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Original Paper

Use of plants and aspects of local knowledge in the rural community of Brejal, Rio de Janeiro, Brazil

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Abstract

Rural communities have repertoires of knowledge associated with the use of plants related to various social and biological aspects. The objective of this study was to identify the diversity of use of food and medicinal plants by the Brejal rural community in Rio de Janeiro state, Brazil. Ethnobotanical data was obtained using the snowball technique and semi-structured interviews with 22 farmers. Species diversity and use-value indices were calculated. Relationships among the numbers of plants cited, interviewee age, gender, and working time in agriculture were investigated. We identified a high diversity index, comprising 185 species belonging to 53 botanical families, notably Asteraceae, Lamiaceae, and Brassicaceae. The greatest use-values were associated with exotic species. Leaves were the plant structures most utilized, and infusions the predominant method of preparation. The prescriptions most commonly cited related to illnesses of the digestive system. Men and women did not differ in terms of the numbers of species cited. We found no correlations between the ages of the interviewees and their working time in agriculture. The uniformity of the number of citations demonstrates the shared knowledge throughout the community, covering a high diversity of plants, uses, indications and preparations.

Key words: ethnobotany, food plants, local knowledge, medicinal plants, social-ecological variables.

Resumo

As comunidades rurais possuem um repertório de conhecimentos associados ao uso de plantas que se relacionam com diversos aspectos biológicos e sociais. O objetivo deste estudo foi identificar a diversidade do uso de plantas alimentícias e medicinais pela comunidade rural do Brejal no estado do Rio de Janeiro, Brasil. Os dados etnobotânicos foram obtidos por meio da técnica "*Snow ball*" e entrevistas semiestruturadas com 22 agricultores. A diversidade de espécies e índices de valor de uso foram calculados. Foram investigadas as relações entre o número de plantas citadas, idade dos entrevistados, gênero e tempo de trabalho na agricultura. Identificamos um alto índice de diversidade, compreendendo 185 espécies pertencentes a 53 famílias botânicas, destacando Asteraceae, Lamiaceae e Brassicaceae. Os maiores valores de uso foram associados a espécies exóticas. As folhas foram as estruturas vegetais mais utilizadas e as infusões o método de preparo predominante. As prescrições mais citadas são relacionadas a doenças do sistema digestivo. Homens e mulheres não diferiram em termos do número de espécies úteis citadas. Não encontramos correlação entre a idade dos entrevistados e o tempo de trabalho na agricultura. A uniformidade do número de citações demonstra o conhecimento compartilhado por toda a comunidade, abrangendo uma grande diversidade de plantas, usos, indicações e preparações.

Palavras-chave: etnobotânica, plantas alimentícias, conhecimento local, plantas medicinais, variáveis sociais-ecológicas.

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Introduction

Humans have always been dependent on plants for their survival, and have manipulated and domesticated them to supply their needs, whether as food resources, medicines, or through rituals designed to help define our existence or maintain social order (Albuquerque 2005). As such, local knowledge about plants, acquired through continuous and dynamic learning processes, manifests itself through interpersonal organizations (Folke 2004), and the manners in which that knowledge becomes incorporated into human society and its importance for maintaining environmental resources has become increasingly relevant in science (Kellert *et al*. 2000; Abreu *et al*. 2017).

In light of the dependence of human communities on environmental resources for self-consumption and socio-economic development, they have developed conservationist attitudes and actions linked to reserve management (Diegues & Viana 2004). The varieties and availability of plant resources throughout the world have generated an ample spectrum of uses by traditional populations, including for medicinal, food, ritualistic, religious, and cultural purposes (Verma 2014). Those human-plant relationships can be observed in diverse traditional communities (Suwardi *et al.* 2020) such as "quilombolas" (settlements of previously enslaved populations) (Beltreschi *et al.* 2019; Yazbek *et al.* 2019; Rodrigues *et al.* 2020) and "caiçaras" (Rossato *et al.* 1999; Hanazaki *et al.* 2000; Brito & Senna-Valle 2012), traditional rural settlements (Hanazaki *et al.* 2006; Ladio & Lozada 2009; Omara 2020), Indigenous Peoples (Kffuri *et al.* 2016; Faruque *et al.* 2018), among others.

Traditional farmers in rural communities stand out as having in-depth knowledge and beliefs associated with plants (Kulshrestha 2018) due to their dependence on income generated from their commercialization (Pilla & Amorozo 2009). Those communities detain information concerning diverse plant species that provide foods and therapeutics, and they culture those plants for both personal consumption and commercialization (Miguéis *et al.* 2019). Traditional rural communities in Brazil have distinct cultural traces of self-determination, local institutions, and subsistence techniques (Ribeiro 1995; Diegues & Arruda 2001; Onakuse 2012). In some communities, local knowledge is transmitted orally between generations and thus can become gradually reduced and restricted to just a few interested members of the community (Weckerle *et al*. 2006; Verma 2014). Moreover the gradual loss of traditions resulting from the adoption of conventional agriculture, rural migration, and urbanization serves to interrupt the legacies of family agriculture (Amorozo 2002; Ladio & Lozada 2004).

The plant species that provide food and medicinal resources for traditional communities have been considered in numerous studies, generating inventories based on local knowledge of biological diversity (Toledo *et al*. 2007; Ladio *et al*. 2007; Leal *et al*. 2018). Although Brazil contains an ample botanical diversity, with at least 46,861 known species [Flora do Brasil 2020 (continuously updated)], only 83 native plants compose its socio-biodiversity of species with food value (Brasil 2018). In relation to therapeutic uses, 85% of the folk medicinal practices among traditional populations in developing countries involve the use of medicinal plants (Farnsworth 1988; Souza *et al*. 2013). Many species cover both medicinal and nutritional needs (Pieroni & Price 2006), tracing the bilateral use of food plants that are also recognized as therapeutic resources (Pieroni & Quave 2006).

The social-ecological, economic, and cultural characteristics of human communities directly influence the diversity of plants they use (Sousa *et al*. 2019), and numerous studies have been initiated in recent years seeking to better understand those influences (Pfeiffer & Butz 2005; Voeks 2007; Souto & Ticktin 2012; Campos *et al*. 2015). Those studies can contribute to ethnobotanical knowledge by defining the relationships between social factors (such as gender, age, income, and educational level) and knowledge concerning local plants (*e.g.*, numbers of species and families) (Sousa *et al*. 2019). In rural communities, the division of social roles between gender (Voeks 2007; Muller *et al*. 2015; Lautenschläger 2018) and the accumulation of knowledge over the years related to age (Toledo *et al*. 2009; Hanazaki *et al*. 2000; Randrianarivony *et al*. 2017) and time spent working in agriculture (Miguéis *et al.* 2019) may lead to variations and disparities in local knowledge. As such, it becomes necessary to better understand how those social factors are interrelated, and how they can interfere with, or reinforce, the acquisition and transmission of knowledge.

Studies of plant uses and management integrate local knowledge, connect diverse cultures with academic research, and relate biological, social-ecological, economic, and cultural aspects of human experiences to the environment in which those communities are inserted (Albuquerque & Alves 2016). As such, attempts to systematize the local knowledge of the plants grown in local agricultural systems and their uses can potentialize our knowledge concerning plant resources. Thus, the objectives of the present study were therefore to: (1) determine the plant species used by the rural community of Brejal, Rio de Janeiro state, Brazil; (2) analyze the diversity and use-values of the plants cited by the interviewees; and, (3) determine the relationships between gender, age, and working time in agriculture to the numbers of plants cited.

Based on the relationship between farmers in rural communities and plants, we raised the following hypotheses: (1) The use of food and medicinal plants by farmers is related to their availability and accessibility in the face of commercial cultivation; (2) farmers have varying levels of knowledge of plants in relation to their social-ecological characteristics; (3) there is a proportional relationship between older participants and time spent in agriculture on the number of plants cited; (4) men and women have heterogeneous knowledge about number of plants cited.

Material and Methods

Study area

The present study was undertaken in Brejal, a rural area located in the municipalities of Petrópolis (14°04’56’’S, 46°22’40’’W) and São José do Vale do Rio Preto (22°11’34”S, 42°57’10”W) in the mountainous region of Rio de Janeiro state, Brazil (Fig. 1). Those municipalities are located in the Serra dos Órgãos mountains within the Serra do Mar Range. The region is included within the Atlantic Forest domain, and the dominant vegetation type within montane and high-montane

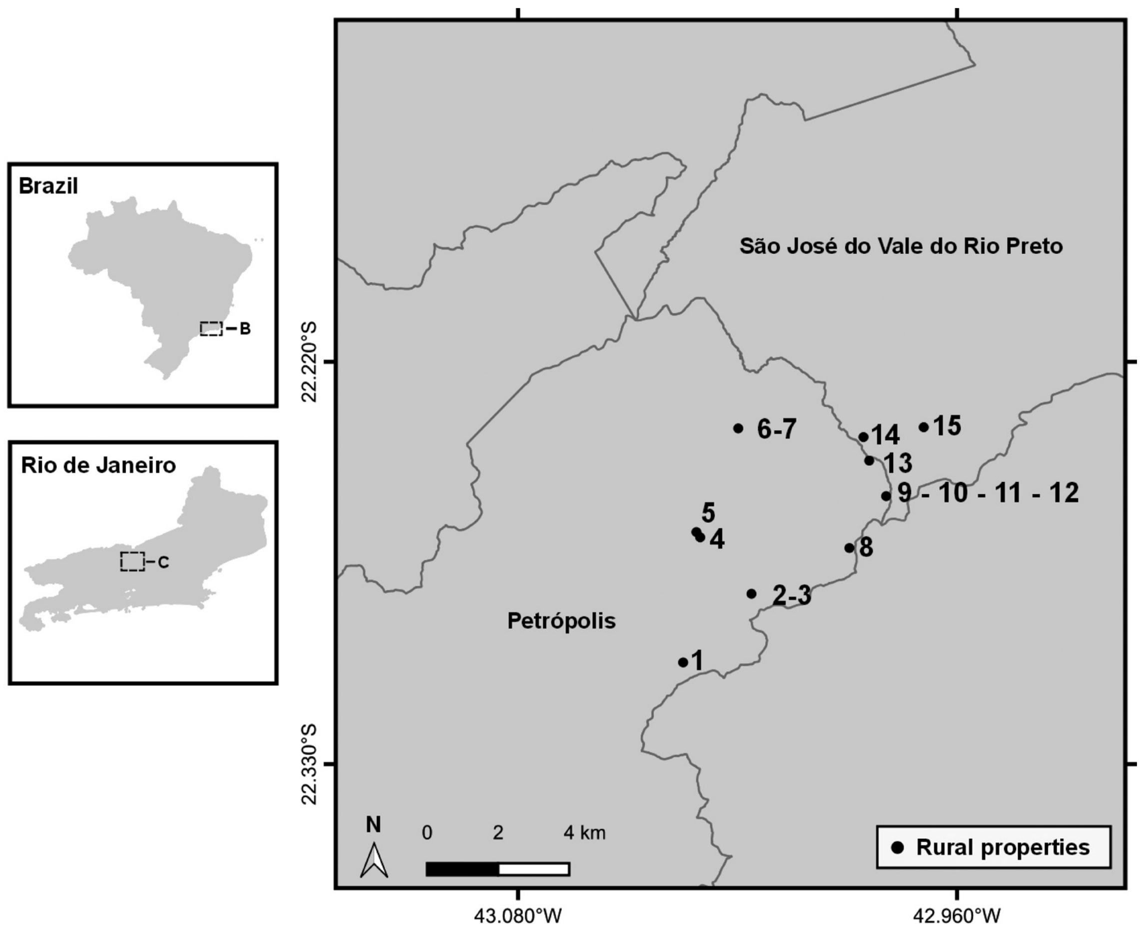

Figure 1 – Study area located in Petrópolis and São José do Vale do Rio Preto, Rio de Janeiro, Brazil. The points represent the location of the properties inserted in the rural community of Brejal.

formations is Dense Ombrophilous Forest (IBGE 2012). The regional climate is altitudinal tropic (type Cwb in the Köppen classification), with a mean annual temperature of 19 °C. The mean annual rainfall rates are between 2,000 and 3,000 mm, with austral summers without a dry season and heavy rains during the winter (Nimer 1977; INMET 2007).

The Brejal community has 2,200 inhabitants (Votre *et al*. 2017) including landowners, land renters, and sharecroppers that occupy areas of less than 10 hectares each (Brignol 2012). The farmers are engaged in conventional or organic production, and also aviculture for meat and eggs (Votre *et al*. 2017). The community constituted the first nucleus of organic agriculture in Rio de Janeiro state in 1978 (Brignol 2012), and those pioneering organic systems initiated the diffusion of that production model among farmers in the region. Women initially stimulated the introduction of organic products in response to good economic returns. Petrópolis became known as the Capital of Organic Products in the state in 2018, as 13% of the total number of organic farmers in Rio de Janeiro were established in that municipality, with 92 certified producers (MAPA 2018).

Ethical aspects

This research was approved by the Research Ethics Commission of the Federal Rural University of Rio de Janeiro / CONEP-UFRRJ (process nº 23268.000287/2018-70, protocol nº 1.187/18, registered with the Sistema Nacional de Patrimônio Genético e Conhecimento Tradicional Associado - SISGEN, nº AB712336). The participants in this project signed an Informed and Free Consent declaration, following Resolution 466/12 for research with humans (Brasil 2012).

Data collection

Data collection occurred between December/2018 and May/2019, employing semi-structured interviews held at the homes of the informants. The local residents were selected using the Snowball Sampling technique (Patton 1990; Cotton 1996; Pinheiro 2003). The inclusion criteria was being an organic farmer. No minimum time of residency was defined for selecting the informants.

We visited 15 properties, where 22 residents were interviewed separately in their homes in the Jurity, Albertos, and Cachoeirinha neighborhoods. Guided tours with direct observations were undertaken during the visits (Albuquerque *et al.* 2010). Participants were asked about the local uses of plants, using the empirical classification of use categories (Miguéis *et al.* 2019). Thus, we adopted three categories of plant use: 1. Medicinal (when the plant was cited as "medicine" or "tea for healing"); 2. Food (when the plant was cited as part of the interviewee's eating habits) and; 3. Food and medicinal (when the plant was cited for both types of use). The method of obtaining (*e.g.*, spontaneous, cultivated) the mentioned plants was identified. For geographical origin of the species, we consulted the List of Species of the Flora of Brazil and used the terminology proposed by Moro *et al.* (2012). The species not covered by the platform were classified according to the International Plant Name Index (IPNI 2021).

The plant species (including varieties cited by farmers) were identified in the field and collected there, or were collected and photographed for later identification. The specimens collected were identified according to the APG IV (2016) system, consulting the Flora do Brasil 2020 (continuously updated), Tropicos ®, World Flora Online, and the International Plant Names Index. The specimens were subsequently deposited in the Campus Três Rios Herbarium (HCTR) at the Federal Rural University of Rio de Janeiro under vouchers 133 to 153.

The common names were recorded exactly as cited by the interviewees. Plant prescriptions were grouped according to the International Classification of Diseases and Problems Related to Health (ICD-11), an official publication of the World Health Organization (WHO 2020).

Data analyses

Species diversity was assessed for the cited species by farmers (following Begossi 1996) using the Shannon diversity index (H'), and species evenness was estimated using the Pielou index (J') to determine species distribution patterns within the community. Shannon diversity and Pielou index were calculated using the "diversity" function in the "vegan" package (Oksanen *et al.* 2013), in R software (R Development Core Team 2019). The relative importance of each species was calculated employing the Use Value (Phillips *et al*. 1994), $UV = \sum Ui / n$, where Ui represents the total number of use citations for a given species by each informant (i), and n represents the total number of informants. The quantitative analyses evidenced the different aspects of plant uses. The diversity index demonstrated the relative intensity of plant use, while the Use Value indicated the importance of each species among all of the plants cited (Rossato *et al*. 1999).

Spearman's correlation coefficient was used to investigate associations between the numbers of plants cited with the numbers of years a given interviewee worked in agriculture, and their ages. The Mann-Whitney test was used to determine the difference between the plants cited and the genders of the interviewees (women and men). These statistical analyses were performed in R software (R Development Core Team 2019).

Results

Of the 22 participants in the study, 14 were men, and eight were women. Their educational levels varied from unschooled to completed high school, with the predominance of uncompleted grammar school levels (n = 14). The ages of the interviewees ranged from 22 to 81, with most falling within the age group of 50 to 59 (n = 6). All interviewees reported that agriculture is the main source of family income.

The informants cited 185 plant species within their respective properties, belonging to 53 botanical families and 47 genus (Tab. S1, available on supplementary material <https://doi.org/10.6084/m9.figshare.23651064.v1>; Fig. 2). The most well represented families were Asteraceae (27 species), Lamiaceae (23), and Brassicaceae (13), representing together 34% of all species cited. Among the species cited, 184 are used as therapeutic resources, with 56 (30%) exclusively belonging to the medicinal category, while 128 are food and therapeutic resource plants. Only the specie *Pteridium aquilinum* (L.) Kuhn had no therapeutic indication.

In relation to the origins of the species, 99 (53%) are considered exotic; the most cited of those were: *Lactuca sativa* L. (alface-lisa), *Lactuca* sp3 (alface-crespa), *Brassica oleracea* L. (brócolis-comum), *Beta* L. sp. (beterraba), and *Lactuca sativa* var. *capitata* L. (alface-americana). Among the exotic species, 16% were naturalized species that had become adapted to environmental conditions in Brazil, such as *Dysphania ambrosioides* (L.) Mosyakin & Clemants (mastruz, erva-santa-maria), *Rumex obtusifolius* L. (labaça, língua-de-vaca), and *R. acetosa* L. (azedinha). There were 42 native species (22%), with 36 of them (86%) being native to the Atlantic Forest (Tab. S1, available on supplementary material <https://doi.org/10.6084/m9.figshare.23651064.v1>), notably *Xanthosoma sagittifolium* (L.) Schott (taioba), *Bidens alba* (L.) DC. (picão-branco), and *Hydrocotyle bonariensis* Lam. (erva-de-capitão). Regarding the method of obtaining, 144 plants are cultivated and 41 are spontaneous.

Species diversity and Use-value

The total number of species cited by the interviewees demonstrated a high diversity index within the community (Shannon index, H' = 4.85), although with a uniformity of species cited by all of the farmers (Pielou, J' = 0.92). The plants with the greatest use-values were edible species in high demand among consumers: *Daucus carota* L. (cenoura; 0.95), *Lactuca* L. sp. (alface-roxa; 0.85), *Lactuca sativa* (alface-lisa; 0.85), *Lactuca sativa* var. *crispa* (alface-crespa; 0.76), and *Brassica oleracea* (brócolis-comum; 0.76). The interviewees likewise identified important therapeutic resources: *Daucus carota*, for example, was indicated as a diuretic, sedative, and as useful in treating the skin, indigestion, and bursitis. The species *Lactuca sativa* and *Lactuca sativa* var. *crispa* were indicated to treat intestinal problems and were also used as sedatives, while *Brassica oleracea* was indicated to treat anemia.

Part used and Preparation

In relation to the food and medicinal plant parts utilized, leaves were most widely used in preparations (111 citations), followed by fruits (42), roots (20), and flowers (16). Herbs (122), trees (23), shrubs (21), subs shrubs (11), vines (five), and lianas (four) were cited as the principal plant habits (Fig. 3). The interviewees also reported the use of mixtures of plants, such as the use together of *Citrus aurantiifolia* (Christm) Swing (limão), *Baccharis crispa* Spreng. (carqueja), and *Barbarea verna* (Mill.) Asch. (agrião) to make syrups to treat colds and sinusitis.

Prescriptions/ ICD-11

The interviewees also stated that the same species could often be used to treat different symptoms in different systems of the human body. According to ICD-11 of the World Health Organization (WHO 2020), the most frequent indications of plant remedies were for: diseases of the digestive system (Code 13) with 28% (n = 49) of the plants; diseases of the respiratory system (Code 12), with 15% (n = 27); diseases of the genitourinary system (Code 16), with 16% (n = 30); and endocrine and nutritional or metabolic diseases (Code 05) cited for 14% (n = 26) of the plants (Fig. 4). The classification of illnesses according to the ICD-11 was undertaken to list the prescriptions most cited in the study and indicate the most frequent illnesses in the community.

Among the most cited species used for the treatment of ICD-11 digestive system diseases were: *Daucus carota* (cenoura, n = 17), *Lactuca sativa* (alface-lisa, n = 17), *Lactuca* sp. (alface-roxa, n = 17), and *Lactuca sativa* var. *crispa* (alface-crespa, n = 15). In relation to diseases of the respiratory system, the most cited species were: *Rosmarinus officinalis* L. (alecrim, n = 10), *Stachys byzantina* K. Koch (peixinho-da-horta, n = 10), *Xanthosoma sagittifolium* (taioba, n = eight), and *Ocimum gratissimum* L. (alfavaca, n = eight). Diseases of the genitourinary system was widely represented by *Daucus carota* (cenoura, n = 17), *Cymbopogon citratus* (capim-limão, n = 12), *Amaranthus viridis* L. (caruru, n = 10) and *Zea*

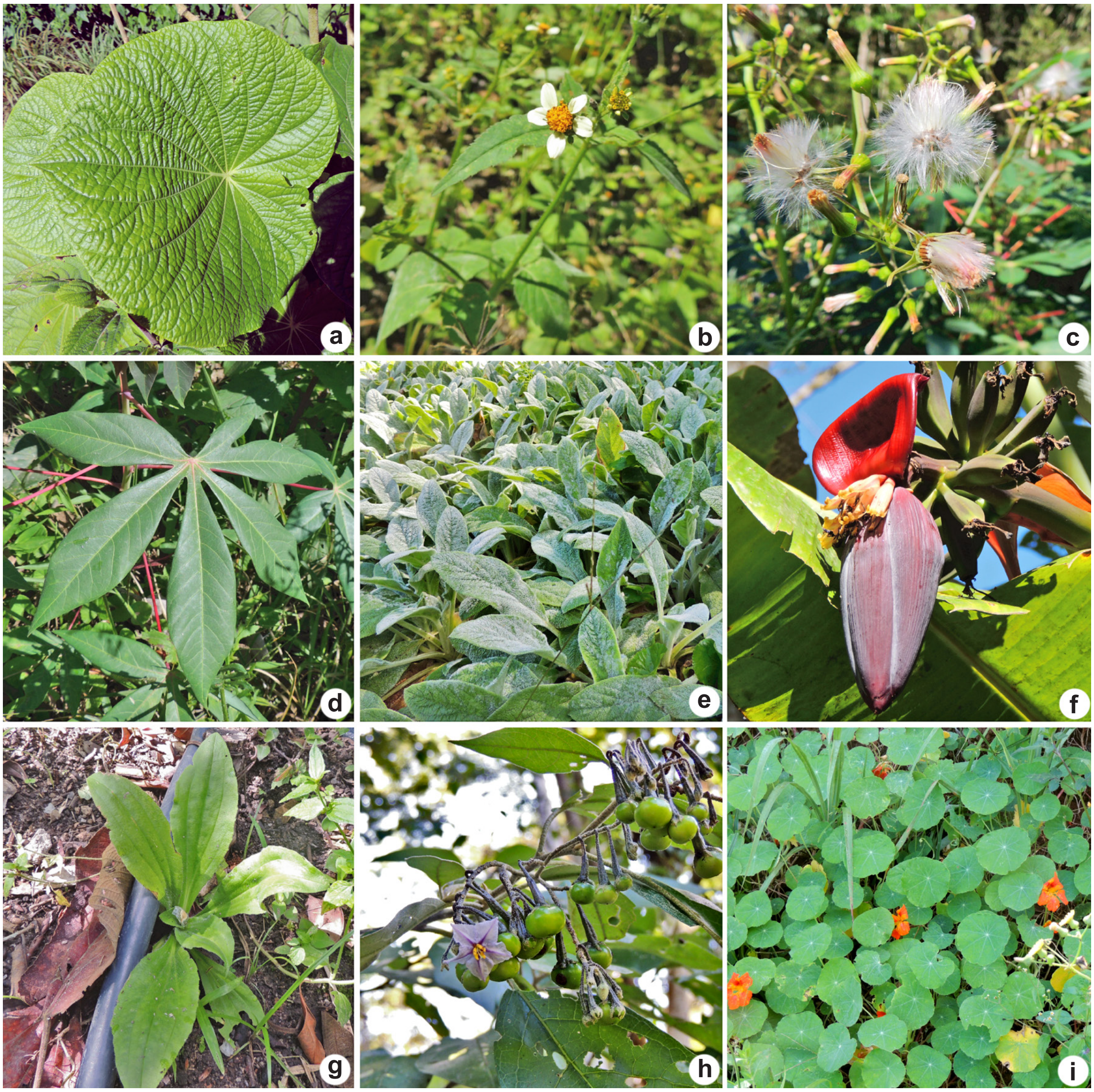

Figure 2 – a-i. Species occuring in the rural community of Brejal, Petrópolis and São José do Vale do Rio Preto, Rio de Janeiro, Brazil – a. *Echinodorus grandiflorus*; b. *Bidens alba*; c. *Emilia sonchifolia*; d. *Manihot esculenta*; e. *Stachys byzantina*; f. *Musa* sp.; g. *Plantago major*; h. *Solanum paniculatum*; i. *Tropaeolum majus*.

mays L. (milho, n = nine). The species *Solanum melongena* L. (berinjela, n = nine), *Abelmoschus esculentus* (L.) Moench (quiabo, n = eight), *Lactuca canadensis* L. (almeirão-roxo, n = seven), and *Cucurbita maxima* Duchesne *ex* Lam. (abóbora, n = seven) were the most representative of endocrine and nutritional or metabolic diseases.

Three species had the greatest numbers of indicated uses: *Artemisia absinthium* L. (losna) (eight), *Bidens pilosa* L. (picão-preto) (six), and *Salvia officinalis* L. (sálvia) (five) and thus demonstrated elevated versatility. *Artemisia absinthium* was cited in five ICD-11 codes and had eight indications for its use in infusions (to treat stomach aches, pneumonia and intestinal infections, as an antibiotic, and to eliminate blotches on the liver) and as a bath to treat burns and gynecological infections.

Relationship between the plants mentioned and the social-ecological variables

No significant correlations were noted in the rural community of Brejal among the social-ecological variables of the farmers and the numbers of plants they cited. Likewise, no significant differences were observed between the numbers of plant citations and interviewee's gender (Mann-Whitney test, $P > 0.05$, Fig. 5). The Spearman correlation indicated no significant correlation among the numbers of species mentioned and the ages of the interviewees ($\rho = 0.15$, $P > 0.05$) or their working time in agriculture ($\rho = 0.13$, $P > 0.05$) (Fig. 5).

When the interviewees were questioned about the probable continuity of agricultural activities among their sons and daughters and other family members up to 29 years old, 13 (59%) indicated that those young people would continue farming. Six interviewees (27%), on the other hand, reported an absence of continuity, while two (9%) indicated that their sons (< 10 years old) demonstrated interest in continuing farming activities; one farmer (5%) did not have any sons or other younger family.

Discussion

The knowledge of food and medicinal plants presented by the farmers of the Brejal community is strongly associated with the cultivation of the species for commercialization. This knowledge was reflected in the number of species (n = 185) and families mentioned (n = 57) that are used in their crops. The plant families most mentioned by farmers (Asteraceae, Lamiaceae, and Brassicaceae) were also quite prominent in other ethnobotanical studies undertaken in rural communities, quilombolas, and Indigenous areas (Ávila *et al*. 2017; Umair *et al*. 2017; Miguéis *et al*. 2019; Prado *et al*. 2019; Tuler *et al*. 2019; Yazbek *et al*. 2019). In addition, these families represent plants widely available in the Brejal crops that are commercialized on a large scale (*e.g.*, *Lactuca sativa* L., *Cichorium endivia*

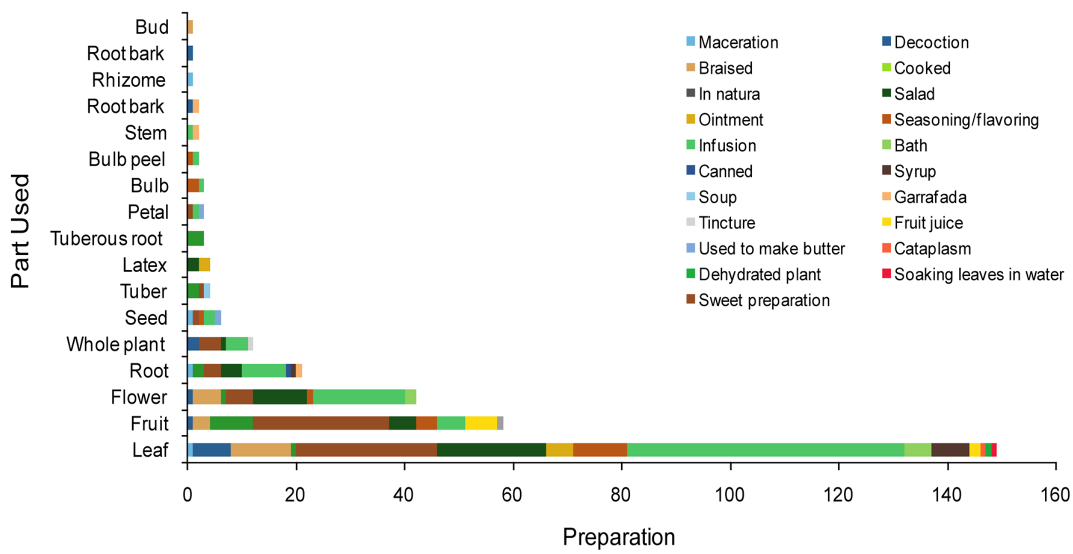

Figure 3 – Parts used and preparations of the species cited by the participants of the Brejal, Petrópolis and São José do Vale do Rio Preto, Rio de Janeiro, Brazil.

L., *Ocimum basilicum* L., *Rosmarinus officinalis* L., *Brassica oleracea* L.).

Asteraceae is one of the largest botanical families, comprising approximately 1,700 genera and 27,000 species; it comprises 10% of all angiosperm species (Funk *et al*. 2009; Panero *et al*. 2014; Panero & Crozier 2016). There are approximately 289 genera and 2,097 species of Asteraceae in Brazil, distributed in essentially all of its vegetation formations (Flora do Brasil 2020, continuously updated). The Lamiaceae family contains many species traditionally commercialized throughout the world for their medicinal value, and as spices and aromatic condiments (Raja 2012). Among olericultural plants, the Brassicaceae family comprises the largest number of species and has elevated economic importance (Al-Shehbaz *et al*. 2006; Filgueira 2008), standing out for having high mineral salt and vitamin concentrations and for their ease of cultivation (Camargo 1984).

The number of species encountered in Brejal was expressive as compared to studies undertaken in other rural communities [Cunha & Albuquerque 2006 (n = 42); Santos *et al.* 2009 (n = 119); Christo *et al*. 2010 (n = 96); Miguéis *et al*. 2019 (n = 152)]; in Indigenous communities [Albuquerque *et al*. 2008 (n = 107); Albuquerque *et al.* 2011 (n = 44)]; and in "quilombolas" [Beltreschi *et al*. 2019 (n = 69); Yazbek *et al*. 2019 (n = 92); Sauini *et al*. 2020 (n = 82)]. Those results reflect the importance of those plants to rural communities in terms of self-consumption, health, and income generation.

Among the plants mentioned by the interviewees, we found exotic and naturalized species with invasive potential (*e.g.*, *Agave americana* L., *Monstera deliciosa* Liebm., *Taraxacum officinale* F.H. Wigg.) (Badano & Pugnaire 2004; Sampaio & Schmidt 2013; Cordeiro *et al.* 2018). The most cited medicinal and food resource species present in the daily diet of these traditional populations include exotic species that reflect the hybridization of cultures and the circulation of germplasm between different peoples. Diffusion in the use of introduced species occurs due to these species becoming essential resources for populations that do not access modern medicines (Bennett & Prance 2000). Furthermore, dependence on consumer demands encourages the cultivation of these species (Guarim-Neto *et al.* 2000; Amorozo 2002).

The availability of introduced plants is an important factor for their incorporation or use as medicines (Voeks 2004; Albuquerque 2006; López-Patiño *et al.* 2022). Indeed, the accessibility and local abundance of these plants is strongly related to their use, strengthening the well-established availability hypothesis (see Gaoue *et al.* 2017). However, like our findings, Hart *et al*. (2017) observed that there is a strong association between cultivation and medicinal use, and further investigation into the types of cultivation and the relationship of cultivation to availability is needed.

Species diversity and use-value

The diversity index of cultivated plants found in the community studied here (H' = 4.85) was a value similar to that reported in several other studies. [Hanazaki *et al*. 2000 (H' = 4.57 - 4.59); Amorozo 2002 (H' = 5.09); Meyer *et al*. 2012 (H' = 4.23); Prado *et al*. 2019 (H' = 4.97); Miguéis *et al*. 2019 (H' = 4.50)] and their high

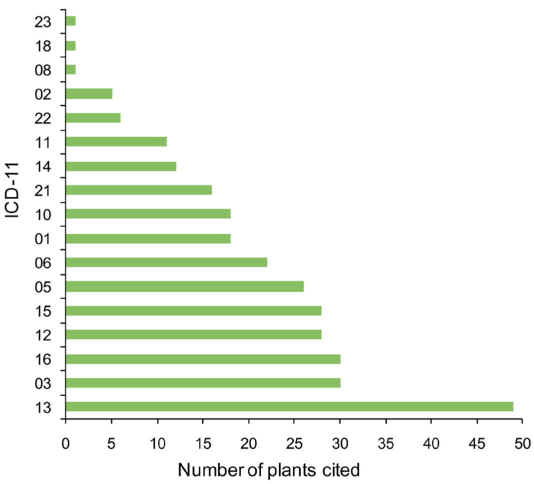

Figure 4 – Citation frequency of medicinal plant used to treat bodily systems, classified according to ICD-11, by the participants of the Brejal, Petrópolis and São José do Vale do Rio Preto, Rio de Janeiro, Brazil – 01: certain infectious or parasitic diseases; 02: neoplasms; 03: diseases of the blood or blood-forming organs; 05: endocrine, nutritional or metabolic diseases; 06: mental, behavioural or neurodevelopmental disorders; 08: diseases of the nervous system; 10: diseases of the ear or mastoid process; 11: diseases of the circulatory system;12: diseases of the respiratory system; 13: diseases of the digestive system; 14: diseases of the skin; 15: diseases of the musculoskeletal system or connective tissue; 16: diseases of the genitourinary system; 18: pregnancy, childbirth or the puerperium; 21: symptoms, signs or clinical findings, not elsewhere classified; 22: injury, poisoning or certain other consequences of external causes; 23: external causes of morbidity or mortality.

use-values were associated with dietary species that aggregated therapeutic uses. The species with high use values are widely commercialized, demonstrating a favorable relationship between the goal of commercial sales and their availability (Prado *et al*. 2019). Additionally, the farmers noted that medicinal species are also inhibitors of certain insect pests prejudicial to their crops (and they accordingly stimulate their planting) - demonstrating their acquired understanding that both native and spontaneous plants (*e.g.*, *Cymbopogon citratus* (DC.) Stapf, capim-limão; *Mesosphaerum suaveolens* (L.) Kuntze, erva-cidreira) important ecological functions in agro-ecosystems. Communities that establish close relationships with biodiversity have relevant roles in fostering and maintaining cultivated germplasm variability (Peroni & Sodero Martins 2000).

Part used and preparation

We identified leaves as the principal plant organ used by the residents of the Brejal community. Similar results were like wise reported in other studies of rural communities (Garlet & Irgang 2001; Pasa *et al*. 2005; Pinto *et al*. 2006; Nadembega *et al*. 2011; Prado *et al*. 2019). The preponderance of the use of leaves is probably related to the growth habits of plants and the predominance of herbaceous species, as was also noted by Conde *et al*. (2017) and Umair *et al*. (2017). The extensive use of leaves must also be associated with their facility of access (as compared to other plant organs) (Silva *et al*. 2012; Chahad *et al*. 2015). Harvesting leaves is also more sustainable due to their renewable nature, allowing not only their easy use, but also the continued development and reproduction of the plants (Ramos *et al*. 2011).

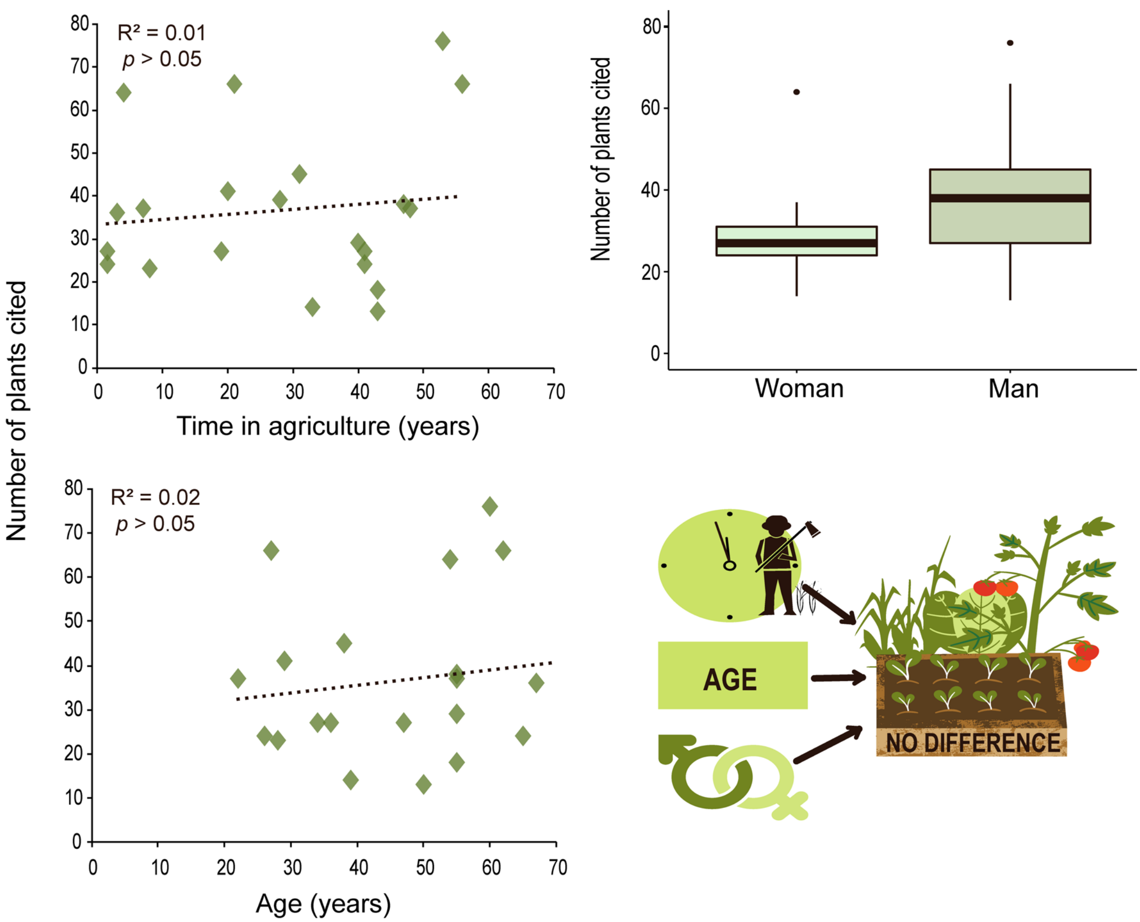

Figure 5 – Dispersion diagram and box-plot of the plant species cited in relation to age, working time in agriculture and gender in the rural community of Brejal, Petrópolis and São José do Vale do Rio Preto, Rio de Janeiro, Brazil. Box-plot represents the medians, first quartile, third quartile, minimum and maximum values. The circle highlights the outlier point.

Infusions are commonly identified as the principal method used to obtain plant extracts (Amorozo 2002; Silva & Freire 2010), as was seen in the present study, and leaves are largely used in those preparations (Silva & Freire 2010). Additionally, the consumption of plants in natura or by recipes is quite common, as most species are edible.

Prescriptions / ICD-11

The indication of medicinal plants as the principal treatment for digestive problems may reflect the fact that most of the illnesses experienced in the community fall within that category, with the use of plants as laxatives, stomach cleansers, and anti-diuretics. On the other hand, in many studies the most recurrent indication may be associated with health problems that are easier to treat, such as colds or gastrointestinal problems (Benítez *et al.* 2010). Very similar results were reported in rural communities by Amorozo (2002) and Neto *et al.* (2014), in "quilombola" communities by Monteles & Pinheiro (2007), and in river side communities by Ribeiro *et al*. (2017). Ethnobotanical data concerning the treatments of the illnesses that most afflict communities indicate their need for basic health care assistance (Pasa *et al*. 2005; Ribeiro *et al*. 2017).

Combining different plants in treatments is a common practice in traditional communities, taking advantage of the synergy of different plant resources in different prescriptions (Miguéis *et al*. 2019). The preference of using medicinal plants in rural communities can be explained by the absence of pharmacies and nearby hospitals, requiring the utilization of plants as therapeutic resources as the only immediate option available (Pasa *et al*. 2005). Additionally, the numbers of plants used in different treatments demonstrate the relevance of their medicinal potentials (Hanazaki *et al*. 2006; Miguéis *et al*. 2019; Prado *et al*. 2019), and agriculture directed towards commercialization can largely explain the high numbers of food species encountered.

Relationship between the plants mentioned and the social-ecological variables

Contrary to our hypotheses we found a high degree of uniformity in terms of the number of species cited by different members of the local community. Regarding gender, differences not found between men and women may indicate similar patterns in their repertoires of cited plants. Men and women can have the same relevance in plant knowledge, so there is no global pattern of influence of the gender on the richness of known species (Torres-Avilez *et al*. 2016; Souza *et al.* 2021). However, at small scales such differences can be observed (Torres-Avilez *et al*. 2016), with studies demonstrating a distinct knowledge between genders (Caniago & Siebert 1998; Voeks & Leony 2004; Lautenschläger *et al.* 2018; Costa *et al.* 2021). Therefore, assessing the domains of knowledge between genders is essential, as men and women work in different cultural spaces (Méndez *et al.* 2001; Howard 2003), especially in tropical regions where the activities of rural communities are markedly segregated (Voeks 2007).

We did not find any relationship between working time in agriculture and the number of cited species. The farmers in the community studied that had spent less working time in agriculture indicated that much of their knowledge had been acquired from contact with more experienced local producers, as well as from their participation in practical courses. Those factors can largely explain the equivalence of knowledge among farmers having different times of dedication to that trade. Dweba & Mearns (2011) point out that local knowledge can be transformed due to changes caused by modern agriculture, such as habitat loss, introduction of new varieties, historical policies and stigma related to the use of traditional species. Therefore, evaluating the influence of working time on knowledge associated with plants demonstrates the access of novice farmers to local knowledge and its continuity in cropping systems. Observations, experiments and the exchange of information between farmers with different work experiences have a positive effect on agriculture by encouraging the development of efficient techniques over the years (Albuquerque *et al.* 2012).

Similarly, age was not a determining factor in the continuity of knowledge about plants. In Brejal, most farmers (n = 13) mentioned the continuation of their descendants in agricultural activity, allowing the perpetuation of local traditions and wisdom. On the other hand, six farmers reported that the continuity of plant knowledge does not persist. Some studies have demonstrated the existence of knowledge accumulation between generations (Albuquerque *et al.* 2010; Bortolotto *et al.* 2015; Singh *et al*. 2017). In these cases, older people have more experience, contact with plant resources and time to exchange knowledge with other people (Almeida *et al.* 2012; Ladio & Lozada 2009). However, different mechanisms and traits of cultural transmission (*e.g.*, religion and politics) can be determined within and between different groups (Cavalli-Sforza *et al.* 1982), not depending exclusively on age or kinship. In Brejal, comparable knowledge between youth and adults seems to be mainly influenced by agricultural activity, where young people contribute to this work from an early age and acquire knowledge through daily exchanges of experience.

This study represents the first record of the use of medicinal and food plants by the Brejal rural community, with evaluations and descriptions of popular knowledge about plant resources and their dissemination. The Brejal rural community demonstrated ample knowledge concerning plants for food and medicinal use, with a high level of species diversity and use indications. The most utilized plants were species raised as food resources, and they corresponded to the plants that had the highest use values. Differences between social-ecological variables (age, sex and time working in agriculture) were not determinant for the knowledge of plants in the community. The integration of knowledge in the community was essential to the observed parity among the different age groups and between men and women. As such, the appreciation and dissemination of knowledge about plants is important to contribute to local socioeconomic development and strengthening the identity of family farmers.

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Data availability statement

In accordance with Open Science communication practices, the authors inform that all data are available within the manuscript.

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