Decoction
49	Malvarisco	*Coleus amboinicus* Lour.	Lamiaceae	Liver	Leaf	Infusion
50	Mangirioba	*Senna occidentalis* (L.) Link	Fabaceae	Fever	Root	Decoction
51	Marcela	*Egletes viscosa* (L.) Less.	Asteraceae	Malaria/fever/ liver	Leaf	Infusion
52	Mamão	*Carica papaya* L.	Caricaceae	Malaria	Root	Infusion
52	Mata-pira	*Galipea longiflora* K.Krause	Rutaceae	Headache	Bark	Poultice
54	Melão-caetano	*Momordica charantia* L.	Cucurbitaceae	Malaria/liver/ vomit	Whole plant	Infusion/ decoction/ maceration
55	Morceguinho	*Dolichandra uncata* (Andrews) L.G. Lohmann	Bignoniaceae	Liver	Root	Decoction
56	Muçambê	*Cleome parviflora* Kunth	Cleomaceae	Malaria	Root	Decoction
57	Paracanaúba/ Carapanaúba	*Aspidosperma megaphyllum* Woodson	Apocynaceae	Malaria/ liver	Bark	Decoction
58	Pariquina	*Aspidosperma excelsum* Beth.	Apocynaceae	Malaria/fever/ liver	Bark	Decoction
59	Parreira –árvore de igapó			Liver	Bark	Decoction
60	Pau-d'arco roxo	*Tabebuia* sp.	Bignoniaceae	Malaria/liver/ fever	Bark	Decoction/ garrafada
61	Picão ou Carrapicho-agulha	*Bidens pilosa* L.	Asteraceae	Malaria/liver	Leaf	Infusion
62	Picão-plantado	*Leonotis nepetifolia* (L.) R. Br.	Lamiaceae	Malaria/liver/ fever	whole plant	Decoction
63	Piranheira			Liver	Bark	Decoction
64	Pinhão-branco	*Jatropha curcas L.*	Euphorbiaceae	Liver	Leaf	Infusion
65	Pinhão-roxo	*Jatropha gossypiifolia* L.	Euphorbiaceae	Liver	Leaf	Infusion
66	Pracuúba			Liver	Bark	Decoction
67	Preciosa	*Aniba canelilla* (Kunth) Mez	Lauraceae	Fever	Bark	Decoction
68	Quebra-pedra	*Phyllanthus niruri* L.	Phyllanthaceae	Liver	whole plant	Infusion
69	Quina-quina	*Geissospermum reticulatum* A.H.Gentry	Apocynaceae	Malaria/liver/ fever	Bark	Decoction
70	Quina-quina	*Stenostomum acreanum* (K.Krause) Achille & Delprete	Rubiaceae	Malaria/fever	Bark/seed	Decoction
71	Rinchão	*Stachytarpheta cayennensis* (Rich.) Vahl	Verbenaceae	Liver	Leaf	Infusion
72	Relógio	*Sida rhombifolia* L.	Malvaceae	Liver/fever	Leaf	Infusion
73	Sabugueira	*Sambucus canadensis* L.	Adoxaceae	Fever	Leaf	Infusion
74	Sacaca	*Croton cajucara* Benth.	Euphorbiaceae	Fever/liver	Leaf	Infusion
75	Sara-tudo	*Justicia acuminatissima* (Miq.) Bremek	Acanthaceae	Malaria	Leaf	Infusion
76	Seringueira	*Hevea brasiliensis* (Willd. ex A.Juss.) Müll.Arg.	Euphorbiaceae	stomach ache	Bark	Decoction
77	Sapé	*Imperata brasiliensis* Trin.	Poaceae	Liver	Leaf	Infusion
78	Sucuúba	*Himatanthus sucuuba* (Spruce ex Müll. Arg.) Woodson	Apocynaceae	Liver	Bark	Decoction
79	Tanchagem	*Plantago* sp.	Plantaginaceae	Fever	Leaf	Infusion
80	Tangerina	*Citrus reticulata* Blanco	Rutaceae	Fever	Leaf	Infusion
81	Terramicina	*Alternanthera brasiliana* (L.) Kuntze	Amaranthaceae	Fever	Leaf	Infusion
82	Tipi (murucaá)	*Petiveria alliacea* L.	Phytolaccaceae	Headache	Leaf/bark	Infusion/ decoction
83	Unha-de-gato	*Uncaria guianensis* (Aubl.) J.F.Gmel.	Rubiaceae	Malaria / liver	Bast	Decoction / garrafada
84	Species in testing 2.	Species in testing 2.	Humiriaceae	Malaria / liver	Bark	Decoction
85	Orelha-de-anta	*Costus* sp.	Costaceae	Liver	Leaf	Infusion
86	Vassourinha	*Scoparia dulcis* L.	Plantaginaceae	Liver	Whole plant	Infusion

cited for malaria, as carapanúba, cedro, carrapicho-agulha, joão-brandin, lima, mamão, mangirioba, marcela, melão-caetano, pariquina e quina-quina.[12] All these plants were also mentioned in this study, is to malaria or symptoms associated with the disease, confirming its use by communities studied.

Among the plants mentioned priority for malaria, are also symptoms associated with the disease. Found the following: malaria/ liver/fever (34%), indicated plants only to malaria (31%), malaria/liver (27%). It was considered that the respondents consider, in addition to fever associated with the disease, liver problem is a very important symptom for which plants malaria are also indicated.

In this set of plants 2 species are cited for malaria, but there are no research in scientific literature conducted for the disease with them. The same situation is happening in specie in testing 1 and specie in testing 2.

The most frequently prescribed and used species in the study were *Stenostomum acreanum* (40), in the Acre region, followed by *Aspidosperma nitidum* (39), which was found in both regions. The species *S. acreanum* was found in the municipality of Xapuri, in the Reserva Extrativista Chico Mendes.

About 53 respondents in the communities of Xapuri, almost all cited *S. acreanum* and stated that it is effective in treating malaria and was widely used in the rubber boom.

In the city of Pauini, among plants cited, stands out *Geissospermum reticulatum* (16), which was marked by the use and efficiency according to the interviewed.

In all 47 species were mentioned for the specific treatment of malaria, and fever in a total of 86 species, or 52% of the plants were cited for fever and malaria; Then, plants were mentioned for the treatment of liver, which is closely related to the disease, headaches, body aches, inflammation in the stomach and for the treatment of anemia.

In this study it became evident that communities use the medicinal plants for the treatment of malaria even in association with the drugs provided by FUNASA malaria, and that most of the plants of this study was related to malaria, fever and liver: the most cited plant was boldo (52) to the liver, followed by quina-quina (40) for malaria and fever and carapanaúba (39) for malaria, liver and fever. Thus, the perception of malaria and its associated symptoms must influence the number of species known for its treatment. Thus, the multiple use of the indicator species can be high cultural importance for human populations.[13]

As perceived by the informants, the part that is affected first when you have malaria is the liver, and always related with inflammation of the stomach and the liver as well. And after these symptoms other are always together: fever, cold and headache.

Conclusions

People who indicated and used the plants for malaria and its symptoms covered wide age range for both sexes, and living on average 30 years in the same location. The communities studied using medicinal plants for malaria and its symptoms after the administration of medications prescribed by FUNASA, and these remedies do not replace the use of medicinal plants. This research may contribute to future pharmacological studies with wild and cultivated plant species used for the treatment of malaria and its associated symptoms, that indicate species with promising potential used by these traditional communities.

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