Ethnobotanical assessment in protected area from Brazilian Atlantic Forest

Avaliação etnobotânica em área protegida da Mata Atlântica brasileira

Evaluación etnobotánica en área protegida de la Mata Atlántica brasileña

Received: 03/09/2021 | Reviewed: 03/16/2021 | Accept: 03/26/2021 | Published: 04/04/2021

Gracimerio J. Guarneire
ORCID: https://orcid.org/0000-0002-8699-7491
Federal University of Jequitinhonha and Mucuri Valleys, Brazil
E-mail: gracimerio@yahoo.com.br
Nerilson Marques Lima
ORCID: https://orcid.org/0000-0001-9669-0306
Federal University of Juiz de Fora, Brazil
E-mail: nerilsonmarques@gmail.com
Gabriela P. Carli
ORCID: https://orcid.org/0000-0003-3324-7686
Federal University of Juiz de Fora, Brazil
E-mail: gabicarli15@gmail.com
Teresinha de Jesus A. S. Andrade
ORCID: https://orcid.org/0000-0002-2415-9222
Federal Institute of Education, Science and Technology of Maranhão, Brazil
E-mail: aguiarte10@gmail.com
Sandra Bertelli Ribeiro de Castro
ORCID: https://orcid.org/0000-0002-5535-0919
Federal University of Juiz de Fora, Brazil
E-mail: sandrabertelliribeiro@gmail.com
Caio Cesar S. Alves
ORCID: https://orcid.org/0000-0001-9765-8527
Federal University of Jequitinhonha and Mucuri Valleys, Brazil
E-mail: caiocsa@gmail.com
Alessandra P. Carli
ORCID: https://orcid.org/0000-0002-7956-8947
Federal University of Jequitinhonha and Mucuri Valleys, Brazil
E-mail: alessandrapcarli@hotmail.com

Abstract
In the present study, we conducted a survey on ethnobotanical information of chemical-pharmacological interest, which was acquired via on-site interviews using semi-structured questionnaires with informants in the community in Mucuri Basin in Minas Gerais, Brazil. 184 interviews were conducted with residents with 102 botanical species in approximately 87 genera and 41 families cited. In addition, respiratory system diseases were the most cited, accounting for 26.35% of the cases cited. *Lippia alba* (lemon balm) was the most cited species with a corrected popular use concordance of about 86.11%. The results suggested that vegetables are important therapeutic resources for the population. Such ethnobotanical studies are fundamental for the understanding and conservation of local culture with regard to the exploitation of medicinal plants. The findings of the present study contribute to the documentation of medicinal species in a Brazilian state characterized by mining, which implies the suppression of vegetation growth or the impairment of regeneration, which could lead to the disappearance of critical and invaluable plant species. The preservation of ethnobotanical knowledge is vital in areas with high human activity and areas undergoing deforestation.
Keywords: Ethnobotany; Environmental preservation area; Brazilian Atlantic Forest hotspot; Medicinal plants; Phytochemical methods.

Resumo
No presente estudo, realizamos um levantamento de informações etnobotânicas de interesse químico-farmacológico que foi adquirido por meio de entrevistas in loco por meio de questionários semiestruturados com informantes da comunidade da Bacia do Mucuri em Minas Gerais, Brasil. 184 entrevistas foram realizadas com residentes com 102 espécies botânicas em aproximadamente 87 gêneros e 41 famílias citadas. Além disso, as doenças do aparelho respiratório foram as mais citadas, correspondendo a 26, 35% dos casos citados. *Lippia alba* (erva-cidreira) foi a espécie mais citada com uma concordância de uso popular corrigida de cerca de 86, 11%. Os resultados sugerem que as hortaliças são importantes recursos terapêuticos para a população. Esses estudos etnobotânicos são fundamentais para a compreensão e conservação da cultura local no que diz respeito à exploração de plantas medicinais. Os achados do presente estudo contribuem para a documentação de espécies medicinais em um estado brasileiro caracterizado pela

mineração, o que implica na supressão do crescimento da vegetação ou no comprometimento da regeneração, o que pode levar ao desaparecimento de espécies vegetais críticas e inestimáveis. A preservação do conhecimento etnobotânico é vital em áreas com alta atividade humana e áreas em processo de desmatamento.
Palavras-chave: Etnobotânica; Área de preservação ambiental; Hotspot da Mata Atlântica brasileira; Plantas medicinais; Métodos fitoquímicos.

Resumen
En el presente estudio, realizamos un levantamiento de información etnobotánica de interés químico y farmacológico que se adquirió a través de entrevistas in situ a través de cuestionarios semiestructurados con informantes de la comunidad de la Cuenca del Mucuri en Minas Gerais, Brasil. Se realizaron 184 entrevistas con residentes con 102 especies botánicas en aproximadamente 87 géneros y 41 familias citadas. Además, las enfermedades del aparato respiratorio fueron las más citadas, correspondientes al 26,35% de los casos citados. *Lippia alba* (limoncillo) fue la especie más citada con un acuerdo de uso popular corregido de alrededor del 86,11%. Los resultados sugieren que las verduras son importantes recursos terapéuticos para la población. Estos estudios etnobotánicos son fundamentales para el conocimiento y conservación de la cultura local en lo que respecta a la exploración de plantas medicinales. Los hallazgos del presente estudio contribuyen a la documentación de especies medicinales en un estado brasileño caracterizado por la minería, lo que implica la supresión del crecimiento de la vegetación o el deterioro de la regeneración, lo que puede conducir a la desaparición de especies vegetales críticas e invaluables. La preservación del conocimiento etnobotánico es vital en áreas con alta actividad humana y áreas en proceso de deforestación.
Palabras clave: Etnobotánica; Área de preservación ambiental; Hotspot del Bosque Atlántico brasileño; Plantas medicinales; Métodos fitoquímicos.

1. Introduction

Ethnobotany plays a fundamental role in the dissemination of traditional knowledge from medicinal plants and its relationship with scientific knowledge, an association that allows us to understand how plant raw materials are used and their contribution to the development of new pharmaceutical products by populations through previous knowledge of generation to another (Castro, et al., 2021). Brazil is the country with the greatest biodiversity on the planet hosting approximately 25% of the recognized species, which are distributed in six biomes, including the Amazon, Caatinga, Cerrado, Pampas, Pantanal, and Atlantic Forest (Joly, 2011). Particularly, the Atlantic Forest is widely considered to have the highest species richness and rates of endemism on the planet (Ribeiro, et al., 2009). The therapeutic and biotechnological potential of these species could be exploited rationally to conserve the available natural resources. However, according to data from the *SOS Mata Atlântica* Foundation, due to great losses in the biodiversity of the Atlantic Forest, its size has decreased recently by about 12% from its original size (State Forest Institute, 2017; Costa, et al., 2011).

The present study was conducted in a protected area, which was established via Decree 45.877 of December 31. 2011 (Alto do Mucuri Environmental Protection Area, Minas Gerais state) under the phytogeographic domain of the Atlantic forest hotspot. The biome hosts diverse forest communities under millions of hectares, which are distributed along the Brazilian coast, and it is currently the most degraded biome in the country (Costa, et al., 2011). Particularly, the Mucuri Basin is one of the most devastated Atlantic Forest areas of the state of Minas Gerais, Brazil. This is potentially due to the high levels of mining activity in the region, which could suppress vegetation growth and development or impeding its regeneration (Grant & Koch, 2007). Such conditions could lead to the disappearance of plant species with potentially invaluable applications. In addition, research in the region has led to the discovery of novel species, which suggests that its huge diversity has not been studied exhaustively (Brito, et al., 2019; Maia & Monteiro, 2017; Goldenberg, et al., 2016; Coelho & Valadares, 2019).

The interactions that local communities have had with the biomes over the years have generated a wealth of experience and knowledge about the environments they inhabit with the interest in medicinal plants promoting the accumulation of key information about the environment (Alexiades, 1996; Alexiades & Sheldon, 1996; Lacerda, et al., 2013). To understand the value of the medicinal plants, it is necessary to understand the communities and their knowledge transmission mechanisms, the environments they inhabit, and the sources of the plants used. Through close and continuous contact with a community, a researcher could obtain information regarding the knowledge of local plants within the community (Almada, 2010; Freitas, et al., 2012).

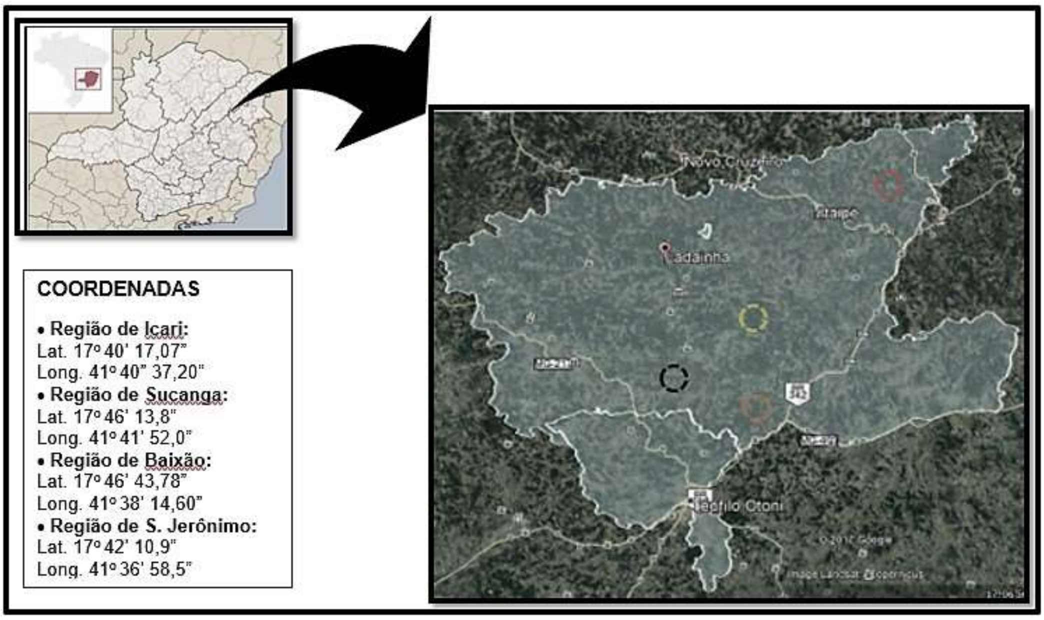
The findings of the present study could contribute to the documentation of medicinal species in the Mucuri Basin, which is one of the most degraded environments in the state of Minas Gerais, Brazil. This area is characterized by mining, which implies the impairment of vegetation growth and development in addition to its regeneration, which could further lead to the disappearance of invaluable plant species and resources.

2. Methodology

The study area

The ethnobotanical survey on potentially medicinal plants in the Mucuri Environmental Preservation Area was conducted on-site from individual approaches by applying a semi-structured questionnaire, combined with informal dialogues. Here, the studies were conducted in rural communities, in the São Jerônimo **-** Teófilo Otoni region, in the Sucanga **-** Poté region, in the Icari **-** Ladainha region and in the Baixão **-** Itaipé region, located in the Alto Mucuri, in the Northeast from Minas Gerais state. The information was obtained individually at the informant's residence, from February to December 2017. As inclusion criteria, the resident informants born in the region, aged 18 years or over, who knew and used medicinal plants were selected. This research was submitted and approved by the Research Ethics Committee of the Federal University of Jequitinhonha and Mucuri Valleys (CAAE 1.915.673).

Figure 1 - Location map from Environmental Preservation Area Alto do Mucuri **-** MG and the coordinates of the communities studied. Dashed circle: approximate delimitation of the community. Orange: São Jerônimo region; Black: Sucanga region; Yellow: Icari region; Red: Baixão region.



Source: Modified from: State Forest Institute - IEF. Environmental Protection Area. Available at: <http://www.ief.mg.gov.br/noticias/1/1330-governo-de-minas-cria- environmental protection area in the mucuri>.

When necessary, we used the technique "walking in the forest" or adapted guided tour by Alexiades (1996). This technique is particularly based on interviews conducted in the field where the researcher follows the informant on a walk, indicating and collecting botanical samples and information about the different uses of plants. All informants were interviewed individually as recommended by Phillips and Gentry (1993) to prevent responses from being influenced by another informant.

Botanical Identification and Collection

The cited species were collected immediately with the interviewee's authorization, observing the representative parts of the botanical material according to their indication of use, as well as parts in the reproductive phase. Subsequently, this material was properly pressed and dried in a greenhouse at an average temperature of about 40°C. After drying the material was herbified according to the techniques suggested by Cunningham (2001). Identification was performed through morphological analysis, through comparison with material deposited in herbarium, dichotomous keys for botanical identification, specialized literature such as Lorenzi (2000), Lorenzi and Matos (2008), Martinelli and Moraes (2013), Species List from Flora do Brasil (2016), specialized sites like Tropicos.org, Missouri Botanical Garden (The Plant List, 2016). International Union for Conservation Red List (IUCN, 2016). The collected species were deposited in the Jeanine Felfili Dendrological Herbarium (HDJF) of the Federal University of Jequitinhonha and Mucuri Valleys.

Data processing and analysis

Indications of use for therapeutic treatment were grouped according to biological systems and health problems and symptoms, according to the International Statistical Classification of Diseases and Reported Health Problems (ICD-10, 2015) version 2016, used by the WHO.

From the data obtained, we calculated the Relative Importance Index (RI) of the species cited as medicinal, obtained by calculating the percentage of Principal Use Agreement (CUP) of each species according to the methodology described by Amorozo and Gély (1988). The CUP for each species was found using the formula: CUP = (ICUP / ICUE)*100; where: ICUP is the number of informants who cited the main use, and ICUE is the total of informants who cited the use of the species (Amorozo & Gély 1988).

In order to compare the number of species cited in each locality, Begossi (1996) proposed the adaptation of ecological quantitative methods in ethnobotanical science, which allows evaluating similarities and differences of ethnobotanical knowledge between distinct communities or between groups from the same community.

A comparison between communities was also performed using the plants cited by the informants, obtained from the cluster technique, which makes the ordering of data. Thus, a similarity dendogram was constructed using the Jaccard index, which expresses the similarity between environments, based on the number of common species (Rode, et al., 2009).

To evaluate diversity, the Shannon-Weaver (H') diversity index was used, which is widely used in research that makes comparisons of ethnobotanical studies (Brito, et al., 2011) in different communities and is better known as the Shannon-Wiener index (H).

3. Results and Discussion

Social Profile of the Interviewed Community

In the four communities studied, 184 residents were interviewed, aged between 25 and 91 years; being that 54.89% were male. With regard to their levels of education, 39.14% of the respondents did not complete elementary school (Table 1). The proportion of male respondents who were informants in the present study is inconsistent with the reports of most such studies in Brazil (Amorozo, 2002; Povh & Siqueira, 2013) which have reported a dominance of female informants. The higher proportion of males in the present study could be due to the characteristics of the rural environment studied. While the average

age of the informants was 54.20 years, the youngest population, aged between 18 and 29 years, accounted for only 2.17% of the informants.

Regarding the level of education, a large proportion of the population did not complete basic education, which could be due to a need to work to boost family income.

Table 1 - Profile of gender, age and education of informants.

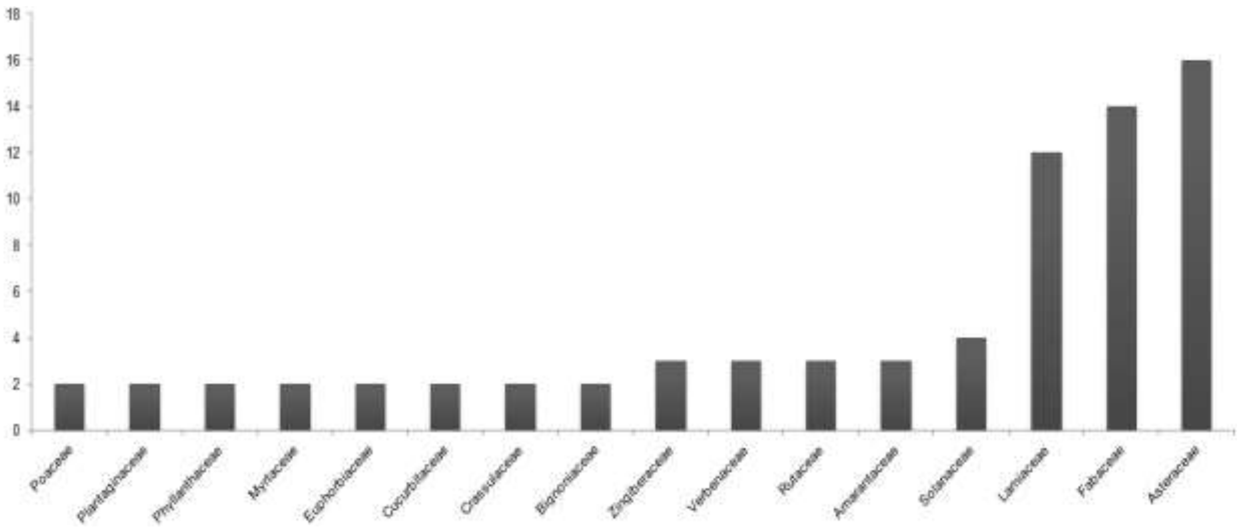
Informant Data		**%**
Gender	Male	54.89
	Feminine	45.11
Age range	18-39	20.10
	40-59	34.78
	60-79	38.58
	80 ou +	6.52
Scholarity	No schooling	8.15
	Incomplete elementary school	39.14
	Complete elementary school	30.98
	Incomplete high school	5.43
	Complete high school	16.30

Source: Authors.

Ethnobotanical Survey

The field ethnobotanical survey in the communities studied resulted in the listing of 102 species distributed in 87 genera and 41 families. Most species belonged to the families Asteraceae (16 species), Fabaceae (14 species), Lamiaceae (12 species) and Solanaceae (4 species).

Figure 2 - Families with greater richness of medicinal plant species in the communities of the Alto do Mucuri APA, MG.



Source: Authors.

Other studies conducted in rural communities in the Atlantic Forest biome in the state of Minas Gerais have also reported the predominance of species belonging to the Lamiaceae and Asteraceae families (Alves & Pohv, 2013); these families have a cosmopolitan distribution and have potential therapeutic, nutritional, and economic applications (Silva & Andrade, 2013).

Sampling and Estimated Wealth

RI index values between 0 and 24 correspond to rarely used species, between 25 and 49 to intermediately use species, and between 50 and 100 to widely used species. Most of the cited species (66.67%) had RI indices between 0 and 24. Species with RI values between 25 and 49 accounted for 26.47% of the cited species, while species with values between 50 and 100 accounted for only 6.86% of the cited species, representing seven out of the total 102 species listed in the area. *Lippia alba* (lemon balm) was the most cited species in the present study, with a CUPc of 86.11 (Table 2). Various studies conducted in other areas of the Atlantic Forest also reported *L. alba* as the most commonly cited species (Brito & Senna-Valle, 2011; Oliveira, 2015).

Leaves were the most commonly used plant organs in preparations for medicinal purposes. Leaves were cited the most (47.10%) for use in the treatment of diseases, followed by roots (10.14%) and flowers (7.97%) (Figure 3A). Other studies have also reported leaves to be the major organs used for therapeutic purposes (Messias, et al., 2015; Guimarães, 2016; Lima, 2015).

The major route of consumption of plant organs was reported via tea. Decoctions were the most used (46.92%) preparations, while infusions were the second most used preparations (25.93%) within communities (Figure 2B). Borges and Bautista (2010), Mota and Dias (2012), Ferreia *et al.* (2014) and Soares *et al.* (2009) also reported tea as the major preparation used.

Hence, the use of leaves implies that plant structure and survival are not compromised. Regarding the selection of methods of preparation, the long-term activity of the active ingredients in the species should be taken into account.

Table 2 - List of medicinal plants. scientific name; EUCI **-** number of informants citing use of the species; ICUP **-** number of informants citing main use; CUP **-** agreement of use index; HR **-** correction factor; CUPc **-** corrected CUP; HDJF **-** Herbarium deposit number, GJ **-** Gracimerio Jose, collection number.

Scientific name	Popular name	ICUE	ICUP	CUP	FC	CUPc	Reference
Lippia alba (Mill.) N. E. Br.	Erva cidreira	36	31	86.11	1.00	86.11	5492
Mentha spicata	Hortelã verdadeiro	33	29	87.87	0.91	79.96	5501
Plectranthus barbatus Andr.	Boldo	34	27	79.41	0.94	74.65	5513
Bidens pilosa L.	Picão	24	23	95.83	0.66	63.24	5551
Lantana camara	Camará/ Iantana camará	25	21	84	0.69	57.96	5533
Punica granatum	Romã	21	19	90.47	0.58	52.47	5507
Eclipta alba	Arnica	24	19	79.16	0.66	52.24	5548

Gossypium arboreum L.	Algodão	26	18	69.23	0.72	49.84	5515
Cymbopogom citratus	Capim cidreira	21	18	85.71	0.58	49.71	GJ9
Costus spicatus Sw.	Cana-de-macaco	22	17	77.27	0.21	47.13	5554
Plectranthus amboinicus	Hortelã pimenta	25	17	68.00	0.69	46.92	5499
Echinodorus macrophyllus (kunth) Michel	Chapéu de couro	23	17	73.91	0.63	46.56	5537
Momordica charantia L.	São Caetano	23	17	70.91	0.63	44.99	5521
Ocimum basilicum L.	Alfavaca	24	16	66.66	0.66	43.99	5523
Anadenanthera colubrina	Angico	23	15	65.21	0.63	41.08	5528
Carica papaya L.	Mamão	19	15	78.94	0.52	41.04	5550
Plantago major	Tanchagem	26	14	53.84	0.72	38.76	5518
Vernonia polyanthes Less.	Assa peixe	21	14	66.66	0.58	38.66	5519
Joannesia princeps Vell.	Boleira	20	14	70.00	0.55	38.50	5491
Ageratum conyzoides L.	Mentrasto	18	13	72.22	0.50	36.11	5493
Zingiber officinale Roscoe	Gengibre	17	13	76.47	0.47	35.94	5498
Mentha pulegium L.	Poejo	17	13	76.47	0.47	35.94	5544
Morus nigra L.	Amora	17	12	70.58	0.47	33.17	5509
Aristolochia labiata	Buta	17	12	70.58	0.47	33.17	5494
Mentha longifolia (L.) L.	Favaquinha	17	12	70.5	0.47	33.13	5503
Phyllantus niruri L.	Quebra pedra	13	11	84.61	0.36	30.45	5552
Aloe vera (l.) Burm.f.	Babosa	17	14	64.70	0.47	30.40	GJ10
Baccharis crispa Spreng.	Carqueja	17	11	64.70	0.47	30.40	5496
Lavandula angustifolia Mill.	Alfazema	20	11	55.00	0.55	30.25	GJ47
Rosmarinus officinalis L.	Alecrim	15	11	73.33	0.41	30.06	5502
Gomphrena arborescens L.f.	Para-tudo	15	11	73.33	0.41	30.06	GJ66
Sambucus australis Cham. and Schltdl.	Sabugueiro	15	11	73.33	0.41	30.06	5517
Euphorbia prostata Aiton	Quebra pedra rasteiro	11	11	100	0.30	30.00	5497
Senna occidentalis (l.) Link	Fedegoso	17	10	58.82	0.47	27.64	5545
Acanthospermum australe	Maroto	13	9	69.23	0.36	24.94	5505
Bixa oreliana L.	Urucum	13	9	69.23	0.36	24.92	GJ21
Leonurus sibiricus L.	Chico Ramos / macaé	21	9	42.85	0.58	24.85	5553

Gymnanthemum amygdalinum Delile) Sch. Bip. Ex walp.	Boldo	12	9	75.00	0.33	24.75	5524
Citrus sp	Laranja	11	9	81.81	0.30	24.54	GJ55
Piper umbellatum L.	Capeba	14	9	64.28	0.38	24.42	5540
Stachytarpheta glabra	Gervão	9	8	88.88	0.25	22.22	5529
Erythrina velutina Willd.	Mulungu	13	8	61.53	0.36	22.15	GJ22
Artemisia absinthium L.	Losna	12	8	66.66	0.33	21.99	5547
Schinus terebinthifolia Raddi	Aroeira	11	6	72.72	0.30	21.81	5543
Amburana cearensis A. C. Sm.	Amburana	14	8	57.14	0.38	21.71	5536
Pimpinela anisum L.	Erva doce	14	8	57.14	0.38	21.71	GJ50
Ipomoea batatas	Jalapa	10	8	80.00	0.27	21.60	GJ72
Cotyledon orbiculata L.	Baspo	10	8	80.00	0.27	21.26	GJ53
Dysphania ambrosioides (L.)	Erva Santa Maria	9	7	77.77	0.25	19.44	GJ51
Desmodium heterophyllum	Seninha	9	7	77.77	0.25	19.44	5512
Artemisia vulgaris L.	Artemísia	13	7	53.84	0.36	19.38	GJ99
Melanoxylon brauna Schott	Braúna	15	7	46.66	0.41	19.13	5539
Alpinia purpurata	Aguas flora	11	7	63.63	0.30	19.08	GJ89
Anthaenantia lanata	Capim-açú	11	7	63.63	0.30	19.08	5504
Petiveria alliacea L.	Guiné	11	7	63.63	0.30	19.08	5549
Copaifera reticulata Ducke	Pau d'olho / Copaíba	11	7	63.63	0.30	19.08	GJ95
Genipa americana L.	Jenipapo	16	7	43.00	0.44	18.92	GJ94
Luffa operculata	Buchinha	10	7	70.00	0.27	18.90	5541
Bryophyllum pinnatum (Lam.) Oken	Saião	10	7	70.00	0.27	18.90	GJ80
Tradescantia serrulata (Vahl) Handlos	Capoeiraba	9	6	66.66	0.25	16.66	GJ102
Citrus sp	Limão	8	6	75.00	0.22	16.50	GJ81
Lepidium ruderale L.	Mantruz	10	6	60.00	0.27	16.20	5514
Curcuma longa L.	Açafrão	10	6	50.00	0.27	16.20	5555
Pterodon emarginatus	Sucupira	8	5	62.50	0.22	13.75	GJ92
Matricaria chamomilla L.	Camomila	8	5	62.50	0.22	13.75	GJ79
Ocimum minimum L.	Manjericão	12	5	41.66	0.33	13.74	5525
Cyperus acicularis	Junça	11	5	45.45	0.30	13.63	GJ98

Ruta graveolens L.	Arruda	7	5	71.42	0.19	13.56	5520
Malpighia emarginata DC.	Acerola	10	5	50.00	0.27	13.50	GJ86
Psychotria sp	Trucisco	6	5	83.33	0.16	13.33	GJ97
Mandevilla velame (A. St. - Hil.) Pichon	Vela Branca	9	4	44.44	0.25	11.11	GJ76
Eugenia uniflora L.	Pitanga	9	4	44.44	0.25	11.11	5508
Cajanus cajan (L.) Millsp.	Andu	9	4	44.44	0.25	11.11	5542
Solanum aculeatissimum	Juá / melancia da praia	4	4	100	0.11	11.00	5532
Bauhinia splendens	Cipó escada de macaco	7	4	57.14	0.19	10.85	5538
Symphytum officinale L.	Confrei	6	4	66.66	0.16	10.66	GJ85
Jacaranda caroba (Vell.) A. DC.	Carobinha	6	4	66.66	0.16	10.66	5534
Leonotis nepetifolia (L.) R. Br.	Cordão de frade	5	4	80.00	0.13	10.40	GJ96
Bauhinia rufa	Unha de vaca	4	3	75.00	0.11	8.25	5535
Trixis vauthieri	Seripentina	4	3	75.00	0.11	8.25	GJ78
Senna alexandrina Mill.	Seninha I	4	3	75.00	0.11	8.25	GJ83
Stryphodendron adstringens (Mart.) Coville	Barbatimão	8	3	37.5	0.22	8.25	GJ77
Artemisia camphorata Vill.	Alcanfor	4	3	75.00	0.11	8.25	GJ101
Hymenaea courbaril L.	Jatobá	6	3	50.00	0.16	8.00	GJ73
Cecropia hololeuca	Embaúba branca	6	3	50.00	0.16	8.00	5495
Annona squamosa	Pinha	5	3	60.00	0.13	7.80	GJ100
Alternanthera philoxeroides (Mart.) Griseb.	Novalgina	5	3	60.00	0.13	7.80	GJ82
Miconia albicans	Canela de Velho	5	3	60.00	0.13	7.80	5546
Solanum paniculatum L.	Jurubeba	4	2	50.00	0.11	5.50	5556
Corymbia citriodora	Eucalipto citrodor	4	2	50.00	0.11	5.50	GJ74
Mentha piperita	Menta	4	2	50.00	0.11	5.50	GJ75
Conyza bonariensis	Emenda nervo	3	2	66.66	0.08	5.33	5506
Sp NI	Desinchadeira	3	2	66.66	0.08	5.33	GJ93
Solanum lycocarpum A. St.-Hil.	Lobeira	3	2	66.66	0.08	5.33	5531
Scoparia dulcis L.	Vassourinha	3	2	66.66	0.08	5.33	GJ90

(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v10i4.13714

Solanum americanum	Santa Maria	5	2	40.00	0.13	5.20	5522
Siparuna brasiliensis (Spreng.) A.DC.	Negra mina	3	1	33.33	0.08	2.66	5510
Achillea millefolium L.	Anador	2	1	50.00	0.05	2.50	GJ88
Baccaris crispa Spreng.	Carqueja do brejo	2	1	50.00	0.05	2.50	GJ84
Pyrostegia venusta	Cipó São João	2	1	50.00	0.05	2.50	5530
Erigeron bonariensis	Enxota	2	1	50.00	0.08	2.50	GJ91
Borreria verticillata (L.)	Poaia	2	1	50.00	0.05	2.50	GJ87

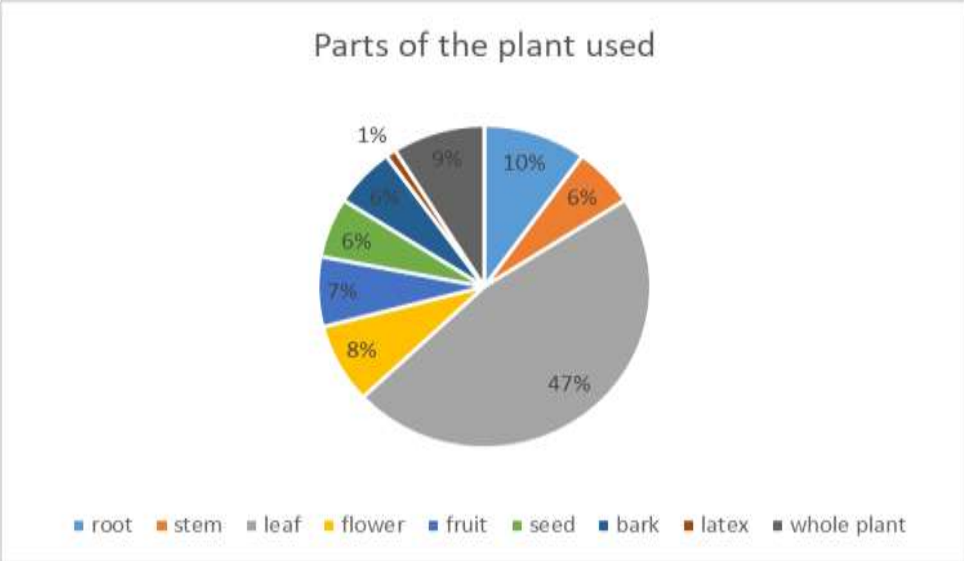
sp = Unidentified species. Source: Authors.

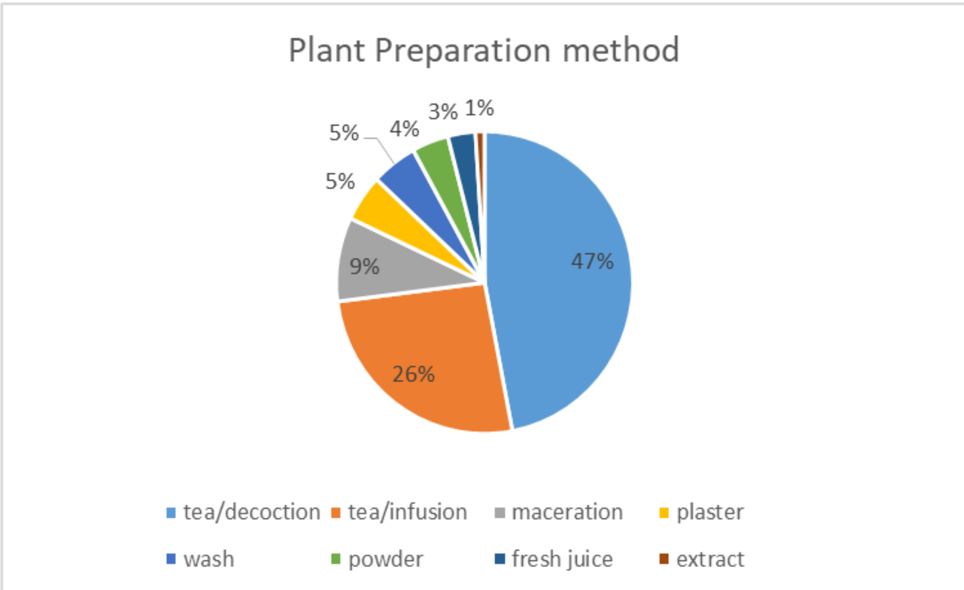
Plant Material and method of preparation used by communities

Concerning the plant organs used in plant preparations for medicinal purposes, it was observed that the leaves of the species are the most used. The leaves showed 47.10% of citations have a higher predominance of use for the treatment of diseases, followed by root (10.14%) and flower (7.97%) (Figure 3A). This fact has been verified by other studies in which leaves are the main botanical part used for medicinal use (Messias, et al., 2015; Guimarães, 2016; Lima, 2015).

As for the method of preparation, the survey showed that the main form of consumption of the plant is the preparation of tea. Decoction with 46.92% is the most used form of preparation. Infusion (25.93%) is the second most used form in communities (Figure 2B). Other authors such as Borges and Bautista (2010), Mota & Dias (2012), Ferreia, et al., (2014) and Soares, et al., (2009) also pointed out in their studies tea as the main form of preparation of the plant for use. The use of leaves becomes an important factor because it does not compromise plant structure and survival. Regarding the method of preparation, should be considered at term sensitivity of the active principles present in the species.

Figure 3 - A: Distribution of the botanical parts used. B: Preparation for medical use reported by respondents.





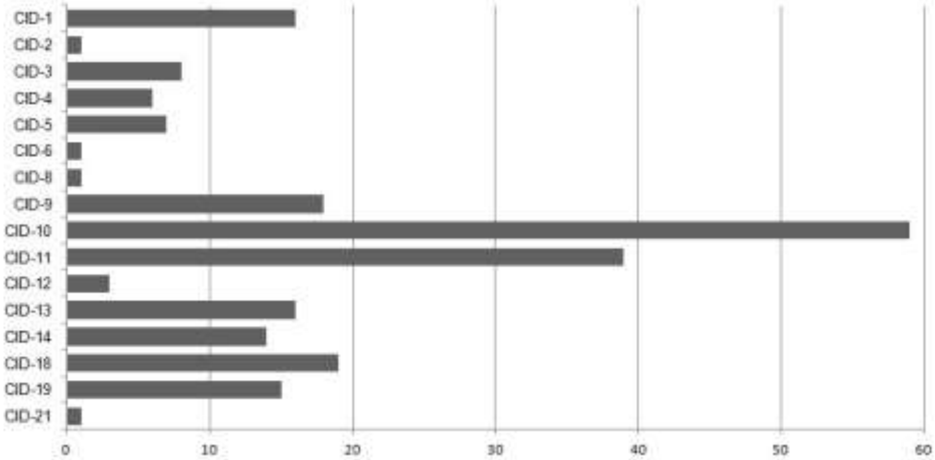
Source: Authors.

Indications for therapeutic use of medicinal plants

The indications for use of botanical species in therapeutic treatment were grouped based on biological systems, health problems, and symptoms, according to the International Statistical Classification of Diseases and Reported Health Problems (ICD-10, 2015) version 2016, used by WHO.

The various uses cited by the informants were classified into 16 categories according to ICD-10. The indications of diseases with the highest number of citations that could be treated with plant use by the communities in the studied areas were in category X - Diseases of the respiratory system (26.35%), followed by diseases in category XI - Diseases of the digestive system (17.41%), and category XVIII - Symptoms, signs and abnormal clinical and laboratory findings (8.48%), not classified elsewhere (Figure 4). Within the category of diseases of the respiratory system, influenza was the most cited and had the highest indication with 47 different plants for its treatment.

Figure 4 - Therapeutic indications of plants cited in categories according to the International Statistical Classification of Diseases and Health Related Problems (WHO, 2016)



CID -1 infectious and parasitic diseases; CID-2 neoplasms (tumors); CID-3 blood and hematopoietic organ disorders and some immunity disorders; CID-4 endocrine, nutritional and metabolic diseases; CID-5 mental and behavioral diseases; CID-6 nervous system disorders; CID-8 ear and mastoid apophysis diseases; CID-9 blood circulation diseases; CID-10 respiratory tract diseases; CID-11 digestive tract diseases; CID-12 skin and subcutaneous tissue diseases; CID-13 skin and subcutaneous tissue diseases; CID-14 genitourinary tract diseases; CID-18 Symptoms, signs and abnormal findings of clinical and laboratory examinations not elsewhere classified; CID-19 injury, poisoning and some other consequences of external causes; CID-21 factors that influence health status and contact with health services.
Source: Authors.

Similar studies have been reported indicating that respiratory system disorders and gastrointestinal system disorders correspond to the highest indications for use of these medicinal plants (Brito, et al., 2015).

4. Discussion

Ethnobotany, a field of study that explores the interrelationships between plants and human societies based on anthropological, ecological, and botanical dimensions, enhances our understanding of human societies and how they interact with plants (Albuquerque, et al., 2002; Soldati, 2013; Almeida, et al., 2009). Such ethnobotanical surveys provide information from local communities with regard to medicinal plants could guide chemical and pharmacological studies carried out in laboratories, which could facilitate the discovery of novel drugs and herbal remedies.

Several factors have been evaluated and are described in the text, which contribute to understand the dissemination of traditional knowledge, the preservation of flora in active human activity ecosystems and to conduct bioactivity and chemiodiversity studies in order to confirm the therapeutic potential of the species and discover the potential of the molecules responsible for this bioactivity.

Among the four communities studied, most of the respondents were aged 60–69 years and less than 50% of the respondents had not completed elementary school, indicating that the ethnopharmacological knowledge obtained was passed down through generations (Amorozo, 2002; Povh & Siqueira, 2013). In addition, the results of the present study indicate that the majority of the informants were males, which is consistent with the characteristics of the rural environment studied, mostly composed of small farms, characteristic of subsistence farming, where property is often inherited from descendants. Therefore, the heads of households (male) are often present around the home. In addition, the interview was conducted on a Saturday, which could have influenced the number of males reported, considering the increase in incidences of violence and fraud (report by some informants) in rural areas.

In a survey on medicinal plants conducted by Freitas, et al., (2012), the average age of the informants was 51.75 years. In the present study, young individuals aged 18 to 29 years had a low level of participation, representing only 2.17% of the informants. Interviewees generally referred the researchers to other family members, who were often the oldest members with the relevant knowledge to answer the questionnaires.

With regard to the level of education individuals, in rural areas often encounter the dilemma of choosing between work and study. Many young people opt to work, as they often need to complement family income. In addition, in the capitalist societies they live in, having a job is critical for social recognition (Queiroz, 2009).

More recent works such as Alves and Pohv (2013) investigated the medicinal plants of a rural community in the Atlantic Forest in Minas Gerais and the predominant plant families were Lamiaceae and Asteraceae, in Ouro Preto city (Minas Gerais. Brazil), in a study by Messias, et al., (2015). Asteraceae, Fabaceae, and Lamiaceae were the most dominant families. The high frequency of the species from the families could be associated with their wide distribution, the high number of species in the families, and their economic importance. The high numbers of the Lamiaceae, for example, could be explained by its cosmopolitan distribution and its broad medicinal applications (Mosca & Loiola, 2009; Freitas, et al., 2012; Paulino, et al., 2012; Alves & Povh, 2013; Moreira & Guarim Neto, 2015).

RI values between 0 and 24 correspond to rarely used species, between 25 and 49 to intermediately used species, and between 50 and 100 to widely used species. According to the results, most of the cited species (66.67%) has an IR between 0 and 24. Species with IR values between 25 and 49 accounted for 26.47% of the cited species, while species with IR values between 50 and 100 accounted for only 6.86% of the cited species, which were 7 out of the 102 species in the area. Different studies conducted in other areas in the Atlantic Forest also reported similar results (Brito & Senna-Valle, 2011; Oliveira, 2015).

The H′ index, a factor widely used in ecological studies, was 4.09 for the Icari region, 4.19 for the Baixão region, 3.98 for the São Jerônimo region, and 4.06 for the Sucanga region. In a study by Pereira, et al., (2011) in Gaspar Alto Central - SC, the H′ value reported was 3.74, In Itacaré - BA. Pinto *et al.* (2006), in studies on medicinal plants in rural communities of the Atlantic Forest, reported a value of about 4.21.

Different plant parts are used by communities for medicinal preparations. In the present study, leaves, with 47.10% of citations, were predominantly used to treat diseases, followed by roots (10.14%) and flowers (7.97%). Other studies have also reported the predominant use of leaves (Messias, et al., 2015, Guimarães, 2016; Lima, 2015). The predominant use of leaves in medicinal preparations could be due to the relative ease of use of leaves in preparations when compared to other plant parts, greater availability throughout the year (Spagnuolo & Baldo, 2009), or according to Gonçalves & Martins (1998), relative ease of collection and the higher chances of survival of a plant.

Regarding the methods of preparation of medicinal products, the survey revealed that the main form of consumption of the plant is tea. Decoction (46.92%) was the most widespread preparation followed by infusion (25.93%). The data are consistent with the findings of other studies (Borges & Bautista, 2010; Mota & Dias, 2012; Ferreia, et al., 2014; Soares, et al., 2009).

The use of leaves in medicinal preparations has relatively low negative impacts on ecological systems. According to Pilla, et al., (2006), the widespread use of leaves that are mostly collected manually for the preparation of “tea” is beneficial based on conservation and sustainable development perspectives, since the collection of leaves would not adversely impair plant development or result in plant death. The removal of other plant parts such as stem bark is largely destructive because it compromises the conductive systems, in turn adversely affecting the development and longevity of the plant (Rodrigues & Carvalho, 2001).

The method of preparation may be related to the type of organ of the plant used, considering that leaves often bear active thermolabile compounds.

Indications for exploitation of the botanical species for therapy were grouped according to biological systems, and health problems and symptoms based on the ICD-10, 2015 version 2016, used by WHO. The various uses cited by the informants were classified into 16 categories. Most of the diseases that could be treated with plants used by the communities in the studied areas were in category X - Diseases of the respiratory system with 26.35%, followed by diseases of category XI – Diseases of the digestive system (17.41%) and category XVIII - Symptoms, signs and abnormal clinical and laboratory findings 8.48%, not elsewhere classified. Within the f diseases of the respiratory system, influenza was the most cited disease, and it had the highest indication with 47 different plants for treatment.

Brito, et al., (2015) also obtained similar results, where the respiratory system and its disorders (influenza, cough, cold) accounted for 24.8% of citations, followed by gastrointestinal system disorders (11.1%), and undefined pain (8.3%). In addition, other studies have reported similar results (Amorozo, 2002; Begossi, et al., 2002; Giraldi & Hanazaki, 2010; Cunha & Bortolotto, 2011).

The application of species in therapeutic activities requires the selection of species that are effective and safe, either based on tradition or on scientific validation. In addition, the pharmacological properties of species that have diverse applications and are cited more frequently should be investigated further. The high numbers of species among the three families demonstrate their potential medicinal, economic, and nutritional applications, in addition to their potential to supply medicinally functional biomolecules, as they have key secondary metabolites that could be explored through pharmacological studies.

5. Conclusion

The findings of the present study contribute to the documentation of medicinal species in a Brazilian state characterized by mining, which implies the suppression of vegetation growth or the impairment of regeneration, which could lead to the disappearance of critical and invaluable plant species. The preservation of ethnobotanical knowledge is vital in areas with high human activity and areas undergoing deforestation. To the best of our knowledge, this is the first report on the use of plants for medicinal purposes in rural communities in the region of the Mucuri Basin area in the Minas Gerais region, Brazil. Therefore, the results of the survey could facilitate future ethnobotanical and pharmacological studies in the region and chemical studies exploring the active ingredients in the cited species.

Acknowledgments

The authors declare no conflict of interests in this work. This research was supported by Brazilian Research Agencies CNPq, CAPES and FAPEMIG for financial support.

References

Albuquerque, U. P., Alves, A. G. C., Silva, A. C. B. L., & Silva, V. A. (2002). Atualidades em etnobiologia e etnoecologia. *Sociedade Brasileira de Etnobiologia e Etnoecologia*. 151p.

Alexiades, M. N. (1996). Diretrizes selecionadas para pesquisa etnobotânica: um manual de campo. *The New York Botanical Garden*.

Almeida, N. F. L et al. (2009). Levantamento etnobotânico de plantas medicinais na cidade de Viçosa-MG. *Revista Brasileira de Farmácia, 90*, 316-20.

Almada, E. D. (2010). Sociobiodiversidade urbana: por uma etnoecologia das cidades. In: Silva, V. A., Almeida, A. L. S., Albuquerque, U. P. (2010). Etnobiologia e etnoecologia – pessoas e natureza na América Latina. Recife: NUPEEA. 39-63.

Alves, G. S. P. et al. (2013). Estudo etnobotânico de plantas medicinais na comunidade de Santa Rita. *Revista Biotemas. Ituiutaba–MG, 26*: 231-242.

Amorozo, M. C. M et al. (1988). Uso de plantas medicinais por caboclos do Baixo Amazonas. Boletim do Museu Paraense Emilio Goeldi. Série Botânica 4: 47-131.

Amorozo, M. C. M. et al. (2002). Uso e diversidade de plantas medicinais em Santo Antonio do Leverger. MT. Brasil. *Acta Botanica Brasilica, 16*: 189-203.

Begossi, A. (1996). Use of ecological methods in ethnobotany: diversity indices. *Economic Botany, 50*: 280–289.

Begossi, A. et al. (2002). Medicinal plants in the atlantic Forest (Brazil): knowledge, use and conservation. *Human Ecology, 30*: 281-299.

Borges, N. K. et al. (2010). Etnobotânica de plantas medicinais na comunidade de cordoaria. Litoral Norte do Estado da Bahia. Brasil. *Plurais, 1*: 153-174.

Brito, M. F. M. et al. (2015). Conhecimento etnobotânico local sobre plantas medicinais: uma avaliação de índices quantitativos. *Interciência, 40*: 156-164.

Brito, M. R. et al. (2011). Plantas medicinais utilizadas na comunidade caiçara da Praia do Sono. Paraty. Rio de Janeiro. Brasil. *Acta Botanica Brasilica, 25*: 363-372.

Brito, R. et al. (2019). Description of three new species of Phyllocnistis Zeller. 1848 (Lepidoptera: Gracillariidae) from the Atlantic Forest south Brazil with notes on natural history and phylogeny. *Austral Entomology, 58*:27-51.

Castro, M. A. et al. (2021). Conhecimento etnobotânico dos alunos de Ensino Médio sobre plantas medicinais em Maranguape –Ceará. *Research, Society and Development, 10*(3), 1-16.

CID-10. ICD-10 Version: (2016). International Statistical Classification of Diseases and Related Health Problems. <http://apps.who.int/classifications/icd10/browse/2016/en>.

Coelho, M. A. N., & Valadares, R. T. (2019). Three New Species of Anthurium (Araceae) from the Atlantic Forest of Rio de Janeiro. Minas Gerais. and Espírito Santo. *A J. for Botanical Nomenclature, 27*:22-32.

Collwell, R. K. (2013). EstimateS: statistical estimation of species richness and shared species from samples. <http://viceroy.eeb.uconn.edu/EstimateS>.

Costa, A. S. V. et al. (2011) Revista Científica Vozes dos Vales – UFVJM – MG – Brasil – Nº 09 – Ano V – 05/2016 Reg.: 120.2.095.

Cunha, S. A. et al. (2011). Etnobotânica de Plantas Medicinais no Assentamento Monjolinho, município de Anastácio. Mato Grosso do Sul. Brasil. Acta *Botanica Brasílica, 25*: 685-698.

Cunningham, A. B. (2001). Applied Ethnobotany: People. Wild Plant use and Conservation. 1Earthscan 300p.

Ferreira, F. M. C. et al. (2014). Levantamento etnobotânico de plantas medicinais na comunidade quilombola Carreiros. Mercês – Minas Gerais. *Revista Verde de Agroecologia e Desenvolvimento Sustentável, 9*: 205-212.

Freitas, A. V. L. et al. (2012). Plantas medicinais: um estudo etnobotânico nos quintais do Sítio Cruz. Rio Grande do Norte. Brasil. *Revista Brasileira de Biociências, 10*: 48-59.

Giraldi, M. et al. (2010). Uso e conhecimento tradicional de plantas medicinais no Sertão do Ribeirão. Brasil. *Acta Botanica Brasilica, 24*: 395-406.

Goldenberg, R. et al. (2016). Angiosperms and the Linnean shortfall: three new species from three lineages of Melastomataceae at one spot at the Atlantic Forest. *PeerJ 4*:e1824.

Gonçalves, M. I. A. et al. (1998). Plantas medicinais usadas pela população do município de Santo Antônio de Leverger. Mato Grosso. Brasil. *Revista Brasileira de Farmácia, 79*: 56-61.

Grant, C. D., & Koch, J. (2007). Decommissioning Western Australia's first bauxite mine: co-evolving vegetation restoraiotn techniques and targets. *Ecol Mgmt Restor, 8*:92–105.

Guimarães, M. F. M. (2016). Plantas úteis em comunidades urbanas: A importância das espécies exóticas e do gênero na manutenção do conhecimento e uso dos recursos vegetais. 119p. Dissertação (Mestre – Área de Concentração Evolução e Funcionamento de Ecossistemas) - Departamento de Biodiversidade. Evolução e Meio ambiente. Universidade Federal de Ouro Preto. Ouro Preto.

http://site.ufvjm.edu.br/revistamultidisciplinar/files/2016/06/Anna.pdf

Instituto Estadual de Florestas (IEF). Área de Proteção Ambiental. <http://www.ief.mg.gov.br/noticias/1/1330-governo-de-minas-cria-area-de-protecao-ambiental-no-mucuri>.

IUCN - Lista Vermelha de Espécies Ameaçadas. <http://www.iucnredlist.org>.

Joly, C. A. et al. (2011) Diagnóstico da pesquisa em biodiversidade no Brasil. *Revista USP, 89*: 114-133.

Lacerda, J. R. C. et al. (2013). Conhecimento popular sobre plantas medicinais e sua aplicabilidade em três segmentos da sociedade no município de Pombal-PB.

Patos: Revista ACSA *Agropecuária Científica no Semiárido 9*: 14-23.

Lima, M. H. V. (2015). Uso e conhecimento de plantas medicinais utilizadas pelas mulheres da Comunidade Mendes. Limoeiro. Pernambuco. Brasil. *Revista Ouricuri, 5*: 168-182.

Lista De Espécies Da Flora Do Brasil. (2017) Instituto de Pesquisas Jardim Botânico do Rio de Janeiro. 2016. <http:// floradobrasil.jbrj.gov.br/>.

Lorenzi, H. (2000). Plantas Daninhas do Brasil: terrestres, aquáticas, parasitas e tóxicas. (3a ed.), Plantarum 620p.

Lorenzi, H., & Matos, F. J. A. (2002). Plantas medicinais no Brasil nativas e exóticas. Instituto Plantarum 512p.

Maia, V. C. & Monteiro, R.F. (2017). Lopesia davillae (Diptera. Cecidomyiidae). A new species of gall midge from Brazil associated with Davilla rugosa (Dilleniaceae). *Braz. J. Biol., 77*:680-685

Martinelli, G., & Moraes, M. A. (2013). Livro vermelho da flora do Brasil. Instituto de Pesquisas Jardim Botânico do Rio de Janeiro 1100p.

Messias, M. C. T. B. et al. (2015). Uso popular de plantas medicinais e perfil socioeconômico dos usuários: um estudo em área urbana em Ouro Preto. MG. Brasil. *Revista Brasileira de Plantas Medicinais, 17*:76-104.

Moreira, R. P. M. et al. (2015). A flora medicinal dos quintais de Tangará da Serra. *Biodiversidade, 14*: 63-83.

Mosca, V. P. et al. (2009). Uso popular de plantas medicinais no Rio Grande do Norte. Nordeste do Brasil. *Revista Caatinga, 22*: 225-234.

Mota, R. S. et al. (2012). Quilombolas e recursos florestais medicinais no sul da Bahia. *Interações, 13*: 151-159.

Paulino, R.C. et al. (2012). Medicinal plants at the Sítio do Gois. Apodi. Rio Grande do Norte State. Brazil. *Revista Brasileira de Farmacognosia, 22*: 29-39.

Pereira, A. J. et al. (2011). Estudo etnobotânico de espécies medicinais em Gaspar alto Central. SC. *Revista Científica Eletrônica de Engenharia Florestal, 18*.

Peroni, N. et al. (2010). Métodos ecológicos na investigação etnobotânica e etnobiológica: o uso de medidas de diversidade e estimadores de riqueza. In: Albuquerque UP. Lucena RFP. Cunha LVFC (2010) Métodos e técnicas na pesquisa etnobiológica e etnoecológica. (2a ed.), NUPPEA 257-276.

Phillips, O. et al. (1993). The useful plants of Tambopata. Peru: I. Statistical hypotheses tests with a new quantitative technique. *Economic Botany, 47*:15-32.

Pilla, M. A. C. et al. (2006). Obtenção e uso de plantas medicinais no distrito de Martim Francisco. Município de Mogi Mirim. SP. Brasil. *Acta Botanica Brasilica, 20*: 789-802.

Pinto, E. P. et al. (2006). Conhecimento popular sobre plantas medicinais em comunidades rurais de Mata Atlântica. *Acta Botanica Brasilica, 20*: 751-762.

Queiroz, S. G. (2009). Aspectos da escolarização de jovens rurais: um campo de incertezas e possibilidades. In: Seminário De Estudos Culturais. Identidades E Relações Interétnicas. (2009). Anais... São Cristóvão: UFS 1-10.

Ribeiro, M. C. et al., (2009). The Brazilian Atlantic Forest: How much is left and how is the remaining forest distributed? Implications for conservation. *Biological conservation, 142*: 1141-1153.

Rode, R. et al. (2009). Comparação florística entre uma floresta ombrófila mista e uma vegetação arbórea estabelecida sob um povoamento de Araucaria angustifolia de 60 anos. *Revista Cerne, 15*: 101-115.

Rodrigues, V. E. G. et al. (2001). Levantamento etnobotânico de plantas medicinais no domínio do cerrado na região do alto Rio Grande –Minas Gerais. *Ciência e Agrotecnologia, 25*: 102-123.

Silva, A. A., & Andrade, L. D. H. C. (2013). Utilização de espécies de Asteraceae por comunidades rurais do nordeste do Brasil: relatos em Camocim de São Félix. Pernambuco. *Biotemas, 26*: 93-104.

Soares, M. A. A. et al. (2009). Levantamento etnobotânico das plantas medicinais utilizadas pela população do município de Gurinhém - Paraíba. *Revista Homem. Espaço e Tempo 3*: 36-47.

Soldati, G. T. (2013) Transmissão de conhecimento: origem social das informações e evolução cultural. In: Albuquerque UP. (org.). (2013) Etnobiologia: bases ecológicas e evolutivas. 1NUPEEA 37-61.

Spagnuolo, S. R. et al. (2009). Plantas medicinais e seu uso caseiro: o conhecimento popular medicinal. Ciências Biológicas e da Saúde 11: 31-4.
The Plant List. 2013. <http://www.theplantlist.org/>.