



Amazonian Brazilian medicinal plants described by C.F.P. von Martius in the 19th century



Ulrike B. Breitbach^a, Michael Niehues^a, Norberto P. Lopes^a, Jair E.Q. Faria^b,
Maria G.L. Brandão^{c,d,*}

^a FCFRP—Universidade de São Paulo, Ribeirão Preto, São Paulo, Brazil

^b Instituto de Ciências Biológicas, Departamento de Botânica, Universidade de Brasília, Brazil

^c DATAPLANT, Museu de História Natural e Jardim Botânico, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil

^d Faculdade de Farmácia, Universidade Federal de Minas Gerais, Avenida Antônio Carlos 6627, 31270-901 Belo Horizonte, Minas Gerais, Brazil

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ABSTRACT

Ethnopharmacological relevance: Information regarding the use of beneficial, native Brazilian plants was compiled by European naturalists during the 19th century. The German botanist C.F.P. von Martius was one of the most prominent naturalists and described the use of several Brazilian plants.

Aim of the study: To present data on Amazonian medicinal plants documented by von Martius in his books.

Materials and methods: Data on Amazonian medicinal plants were obtained from three books published by von Martius. Traditional information about these plants was translated from Latin and the cited plant species reorganised according to current taxonomic criteria. Correlated pharmacological studies were obtained from different scientific databases.

Results: A total of 92 native medicinal species from the Amazon were recorded in von Martius' books. These accounts described 117 different medical uses for these plants. Several parts of the plants were used, including many exudates. The principal use of the species recorded was the treatment of dermatological problems, followed by gastro-intestinal, urinary and respiratory disorders. Few species were recorded as purgatives and febrifuges, a result that differs from the observations of other naturalists. The efficacy of the recorded traditional uses has been confirmed for the few species that have been subjected to laboratory studies.

Conclusion: The data recorded by the German naturalist von Martius represent a rich, unexplored source of information about the traditional uses of Brazilian plants.

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1. Introduction

Brazil became a Portuguese colony in 1500 and this period produced important records of the use of plants by native Brazilians. Jesuit priests were the first to establish direct contact with the native inhabitants. Other reports followed, including that of Gabriel Soares de Souza, who recorded the use of several plants (Souza, 1938). Brazilian territory remained under rigid colonial control until the early 19th century. This policy was intended to conceal the potential of the country's natural resources from other nations. From 1630 to 1654, northwestern Brazil was occupied by the Dutch. During this period, the physician William Pies described the use of important indigenous drugs, including

jaborandi, ipecac, copaiba and tobacco (Pisonis, 1648). In 1808, Bonaparte's invasion of Portugal forced the Portuguese royal family to resettle in Rio de Janeiro. Remarkable progress occurred in the economy and in culture and science during the 13 years that they lived in Rio de Janeiro. During this period, foreigners gained permission to enter the country. Several European naturalists, artists and scientists travelled in the vast Brazilian territory and recorded the mineral, animal and vegetal resources as well as the customs of the inhabitants. The information gathered by naturalists has contributed significantly to the growing knowledge of South American biodiversity and has produced significant advances in understanding of the continent's natural history (Brandão et al., 2008, 2011).

Carl Friedrich Phillip von Martius was one of the most prominent naturalists to travel in Brazil. His studies of the country included investigations in botany and anthropology (Schmelz, 2000). He travelled throughout the country, accompanied by the zoologist Johann Baptist von Spix. After their arrival in Rio de Janeiro in November 1817, von Martius and Spix travelled

* Correspondence to: Faculdade de Farmácia, Universidade Federal de Minas Gerais, Avenida Antônio Carlos 6627, 31270-901 Belo Horizonte, Minas Gerais, Brazil. Tel.: +55 31 34096970; fax: +55 31 34096935.

E-mail addresses: mbrandao@farmacia.ufmg.br, mglinsbrandao@gmail.com (M.G.L. Brandão).

southwards in the direction of São Paulo, proceeded through Minas Gerais over Goiás to Bahia, and then travelled farther north to the Amazon. In Fortaleza da Barra do Rio Negro, today's Manaus, von Martius and Spix separated to make independent journeys to the frontiers of Colombia and Venezuela. In December 1820, they returned to Rio de Janeiro and Munich. The collections made by this important expedition included thousands of natural history specimens. In all, these collections included 86 specimens of mammals, 350 of birds, 130 of amphibians, 116 of fish, 2700 of insects, 6500 types of plants, minerals and a great number of cultural objects from the native tribes (Tiefenbacher, 1994). A substantial number of important publications in the fields of botany and other sciences were also produced. These publications still possess extraordinary scientific value. Von Martius' comprehensive work "Flora brasiliensis" (<http://florabrasiliensis.cria.org.br/>) remains the most extensive complete publication about the plants of Brazil. The work of more than 60 years and several specialists was required to produce this substantial project, which comprises 15 volumes divided into 40 parts and containing information on 22,267 plant species, primarily Brazilian angiosperms (Wuschek, 1989; Riederer, 2007). The interests of von Martius extended beyond taxonomy to the traditional uses of Brazilian plants (Wuschek, 1989). In this area of study, he published the "Systema de Materia Medica Vegetabilis Brasiliensis" (Systema) as well as "Das Naturell, die Krankheiten, das Arztthum und die Heilmittel der Urbewohner Brasiliens". The Systema includes detailed descriptions of the origin of popular plant names, scientific names and the traditional/ medicinal use of 730 species (Martius, 1843).

This study aims to retrieve, organise and update information on medicinal plants from the Amazon described in the Systema and to complement these results with data from other studies published by von Martius. The medicinal use of plants was compared and/or confirmed by referring to relevant correlated pharmacological studies if available.

2. Materials and methods

2.1. Ethnopharmacological historical literature survey

The selection of data on Amazonian medicinal plants was based on the *Systema de Materia Medicae Vegetabilis Brasiliensis* (Martius, 1843). To access information in the Systema is a difficult undertaking because the data are not always logically organised, often appear incomplete, are taxonomically antiquated and are generally presented in Latin, Portuguese or German. In this report, we restrict our investigations to the plants of the Amazon because the naturalists covered a wide geographical area and because data on the medicinal plants of this region are scarce.

Native species for which data on traditional medicinal use were included and the vernacular names of the plants specified in the Systema were selected for further analysis. The actual botanical names were checked in the *Flora Brasiliensis* <http://florabrasiliensis.cria.org.br/> and the websites www.theplantlist.org and www.mobot.org. The status of each species as a plant native to Brazil was verified in an official Brazilian species list, "Lista de Espécies da Flora do Brasil" (Jardim Botânico do Rio de Janeiro; <http://floradobrasil.jbrj.gov.br>).

The traditional uses described by von Martius (in Latin or German) in the bibliography were summarised from the original books, translated into English and included in Table 1. Particular uses such as "chlorosis" (hypochromic anaemia) or "alexipharmaca", are described in their original format. The uses of certain exotic species, such as *Zingiber officinale* Roscoe or *Sesamum indicum* L., were also recorded by von Martius from the Amazon

but are not considered in this study. Additional data were obtained from the travel diaries, published from 1823 to 1831 and first translated into Portuguese soon afterwards, in 1838.

2.2. Recent pharmacological studies correlated with traditional uses

Information on these recent studies was obtained from searches of scientific databases (Pubmed, Scopus, ISI Web of Knowledge).

3. Results

A total of 92 different species were described as medicinal by von Martius in the Amazon (Table 1). The species belong to 38 families. The Leguminosae and Euphorbiaceae are best represented, with 11 and 8 species, respectively. The Lauraceae, Asteraceae, Apocynaceae and Araceae are represented by six, five, four and four species, respectively. The Cucurbitaceae and Solanaceae are each represented by three species. The other families are represented by two or one species each.

Traditional uses of the plants were observed in different parts of the Amazon, primarily in villages located near the banks of the Negro, Solimões, Japurá, Uaupés, Tocantins and Amazon Rivers as well as near larger cities such as Manaus, Belém and Santarém. The remedies were prepared from different parts of the plants. As shown in Table 1, the plant parts most frequently used were the roots (18), leaves (16), herbs (16), bark (12), fruits (11) and seeds (9). Different types of exudates from Amazonian trees were also used, including six latex/milk exudates, four juices and four balsam/resin exudates. Von Martius conducted many comparisons involving several of these exudates. The balsam obtained from *Protium heptaphyllum* (Aubl.) Marchand (Burseraceae) was compared with elemi and animes (*Hymenaea* spp.), and *Humiria balsamifera* Aubl. was compared with *Copaifera* L.

A total of 117 traditional uses were recorded by von Martius for the plants listed in Table 1. The most common use was the treatment of dermatological problems: 39 plants (42.3% of the total number of species) were used for this purpose. Of these plants, 23 species were found to serve in treating ulcers and in healing wounds and four in treating warts, four were used against condyloma, three were used as emollients, two were used for exanthema disease and two were used for impingements or insect bites. One plant each was mentioned for the treatment of dry skin, dermatophytoses, erysipelas, herpes, psoriasis, burn and sunstroke. Other plants were recorded as useful for treating digestive disorders. Of these plants, 17 species were found to serve in treating intestinal constipation (for example, as "counteracting obstructions of the abdominal viscera") and as laxatives, purgatives, cathartics or drastic remedies; 11 species were used as antihelmintics; 7 were used as inducers of vomiting/emetics and to treat dyspepsia/stomachic and other digestive disorders; five were used as antidiarrheal agents; four were used as carminatives/anti-flatulence agents; and one was used against blood dysentery. Other well-documented uses involved water retention and urinary problems. A total of 14 plants were used as diuretics (including treatments for dysuria and stranguria), seven to treat hydrops, seven to treat oedema of the foot, three to treat the pain of nephritis, two to treat gout and one to treat blood in the urine. Traditional uses for treating respiratory diseases were also frequently mentioned. The use of three plants was mentioned for each of the following catarrhal diseases: chronic cough, lung debility and tuberculosis. Ten plants were used to treat venereal disease, six of which were used against gonorrhoea and four as antisyphilitics. Nine species were used as diaphoretics, seven as febrifuges/antipyretics (two of which were used against

Table 1Medicinal species from the Brazilian Amazon recorded by von Martius in the 19th century.

Family and botanical name	Vernacular names	Part	Occurrence	Traditional use ^{a,b,c}	Correlated studies
Apocynaceae					
<i>Couma utilis</i> (Mart.) Müll.Arg. (<i>Colophora utilis</i> Mart.) ^a	Sorveira	Latex	Rio Negro, near Barra	Antihelminthic with ricinus oil ^{a,c}	None
<i>Himatanthus phagedaenicus</i> (Mart.) Woodson (<i>Plumeria phagedaenica</i> Mart.) ^a	Sebuü-üva, Sucu-üba	Latex	Rio Negro	Externally: infected ulcers; internally: against worms ^{a,c} , psoriasis and warts	None
<i>Odontadenia macrantha</i> (Roem. & Schult.) Markgr. (<i>Echites grandiflorus</i> G. Mey.) ^a	Sipó cururu	Wood	Amazonas, Guyana	Infusion in water to treat dyspepsia and other digestive disorders ^a , diaphoretic, purgative ^c	None
<i>Odontadenia puncticulosa</i> (Rich.) Pulle (<i>Echites cururu</i> Mart.) ^{a,b,c}	Cipó-cururu	Wood after flowering	Near Panurê; near Rio Urupês	Infusion is used as drastic, to treat dyspepsia and digestive disorders ^a ; to treat gastric fever ^b Diaphoretic and purgative ^c	None
Araceae					
<i>Caladium bicolor</i> (Aiton) Vent. ^a	Pê de bezerro, Papagaio, Tagurá, Tinhorão, Tanhorão	Juice	Pará, Amazonas	Cathartic, antihelminthic, against ascarids ^a	None
<i>Dracontium polyphyllum</i> L. ^a	Jiraraca, Herva de Santa Maria	Tubers	“ <i>Brasília amazonica</i> ”	Externally: wounds ^a ; Internally: asthma, chlorosis, amenorrhoea, viper bites ^a	None
<i>Montrichardia arborescens</i> (L.) Schott (<i>Philodendron arborescens</i> (L.) Kunth, <i>Arum arborescens</i> L.) ^a	Aninga, Aninga-üva	Leaves, thallus, roots	Amazonas near Japurá, Pará	Healing wounds and ulcers, with fresh juice. Decoction of fresh leaves or dried roots as bath to treat rheumatic pain, testicular and articulation tumours; hydrothorax ^a	None
<i>Pistia stratiotes</i> L. (<i>Pistia occidentalis</i> Blume) ^{a,b}	Flor d'água, Lentilha d'água	n.d.	Amazonas, Ega, Rio Solimões, Pará	Mucilaginous herb, used to clean wounds, infusion internally to treat blood in urine, diabetes, tumours from erysipelas, herpes and hemoptysis ^a ; old wounds can be healed by application of fresh flowers ^b	Antidiabetic, antidermatophytic, antifungal, antimicrobial, diuretic (Tripathi et al., 2010)
Asteraceae					
<i>Ayapana triplinervis</i> (Vahl) R.M. King & H. Rob. (<i>Eupatorium ayapana</i> Vent.) ^{a,c}	Ayapana	Herb	Amazonas, near São João do Príncipe (Rio Negro)	Squeezed herb juice or infusion (internally) and pressed herb (externally) against snake bites and as alexipharmac ^a	Antimicrobial (Gupta et al., 2002)
<i>Acanthospermum australe</i> (Loefl.) Kuntze (<i>Acanthospermum xanthioides</i> DC.) ^a	Poejo-da-praia	Herb	Amazonas near Manaus, Pará	Diuretic, diaphoretic; infusion against diarrhoea (originating from colds) ^a	Antiviral (Rocha Martins et al., 2011); antifungal (Portillo et al., 2001)
<i>Bidens pilosa</i> L. (<i>Bidens leucantha</i> (L.) Willd.) ^a	n.d.	Herb, branches	Near Pará	Mucilaginous herb used together with indigo, <i>Senna uniflora</i> (Mill.) H.S. Irwin & Barneby (<i>Cassia sericea</i> Sw.), to treat skin ulcers and lymphoedema. Roots are more mucilaginous than the stems	Antiviral (Nakama et al., 2012); antitumour (Nakama et al., 2011); antibacterial (Tobinaga et al., 2009)
<i>Eclipta paludicola</i> Steud. (<i>Eclipta prostrata</i> (L.) L., <i>Eclipta erecta</i> L.) ^a	Tangaraca	Herb	Amazonas, Pará	Decoction is used to treat diarrhoea	None
<i>Elephantopus mollis</i> Kunth (<i>Elephantopus martii</i> Graham) ^a	Sucuaya	Roots	Amazonas	Decoction is used in asthenic fevers ^a	None
Bignoniaceae					
<i>Cybastax antisyphilitica</i> (Mart.) Mart. ^a	Caroba de flor verde	Young branches; roots, leaves	Amazonas, near Manaus	Antisyphilitic, decoction and infusion to treat dysuria, hydrops, water retention; poultice and lotions against syphilitic ulcers ^a	None
<i>Jacaranda copaia</i> (Aubl.) D. Don (<i>Jacaranda procera</i> (Willd.) Spreng.) ^a	Caroba	Leaves	Rio Japurá	Used against venereal diseases, mainly inflammations of inguinal lymph, in baths of infusion or decoction for impingement. High doses of decoction cause vomiting and diarrhoea	None
Boraginaceae					
<i>Heliotropium indicum</i> L. (<i>Tiaridium indicum</i> (L.) Lehm.) ^a	Aguara ciunha-açu Jacua-acanga	n.d.	Near Óbitos, Pará	Desobstruents, to clean wounds and ulcers, against cutaneous affection; used on anal inflammations	Wound healing (Dash and Murthy, 2011); antibacterial (Nethaji and Manokaran, 2009)

Table 1 (continued)

Family and botanical name	Vernacular names	Part	Occurrence	Traditional use ^{a,b,c}	Correlated studies
Burseraceae					
<i>Protium heptaphyllum</i> (Aubl.) Marchand (<i>Icica heptaphylla</i> Aubl.) ^a	n.d.	n.d.	Amazonas, near Manaus	Tree with dried balsam similar to elemi and animes ^a	Antiinflammatory (Melo et al., 2011)
Calophyllaceae					
<i>Calophyllum brasiliense</i> Cambess. ^{a,c}	Lantim, Landy, Jacaré-tiva	Bark, balsam	Amazonas, near Manaus, Barcellos	Decoction is used to relax sinews ^a	Antinociceptive (Isaías et al., 2004)
<i>Mammea americana</i> L. ^a	Abrico	Seeds, inner root	Pará	Seeds are anthelmintic. The inner bark has a balsam that is used to treat wounds from biting insects, mainly <i>Culex penetrans</i> , and malignant ulcers ^a	Antibacterial (Yasunaka et al., 2005)
Cannaceae					
<i>Canna glauca</i> L. ^{a,b,c}	Albara, herva dos feridos	Roots, fresh herb, half-ripe fruit	Pará	Increases diuresis, diaphoresis, wound healing ^{a,b} ; Rheumatic pain, limb torpor, ulcers, earache	None
Caricaceae					
<i>Jacaratia digitata</i> (Poepp. & Endl.) Solms (<i>Carica digitata</i> Poepp. & Endl.) ^a	n.d.	n.d.	Amazonas,	Poultice to treat wound and ulcer healing ^a	None
<i>Jacaratia spinosa</i> (Aubl.) A.DC (<i>Carica dodecaphylla</i> Vell.) ^a	Jacaratiá	n.d.	Guyana, near Acarouany	Poultice to treat wound and ulcer healing ^a	None
Clusiaceae					
<i>Moronobea coccinea</i> Aubl. ^a	Oanani	n.d.	Pará, Rio Negro	The tree has a gum-resin used to treat wound	None
Convolvulaceae					
<i>Ipomoea pes-caprae</i> (L.) R.Br. (<i>Convolvulus brasiliensis</i> L., <i>Convolvulus maritimus</i> Desr.) ^a	Salsa da praia	Leaves, roots, thallus	Pará	Mucilaginous leaves (acres) are used to treat, the effects of colds and chronic gonorrhoea, externally or by mouth ^a . Roots are drastic, thallus and leaves are emollients ^a	Antinociceptive (de Souza et al., 2000), antispasmodic (Pongprayoon et al., 1992) Antagonistic to histamine (Wasuwat 1970)
Costaceae					
<i>Costus cylindricus</i> Jacq. ^a ; <i>Costus scaber</i> Ruiz & Pav. (<i>Costus anachiri</i> Jacq.) ^a	n.d.		Pará, Rio Negro	Mucilaginous juice, refreshing, febrifuge, nephritic pain and gonorrhoea	None
Cucurbitaceae					
<i>Luffa sepium</i> (G. Mey.) C. Jeffrey (<i>Luffa purgans</i> (Mart.) Mart.) ^a	Buchinha	Fruit	Amazonas	“Coloquintidas”, hydropisia and chronic ophthalmia, emetic ^a	None
<i>Luffa operculata</i> (L.) Cogn. (<i>Momordica operculata</i> L.) ^{a,c}	Bucha de Paulista, Purga de João Paes	Fruit	Amazonas	Against amenorrhoea, anasarcha, chlorose, herpetic diseases, emetic, diuretic ^a ; hydrops and chronic ophthalmia	None
<i>Melothria pendula</i> L. ^{a,c} (<i>Melothria fluminensis</i> Gardner) ^d	Cereja de purga	Fruit	Para, Santarem, near S. Gabriel	Purgative ^a	None
Dilleniaceae					
<i>Davilla kunthii</i> A.St.-Hil. (<i>Hieronias scabra</i> Vell.) ^a	None	Leaves	Amazonas, Santarem (Para)	Against testicular swelling from venereal abuse or effects of horseback riding effects and fumigations ^a	None
Euphorbiaceae					
<i>Euphorbia cotinifolia</i> L. ^{a,b} (<i>Euphorbia cotinoides</i> Miq.) ^d	n.d.	Milk, juice	Amazonas, Rio Negro	Treatment of warts and condyloma with poultices ^{a,b}	Antiviral (Betancur-Galvis et al., 2002)
<i>Hevea guianensis</i> Aubl. (<i>Siphonia elastica</i> Pers.) ^a	Pao seringá, seringueira, Xeringueira	Milk	Pará, Rio Negro	Latex with <i>Ricinus</i> L. oil against worms ^a	None
<i>Hura crepitans</i> L.	Oassacú, Assacú	Milk	Pará, Rio Negro,	Latex is anthelmintic ^a	Leishmanicidal (García et al., 2012), antibacterial (Bussmann et al., 2010)

Table 1 (continued)

Family and botanical name	Vernacular names	Part	Occurrence	Traditional use ^{a,b,c}	Correlated studies
(<i>Hura brasiliensis</i> Willd.) ^a <i>Jatropha curcas</i> L. ^c	Pinheiro de purga, Pinhão paraguay, Mandubiguaçu, Munduy-guaçu	Seeds	S. João, S. Anna, Santarem Pará, near Santarem, Amazon near Ega	Seeds are emetic and cathartic ^c	None
<i>Mabea fistulifera</i> Mart. ^a	Canudo de pita	Bark	Near Santarém	Bitter bark, astringent, resolvent, febrifuge	None
<i>Manihot esculenta</i> Crantz (<i>Manihot utilissima</i> Pohl) ^a	Mandioca, Mandiba	n.d.	Pará, Amazonas	Lymphatic system ^a , fresh leaves are antidote For poisoning from roots. Emetic.	Antihelmintic Marie-Magdeleine et al., 2010.
<i>Euphorbia tithymaloides</i> L.	n.d.	Herb and root	Rio Negro	Latex is used against warts, gonorrhoea, condyloma and malignant ulcers. Roots are used against syphilis and amenorrhoea	Antiinflammatory and antioxidant (Abreu et al., 2006)
(<i>Pedilanthus tithymaloides</i> (L.) Poit.) ^a <i>Sapium glandulosum</i> (L.) Morong (<i>Sapium hippomane</i> G. Mey.) ^a	n.d.	Latex and leaves	Amazonas, near Rio Negro, S.G. Cachoeira, Pará	Syphilis; elephantiasis; against warts ^a	None
Gentianaceae <i>Potalia resinifera</i> Mart. ^a	Anabi	Leaves	Amazonas, near Manaus, Pará, Santarem ^a	Decoction for ophthalmia, palpebral diseases ^a	None
<i>Tachia guianensis</i> Aubl. ^{a,c}	Raiz de jacaré-arú Caferana	Root	Rio Negro ^a Amazonas, near S. Gabriel ^a	Extremely bitter roots, tonic, incisive, intermittent fevers ^c	Antimalarial (Carvalho et al. 1991)
Humiriaceae <i>Humiria balsamifera</i> var. <i>floribunda</i> (Mart.) Cuatrec. (<i>Humirium floribundum</i> Mart.) ^a	Umiri	Bark	Pará, Amazonas, near Rio Uaupés	Balsam yellow, limpid, similar to copaiba and Peru ^a	None
Lamiaceae <i>Leonotis nepetifolia</i> (L.) R.Br. ^a <i>Hyptis mutabilis</i> (Rich.) Briq. (<i>Hyptis spicata</i> Poit.) ^a ; <i>Hyptis suaveolens</i> (L.) Poit. ^a	Cordão de frade n.d.	Herb Herb	Pará Para, Santarem	Used as baths against rheumatic affections and dysuria ^a Diaphoretic, several catharral disease, carminative, wound healing	Anti-inflammatory (Parra-Delgado et al., 2004) Anti-inflammatory (Grassi et al., 2006)
Lauraceae <i>Licaria puchury-major</i> (Mart.) Kosterm. (<i>Nectandra puchury-major</i> (Mart.) Nees. & C. Martius ex Nees) ^a <i>Aniba cujumary</i> (Mart.) A.Lyons (<i>Aydendron cujumary</i> (Mart.) Nees) ^a <i>Ocotea longifolia</i> Kunth (<i>Oreodaphne opifera</i> (Mart.) Nees) ^a <i>Ocotea cymbarum</i> Kunth (<i>Nectandra cymbarum</i> (Kunth) Nees) ^a <i>Ocotea odorifera</i> (Vell.) Rohwer (<i>Mespilodaphne pretiosa</i> var. <i>latifolia</i> Nees & Mart.) ^a	Puchury Cujumary Canella de cheiro Pão sassafráz Pereiorá, pão ou casca preciosa	Fruits, seeds Seeds Fruit oil bark bark	Rio Negro ^a . Amazonas, near Tabatinga Rio Negro Rio Negro Rio Negro, Amazonas Orinoco	Indigestion, diarrhoea, leucorrhoea, dysentery ^a Digestive, stomachic ^a Arthralgy, rheumatic diseases ^a Tonic, carminative, stomachic ^a Used as decoction in baths for diseases of nervous system, memory, oedema of feet, catarrhal disease, hydrops, gout, syphilis and vaginal discharge	Antitumour (Uchiyama et al., 2009) None None None None
Lecythidaceae <i>Gustavia hexapetala</i> (Aubl.) Sm. (<i>Gustavia brasiliensis</i> DC.) ^a	Janiparandiba, Japoarandiba, Jandiparana	roots, leaves, fruits	Near Rio Negro, Gurupá, Pará, Amazonas	Infusion of the roots used to treat liver and spleen disorders, mesenteric glands;	Antitumour (Pettit et al., 2004)

Table 1 (continued)

Family and botanical name	Vernacular names	Part	Occurrence	Traditional use ^{a,b,c}	Correlated studies
wound healing; engorgement of the spleen ^a ; emetic ^a					
Leguminosae					
<i>Bowdichia virgilioides</i> f. <i>major</i> (Mart.) Yakovlev (<i>Sebipira major</i> Mart.) ^a	Sebipira, Sebupira, Sicopira, Sucupira	Bark	Near Santarem (Pará)	Diaphoretic, incisive, corroborant. To treat rheumatic pain, arthritic tumours, weakened by syphilitic virus, hydrops, impingements ^a	None
<i>Caesalpinia pulcherrima</i> (L.) Sw (<i>Poinciana pulcherrima</i> L.) ^a	n.d.	n.d.	Near Rio Tocantins, Pará, Santarem, Rio Tapajoz	Leaves are cathartic	None
<i>Copaifera guyanensis</i> Desf. ^a	n.d.	Resin	Near Rio Negro, Manaus, Barcellos	Gonorrhoea ^a	None
<i>Copaifera martii</i> Hayne ^a	n.d.	Resin	Pará, near Maraca and Santarem	Gonorrhoea	Antimicrobial (Santos et al., 2008)
<i>Cynometra spruceana</i> Benth. var. <i>spruceana</i> (<i>Trachylobium martianum</i> Hayne) ^a	n.d.	Resin	Rio Negro	To treat weakness of the lungs, tuberculosis, chronic cough ^a	None
<i>Dipteryx odorata</i> (Aubl.) Willd. ^a	Cumarú, fava de Tonka	Seeds	Pará and Rio Negro	Nervine, analeptic (restorative), cardiac, diaphoretic and emmenagogue ^a	None
<i>Hymenaea courbaril</i> L. ^a	n.d.	Leaves	Maranhão	Used for lung debility, inhalation to treat tuberculosis and chronic cough	Antiviral (Cecílio et al., 2000)
<i>Senna multijuga</i> subsp. <i>lindleyana</i> (Gardner) H.S. Irwin & Barneby (<i>Cassia magnifica</i> Mart.) ^a	None	Leaves	Pará, Amazonas	Laxative, cathartic ^a	None
<i>Senna occidentalis</i> (L.) Link (<i>Cassia occidentalis</i> L.) ^a	Pajomarioba	Herb	Pará	Used as is <i>Senna</i> from Egypt, as laxative and cathartic. Effects are similar but weaker. Some produce colic. <i>Senna uniflora</i> (Mill.) H.S. Irwin & Barneby (<i>Cassia sericera</i> Sw.) is better.	Several activities (see Review from Yadav et al., 2010)
<i>Taralea oppositifolia</i> Aubl. (<i>Dipteryx oppositifolia</i> (Aubl.) Willd.) ^a	Coumarourana	Seeds	Same region as <i>Dipteryx odorata</i>	Similar to <i>Dipteryx odorata</i> (Aubl.) Willd. but weaker ^a	None
<i>Cynometra spruceana</i> Benth var. <i>spruceana</i> (<i>Trachylobium martianum</i> Hayne) ^a	n.d.	n.d.	Near Manaus, Pará, near Rio Caipuru, Santarem, Rio Negro, S. Carlos	Used for lung debility, inhalation to treat tuberculosis and chronic cough.	None
Linderniaceae					
<i>Lindernia diffusa</i> (L.) Wettst. (<i>Vandellia diffusa</i> L.) ^a	Caa-ataya, Mata canna, Purga de João Paez, Orelha de rato	Herb	Pará, Santarem, Amazonas	Bitter, mucilaginous, purgative, diuretic ^a	None
Malvaceae					
<i>Sida cordifolia</i> L. (<i>Sida altheifolia</i> Sw.) ^a (<i>Sida altheifolia</i> Sw.) ^a	n.d.	Herb	Amazonas near Manaus	Emollient herb, same use as <i>Malva</i> , infusion to treat throat inflammation	Anti-inflammatory (Swathy et al., 2010; Bonjardim et al., 2011)
Meliaceae					
<i>Carapa guianensis</i> Aubl. ^a	Andiroba, Angiroba, Nandiroba	Seed oil, bark, leaves	Rio Negro, Amazonas	Exanthema, especially that originating from bites of insects of the family Simuliidae. Decoctions against <i>Ascaris</i> (internally), dermatophytosis ^a	Antihelmintic (Carvalho et al., 2012), wound healing (Nayak et al., 2010), anti-inflammatory (Penido et al., 2006)
Menispermaceae					
<i>Abuta rufescens</i> Aubl. ^a	Abúta	Root, bark	Pará, Japurá	Stomach debility, digestive, intermittent fever, obstruction of abdominal viscera ^a	Antimalarial (Ruiz et al., 2011)
<i>Abuta imene</i> (Mart.) Eichler (<i>Cocculus imene</i> Mart.) ^a	n.d.	Root	Amazonas, near S.G. Cachoeira, Manaus, Rio Negro	Emetic	None
Moraceae					
	Coajinguba	Juice		<i>Ascaris</i> ^a	None

Table 1 (continued)

Family and botanical name	Vernacular names	Part	Occurrence	Traditional use ^{a,b,c}	Correlated studies
<i>Ficus adhatodifolia</i> Schott (<i>Ficus anthelmintica</i> Mart.) ^a			Para, near Rio Negro		
Myristicaceae <i>Virola sebifera</i> Aubl. (<i>Myristica sebifera</i> (Aubl.) Sw.) ^a	Ucuúba	Aromatic fat, oil of cooked seeds	Guyana, Pará, near Santarem	Colic, dyspepsia ^a ; rheumatic pain, arthritic tumours ^a	Antioxidant (Rezende et al., 2005)
Phyllanthaceae <i>Phyllanthus niruri</i> L. ^a	Herva pombinha	Herb, seeds	Pará	Diabetes mellitus ^a	Antidiabetic (Okoli et al., 2011)
<i>Phyllanthus brasiliensis</i> (Aubl.) Poir. (<i>Phyllanthus conami</i> Sw.) ^a	Conabi, Conavi, Cunabi	Herb	Pará, Rio Negro, Amazonas	Diuretic ^a	None
Phytolacaceae <i>Seguiera alliacea</i> Mart. ^a	Ybirarema, Guararema, Páo ou sipó d'algo, Ubirarema	Wood, leaves, bark	Pará, S. João and S. Anna	Externally: exanthemic illnesses, rheumatism, haemorrhoid pain, and water retention. In combination with <i>Bidens pilosa</i> L. herb, <i>Acmella oleracea</i> (L.) R.K.Jansen, <i>Kalanchoe laciniata</i> (L.) DC. ^a (<i>Kalanchoe brasiliensis</i> Cambess.) and <i>Kalanchoe gastonis-bonnieri</i> Haym.-Hamet & H. Perrier against prostate tumours ^a	None
<i>Petiveria alliacea</i> var. <i>tetrandra</i> (Ortega) Hauman (<i>Petiveria tetrandra</i> B.A.Gomes) ^a	Herva de pipi, Raiz de guiné	Roots, leaves	Pará	Decoction: limb debilitation. Against the weaker members of the body to treat cold, and against paralysis ^a	None
Piperaceae <i>Piper peltatum</i> L. ^a	None	Roots, juice of pressed herb, leaves	Pará	Internally: lymphatic system stimulation, diuretic ^a . Externally to clean ulcers, burns ^a	Antimicrobial (Mongelli et al., 1995)
Polygonaceae <i>Persicaria punctata</i> (Elliott) Small (<i>Polygonum acre</i> Kunth) ^a	Herva do bicho	Juice; herb	Banks of Rio Amazonas (Pará)	Against strangury, blood dysenteriae ^a ; Arthritis and haemorrhoid pain ^a	None
<i>Polygonum stypticum</i> Cham. & Schltdl. ^a	None	juice	Rio Negro	Astringent and refreshing; diarrhoea and gonorrhoea ^a	None
<i>Microgramma percuta</i> (Cav.) de la Sota (<i>Polypodium percutum</i> Cav.) ^a	Samambaia, Feto, feto macho	n.d.	Amazonas	Against worms in a way similar to <i>Dryopteris filix-mas</i> (L.) Schott (<i>Aspidium filix-mas</i> (L.) Sw.) ^a	None
Rhizophoraceae <i>Rhizophora mangle</i> L. ^a	Guaparaiba, Mangue vermelho, verdadeiro ou amarelo.	Bark	Pará	Considered one of the most potent astringents for medical or technical use ^a	Antiinflammatory (Marrero et al., 2006), wound healing (Fernandez et al., 2002)
Rubiaceae <i>Genipa americana</i> L. (<i>Genipa brasiliensis</i> (Spreng.) Baill.) ^a	Jenipapeiro, Jenipaba, v	Fruit	Amazonas, Pará, near Santarem	In baths to heal syphilitic ulcers ^a	Antitumour (Ueda et al., 1991)
<i>Palicourea marcgravii</i> A.St.-Hil. ^a	Erva do rato	n.d.	Pará, S. João, S. Anna	Strong effects in kidneys and skin; used in veterinary medicine against dysuria of horses and mules	None
Rutaceae <i>Ertela trifolia</i> (L.) Kuntze (<i>Monnieria trifoliata</i> L.) ^a	Alfavaca de cobra, Jaborandi	Roots	Maranhão, Alcantara, Pará, Santarém	Diaphoretic, diuretic, sialagogue, expectorant, antidote (preservative) ^a	None
Salicaceae <i>Casearia decandra</i> Jacq. (<i>Casearia adstringens</i> Mart.) ^a	None	Bark	Pará	Adstringent, use in baths for wound ^a	None
Sapindaceae <i>Paullinia cupana</i> Kunth (<i>Paullinia sorbilis</i> Mart.) ^a	Guarana-üva, guaraná	Seeds	Amazonas, Pará	Stomachic, antipyretic, digestive, cardiac, diaphoretic. Good for the treatment of colds, sunstroke, cramps, flatulence,	Anxiolytic (Roncon et al., 2011), antidepressant (Campos et al., 2005),

Table 1 (continued)

Family and botanical name	Vernacular names	Part	Occurrence	Traditional use ^{a,b,c}	Correlated studies
<i>Paullinia pinnata</i> L. ^a	Timbó, Timbo-sipó, Cururú-apé	Bark, leaves, fruits	Pará	anorexia, nervous headache, dry skin. Aphrodisiac but decreases the fertility of sperm ^a Poisonous to the brain and kidneys. Against hydrophobia, melancholia and other types of mental illness ^a	gastroprotective (Campos et al., 2003) Antioxidant (Jimoh et al., 2007).
Smilacaceae					
<i>Smilax longifolia</i> Rich. (Poir.) ^a	Legação, Salsaparrilha, Japicanga, Sipó-em	Roots	Rio Amazonas ^a Rio Negro, Ega, Japurá near Porto Dos Miranhas	Roots are rich in a bitter substance that adheres to the throat. The cooked roots are used to treat diseases of the kidneys ^a	None
<i>Smilax syphilitica</i> Humb. & Bonpl. ex Willd.	Legação, Salsaparrilha, Japicanga, Sipó-em	Roots	Pará, Amazonas	Same use as the true salsaparrilha (<i>Smilax longifolia</i> Rich.). Fresh plants are better than dried or old plants ^a	None
Solanaceae					
<i>Capsicum annuum</i> L. ^a	Quiyaqui, Quiya-cumari, Quiya-cumari, Quiya-apuá, Pimentão comprido, Pimentão, Quiya-acú, Pimenta de cheiro; Pimenta da Índia	Fruits	Pará	Used against constipation, anorexia, indigestion, atony of the tongue and throat, gangrenous angina and gout. Externally as caustic ^a	Several (see literature)
<i>Physalis pubescens</i> L. ^a	n.d.		Pará	Resolvent, anodyne, diuretic. Infusion used in catharrhal fever. Against stranguria.	None
<i>Solanum americanum</i> Mill. (<i>Solanum pterocaulon</i> Dunal, <i>Solanum oleraceum</i> Dunal, <i>Solanum nigrum</i> L.) ^a	Aguara-quiya, Pimenta dos cães, Erva do bicho, Pimenta de gallinha, Erva moura	Herb, fruits, leaves	Japurensibus (Rio Negro)	Herb emollient, diuretic, used against inflammation of the anus and urinary retention. Dried berries are used against toothache and prosopalgia. Leaves are applied to treat skin wounds on the legs ^a	None
Zingiberaceae					
<i>Renealmia alpinia</i> (Rottb.) Maas (<i>Alpinia pacoseroca</i> Jacq., <i>Renealmia exaltata</i> L.f.) ^{a,b,d}	Pacoseroça	Tuberous roots	Amazonas, near Japura	Carminatives, stomachic, resolutive and alexipharmacs (antidote). Wound disinfection and healing ^b	Leishmanicidal (Valadeau et al., 2009), antifungal (Melo e Silva et al., 2009)

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^a According to Systema de Materia Medica (Martius, 1843).^b According to Natureza, Doenças, Medicina e Remédios dos Índios Brasileiros (Martius, 1844).^c Spix, J.B. Viagem pelo Brasil (Travel in Brazil) 1817–1820/ Spix e Martius—Belo Horizonte: Ed. Itatiaia; São Paulo: Ed. da Universidade de São Paulo, 1981, vol. III.^d Flora Brasiliensis.

intermittent fevers), seven to treat rheumatic diseases, five to treat amenorrhoea/as emmenagogues and five to treat arthritis/arthralgia. Other uses were as astringents, as anti-haemorrhoids, to treat lymphedema and leucorrhoea and as neurological, cardiac and ophthalmic remedies. A total of three or four plants were recorded for each of these uses. The other 40 traditional uses were identified with one or two species. Of the species listed in Table 1, only 33 (35%) have been studied pharmacologically to verify the efficacy of the traditional remedies, but all of the species studied in these investigations showed activity.

4. Discussion and conclusions

Brazil offers an immense amount of biodiversity, including plants with great pharmacological interest, as recorded by several European naturalists who travelled throughout the country during the 19th century. Data on the medicinal uses of plants of southwestern Brazil recorded in the travel diaries of European naturalists have previously been presented (Brandão et al., 2008, 2011). In a recent study, we have additionally presented the first data on records of Brazilian medicinal plants in the field notebook of the French naturalist Auguste de Saint-Hilaire (Brandão et al., 2012). The Amazon Basin, in northern Brazil, also has a highly

diverse biota and still harbours a variety of unknown and unstudied plant species (Hopkins, 2007; Schulman et al., 2007). The Germans Spix and von Martius travelled in a vast area of the Amazon (from the frontiers of Colombia and Venezuela to the Brazilian State of Maranhão), and they recorded important data about the use of plants by native Brazilians during that period.

Table 1 shows traditional uses for 92 Amazonian plant species. This high number most likely reflects not only the extensive biodiversity of the area but also von Martius' knowledge of medicine. The remedies were prepared with different parts of the plants roots, herbs and leaves. It is interesting to note the use of several exudates of the plants, including juice, latex, resin and balsam. Many of these exudates were used to treat different dermatological diseases. The high frequency of exudate use is due to the type of vegetation found in the area of these explorations. The Brazilian Amazon is the largest continuous forest on Earth, representing more than 40% of the world's existing tropical rainforest and including a great abundance of trees (Rangel, 2012).

Dermatological problems, including leprosy and wounds, were the most frequent diseases in the Amazon region in the 19th century because of the region's climate (Galvão, 2003). In accordance with this situation, almost one-half of the recorded plant species (39, 42.3% of the total) were recorded by von Martius as

useful for treating skin infections. Very few of these species have been subjected to any pharmacological evaluation. The species *Pistia stratiotes*, *Ipomoea pes-caprae*, *Sida cordifolia*, *Heliotropium indicum*, *Couroupita guianensis* and *Rhizophora mangle* have been confirmed as effective wound-healing agents. Two species (*Hura crepitans* and *Renalmia alpinia*) have also shown activity against leishmaniasis in experimental studies. Note that ethnobotanical studies performed recently in other and different areas of the Amazon have also shown that most of the plants investigated are used to treat skin diseases (Bourdy et al., 2000; Herndon et al., 2009; Valadeau et al., 2009; Luziatelli et al., 2010). As observed by von Martius, these studies also show that plants are frequently used to treat digestive disorders in the Amazon region. Skin infections and digestive disorders are still severe public health problems in several areas of the world, and promising laboratory results indicate that these species can be useful for developing new medicines. Parasitic disease remains a health problem in the Amazon region, as it was in the 19th century, and many plant species used by the population to treat parasitic diseases were recorded by von Martius. Other diseases affecting the population of the Amazon region in the area investigated by von Martius include rheumatism, influenza, dysentery, diseases and symptoms associated with insect and snake bites, diseases of the respiratory system (e.g., pneumonia) and digestive disorders (Galvão, 2003). Von Martius recorded the use of plants for all these disorders. However, few of these plants have been evaluated to date, and their potential remains to be explored.

In contrast to the observations of other European naturalists, only two species (*Tachia guianensis* and *Abuta rufescens*) were recorded by von Martius as useful for treating intermittent fevers, the principal symptom of malaria. Both of these species have shown antimalarial activity in in vitro studies (Ruiz et al., 2011; Carvalho et al., 1991). Malaria is currently widespread in the Amazon and is one of the most serious public health problems in that region. The reason for the small number of plants used to treat this disease in the 19th century is that this disease was widespread in other areas of Brazil at that time but not in the Amazon region. The history of malaria is directly related to demographic, ecological, socio-economic and cultural changes in the region beginning in the first half of the 20th century. The earliest evidence for malaria in the Brazilian Amazon was presented by the Brazilian naturalist Alexandre Rodrigues Ferreira in his work “Endemic Diseases of the Captaincy of Mato Grosso”, published in the 18th century. In this work, he describes intermittent fevers, ague and related ailments and recommends quina (*Cinchona* species) as the best febrifuge (Ferreira Jr. et al., in press).

In the 19th century, the principal source of income in the Amazon region was the extraction of native products known as “hinterland plants” (“drogas do sertão”), such as cacao (*Theobroma cacao*), salsaparrilha (*Smilax* spp.), annatto (*Bixa orellana* L.), canela (*Cinnamomum* spp.), copaiba balsam, vanilla and guaraná (Emperaire, 2000). Von Martius furnished detailed descriptions of the use of two species of salsaparrilha and two species of copaiba balsam by the Brazilians. Salsaparrilha is the vernacular name for different species of *Smilax*, but von Martius only recorded the use of *Smilax longifolia* Rich. and *Smilax siphilitica* Humb. & Bonpl. ex Willd. The roots of these plants are rich in saponins and had great commercial value at the time due to their use as diuretics and for the treatment of venereal diseases. Paul Marcoy was a French botanist who travelled in the 19th century in the same areas of Amazonas von Martius. In his book, first published in 1860, he mentioned that many typical Amazon products were already scarce due to excessive collection and that *Smilax* roots were one of the products showing increasing scarcity (Marcoy, 2006). The seeds of *Paullinia cupana* (guaraná) are used for preparing a

refreshing and stimulating drink. The stimulant effect of this drink is due to its high caffeine content. This scarce product obtained from American plants has gained an international market and is now known worldwide (Desmachelier, 2010). The Maués Indians were the first inhabitants of the Amazon to develop the preparation of guaraná, and von Martius was responsible for the first detailed description of this preparation. This description appears in his travel diaries (Spix and Martius, 1823–1831).

This study shows that many of the medicinal plants described by von Martius from the Amazon have not been studied in greater detail until recently or have not been studied at all. Unlike other areas of Brazil (e.g., the Atlantic Forest and Cerrado), where the native vegetation has been severely degraded, the Amazon region still preserves its biodiversity. The collections, bibliographic and botanical samples collected by von Martius in the Amazon represent highly valuable and critical materials for the development and conservation of the Amazon region. We also hope that this work will provide an additional incentive for the valuation of the traditional knowledge of the people of the Amazon region and will be useful in the protection of collective intellectual property rights.

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