Medicinal plants used by urban and rural inhabitants of Luziânia, Goiás, Brazil

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Abstract

The Brazilian flora is highly diverse, with the Cerrado biome featuring as the savanna with the highest richness of species in the world. Furthermore, the use of medicinal plants is a common and traditional practice among the Brazilian population. In that regard, it is expected that the populations of historical cities located in the Cerrado should have vast ethnobotanical knowledge. From this perspective, this study aimed to record the medicinal plants used by the inhabitants of Luziânia (GO), Brazil, and evaluate their socio-economic profiles. The inhabitants (18 from the urban area and 20 from the rural area) were selected by the 'snowball' technique and underwent semi-structured interviews that addressed socio-economic and ethnobotanical aspects. Among the interviewees, 74.4 % were women, with adults and older adults constituting the main connoisseurs, and 71 % had incomplete primary education. Most interviewees cultivated medicinal plants in their backyards and cited using leaves as the main plant organ for medicinal purposes. The interviewees from the urban and rural areas differed with regard to the form of obtaining knowledge (c^2= 10,367; $p < 0,05$) since its origin was attributed to family transmission, reading, and from third parties in the urban area, whereas the rural inhabitants reported mainly family transmission. The interviewees cited 95 species, with no statistical difference between exotic and native species. However, the mentioned species were predominantly exotic. Lamiaceae, Asteraceae, and Fabaceae were the most representative families, and herbs were the most common type of medicinal plant. The most used species were *Lippia alba* (lemon balm), *Mentha arvensis* (mint), *Dysphania ambrosioides* (mastruz), and *Plectranthus barbatus* and *Plectranthus grandis* (boldo). The main health problems treated with medicinal plants were cold, indigestion, stress, and respiratory problems.

Keywords: Cerrado. Family knowledge. Backyard cultivation. Exotic medicinal plants.

Introduction

Medicinal plants can promote health (ANTONIO *et al.*, 2013) and are used as an alternative treatment for various diseases (MIRANDA, 2021). A large part of the world population (70 % to 80 %) meets their basic health needs by administering different plant species, with around 53 thousand species having been used to treat diseases since the early times of human history until the present days (QADIR; RAJA, 2021).

The use of medicinal plants is a traditional practice in Brazil as its indigenous peoples already used them to cure diseases even before the arrival of the Portuguese (AMOROZO, 2002). With colonization, the Europeans brought their medicinal species to be cultivated in Brazil and tested native Brazilian species with uses similar to European species. Finally, the Africans also incorporated their plants into the list of medicinal species used in Brazil (LORENZI; MATOS, 2011).

In addition to the historical context, which justifies the vast diversity of medicinal plants used in the country, Brazil contains the largest plant diversity in the world (BFG, 2015). Therefore, the possibility of identifying products with potential medicinal use among the native vegetation is gigantic since plants constitute the primary source of active ingredients, with 11 % of the 252 drugs considered essential by the World Health Organization (OMS) being acquired only from plants (BRAGA *et al.,* 2021). However, the intensive deforestation observed in Brazil (GONÇALVES-SOUZA *et al.,* 2021) causes a significant loss in biodiversity

(BLUM *et al.,* 2019), with excessive plant extraction and the destruction of natural habitats resulting in high risks to the perpetuation of medicinal species (RASHID *et al.,* 2021). In this scenario, the degradation of the Amazon rainforest in Brazil is one example of an intervention that has reduced the availability of some medicinal plant species (SHANLEY; LUZ, 2003).

Approximately 10.9 % of the Brazilian territory covered by natural vegetation (939.050 km^2) has been already devastated, with about a third of this loss (338.774 km^2) occurring in Cerrado, which is proportionately the most impacted Brazilian biome (GONÇALVES-SOUZA *et al.,* 2021). Even thoug, there is significant devastation, Cerrado is classified as an area of high priority for conservation since it comprises a large number of species and endemism (MEYERS *et al.*, 2000). Furthermore, Cerrado shows many plant species with food, ornamental, and medicinal potential, many of which are still unknown to science (SOUZA *et al.,* 2018). Therefore, ethnobotanical surveys are essential to know the native medicinal flora used by Cerrado communities (SOUSA *et al.,* 2020, given the significant number of species traditionally used for that purpose, e.g., pau-santo (*Kielmeyera coriaceae*), barbatimão (*Stryphnodendron adstringens*), baru (*Dipteryx alata*), jurubeba (*Solanum* spp.), mama-cadela (*Brosimum gaudichaudii*), and ipecacuanha (*Carapichea ipecacuanha*) (SOUZA *et al.,* 2018).

The municipality of Luziânia is located in the Cerrado, in western Goiás, and has 174,531 inhabitants, according to the last census of 2010 (IBGE, 2017), distributed in the urban area (formed mostly by houses and a few buildings) (CODEPLAN DF, 2014) and in the rural area (formed mostly by small farms). The urbanization rate of Luziânia is high (93.28 % in 2010), above the average of the state of Goiás (90.29 %). The local economy is mainly based on the service sector (57.2 %), the industrial sector (34 %), and the agricultural sector (8.8 %). Furthermore, Luziânia is one of the oldest cities of Goiás, dating from the 18th century, where gold was initially mined and with several colonial buildings, e.g., mansions on Rosário Street, the church of Our Lady of the Rosary, and the Andorinhas Palace (IMB, 2016). From this perspective, inventorying the medicinal plants used by the inhabitants of Luziânia is a promising endeavor that could assist in bioprospecting native species still little referenced in the literature, considering the location of the municipality in the Cerrado, with colonial origins and whose inhabitants live mostly in houses with domestic backyards.

Therefore, the hypotheses tested in this study were: (1) the inhabitants of the urban and rural areas of Luziânia should have similar socio-economic profiles and ethnobotanical knowledge since most of them work in the services sector and the industry and live-in houses; (2) the inhabitants of Luziânia should have significant knowledge about medicinal plants, both exotic and native, since they live in a colonial and traditional city inserted in the Cerrado. From this perspective, this study was developed to assess the socio-economic profile of connoisseurs of medicinal plants in Luziânia (Goiás) and list the medicinal plant species used by them.

Material and methods

Ethnobotanical research

Before beginning data acquisition for the research through interviews, the project was submitted to the Brazil Platform and the Research Ethics Committee of the Federal University of Goiás, which approved it and allowed the research to proceed (Presentation Certificate for Ethical Appreciation - CAAE: 17284013.7.0000.5083).

Potential interviewees were determined by the 'snowball' technique, according to which the connoisseurs of medicinal plants indicated

other connoisseurs (ALBUQUERQUE *et al.*, 2010). In order to participate in the research, the interviewees had to sign the free consent term (TCLE), one copy of which was delivered to the interviewees, and the other was stored by the researchers. There were 38 interviewees in total, all over eighteen years of age, 18 of whom lived in the urban area and 20 in the rural area. The urban interviewees came from different neighborhoods, and the rural interviewees came from different regions since the survey aimed to encompass the largest geographic area possible in the municipality of Luziânia.

The inhabitants were interviewed using semi-structured interviews with open and closed questions that addressed socioeconomic questions (place of birth, level of education, etc.) and questions about ethnobotanical knowledge (origin of the knowledge, common names of medicinal plants already used by the interviewees, forms of use etc.) (SOUSA *et al.,* 2020). The interviews also had an interactive nature and were subject to deepening if the interviewee wanted to elaborate on the responses or talk about some life experience (ALBUQUERQUE *et al.,* 2010). Some interviewees also took the researchers to their backyards, where they cultivated medicinal plants.

Data analysis

The data of the interviews conducted in urban and rural areas of Luziânia were analyzed separately. Then, two lists of medicinal plants were prepared, containing their indications for each area. Based on the two lists, the species and family of the medicinal plants cited were identified using their common names, pictures, field observations (backyards visited), therapeutic indication, and the scientific literature (LORENZI; MATOS, 2011). Subsequently, the origin of the species, the correct binomial writing, their authors, their families, and growth habits was checked in the Flora do Brasil 2020 website of the Rio de Janeiro Botanic Gardens (2020, 2021).

All statistical analyses were run with the software Past 3.18 (HAMMER *et al.*, 2001) using a 5 % significance level (α). Chi-squared (c^2) tests were performed to evaluate differences between interviewees from urban and rural areas with regard to (1) the number of men and women; (2) the place of origin; (3) the age range; (4) the level of education; (5) the occupation; (6) the origin of the medicinal knowledge; (7) the organ or part of the medicinal plant most used to obtain the therapeutic ingredient (root, stem, bark, leaf, flower, seed, fruit, or whole plant). The Chi-squared (χ^2) test and the Kruskal-Wallis test (H), jointly encompassing both the urban and rural areas, were performed to compare the number of native and exotic species cited and the different locations where the medicinal plants were acquired.

Finally, the most referenced species and medicinal indications were determined by summing the number of citations made by the interviewees.

Results and discussion

Through this study, it was possible to detect that the inhabitants of the urban and rural areas of Luziânia had similar socio-economic profiles and ethnobotanical knowledge and they were connoisseurs of medicinal plants, both exotic and native. However, the interviewees used mainly exotic plants originated from the colonization process and brought to Brazil by the Europeans and Africans. The backyards were the main areas where the species were obtained even though the interviewees lived closed to Cerrado areas and could obtain native species for medicinal use.

Among the people who had ethnobotanical knowledge in Luziânia, 74.4 % were females (TABLE 1). This result was also observed in the urban and rural areas separately, as the gender

distribution with regard to knowledge about medicinal plants was uneven in the two areas (χ^2 = 3.70; p > 0.05). Sousa *et al.* (2020) also highlighted the dominance of women with regard to ethnobotanical knowledge in the city of Sobradinho (Federal District), agreeing with Arnous *et al.* (2005) and Zeni (2017). According to Budó *et al.* (2008), domestic chores and family care (feeding and health) have been considered female work since the early beginnings of human civilization.

Both in urban and rural areas, most of the interviewees were born in other cities and then migrated to Luziânia, with no difference between the place of birth in the two areas (χ^2 = 0.867; p > 0.05). This fact demonstrates that the knowledge about medicinal plants in Luziânia was enrichened by the knowledge from other states, including Rio Grande do Sul, Minas Gerais, Sergipe, Ceará, Paraíba, and Maranhão, which was also observed by SOUSA *et al.* (2020).

Adults (50 % of the interviewees) and older adults (42 % of the interviewees) had more ethnobotanical knowledge than the younger people (8 % of the interviewees), with no difference with regard to age between the urban and rural interviewees of Luziânia (TABLE 1) (χ^2 = 1.371; p > 0.05). The higher concentration of medicinal knowledge among adults and older adults, respectively, refuted the common-sense

Table 1 – Social data of the interviewees in the urban and rural areas of Luziânia-GO obtained in the interviews. N= 38 people, 18 from the urban area and 20 from the rural area

Social data		Urban area	Rural area	Luziânia
Sex	Man	2	7	9
	Woman	16	13	29
Place of birth	Luziânia (GO)	6	4	10
	Other places	12	16	28
Age range	Young (18 to 30)	3	1	4
	Adults (31 to 60)	8	10	18
	Elderly (over 60)	7	9	16
Education	Illiterate	0	1	1
	Incomplete primary school	7	16	23
	Complete primary school	1	0	1
	Incomplete high school	2	0	2
	Complete high school	7	3	10
	University degree	1	0	1
Occupation	Civil servant	2	0	2
	CLT employee	7	0	7
	Student	1	0	1
	Homemaker	2	8	10
	Retired	6	8	14
	Farmer/herb seller	0	4	4
Origin of the knowledge	Family member	17	16	33
	Books and magazines	11	1	12
	Self-experience	11	1	12
	Third party	13	6	19

Source: Elaborated by the authors (2021).

idea that older people are the main connoisseurs of medicinal plants (PRADEICZUK *et al.*, 2017) and corroborated the observations reported for Sobradinho (Distrito Federal) (SOUSA *et al.,* 2020), a city close to Luziânia, since the ethnobotanical knowledge was effectively transmitted from the older to the intermediate generations in Luziânia. However, this fact was not observed for the youngest generation.

Among the interviewees, 71 % had not completed primary school, although they were older than 18 years and were not within the appropriate age range for regular primary or high school (TABLE 1). Furthermore, the level of education was similar between the people from the two areas ($\chi^2 = 10.044$; $p > 0.05$), although there were more interviewees with complete primary education in the urban area than in the rural area, whereas most of the rural residents had incomplete primary education (TABLE 1). The scarcity of formal education had already been observed in the population of Luziânia in the survey conducted by CODEPLAN DF (2014).

The interviewees showed different types of occupation that strongly differed between rural and urban inhabitants ($\chi^2 = 17.83$; $p < 0.05$) since most were professionals in the services sector or retirees living in the urban area. In contrast, many rural interviewees were farmers and homemakers, and one of them was an herb seller. With regard to the urban area, no pattern could be established between ethnobotanical knowledge and the type of occupation. However, in rural area, homemakers verified the history that women always had a crucial role in agriculture and the therapeutic care of the family. According to Budó *et al.* (2008), both in rural and urban areas (data obtained in the present study), the women are responsible for family care and transmit this knowledge to their daughters and granddaughters. Furthermore, since farmers had daily contact with plants, they had more interest in learning and valuing ethnobotanical knowledge (SOUSA *et al.,* 2020). Finally, being an expert on medicinal plants is essential for the herb seller role since this individual manages the preparation and use of medicinal plants for health promotion purposes.

The interviewees from the rural and urban areas of Luziânia differed with regard to the form of obtaining ethnobotanical knowledge ($\chi^2 = 10.367$; $p < 0.05$), although the level of knowledge was similar among them, respectively citing 61 and 60 species. The primary origin of knowledge for rural residents was family transmission (TABLE 1). According to Guerra and Nodari (2003), ethnobotanical knowledge is primarily generational. In addition to the family origin, many urban interviewees reported using books and magazines, their own experiences, and sharing information with third parties, which was also described by Messias *et al.* (2015) and Sousa *et al.* (2020). It should also be noted that, of the six interviewees in the rural area who signaled third parties as one of the origins of ethnobotanical knowledge, one was the herb seller who claimed to have learned his skills with the indigenous people of the state of Mato Grosso.

Medicinal plants were primarily obtained in domestic backyards rather than in nature, commerce or other places ($H = 37.95$; $p < 0.01$), as observed in Ouro Verde (GO) by Silvia and Proença (2008) and in the islands of the São Francisco River in Petrolina (PE) and Juazeiro (BA) by Pio *et al.* (2019). The predominance of domestic cultivation to the detriment of other forms of acquisition is probably because Luziânia is mainly formed by houses (CODEPLAN DF, 2014), small rural properties, and a few buildings, although vertical growth can also be observed. Domestic backyards are areas around the house where valuable species are grown, e.g., fruit trees, medicinal plants, ornamental plants, and some other species cultivated for food purposes (SALES, 2008).

Therefore, urban backyards are essential for the conservation of the native flora and cultivation spaces of the agrobiodiversity (WINKLERPRINS, 2002) and play an important role in maintaining cultural diversity since they are family coexistence sites (PASA *et al.*, 2005). It should be noted that the interviewees also cited nature, markets, open fairs, pharmacies, and other places (public or private gardens, wastelands, and anthropized places with ruderal plants) as forms of obtaining medicinal plants.

Most of the interviewees from the rural and urban areas of Luziânia cited the leaves as the main plant organ used, with no difference between areas ($\chi^2 = 8.063$; $p < 0.05$). Leaves have also been cited as the most used plant part in other studies (ZENI *et al.*, 2012; GOMES *et al.*, 2015; COSTA; MARINHO, 2016; PIO *et al.,* 2019; SOUSA *et al.,* 2020). According to Sousa *et al.* (2020), leaf extraction is less harmful to plants since it rarely causes the death of the organism, unlike the extraction of barks and roots. Moreover, the balanced removal of leaves also allows plant growth and reproduction (PILLA *et al.*, 2006). The leaves commonly cited in this study were usually obtained from exotic medicinal plants grown in backyards and used to prepare teas, e.g., rosemary, lemongrass, anise, and mint. The use of teas is also reported as the most common way of administering medicinal plants in other studies (AMOROZO, 2002; GOMES *et al.,* 2015; ZENI *et al.,* 2017).

Bark, oils, resins, roots, flowers, fruits, and seeds were also cited by the interviewees but in lower numbers, which could be considered positive with regard to the conservation of medicinal species that undergo that form of extraction. The inappropriate collection of barks, oil, resin or gums can cause plant death through girdling or large injuries that serve as entry points for pathogens and pests (FILIZOLA; SAMPAIO, 2015). Therefore, this type of extraction can bring conservationist problems to native species (FELFILI; BORGES-FILHO, 2004) since many species are collected from nature, e.g., *Stryphnodendron adstringens* (Mart.) Coville (barbatimão - bark), *Handroanthus impetiginosus* (Mart. ex DC.) Mattos (purple trumpet tree - bark), *Anadenanthera colubrina* (Vell.) Brenan (angico - bark), and *Copaifera langsdorffii* Desf. (copaiba – oil) (data obtained in the present study).

Therefore, according to Filizola and Sampaio (2015), barks, oils, gums, and resins are suggested to be extracted from the branches of species that accept pruning or, if pruning is not possible, the recommendation is to collect a small and vertical bark fragment in relation to the stem (i.e., the incision should always be longer than wider), using a healing agent immediately after collection. This healing can be performed with beeswax, clay, mineral oils, and resins from other trees. In that regard, the study conducted by Filizola and Sampaio (2015) is recommended for information about good management practices (FILIZOLA; SAMPAIO, 2015).

The excessive collection of fruits, seeds, and flowers/inflorescences is also harmful to the population since it negatively influences the recruiting of new individuals (AQUINO *et al.,* 2008), e.g., in *Hymenaea stigonocarpa* Mart. ex Hayne (jatobá) for fruits, *Pterodon emarginatus* Vogel (sucupira), in *Dipteryx alata* Vogel (baru) for seeds, and in *Achyrocline satureioides* (Lam.) DC. (macela do campo) for inflorescences (data obtained in the present study). Therefore, collecting only 25 % of the seed production is recommended for each parent plant to maintain the species in nature (MEDEIROS; NOGUEIRA, 2006). Also, the partial collection of inflorescences and fruits should be performed in order to maintain the sexual propagation of the species of interest as well as other ecological processes, e.g., feeding of the wild fauna, which is often the dispersing agent of plant species (AQUINO *et al.,* 2008).

The interviewees cited 95 medicinal plant species in Luziânia (GO) (TABLE 2). Since it is a city consisting mainly of houses with small backyards, medicinal knowledge is conveniently maintained in the city, as already observed by Pradeiczuk *et al.* (2017) and Sousa *et al.* (2020). Furthermore, the population of Luziânia is considerably traditional in its habits since it is a colonial city dating from the 18th century (IBGE, 2017). The high number of species cited in Luziânia was similar to the observed in Ouro Verde de Goiás, with 98 species (SILVA; PROENÇA, 2008), Alto Paraíso de Goiás, with 103 species (SOUZA; FELFILI, 2006), and Jataí, where 112 species were mentioned (SOUZA *et al.,* 2016).

Among the cited species, 42.11 % are native to Brazil and 57.89 % are exotic, with no statistical difference between the origin of the species ($\chi^2 = 0.405$; $p > 0.05$), highlighting the richness of local knowledge with regard to both Brazilian and exotic species. Our results differed from those found by Souza & Felfili (2006) in the community of Alto Paraíso de Goiás, which predominantly used the native biodiversity since 69 % of the cited species were Brazilian. On the other hand, the results were similar to those found by Silva and Proença (2008) since the exotic species grown in backyards stood out in absolute numbers in Ouro Verde (GO), similar to Luziânia. However, that difference did not imply a statistical difference in the present survey.

The 95 medicinal plant species in the city of Luziânia were classified into 37 botanical families, with 36 in the Phylum Anthophyta (Angiosperms) and 1 in the Phylum Monilophyta. Among the 10 most representative families, Lamiaceae, Asteraceae, and Fabaceae were the most cited, with 16, 14, and 10 species, respectively (TABLE. 2). These families are often mentioned in ethnobotanical studies (GUARIM-NETO; MORAIS, 2003; OLIVEIRA; LUCENA, 2015; SOUSA *et al.,* 2020) since they comprise a large number of species and favor colonization and cultivation (SOUZA *et al.*, 2016). In the family Lamiaceae, the 16 species cited were exotic to Brazil. In Asteraceae, 8 were native and 6 were exotic. In Fabaceae, 9 were native and 1 was exotic. Therefore, the results highlight the importance of the European (ex: mint, lavender, rosemary) and African flora (e.g., boldo and lemongrass) for Brazilian ethnobotany, especially with regard to the introduction of Lamiaceae species, and the potential of the Brazilian flora for bioprospecting medicinal active ingredients, mainly the families Asteraceae and Fabaceae.

The predominance of the family Lamiaceae, the most cited in Luziânia, was confirmed to the genus level since the following taxa were mentioned more than once for the genus category: *Mentha* L. (Lamiaceae), with four species, and *Ocimum* L. and *Plectranthus* L'Hér. (Lamiaceae), with three species each. The results also contained indications of Alliaceae, Amaranthaceae, Myrtaceae, and Rutaceae in the ten most recorded families (TABLE 2): *Allium* L. (Alliaceae), with three species, and *Alternanthera* Forssk. (Amaranthaceae), *Syzygium* Gaertn. (Myrtaceae), and *Citrus* L. (Rutaceae), with two species each.

The exotic medicinal species were the most used by the population of Luziânia (Central-West Region of Brazil), both in the urban and rural areas (TABLE 3), despite the eventual use of many native species. Mint (hortelã) and lemongrass (capim-santo): 22 citations; boldo: 20 citations; lemon balm (erva-cidreira): 18 citations; aloe (babosa): 18 citations; mastruz: 13 citations; and rosemary (alecrim): 12 citations were also among the most cited plants in the city of Sobradinho, in the Federal District (Central-West Region) (SOUSA *et al.,* 2020). Mint: 21 citations; lemon balm: 20 citations; and aloe: 17 citations were also the most cited plants in the city of Abaetetuba, in Pará (North Region) (GONÇALVES; LUCAS, 2017). Boldo: 24

Table 2 – Medicinal plant species cited by the inhabitants of Luziânia (Goiás) and shown in ascending alphabetical order per family

Medicinal plant species	Common name	Family	Habit	Origin
Sambucus australis Cham. & Schltdl.	sabugueiro	Adoxaceae	shrub	native
Allium sativum L.	alho	Alliaceae	herb	exotic
Allium fistulosum L.	cebolinha	Alliaceae	herb	exotic
Allium cepa L.	cebola	Alliaceae	herb	exotic
Alternanthera brasiliana (L.) Kuntze	terramicina	Amaranthaceae	subshrub	native
Alternanthera philoxeroides (Mart.) Griseb.	dipirona	Amaranthaceae	subshrub	native
Dysphania ambrosioides (L.) Mosyakin & Clemants	mastruz	Amaranthaceae	herb	native
Myracrodruon urundeuva Allemão	aroeira	Anacardiaceae	tree	native
Anethum graveolens L.	endro	Apiaceae	herb	exotic
Foeniculum vulgare Mill.	erva doce	Apiaceae	herb	exotic
Pimpinella anisum L.	erva doce	Apiaceae	herb	exotic
Petroselinum crispum (Mill.) Fuss	salsinha	Apiaceae	herb	exotic
Aloe vera (L.) Burm. f.	babosa	Asphodelaceae	herb	exotic
Solidago chilensis Meyen	arnica	Asteraceae	subshrub	native
Cynara scolymus L.	alcachofra	Asteraceae	herb	exotic
Vernonia polyanthes (Spreng.) Less.	assa peixe	Asteraceae	shrub	native
Chamomilla recutita (L.) Rauschert	camomila	Asteraceae	herb	exotic
Baccharis crispa Spreng.	carqueja	Asteraceae	subshrub	native
Stevia rebaudiana (Bertoni) Bertoni	estévia	Asteraceae	herb	native
Helianthus annus L.	girassol	Asteraceae	herb	exotic
Mikania glomerata Spreng.	guaco	Asteraceae	climber	native
Artemisia absinthium L.	losna	Asteraceae	subshrub	exotic
Achyrocline satureioides (Lam.) DC.	macela	Asteraceae	herb	native
Egletes viscosa (L.) Less.	macela	Asteraceae	subshrub	native
Ageratum conyzoides L.	mentraste	Asteraceae	herb	native
Achillea millefolium L.	mil folhas	Asteraceae	herb	exotic
Bidens pilosa L.	picão	Asteraceae	herb	exotic
Handroanthus impetiginosus (Mart. ex DC.) Mattos	ipê roxo	Bignoniaceae	tree	native
Bixa orellana L.	urucum	Bixaceae	tree	native
Nasturtium officinale R. Br.	agrião	Brassicaceae	herb	exotic
Protium heptaphyllum (Aubl.) Marchand	amescla	Burseraceae	tree	native
Monteverdia truncata (Nees) Biral	folha santa	Celastraceae	tree	native
Calophyllum brasiliense Cambess.	mangue	Clusiaceae	tree	native
Costus spicatus (Jacq.) Sw.	cana do brejo	Costaceae	herb	exotic
Diospyrus kaki L.f.	caqui	Ebenaceae	tree	exotic
Croton antisyphiliticus Mart.	pé-de-perdiz	Euphorbiaceae	tree	native
Euphorbia tirucalli L.	avelós	Euphorbiaceae	shrub	exotic
Equisetum giganteum L.	cavalinha	Equisetaceae	subshrub	native
Amburana cearensis (Allemão) A.C.Sm.	imburana	Fabaceae	tree	native
Anadenanthera colubrina (Vell.) Brenam.	angico	Fabaceae	tree	native
Copaifera langsdorffii Desf.	copaiba	Fabaceae	tree	native
Dipteryx alata Vog.	barú	Fabaceae	tree	native

Medicinal plant species	Common name	Family	Habit	Origin
Hymenaea stigonocarpa Mart. ex Hayne	jatobá	Fabaceae	tree	native
Myroxylon peruiferum L.F.	balsamo	Fabaceae	tree	native
Pterodon emarginatus Vogel	sucupira	Fabaceae	tree	native
Senna occidentalis (L.) Link	fedegoso	Fabaceae	subshrub	native
Stryphnodendron adstringens (Mart.) Coville	barbatimão	Fabaceae	tree	native
Tamarindus indica L.	tamarindo	Fabaceae	tree	exotic
Lavandula angustifolia Mill.	alfazema	Lamiaceae	herb	exotic
Melissa officinalis L.	erva-cidreira	Lamiaceae	subshrub	exotic
Mentha arvensis L.	hortelã	Lamiaceae	herb	exotic
Mentha pulegium L.	poejo	Lamiaceae	herb	exotic
Mentha X villosa Huds.	hortelã	Lamiaceae	herb	exotic
Mentha spicata L.	alevante	Lamiaceae	herb	exotic
Ocimum carnosum (Spreng.) Link & Otto ex Benth.	alfavaca	Lamiaceae	subshrub	exotic
Ocimum basilicum L.	manjeirão	Lamiaceae	herb	exotic
Ocimum gratissimum L.	alfavaca	Lamiaceae	subshrub	exotic
Origanum vulgare L.	manjerona	Lamiaceae	subshrub	exotic
Plectranthus amboinicus (Lour.) Spreng.	malva do reino	Lamiaceae	subshrub	exotic
Plectranthus barbatus Andrews	boldo	Lamiaceae	subshrub	exotic
Plectranthus grandis (Cramer) R. Willemse	boldo	Lamiaceae	subshrub	exotic
Rosmarinus officinalis L.	alecrim	Lamiaceae	subshrub	exotic
Salvia officinalis L.	sálvia	Lamiaceae	herb	exotic
Tetradenia riparia (Hochst.) Codd	mirra	Lamiaceae	shrub	exotic
Cinnamomum zeylanicum Blume	canela	Lauraceae	tree	exotic
Laurus nobilis L.	louro	Lauraceae	tree	exotic
Persea americana Mill.	abacate	Lauraceae	tree	exotic
Linum usitatissimum L.	linhaça	Linaceae	herb	exotic
Punica granatum L.	romã	Lythraceae	shrub	exotic
Malpighia emarginata DC.	acerola	Malpighiaceae	tree	exotic
Abelmoschus esculentus (L.) Moench	quiabo	Malvaceae	shrub	exotic
Cochlospermum regium (Mart. ex Schrank) Pilg.	algodãozinho do campo	Malvaceae	shrub	native
Gossypium hirsutum L.	algodão	Malvaceae	shrub	exotic
Hibiscus sabdariffa L.	hibisco	Malvaceae	subshrub	native
Waltheria communis A.St.-Hil.	douradinha do campo	Malvaceae	herb	native
Dorstenia cayapia Vell.	carapiá	Moraceae	herb	native
Eucalyptus globulus Labill.	eucalipto	Myrtaceae	tree	exotic
Psidium guajava L.	goiaba	Myrtaceae	tree	exotic
Syzygium aromaticum (L.) Merr. & L.M. Perry	cravo	Myrtaceae	tree	exotic
Syzygium cumini (L.) Skeels	jambolão	Myrtaceae	tree	exotic
Phyllanthus niruri L.	quebra pedra	Phyllanthaceae	herb	native
Plantago major L.	trançagem	Plantaginaceae	herb	exotic
Cymbopogon citratus (DC.) Stapf	capim-santo	Poaceae	herb	exotic
Polygonum hydropiperoides Michx.	erva de bicho	Polygonaceae	herb	native

Medicinal plant species	Common name	Family	Habit	Origin
Rubus sellowii Cham. & Schtdl.	amora	Rosaceae	tree	native
Morinda citrifolia L.	noni	Rubiaceae	tree	exotic
Uncaria guianensis (Aubl.) J.F. Gmel.	unha de gato	Rubiaceae	shrub	native
Citrus aurantium L.	laranja	Rutaceae	tree	exotic
Citrus limon (L.) Burm. f.	limão	Rutaceae	tree	exotic
Ruta graveolens L.	arruda	Rutaceae	subshrub	exotic
Camellia sinensis (L.) Kuntze	chá preto	Theaceae	shrub	exotic
Lippia alba (Mill.) N. E. Br.	erva-cidreira	Verbenaceae	subshrub	native
Cissus verticillata (L.) Nicolson & C. E. Jarvis	insulina	Vitaceae	climber	native
Zingiber officinale Roscoe	gengibre	Zingiberaceae	herb	exotic
Curcuma longa L.	açafrão	Zingiberaceae	herb	exotic

Source: Elaborated by the authors (2021).

Table 3 – The most cited medicinal plant species by the inhabitants of Luziânia (GO)

The 10 most cited medicinal plants	Urban	Rural	Urban + Rural	Occurrence
Lippia alba (lemon balm)	11	8	19	native
Mentha arvensis (mint)	13	6	19	exotic
Dysphania ambrosioides (mastruz)	13	3	16	native
Plectranthus barbatus and *P. grandis* (boldo)	9	6	15	exotic
Rosmarinus officinalis (rosemary)	11	2	13	exotic
Aloe vera (aloe)	7	5	12	exotic
Cymbopogon citratus (lemongrass)	5	7	12	exotic
Ocimum carnosum (alfavaca)	2	6	8	exotic
Gossypium hirsutum (upland cotton)	8	2	10	exotic
Foeniculum vulgare (common fennel)	5	4	9	exotic
Mentha pulegium (pennyroyal)	5	4	9	exotic

Source: Elaborated by the authors (2021).

citations; mint: 14 citations, and common fennel (erva-doce): 11 citations were also largely cited in the city of Ascurra, in Santa Catarina (South Region) (ZENI *et al.,* 2012). Furthermore, mint, boldo, common fennel, lemongrass, rosemary, and pennyroyal (poejo) had the highest relative frequency values in the city of Ouro Preto, in Minas Gerais (Southeast Region) (MESSIAS *et al.,*2015). Therefore, there is a common everyday use of the same medicinal plant species in different regions of Brazil.

Herbs were the predominant type of medicinal plant cited (TABLE 4) since they are traditionally grown in backyards. This type of grown habit comprises several easily managed herbs that occupy small species, as observed by Zeni *et al.* (2017). Furthermore, among the 10 most-cited medicinal species (TABLE 3), six were herbs: common fennel, mastruz, lemongrass, mint, pennyroyal, and aloe. Trees were also widely mentioned since many were exotic fruit species grown in domestic backyards (avocado, West Indian Cherry, persimmon, orange, and lemon) (LORENZI; MATOS, 2011), in addition to larger native trees collected in the Cerrado (angico, diesel tree, barbatimão, baru, jatobá, purple trumpet tree, and pink trumpet tree) (FLORA DO BRASIL 2020, 2021).

Table 4 – Growth habits observed in the medicinal plant species mentioned by the population of Luziânia (Goiás)

Habit	Percentage of the habit type
Herb	35.79 %
Tree	30.53 %
Subshrub	20.00 %
Shrub	11.58 %
Climber	2.11 %

Source: Elaborated by the authors (2021).

According to the interviewees, several of the native tree species used in Luziânia were mainly collected from nature, highlighting the importance of cultivating medicinal tree species of the Cerrado and providing training courses to (1) teach sustainable extraction methods and (2) share forms of cultivating and using medicinal plants native to the Cerrado by the population of Luziânia.

The main symptoms treated using medicinal plants in Luziânia (TABLE 5) were those considered less severe or quick diseases, e.g., cold and digestive problems (FIGUEREDO *et al.*, 2014). Allied to those health problems, other symptoms were also cited: insomnia, stress, and respiratory problems (asthma, bronchitis, and cough). Cold symptoms and digestive and respiratory problems are usually treated in the domestic environment, as already reported in other surveys conducted in several regions of Brazil (ALMEIDA; ALBUQUERQUE, 2002; PILLA *et al.,* 2006; ZENI *et al.,* 2017; SOUSA *et al.,* 2020), unlike the ethnobotanical survey conducted in the islands of the São Francisco River (PE and BA), in which intestinal infections, diarrhea, and worms were the most common problems treated with medicinal plants (PIO *et al.,* 2019).

Finally, the socio-economic profile of connoisseurs of medicinal plants in Luziânia (most with low education levels, several retirees, and homemakers) corroborates the wide use of medicinal species to treat common diseases since this is a less expensive treatment than purchasing pharmaceutical drugs (FIGUEREDO, 2013). Therefore, this study demonstrated the social importance of this ethnobotanical knowledge in treating common diseases.

Table 5 – Main use indications for medicinal plants in Luziânia (Goiás)

Use indications	Percentage of the use indication
Cold	16.2 %
Indigestion	15.49 %
Stress and insomnia	12.44 %
Respiratory problems	8.22 %
Sore throat	4.93 %
Urinary tract infection and kidney stone	4.69 %
External wounds	3.76 %

Source: Elaborated by the authors (2021).

Final considerations

The present study demonstrated the importance and tradition of medicinal plants used by the population of Luziânia (GO) as both urban and rural inhabitants were connoisseurs of medicinal plants, especially women, people with less formal education, and homemakers or retirees. These results are probably related to the fact that family care is a traditionally female activity, and Luziânia is a city whose population has low education levels, and treatment with medicinal plants is less expensive than purchasing pharmaceutical drugs.

Furthermore, most inhabitants cultivated medicinal plants in their backyards, which is directly related to the type of plant used, predominantly species of easy maintenance and small size. The inhabitants of Luziânia also knew several native medicinal species even though they used more exotic species to treat symptoms and health improvement, e.g., lemongrass, mint, mastruz, and boldo. Finally, the frequent use of

medicinal species to treat the most common health problems, e.g., colds, digestive problems, stress, and insomnia highlights the social importance of ethnobotanical knowledge for the population of Luziânia.

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