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The importance of home gardens for the conservation of knowledge and practices about medicinal plants in an Environmental Protection Area in the Atlantic Forest of the State of Rio de Janeiro, Brazil

[La importancia de los huertos familiares para la conservación de conocimientos y prácticas sobre plantas medicinales en un Área de Protección Ambiental en la Mata Atlántica del Estado de Río de Janeiro, Brasil]

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Abstract: The Palmares Environmental Protection Area covers almost 90% of Paty do Alferes Atlantic Forest with great biodiversity. This work aimed to research about the knowledge local specialists have about medicinal plants in order to describe the relationship between home gardens and the conservation of biodiversity and local knowledge. 107 ethnospecies were reported belonging to 37 botanical families, Asteraceae the most abundant and a majority of native species. The highest RCF species were *Plectranthus barbatus* and the highest RI was obtained for *Plantago australis*/*P. guilleminiana*. Plants were cited mainly for the treatment of illness related to digestive system and the highest FIC was about the use of plants related to eye diseases. Local experts mainly cited plants for low complexity health problems. Home gardens, as the main collection site, contribute to minimizing anthropic pressure and extractivism, which favours a sustainable relationship within the APA, at least regarding to medicinal plants.

Keywords: Medicinal plant knowledge; Traditional medicine; Primary health care; Local experts; Ethnobotany

Resumen: El Área de Protección Ambiental de Palmares cubre casi el 90% de la Mata Atlántica de Paty do Alferes con una gran biodiversidad. Este trabajo tuvo como objetivo investigar el conocimiento que los especialistas locales tienen sobre las plantas medicinales con el fin de describir la relación entre los huertos familiares y la conservación de la biodiversidad y el conocimiento local. Se reportaron 107 etnoespecies pertenecientes a 37 familias botánicas, Asteraceae la más abundante y la mayoría de las especies nativas. Las especies de RCF más altas fueron *Plectranthus barbatus* y la IR más alta se obtuvo para *Plantago australis*/*P. guilleminiana*. Las plantas se citaron principalmente para el tratamiento de enfermedades relacionadas con el sistema digestivo y el FIC más alto fue sobre el uso de plantas relacionadas con enfermedades oculares. Los expertos locales citaron principalmente las plantas por problemas de salud de baja complejidad. Los huertos familiares, como principal sitio de acopio, contribuyen a minimizar la presión antrópica y el extractivismo, lo que favorece una relación sustentable dentro de la APA, al menos en lo que respecta a las plantas medicinales.

Palabras clave: Conocimiento de plantas medicinales; Medicina tradicional; Atención primaria de salud; Expertos locales; Etnobotánica.

INTRODUCTION

Home garden is an integrated system which comprises different things in its small area (the family house, a kitchen garden, a mixed garden, etc.) and that produces a variety of agricultural products including vegetables and medicinal plants and is adjacent to the house where their gardener(s) live (Vogl *et al*., 2004; Agbogidi & Adolor, 2013). The importance of home gardens in the production of food, medicine for primary health care and other useful products for human beings is widely recognized and, over the last few decades, ethnobotanical studies focused on how much conservation of biodiversity in home gardens had increased (Liporacci *et al*., 2017; Simões *et al*., 2021).

Home gardens have been reported to be a vital reservoir of genetic and cultural diversity, as well as a diverse source of goods and services for the population (Gao, 2012; Pala *et al*., 2019). Some studies demonstrate home gardens' importance for the conservation of genetic diversity *in situ*, for the traditional knowledge as cultural heritage and also to guarantee sustainability regarding conservation and agronomic techniques involving medicinal and edible plants (Rammohan *et al*., 2019; Pala *et al*., 2019). These spaces are a common place for the development of processes that seek to reconcile the demands of the populations with the conservation of the local ecosystems, and they also constitute a scenario that promotes the maintenance and improvement of quality of life (Caballero-Serrano *et al*., 2019). In this sense, a permanent effort to accumulate, process and interpret data and ethnobotanical information is essential, which will contribute to the understanding of the relationships established between local communities and the available plant resources. Ethnobotany is a science that can assist in the establishment of public conservation policies for ecosystems as well as culturally distinct societies (Posey, 1987).

Paty do Alferes is located in the central southern region of Rio de Janeiro State, at the edge of the Serra do Mar Range, which represents one of the largest continuous areas of Dense Ombrophilous Forest within the state and within the phytogeographical domain of the Atlantic Forest (Wängler *et al*., 2015). In order to maintain biodiversity, scenic beauty and preserve water resources face to water scarcity, in 2003 the Palmares Environmental Protection Area (APA Palmares) was created. APA Palmares covers almost 90% of Paty do Alferes Atlantic Forest, which currently represents only 3% of natural vegetation. The area contains an enormous heterogeneity of habitats, with invasive species coming from agricultural activities, abandoned properties or pasture planted areas (Wängler *et al*., 2015). It also has a great diversity of plants and animals from the Atlantic Forest as well as endemic species.

APA Palmares houses a population made up of both permanent residents and vacationers, who spend vacations and extended bank holidays there, and it is possible to identify people who have lived in Palmares for many generations and maintain a relationship with the land and the natural resources that surround them. To understand the importance and use of medicinal plants, it is necessary to understand the communities, the environments in which they live and the sources of the plants used (Guarneire *et al*., 2021). In view of this scenario, this study aimed to acquire information about the know-how of local experts on medicinal plants in order to describe the relationship between home gardens and the conservation of biodiversity and local knowledge.

MATERIAL AND METHODS

Study area

APA Palmares is located to the south of Paty do Alferes (22°27'28 S and 43°23'58 O) in the state of Rio de Janeiro, Southeast Brazil (Figure No. 1). With a total area of 318.8 Km^2, Paty do Alferes has an estimated population of approximately 27 thousand inhabitants mainly concentrated (70.5%) in an urban area. The local Unified Health System (SUS) has seven basic health units, five health posts and 13 family health strategy teams, covering 100% of the population (TCERJ, 2019; DATASUS, 2021). Paty do Alferes has its economy traditionally based on agricultural activities, with 389 ha of planted crops where tomato cultivation is predominant. Due to this practice, the place has the title of greatest producer in the state and 3rd in Brazil. The agricultural model adopted is essentially based on agrochemical based techniques, which contributed to the acidity and low availability of nutrients in the soil, raising the exchangeable aluminium rates (Pinheiro *et al*., 2004). Its agricultural tradition comprehends the sugar cane and coffee cycles and it is primarily responsible for deforestation in the region (Deister, 2003). In the

2016/2017 period, the percentage of plantation coverage in Paty do Alferes reached 7.30% of the territory, with 2.327 hectares of Atlantic Forest, most of which is composed by forest fragments of secondary or tertiary growth and commonly located on steep terrain or escarpments (Pinheiro *et al*., 2004; TCERJ, 2019).

APA Palmares is divided into five environmental zones. The study area corresponds to one of these zones with approximately 178 ha located in elevations that vary from 860 to 1.177m, integrating a mosaic of Conservation Units. The vegetation of the area is characterized as Dense Montana Rainforest, in a secondary stage of regeneration (Veloso *et al*., 2012). The region's climate is classified as temperate Cwa (Köppen-Geiger classification), with average annual rainfall of 1.200 mm, with the rainiest quarter between November and January, which corresponds to approximately 50% of the annual precipitation, and average annual temperature of 20ºC, with June and July being the coldest months and January and February the hottest ones (Nasser, 2008).

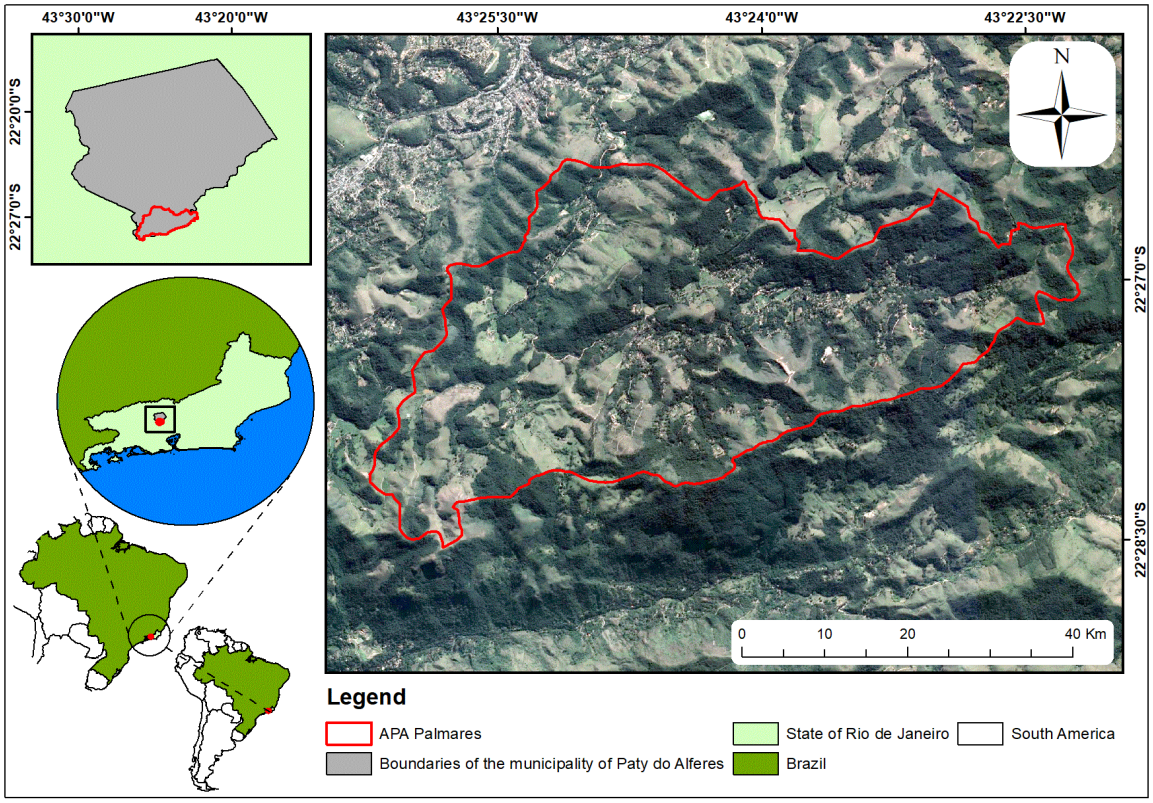

Figure No. 1
Location of the study area

Informants selection and field interviews

The first contact with the local community was through a meeting held in the "Palmares residents association", mediated by local family health care professionals. The goals of the survey were presented, questions were answered, and the community agreed to the study. From this initial contact and according to health care professionals' recommendation, it was possible to identify the first informants and then the others were selected by "snowball" technique (Bernard, 1995). Key informants were selected taking into account the broad and public recognition of their medicinal plant expertise, as they are considered to be local herbal experts. Semi-structured interviews were conducted at the residences of the individual informants by

using a questionnaire including questions about medicinal plant knowledge, plant gathering and socioeconomic data (sex, age, formal education, birthplace). The Guided Tour technique (or walk-in-the-woods technique) was used to complement the information obtained in the interview and to collect the plants specimens mentioned (Alexiades, 1996). This research was approved by the Ethics Committee for Research with Human Beings under protocol No. CAAE: 44604515.8.0000.5257 CEP-HUCFF/UFRJ. All informants have signed the Informed Consent Form.

Botanical material

Plants that were indicated by informants were collected with the help of the local informants, herborized according to Peixoto & Maia (2013) and incorporated into Botanical Department Herbarium at the Federal University of Rio de Janeiro (RFA-UFRJ). The material was identified through comparison with herbarium exsiccates, specialized literature, and/or by specialist consultants. The spelling of the scientific binomial was confirmed in recent taxonomic revisions and/or by using the databases W3 tropics (Missouri Botanical Garden VAST - Vascular tropics), The Plant List (**www.theplantlis.org**) and Flora do Brazil (2020) (**http://floradobrasil.jbrj.gov**). The status of species (Native, Exotic and Naturalized) was determined by consulting the Reflora (**http://reflora.jbrj.gov.br**) and the concepts proposed by Moro *et al*. (2012).

Data analyses

Ethnobotanical data was analysed using different quantitative indexes including Relative Frequency of Citation (RFC), Relative Importance (RI) and Factor of Informant Consensus (FIC). RI was calculated as reported by Bennett & Prance (2000). FIC was calculated according to Heinrich *et al*. (1998), in order to find out the homogeneity on the use of plant species among the local experts. RFC is calculated from the frequency of citation (the number of informants mentioning the usage of the plant species) divided by the total number of informants in the survey and high RCF values indicate the local importance of each species. The therapeutic claims attributed to the plants cited by the informants were classified through the International Classification of Diseases (ICD-10) (WHO, 2004) for Relative Importance analysis.

In order to better understand the conservation level of environments containing medicinal plant species, we analysed habit, source (collected from home gardens or gathered in the woods) and origin (native, exotic or, naturalized). To verify if the proportion of native, exotic and naturalized medicinal plants collected in home gardens and in the woods, cited by men and women, differs significantly (significance level of 5%) between genders and the age group, data was analysed by chi-square test using IBM® SPSS® Statistic V25.

The data obtained was subjected to exploratory analysis by techniques of multivariate statistics of informants' data regarding the presence and absence of species citation through hierarchical cluster analysis (HCA) and main component analysis (MCA) (Höft *et al*., 1999). HCA (Hair *et al*., 2005) was carried out with the intent of organising informants into groups according to their composition patterns by using Euclidean distance as a measure of similarity between species choices, and as a grouping strategy the UPGMA method was used. Then, to explore the existence of patterns among informants from the natural and cultural environments, Principal Component Analysis (PCA) was performed. In this case, the main utility of the PCA was to analyse the variability by trying to detect some patterns. The general variation was graphically represented in three dimensions, by selecting the significant variables for each axis. These analyses were performed using the STATISTICA® 10 software program.

RESULTS

Following the first indications and through the "snowball" technique, it was possible to identify 11 local herbal experts, mostly women (7). One expert is also a "benzedeira" (healer). The average age of the informants was 71 (52– 88 years old), 45.5% of them were born and raised in Palmares and 54.5% have lived, at least, for 20 years in the investigated area. They report that knowledge about medicinal plants was orally transmitted by grandmothers (46.2%) or mothers (38.5%) but that such knowledge was extended by exchanges with neighbours and friends and by books or magazines (18.2%). Almost all of the informants (90.0%) use plants to treat their own health problems before looking for treatment in the SUS and 80.0% declared to use medicinal plants associated with synthetic drugs (medicines). All of them live in houses with a home garden from where

they affirm to gather the majority (78.6%) of medicinal plants they use and/or recommend to others. In these home gardens it was possible to observe ornamental, ritualistic and food plants in addition to exclusively medicinal plants.

Medicinal plants were obtained mainly by gathering from home gardens (86.0%) and those that are not grown from the home gardens are gathered from the forest (11.2%) or purchased from local shops (1.9%). Some species that can be found in the woods are intentionally grown in home gardens because it makes their collection easier. Many informants (63.8%) affirm that medicinal plants grow by themselves, but it is necessary "to clear the home garden from weeds that stop the really important plants from growing". Some informants (27.4%) intentionally grow medicinal plants and few 9.3% affirm that plants grow by themselves but that no specific kind of practice is necessary to keep them growing.

The local experts reported a total of 107 different ethnospecies used for medicinal purposes, a value which corresponds to 102 botanical species. Of these, it was possible to identify 96 to species level, 9 to genus level and 1 to family level. The identified medicinal plants belong to 37 different botanical families and the most abundant ones were Asteraceae (19 spp), Lamiaceae (17 spp) and Rutaceae (5 spp). The other families (61,6%) were represented by one to four species (Table No. 1).

Findings show that two ethnospecies correspond to more than one botanical species and are not distinguished by most of the informants. They are called "guaco", which corresponds to *Mikania laevigata* and *M. glomerata*, used for the same purposes, and "transagem", which corresponds to *Plantago guilleminiana* and *P. australis*. On the other hand, the two different ethnospecies "melissa" and "cidreira", which can be clearly separated based on leaf characteristics (morphology and organoleptic property) but have the same medicinal use, correspond to *Lippia alba*. In addition, some plants have different popular names depending on the local expert knowledge, such as *Alternanthera brasiliana*, which is known as "novalgina", "dipirona" and "methiolate", and also *Lippia alba*, which is called by "cidreira", "erva-cidreira" or "pronto-alívio" as the same ethnospecies.

Table No. 1
Medicinal plants cited by local experts of APA Palmares rural community, Paty do Alferes-RJ, Brazil

Family/ scientific name	Local name	Habit[1]	Origin[2]	CS[3]	Medicinal use	RFC[4] (%)	RI[5]
Acanthaceae		Cl	Nt	H	conjunctivitis	9.1	16.3
Thunbergia alata Bojer ex Sims	Batistonha						
Alismataceae		H	N	H	bowel infection, kidney stone	18.2	32.5
Echinodorus grandiflorus (Cham. & Schltdl.) Micheli	Chapéu-de-couro						
Amaranthaceae		Shr/SShr	N	H	infection, inflammation, fever, pain	27.3	45.0
Alternanthera brasiliana (L.) Kuntze	Dipirona/ Metiolate/ cataflan/ novalgina						
Dysphania ambrosioides (L.) Mosyakin & Clemants	Santa-maria	Shr/SShr	Nt	H	infestation by parasitic worms	9.1	16.3
Anacardiaceae		Ar	N	H	diabetes	9.1	16.3
Anacardium occidentale L.	Cajú						
Mangifera indica L.	Manga	Ar	E	H	cold	18.2	16.3
Schinus molle L.	Aroeira Roxa	Ar	N	H	cancer	9.1	16.3
Schinus terebinthifolia Raddi	Aroeira	Ar	N	H	toothache, dislocation, joint pain	18.2	48.8
Annonaceae		Ar	E	H	lose weight, cholesterol	9.1	22.5
Annona muricata L.	Graviola						

Apiaceae		H	Nt	H	whooping cough	9.1	16.3
Centella asiatica (L.) Urb.	Violeta						
Cuminum cyminum L.	Cominho	H	E	H	diabetes	9.1	16.3
Foeniculum vulgare Mill.	Funcho	H	Nt	S	soothing, high blood pressure, cold	36.4	48.8
Petroselinum crispum (Mill.) Fuss	Salsa	H	E	H	child with tooth being born, soothing	18.2	32.5
Apocynaceae		Ar	N	W	kidney, intestinal worms	9.1	16.3
Geissospermum laeve (Vell.) Miers	Pau-Pereira/Pau-canudo						
Araceae		H	N	H	boost immunity	9.1	16.3
Xanthosoma sagittifolium (L.) Schott	Taioba						
Asteraceae		H	Nt	H	stomach pain, anemia	18.2	32.5
Artemisia absinthium L.	Losna						
Achillea millefolium L	Marcelão	H		H	fever	9.1	16.3
Acmella ciliata (Kunth) Cass.	Boldo-do-Chile	H	N	H	high blood pressure	9.1	16.3
Artemisia alba Turra	Canfor	H	Nt	S	indigestion, pain	27.3	32.5
Artemisia vulgaris L.	Artemijo	H	E	H	emenagogue	9.1	16.3
Baccharis trilobata A.S.Oliveira & Marchiori	Carqueja	H	N	H/W	bad digestion, cold, losing weight, cholesterol, diabetes, fever, lack of appetite	36.4	83.8
Bidens pilosa L.	Picão/ Picão-roxo/ picão-preto	H	Nt	H	bowel infection, kidney stone, urinary infection, viral hepatitis	45.5	55.0
Centaurea benedicta (L.) L.	Cardo-santo/ cravo-santo	H	E	H	cold, pneumonia, anemia	45.5	38.8
Elephantopus mollis Kunth	Erva-grossa	H	N	H	cough	9.1	16.3
Lactuca canadensis L.	Almeirão	H	Nt	H	constipation	9.1	16.3
Matricaria chamomilla L.	Camomila/ Funcho/ Margaridinha	H	E	H	indigestion, soothing	27.3	48.8
Mikania hirsutissima DC.	Cipó-cabeludo	H	N	H	kidneys	9.1	32.5
Mikania laevigata Sch.Bip. ex Baker/ *M. glomerata* Spreng.	Guaco/ Guapo	Cl	N	H	cold, cough	36.4	22.5
Solidago chilensis Meyen	Arnica	Shr/SShr	N	H	hit, pain	27.3	32.5
Sonchus oleraceus L.	Serralha	H	N	H	skin diseases, vesicle, kidneys, vitiligo, cholesterol	36.4	61.3
Taraxacum campylodes	Dente-de-leão	H	Nt	H	vesicle, cholesterol	9.1	32.5

G.E.Haglund							
Vernonanthura polyanthes (Sprengel) Vega & Dematteis	Assa-peixe	Shr/SShr	N	H	cold, cough	27.3	22.5
Bignoniaceae		Ar	N	W	infection, cancer, inflammation	18.2	48.8
Handroanthus sp.	Ipê Roxo						
	Cinco-folhas	Ar		W	blood problem	9.1	16.3
Boraginaceae		H	E	H	cholesterol, lose weight, candidiasis	27.3	38.8
Symphytum officinale L.	Confrei						
Cariaceae		Ar	Nt	H	cold	9.1	16.3
Carica papaya L.	Mamão						
Costaceae	Cana-do-Brejo/cana-de-macaco	H	E	H	indigestion, kidneys	36.4	32.5
Costus spicatus (Jacq.) Sw.							
Crassulaceae		H	Nt	H	stomach, pneumonia, earache, healing	54.5	65.0
Kalanchoe crenata (Andrews) Haw.	Saião						
Cucurbitaceae		Cl	E	H	stroke	9.1	16.3
Citrullus lanatus (Thunb.) Matsum. & Nakai	Melancia						
Cucumis melo L.	Melão	Cl	E	H	stroke	9.1	16.3
Cucurbita sp	Abóbora	H	N	H	stroke	9.1	16.3
Sicyos edulis Jacq.	Chuchu	H	Nt	H	high blood pressure, soothing	18.2	32.5
Equisetaceae		H	N	H	cholesterol	9.1	16.3
Equisetum giganteum L.	Cavalinha						
Fabaceae	Carrapixin/Amor do campo	Shr/SShr	Nt	H	urinary tract infection, tooth infection	18.2	32.5
Desmodium adscendens (Sw.) DC.							
Erythrina verna Vell.	Murungu	Ar	N	H	bronchitis	9.1	16.3
Lamiaceae	Erva-marimbondo/Leonor/Macaé / erva mangangá	H	Nt	H	diarrhea, indigestion, cold, luxation, lack of appetite	36.4	71.3
Leonurus sibiricus L.							
Mentha × gentilis L.	Água-de-alevante	H	Nt	H	anxiety, depression	9.1	22.5
Mentha pulegium L.	Poejo	H	Nt	H	hypertension, flatulence, cold	27.3	48.8
Mentha sp 1	Hortelã	H	Nt	H	oral hygiene, scalp problems, intestinal worms	36.4	48.8
Mentha sp 2	Hortelã Roxa	H	Nt	H	intestinal worms	9.1	16.3
Mentha sp 3	Hortência Branca	H	Nt	H	hair loss	9.1	16.3
Ocimum gratissimum L.	Alfavaca	Shr/SShr	Nt	H	hypertension, gastritis, cold, throat problems, anemia,	27.3	87.5

Ocimum sp.1	Manjericão	Shr/SShr	Nt	H	soothing urinary tract infection	9.1	16.3
Origanum vulgare L.	Manjerona/ orégano	H	E	H	indigestion, flatulence	18.2	22.5
Plectranthus barbatus Andr.	Boldo/ boldo de folha larga	Shr/SShr	E	H	indigestion, liver	72.7	22,5
Plectranthus ornatus Codd.	Boldinho/Boldo da Folha Pequena/Boldo-miúdo	H	E	H	indigestion, liver	27.3	22.5
Rosmarinus officinalis L.	Alecrim	H	E	H/S	hypertension, indigestion, headache, depression	36.4	65.0
Salvia officinalis L.	Salvia	H	E	H	anxiety, heart problems, shortness of breath	18.2	48.8
Stachys byzantina K.Koch	Arquipeixe/Peixinho	H	E	H	cough	9.1	16.3
Tetradenia riparia (Hochst.) Codd	Mirra	Shr/SShr	E	H	anemia	9.1	16.3
Lauraceae		Ar	E	H	soothing	9.1	16.3
Cinnamomum verum J.Presl	Canela						
Laurus nobilis L.	Louro	Ar	E	H/W	indigestion	18.2	16.3
Persea major (Meisn.) L.E.Kopp	Abacate	Ar	N	H	diabetes	18.2	16.3
Loganiaceae		Cl	N	W	Fever, child abdominal pain	9.1	16.3
Strychnos trinervis (Vell.) Mart.	Quina-cruzeiro						
Lythraceae		H	N	W	diarrhea	9.1	16.3
Cuphea carthagenensis (Jacq.) J.F.Macbr	Sete-sangria						
Punica granatum L.	Romã	Shr/SShr	E	H	toothache, kidneys, sore throat, skin	27.3	65.0
Malvaceae		Shr/SShr	E	H	earache	9.1	16.3
Gossypium sp.	Algodão						
Sida acuta Burm.f.	Vassoura -preta	Shr/SShr	N	H	hair loss, dandruff	9.1	16.3
Moraceae	Amora-branca/ amora do mato	Ar	Nt	H	sore throat	27.3	16.3
Morus alba L.							
Sorocea bonplandii (Baill.) W.C.Burger, Lanj. & Wess. Boer	Espinheira-santa	Ar	N	W	hypertension, ulcer, indigestion, lung, back pain	36.4	71.3
Musaceae		H	E	H	cramp, joint pain	9.1	32.5
Musa paradisiaca L	Banana						
Myrtaceae		Ar	E	H	bactericidal	18.2	16.3
Eucalyptus globulus Labill.	Eucalipto						
Eugenia uniflora L.	Pitanga	Ar	N	H	fever, cold, diarrhea	45.5	48.8
Psidium guajava L	Goiaba	Ar	Nt	H	diarrhea	9.1	16.3
Syzygium cumini (L.) Skeels	Cereja	Ar	Nt	H		9.1	
Phytolaccaceae	Guiné	H	Nt	H	pain	9.1	16.3

Petiveria alliacea L.							
Piperaceae		Shr/SShr	N	W	nausea	9.1	16.3
Piper callosum Ruiz & Pav.	Elichir						
Piper umbellatum L.	Pariparoba	Shr/SShr	N	W	kidney	9.1	16.3
Plantaginaceae		H	N	H	toothache,	45.5	100.0
Plantago australis Lam./ *P. guilleminiana* Decne	Transagem				cystitis, kidneys, emenagogue, sore throat, uric acid, inflammation, inflammation in the uterus		
Poaceae		H	Nt	H	urinary	9.1	16.3
Coix lacryma-jobi L.	Conta-de-lágrima				infection		
Cymbopogon citratus (DC.) Stapf	Capim-limão/ capim-santo/ capim da Lapa	H	Nt	H	soothing	18.2	16.3
Cymbopogon winterianus Jowitt ex Bor	Citronela	H	Nt	H	bactericidal	9.1	16.3
Polygalaceae		H	N	W	toothache, hit,	36.4	48.8
Polygala paniculata L.	Gelol/ Vassourinha de São Pedro				knee pain		
Pteridaceae		H	N	H	bronquite	9.1	16.3
Adiantum raddianum C.Presl	Avenca						
Rosaceae		Ar	E	H	cold	9.1	16.3
Prunus persica (L.) Batsch	Pêssego						
Rosa sp.	Rosa branca de chá	Shr/SShr	E	H	flatulence	9.1	16.3
Rubus rosifolius Sm.	Moranguinho	Shr/SShr	N	H	kidney, cold	9.1	32.5
Rubus sellowii Cham. & Schltdl.	Amora	Shr/SShr	N	H	menopause, kidneys, healing, osteoporosis	27.3	55.0
Rutaceae		Ar	Nt	H	hypertension,	9.1	32.5
Citrus aurantiifolia (Christm.) Swingle	Lima				fever		
Citrus limon (L.) Osbeck	Limão	Ar	Nt	H	cold	18.2	16.3
Citrus sinensis Pers.	Laranja da Terra/ laranja	Ar	Nt	H	cold	18.2	16.3
Citrus sp.	Tangerina/ Mexirica	Ar	Nt	H	cold	18.2	16.3
Ruta graveolens L.	Arruda	H	E	H	eyes, conjunctivitis	27.3	32.5
Solanaceae		H	N	H	skin	9.1	16.3
Solanum americanum Mill.	Erva-moura						
Solanum cernuum Vell.	Panaceia	Shr/SShr	N	H	kidney, cough	18.2	32.5
Verbenaceae	Cidreira/ Pronto-Alívio/	Shr/SShr	N	H	poor digestion,	72.7	93.8
Lippia alba (Mill.) N.E.Br. ex Britton & P.Wilson	capim-cidreira/ erva-cidreira/ melissa				women's disease, fever, pain, stinging in the body, "lumbago", soothing		
Stachytarpheta cayennensis (Rich.) Vahl	Gervão/ gervão-roxo	Shr/SShr	N	H		18.2	22.5
Vitaceae	Insulina	Cl	N	H	Diabetes, uric	9.1	38.8

Cissus verticillata (L.) Nicolson & C.E.Jarvis					acid, blood problems, stroke		
Xanthorrhoeaceae		H	E	H	Pimple, anti-inflammatory, cancer, dandruff, hair loss	27.3	55.0
Aloe sp.	Babosa						
Zingiberaceae		H	E	H	Kidney problems, high blood pressure, weight loss	18.2	48.8
Alpinia zerumbet (Pers.) B.L. Burtt & R.M. Sm.	Colônia						
Zingiber officinale Roscoe	Gengibre	H	E	H	Sore throat, anemia	9.1	32.5
INDET	Arquina			W		9.1	
	Cavaca			W		9.1	
	Lírio do Brejo			H		9.1	
	Marcelinha			H		9.1	
	Quina-rosa			W		9.1	

[1]Habit: H-herbaceous; Cl - climber; Shr/SShr - Shrub/Subshrub; Ar - Arboreal
[2] Origin: N-native; Nt-Naturalized; E-exotic
[3]CS (Collection site): H-homegarden; W-woods; S-shop
[4]RFC- Relative Frequency Citation
[5]RI-Relative Importance

Among the species that were identified, it was observed a high amount of native ones (37,8%), followed by exotic ones (32.7%) and naturalized ones (29.6%). Most of the species listed in the survey have an herbaceous habit (48%), followed by arboreal (23.5%), shrub (22.5%) and climbing (5.9) habits (Table No. 1).

On average, local experts cited 20 ethnospecies (SD ± 15), ranging from 02 to 42 ethnospecies/expert. The total number of species mentioned by women (90 spp) was greater than by men (50 spp); however, no statistical difference was shown between gender (p=0,079) as well as age (p=0,278). Some species were mentioned only by women, such as "Pitanga", "Alecrim" and "Amora" and, on the other hand, some species were cited only by men, such as "boldo miúdo", "cipó cabeludo" and "batistonha". The most cited species (RCF) were *Plectranthus barbatus* and *Lippia alba* (72,7%) followed by *Kalanchoe crenata* (54,5%). Plants that ranked high in RI were *Plantago australis*/ *P. guilleminiana*. (2.0), *L. alba* (1.88), *Ocimum gratissimum* (1.75) and *Baccharis trimera* (1.68) (Figure No. 2).

Plants were cited mainly for the treatment of illnesses related to digestive system (18.5%), respiratory system (14.9%), signs and symptoms not classified (11.9%) and genitourinary system (10.1%). The FIC showed that there is a highest consensus about the use of plants related to eye diseases (0.50), respiratory system (0.43), skin and subcutaneous tissues (0.43), digestive and endocrine systems, nutritional and metabolic aspects (0.42, both) (Figure No. 3).

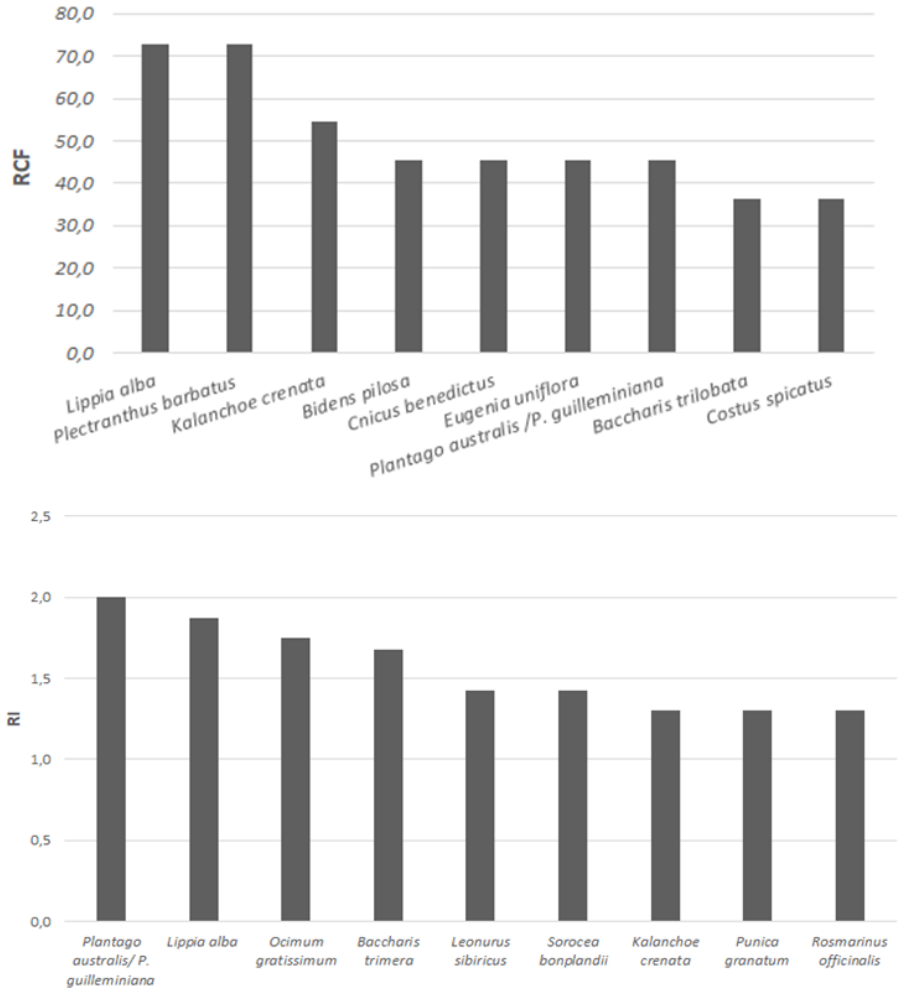

Figure No. 2
Relative Citation Frequency (RCF) and Relative Importance (RI) of medicinal plants cited by local experts in APA Palmares rural community, Rio de Janeiro, Brazil

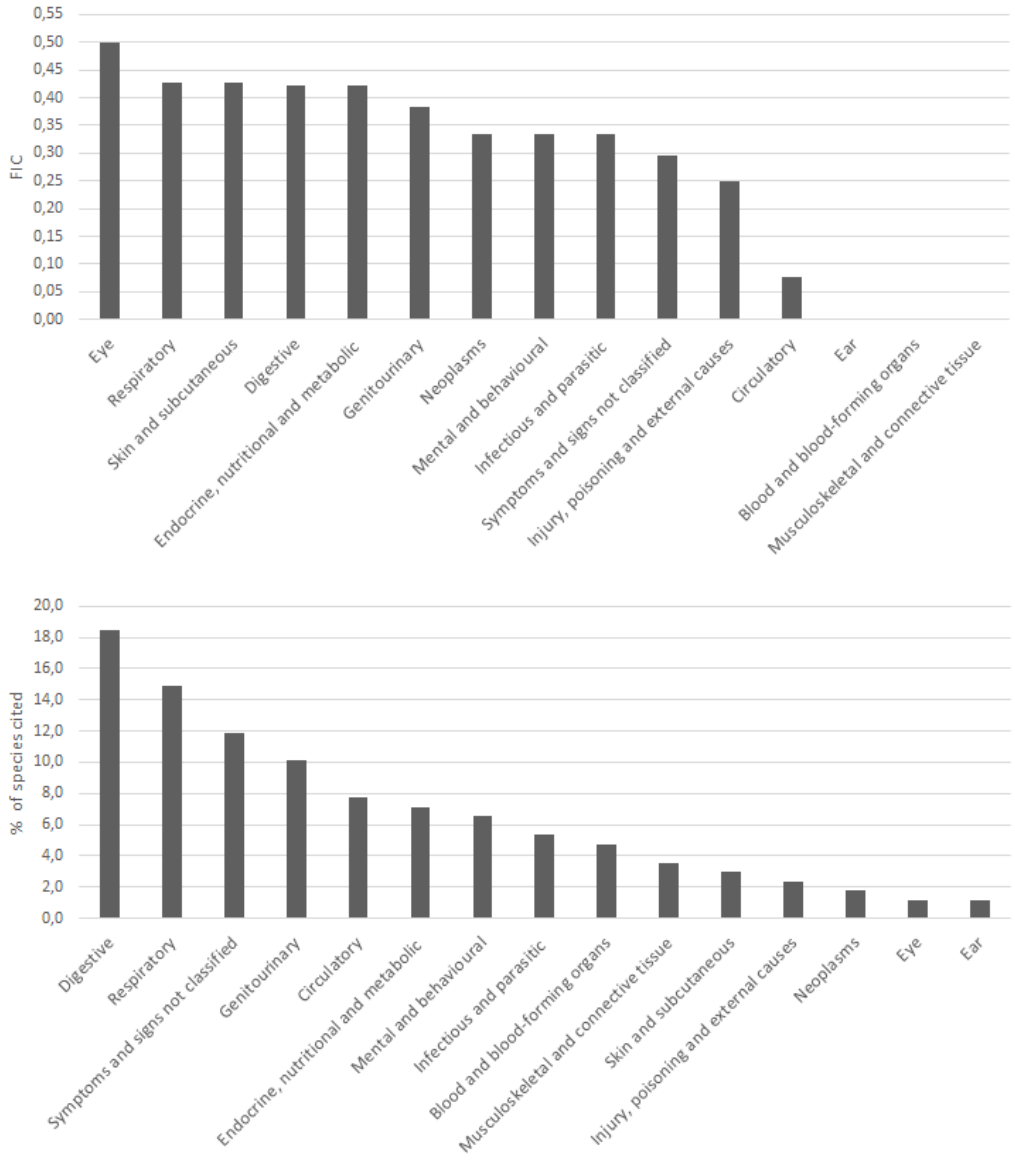

Figure No. 3
Percentage of species cited for different medicinal purposes according with ICD-10 and the Factor of Informant Consensus (FIC) of medicinal plants cited by local experts in the APA Palmares rural community, Paty do Alferes, Rio de Janeiro, Brazil

Leaves were mentioned most often (52,1%), followed by all aerial parts (10,7%), roots (9,1%), flower (8,3%), bark (6,6%), fruit (5%), seed (4,1%) and the whole plant (4,1%). Decoction (boiling the plant parts in water) was the most frequently preparation method cited (44%), followed by infusion (35%) (pouring hot water over the plant part), syrup (8%) and juice (5%). The most common administration forms were oral intake (tea) (68,6%) and bath (10,2%).

The grouping results for the indications for plant use show a clear separation of respondents at the level of eight clusters (Figure No. 4). It is possible to observe the differentiation of two groups: one with fewer informants but with a higher indication of plants (ID3, ID4, ID5 and ID10) and another group with more informants and lower indication of plants (ID1, ID2, ID6, ID7, ID8 and ID9). The local specialist ID5, who is the youngest respondent of all, offers a greater number of plant indications and greater variability in species selection compared to the other respondents.

The use of PCA to examine the relationships between citations of medicinal plants by participants for each of the 107 plants separately showed different clusters and revealed some clustering trends (Figure No. 5). The first three main components explained 40.57% of the variation in the data, which means that the relationships between the groups of plants mentioned have greater variety than agreement between groups of informants. In Figure No. 5, it was possible to observe a tendency of grouping according to the choice of species among ID1, ID2, ID5, ID6 and ID10. Even though the ID 8, who is a healer, presents the lowest number of citations and has the highest agreement with the others in this group, she is not found in this cluster. The ID11, ID9 and ID3 form another group, with less agreement with the other specialists, which demonstrates an originality in the choice of the mentioned species.

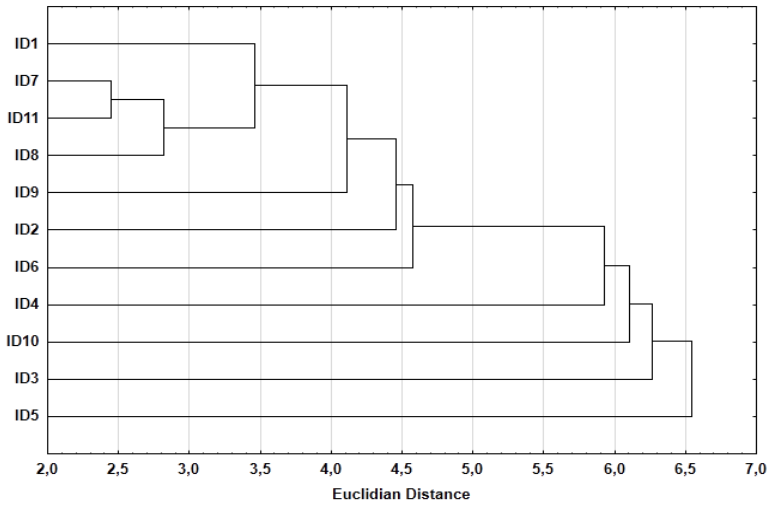

Figure No. 4
Dendrogram based on the distance matrix and showing clustering of eleven respondents (ID) in respect to 107 plants used for medicinal according to the responses of the interviewees, UPGMA clustering

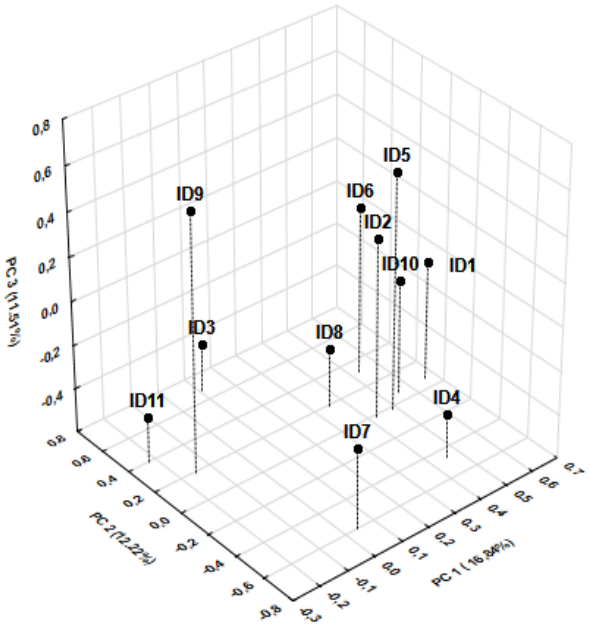

Figure No. 5
Projection of eleven respondents (ID) in the space defined by the first, second and third principal components in the indication of medicinal use of species

DISCUSSION

The identification of local specialists by a community is a process based on the collective recognition that certain people have differentiated knowledge about the plants used in the healing processes, their ways of preparation as well as the means of obtaining them. By comparing the age group and average age of the local specialists interviewed with those of the non-specialists who participated in the study conducted by Valverde *et al.* (2018), at APA Palmares, we see that both the age group (52 to 88 years old) and the average age (71 years old) reflect that local specialists are older. While comparing with studies carried out in other communities (Hoque *et al*., 2018; Coelho *et al*., 2019; Simões *et al.*, 2021), the local experts of APA Palmares are older, which may be the result of a local collective idea that this knowledge needs time to be constructed, besides assigning the elderly an active and inclusive role in the community. This way of thinking about the knowledge of medicinal plants is present in other traditional communities studied in Brazil (Silva *et al*., 2012; Lopes & Lobão, 2013; Fernandes & Boff, 2017).

The way in which experts report having learned about medicinal plants is similar to the one reported in other communities where knowledge is acquired through living with grandparents and mothers, as well as through what is learned in books, magazines and other forms of communication (Lisboa *et al*., 2017; Pérez & Matiz-Guerra, 2017; Castiñeira-Latorre *et al*., 2018; Caballero-Serrano *et al*., 2019; Simões *et al*., 2021). The synthesis provided by the multivariate analyses allows us to see considerable amount of knowledge shared by the specialists, further showing that there is a diversity in the individual choices. These analyses showed not only a pattern for citing species among experts, but also that there is diversity in these citations which results in less agreement between them. This type of knowledge-sharing with individualization among specialists is reported in home gardens by some authors (Salako *et al*., 2014; Gbedomon *et al*., 2015). These analyses also show that there is a conservation of the relationship with the number of species in home gardens. It is possible that for the informant ID08, as she is also a healer, the concept of health and disease is different from the other local specialists and that when asked about the plants

during the interview, she mentioned only those related to the healing of the physical body. This would explain the similarity of citation with the other specialists but the smaller number of plants mentioned, although ID08 is recognized as a local specialist.

There are many reports from traditional communities that use medicinal plants as their first health resource (Silva *et al*., 2012; Tuler & Silva, 2014; Pérez & Matiz-Guerra, 2017). For local experts at APA Palmares, it is no different, even though the community has coverage of the Family Health Strategy and access to the SUS. This preference for the use of plants was also observed among non-specialists in Palmares (Valverde *et al*., 2018). It is not just a matter of access to the conventional medical system, regardless of the quality of such service; we must also consider that many of these people consider the ability to perform self-care as a determining factor for their understanding of the concept of health. Since it is possible to manage some health problems of low complexity through the knowledge that they have, they feel healthier than when they are totally under the care of others or dependent on the help of synthetic drugs. The concomitant use of medicinal plants with synthetic drugs, despite not being an exclusive practice of APA Palmares specialists (Almeida *et al*., 2014; Zank & Hanazaki, 2017; Valverde *et al*., 2018), may result in the interaction of these components and lead to adverse effects, a fact which deserves attention from the local health teams and demonstrate the need to integrate traditional knowledge with the knowledge of modern medicine.

At APA Palmares, most informants were women, a result which is similar to the one found in other communities (Tuler & Silva, 2014; Fernandes & Boff, 2017; Caballero-Serrano *et al*., 2019; Coelho *et al*., 2019; Simões *et al*., 2021). These results may be a consequence of household chores focused on women, including care for home gardens. Another factor that can be considered when we observe this predominance of women among the interviewees in ethnobotanical studies that deal with home gardens is that in many communities, they are responsible for taking care of the health of the family unit and end up extending this care to surrounding community members (Voeks, 2007; Tuler & Silva, 2014; Simões *et al*., 2021).

Even with the intense contact with the natural vegetation in APA Palmares, the maintenance and cultivation of plants in home gardens is part of the daily life of local specialists, as this is the main place to obtain the aforementioned medicinal plants (86%). In many ethnobotanical studies carried out in different biomes, we find the same importance of home gardens (Tuler & Silva, 2014; Almeida *et al*., 2014; Penna & Lamano-Ferreira, 2014; Pérez & Matiz-Guerra, 2017; Pérez-Nicolás *et al*., 2018; Caballero-Serrano *et al*., 2019; Pala *et al*., 2019; Panyadee *et al*., 2019). It is not surprising that the plants used in primary health care, which are the first resource for the relief of low complexity and often recurrent diseases, are close to their homes, readily available just like the most common synthetic medicines for relief from fevers and pain are kept at home. Plants that need to be collected in the forest are generally less accessible when use is needed (Pérez-Nicolás *et al*., 2018). This result demonstrates that the use of medicinal plants may not be an element that promotes damage on the forest areas that make up the APA, since these are not priority collection sites. The same is true when it comes to other communities that also inhabit environmental conservation units (Crepaldi & Peixoto, 2010; Agbogidi & Adolor, 2013; Pérez-Nicolás *et al*., 2018; Prado *et al*., 2019).

The number of medicinal species mentioned and the number of families to which they belong is comparable to the number found in other studies in home gardens in rural areas (Christo *et al*., 2010; Fernandes & Boff, 2017; Panyadee *et al*., 2019). As already mentioned by Panyadee *et al*. (2019), the number of species present in home gardens in rural communities can vary significantly.

Asteraceae and Lamiaceae were the most representative botanical families, which is also observed in other ethnobotanical works focused on medicinal plants both in the same area (Valverde *et al*., 2018) as well as in other rural communities located in different regions and biomes (Almeida *et al*., 2014; Pérez & Matiz-Guerra, 2017; Penna & Lamano-Ferreira, 2014; Castiñeira-Latorre *et al*., 2018; Coelho *et al*., 2019; Awan *et al*., 2021; Vargas-Vizuet *et al*., 2022). Asteraceae is commonly the most representative family in ethnobotany works, which is expected since this family corresponds to one of the most diverse among Angiosperms, with estimated 25,000–35,000 species, comprising 10% of all flowering plant species, occurring on every

continent and nearly every type of habitat (Mandel *et al*., 2019). *Asteraceae* appears as the third richest family in the Atlantic Domain and presents a small number of species with restricted distribution, with the genera *Mikania* and *Baccharis* representing 26% of the total family wealth (Stehmann *et al*., 2009).

At APA Palmares, some species of Asteraceae collected in home gardens are pioneers and are easily found in anthropized environments, such as the farming areas existing in Paty do Alferes, where they are often treated as invasive and unwanted. However, it is clear from the interviewees' speech that "it is necessary to clean the yard and remove unwanted plants", which, when present in home gardens, become important and categorized as useful, (Castiñeira-Latorre *et al*., 2018).

Another hypothesis for the greater representativeness of Asteraceae and Lamiaceae in many ethnobotanical studies is related to the organoleptic properties of many of their representatives. Silva *et al.* (2012), already warned that within traditional medicine systems, smell and taste were important elements for the reliability of certain preparations. Essential oils as well as other secondary metabolites that confer a characteristic odour and flavour present in many of the species of both families may be the reason why plants from these families are so important in popular knowledge and mainly cited in many ethnobotanical research (Castiñeira-Latorre *et al*., 2018; Beauchamp, 2019).

The Rutaceae family is the third most representative among the medicinal plants cited by local experts. Other studies in rural communities also brings this one among the most representative families (Perez-Nicolás *et al*., 2018; Miguéis *et al*., 2019) and as in the study by Montenegro *et al*. (2017), the species of the genus *Citrus* spp are responsible for this high representativeness. Several species of this genus are producers of different secondary metabolites, such as flavonoids and carotenoids, in addition to essential oils, with several applications in folk medicine (Zibaee *et al*., 2020). Besides its medicinal properties, the genus includes species used as fruit and its presence in home gardens may be related to this multiple use.

Among the plants cited by local experts, 37% are native species, a relatively low percentage compared to other studies with rural populations where the main collection site was also home gardens (Pérez & Matiz-Guerra, 2017; Fernandes & Boff 2017; Caballero-Serrano *et al*., 2019; Miguéis *et al*., 2019). Our results also contradict Castiñeira-Latorre *et al*. (2018), who claim that in rural communities, people tend to use a higher proportion of native species rather than alien medicinal species because of their greater familiarity with native medicinal plants and better access to harvesting sites. We must take into account that the rural community of APA Palmares is located in an environmentally protected area and subject to the limitations of use of native vegetation imposed by law, which may be a justification for the low use of native species. In addition, some studies indicate that the use of native medicinal plants in the Atlantic Forest Biome is more limited than in other Biomes such as Cerrado and Caatinga (Medeiros *et al*., 2013; Zank & Hanazaki, 2017).

It was observed that among the species cited there is a predominance of the herbaceous habit, which is a reflection of the most cited families and may also be related to the fact that home gardens are the main collection site because in such places, plants with grass habit or shrubs/sub-shrubs predominate (Almeida *et al*., 2014; Fernandes & Boff, 2017; Pala *et al*., 2019; Caballero-Serrano *et al*., 2019). Due to the prevailing habit, it is reasonable to affirm that the parts most used by local experts are leaves and all aerial parts. Leaves were also the most cited part by non-specialists in the study carried out at APA Palmares (Valverde *et al.*, 2018) as well as in other ethnobotanical studies (Medeiros *et al*., 2013; Tuler & Silva, 2014; Salako *et al*., 2014; Fernandes & Boff, 2017; Lisboa *et al*., 2017). The choice of leaves as the main source of raw material for the production of home remedies can be understood as a reflection of the ease in which they can be obtained when compared to other plant parts (Silva *et al*., 2012). However, another hypothesis, the one about the availability of resources, may be more relevant to the understanding of why herbaceous species and leaves are the choice of populations in most ethnobotanical works. The resource availability hypothesis suggests that the production of defence metabolites in plants is related to the resource level of the habitat to which the plant is adapted (Coley *et al*., 1985). In environments with high availability of nutrients and water, such as the Atlantic Forest, plants are more likely to grow/form new organs quickly and can tolerate higher rates of herbivory and invest more in the production of qualitative secondary metabolites

(such as monoterpenes and saponins) which will have more medicinal uses and will be, consequently, intuitively more sought after by communities than slow-growing species which invest more in quantitative metabolites and would have less diversity in use (Gaoue *et al*., 2017).

The form of preparation most cited by experts was 'decoction' despite the majority use of leaves and the high representativeness of species from botanical families that produce volatile substances; contrary to the recommendation that in these conditions the best way to prepare home remedies would be through 'infusion'. This result contrasts with the one found by Valverde *et al*. (2018), where infusion was the main form of preparation cited by non-specialists at APA Palmares. Decoction, however, was the main form of preparation observed in other communities where the use of leaves predominates over the other botanical parts used (Tuler & Silva, 2014; Miguéis *et al*., 2019; Panyadee *et al*., 2019; Guarneire *et al*., 2021, Vargas-Vizuet *et al*., 2022).

The FIC showed that there is a highest consensus about the use of plants related to eye diseases (0.50), the most cited disease being conjunctivitis, and *Ruta graveolens* the most used species. This high consensus on the use of plants for eye diseases is quite unusual in ethnobotany works. In order to try to understand this result, this data were taken to the professionals of the health team at Basic Health Unit of Palmares. These professionals reported that allergic conjunctivitis is quite common in the area and, the hypothesis heard from such professionals is that there is a lot of dust in the region, since the streets are unpaved and that would justify this high frequency of patients who report this type of irritation. It is also possible to think of some relation with the activities performed by the residents, which include garden maintenance services and agricultural cultivation situations in which it is likely that they have contact with potentially harmful irritating materials (agrochemicals etc.). The use of rue for conjunctivitis, despite being a toxic plant, is reported in other communities (Conde *et al*., 2014; Beltreschi *et al*., 2019).

Diseases related to the digestive and respiratory systems are among those that frequently present the highest citation of the use of plants by local communities throughout Brazil (Coelho *et al*., 2019; Simões *et al*., 2021, Guarneire, 2021) and in studies carried out in other countries (Panyadee *et al*., 2019). Epidemiological data from Paty do Alferes show that among the main causes of hospitalization in the local health system are the diseases related to both systems, which reinforces the result found through the indication of the use of plants (DATASUS, 2021). Such diseases are generally of low complexity and therefore end up being treated through the use of plants that are available in home gardens. The two species that showed the highest frequency of citation by local experts are precisely plants to treat problems of the digestive system. *Plectranthus barbatus* received indication of use exclusively for digestive problems, which is in agreement with the previously documented use in Brazil (ANVISA, 2021). *Lippia alba*, however, in addition to the indications for problems related to the digestive system, was also mentioned for the treatment of diseases of the genitourinary system, musculoskeletal and mental and behavioural disorders. The Brazilian Pharmacopoeia Phytotherapic Form endorses the use of this plant as an anxiolytic, mild sedative, antispasmodic and antidispeptic, which also supports the popular indication found in APA Palmares (ANVISA, 2021). This greater diversity of use of *Lippia alba* is reflected in the high RI observed, with this species having the second highest RI value. Other studie conducted in a different Atlantic Forest area also reported *L. alba* as the most commonly cited species (Guarneire *et al*., 2021). The higher RI value found for *Plantago guilleminiana / P. australis* is due to the greater diversity of therapeutic indications attributed to this ethnospecies, which reflects its importance to local specialists, for the reason that with a single plant they are able to treat a vast number of diseases.

CONCLUSION

Local specialists have extensive knowledge about the use of plants used to care for low-complexity health problems, which are part of primary health care, and their knowledge is recognized and valued by the community where they live. With the development of this work, it was possible to conclude that the knowledge about the use of medicinal plants is distributed in a similar way among the local specialists, who share such knowledge among themselves. This sharing promotes constant feedback and contributes for the acquired knowledge to circulate in the community, which consequently

contributes for the conservation of traditional local knowledge. Additionally, the high average age of specialists draws attention to the need to promote ways of safeguarding this knowledge by other members of the community. Another issue observed through this research work points out that home gardens are the main place for collecting medicinal plants, which are handled so as to meet the needs of their families and community members who seek these specialists. As the main place for obtaining plants, home gardens contribute to minimizing anthropic pressure and extraction in the forested areas of APA Palmares, which favours a sustainable relationship with the place regarding medicinal plants.

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