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Gentiana urnula H. Smith photo by Tshering Pem

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The usage of "et al." in long author lists will also be accepted:

Smith J, Jones M Jr, Houghton L et al. 1999. Future of health insurance. N Engl J Med 965: 325-329. DOI: 10.10007/s002149800025.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in the book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds.). Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta*. 50th annual symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.). Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

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Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. Mol Syst Biol 4: 187. DOI: 10.1038/msb.2008.24. www.molecularsystembiology.com.

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Ethnobotanical study of the wild edible plants used by the indigenous people of Merak in Bhutan

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Abstract. *Jigme, Yangchen K. 2023. Ethnobotanical study of the wild edible plants used by the indigenous people of Merak in Bhutan. Asian J Ethnobiol 6: 1-6.* Merak communities possess one of the oldest and most extensive cultural traditions of using plants for various ethnobotanical purposes, but this traditional knowledge still needs to be reported. As a result, this is the first ethnobotanical survey on Wild Edible Plants (WEPs) in Merak *Gewog*, Tashigang *Dzongkhag*, Bhutan. The data was obtained through an ethnobotanical survey and semi-structured interviews with 40 informants. The study identified 16 plant species from 16 genera and 16 families of WEPs consumed in Merak *Gewog*. Herbs (14 species) were found to be the most important sources, followed by shrubs (1 species) and trees (1 species). The most commonly consumed plant part(s) are leaves (8 species), followed by flowers (4 species), shoots and whole plant (with 3 species each), rhizome, and root (1 species each). Wild edible plants supplement the family diet, and their usage and collecting frequency are constrained by seasonal availability. Summer is the best time to harvest wild edible plants, followed by spring, autumn, and winter. However, many of the wild edible plants found in the Merak are under increased strain due to human and socioeconomic causes such as livestock overgrazing, habitat degradation, unsustainable harvesting, and forest fire. This has resulted in the disappearance of WEP species and the underlying indigenous knowledge. As a result, the importance of wild vegetables must be stressed and included in conservation and food security strategies.

Keywords: Bhutan, herbs, Merak, shrubs, trees, wild edible plants

INTRODUCTION

Wild Edible Plants (WEPs) are plant species that are not cultivated but are edible and collected from various natural habitations (Dema and Dolkar 2022; Yangdon et al. 2022). They may be found in various habitats, including woodlands, cultivable fields, roadside ditches, and wastelands (Dema and Dolkar 2022). Several names are known for wild edible plants. WEPs are known as 'wild vegetables' (Narzary et al. 2013) and 'edible weeds' (Dop et al. 2020). They are also known as 'famine food' because they are consumed to overcome hunger (Mishra et al. 2021; Sachula et al. 2020). Wang et al. (2020) described WEPs as 'functional foods' because they contain physiologically active ingredients capable of providing health benefits beyond basic nutrition.

About 12,000 years ago, when agriculture had not yet emerged, humans could only feed on the vegetables they found in nature and the hunted products (Pereira et al. 2020). Despite the primary reliance of agricultural societies on domesticated plants and animals for food, the tradition of consuming wild edible plants has not been entirely abandoned, owing to their nutritional value and health benefits (Panda 2014; Ashagre et al. 2016; Pereira et al. 2020; Yangdon et al. 2022). According to Pereira et al. (2020), WEPs are consumed by humans in different ways. For example, they are consumed as snacks, herbal teas, salads, alcoholic beverages, and cooked in traditional recipes. Therefore, Motti (2022) stated that WEPs have become a part of the human diet and traditional food system and play a significant role in ensuring food sovereignty and security during food crop scarcity. Similarly, Thakur et al. (2020) added that WEPs also play an important role in developing new crops through domestication, giving rise to cultivated food plants and strengthening local food security.

Tribal and rural communities mostly consume WEPs during times of food scarcity when cultivated vegetables and fruits are unavailable to meet their food requirements (Panda 2014; Yangdon et al. 2022). However, Bharucha and Pretty (2010), Cao et al. (2020), and Cheng et al. (2022) argued that eating WEPs has also become a way of life for modern and urban people. They are consumed to meet the needs of a green and healthy diet and enhance the culture of the modern diet. Similarly, Ding et al. (2021) highlighted that WEPs remain indispensable sources of vegetables and fruit in some urban areas. WEPs provide alternatives to staple foods during food deficit and a valuable supplement for a nutritionally balanced diet (Narzary et al. 2013; Haokip and Panmei 2022.). Furthermore, it is one of the primary sources of income for residents in poor communities and plays an essential role in helping communities eradicate poverty (Cheng et al. 2022).

Similarly, WEPs were the major source of diet in Bhutan before agriculture (Dema and Dolkar 2022). Therefore, the WEPs collection is considered an important activity in boosting rural communities in Bhutan (Chhoeda and Yangchen 2017). However, the government's push for

commercialization and the promotion of high-yielding cultivars in recent decades has posed a significant challenge to Bhutan's traditional use of WEPs (Yangdon et al. 2022). Furthermore, dependence on wild plants is projected to shrink over time due to the easy availability of improved varieties and a reduction in species variety caused by habitat damage from deforestation and infrastructural development. As a result, indigenous knowledge and WEPs usage among younger generations are quickly disappearing (Yangdon et al. 2022). With the increasing erosion of indigenous knowledge of WEPs and increased reliance on improved vegetable varieties, there is a risk that WEPs will be completely replaced by imported and cultivated vegetables, disrupting the coexistence of people and forests and resulting in the loss of traditional knowledge. As a result, it is critical to record the diversity of species and their indigenous usage for sustainable management of natural resources before indigenous species and traditional knowledge become extinct. Although there has been some earlier research on wild vegetables, non-wood forest products, and medicinal plants in certain places in Bhutan, studies on WEPs in Merak have yet to be done.

Merak people are semi-nomadic and rely mostly on animal products and untamed natural resources. However, they have the oldest and richest cultural traditions of using plants for various ethnobotanical purposes. Although foraging for plants in the wild was a significant aspect of human sustenance, the utilization of these plants in Merak remains largely unexplored. As a result, the current study concentrated on recording the species diversity of WEPs and their ethnobotanical applications in Merak *Gewog* to enable future generations to acquire traditional knowledge associated with WEPs, to promote the conservation and sustainable use of WEPs, and to help economically backward and low-living areas to uplift themselves out of poverty and food insecurity.

MATERIALS AND METHODS

Study area

Merak is one of the remotest *Gewogs* located in the easternmost tip of Bhutan under Tashigang *Dzongkhag* (District) and Sakteng *Drungkhag* (Sub-district). Merak is located about 3,400-3,500 meters above sea level and has an area of 867.7 sq. km. The study area is shown in Figure 1.

The people of Merak are called *Brokpa*. They are semi-nomadic and rely mostly on livestock and livestock products for a living. However, some bitter buckwheat and vegetables are grown in the greenhouse, but no other cereal crops can be grown at such a high altitude. They travel from one location to another with their herds of Yaks, Sheep, and Goats as the seasons change. They travel to the warmer location when it receives significant snowfall in the winter and returns when summer arrives.

Ethnobotanical data collection

An ethnobotanical survey was conducted to document the wild edible plants used by indigenous people in Merak *Gewog*. Data were collected using semi-structured interviews with 40 informants from different age groups. Ethnobotanical data that were primarily aimed to document are local names of the plants, growth form of plants (habit), edible parts, time of collection (season), and modes of consumption.

Plant identification

Photographs with their vernacular names were recorded based on the ethnobotanical information obtained from the informants. The identifications of the plants were based on the published guides of useful plants and trees in Bhutan, especially the Flora of Bhutan (Grierson and Long 1983). Botanical names of the plants were reported according to the Plants of the World Online (POWO).

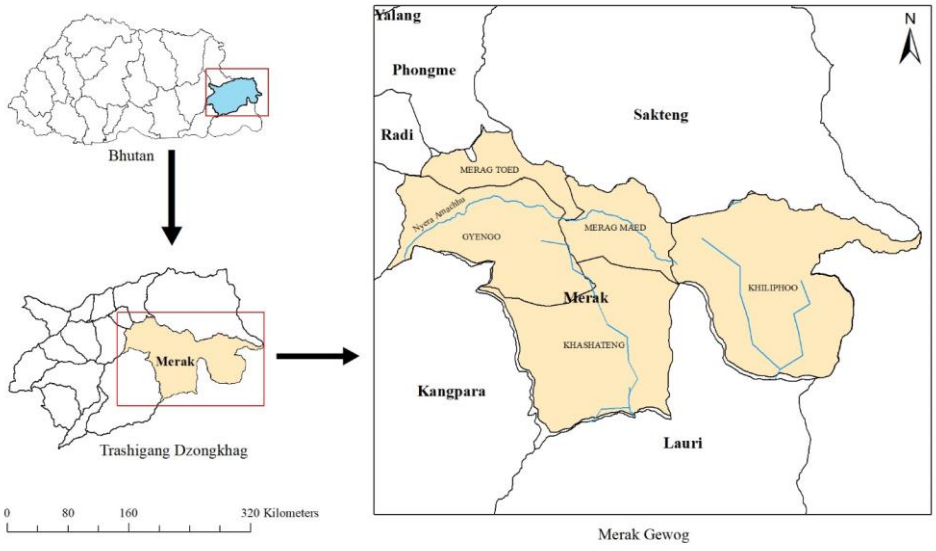

Figure 1. Study map showing Merak *Gewog*, Bhutan

Data analysis

Descriptive statistics (frequency and percentage) were used to analyze the ethnobotanical data of the reported wild edible plants and their associated indigenous knowledge. Priority ranking was employed to determine threats to wild edible plants based on their level of destructive effects. To recognize threats of wild edible plant species, we valued from 1 to 5: 1 is the least destructive threat, and 5 is the most destructive threat (Berihun and Molla 2017; Dema and Dolkar 2022).

RESULTS AND DISCUSSION

Taxonomic diversity of WEPs

A total of 16 plant species belonging to 16 genera and 16 families were reported as wild edible plants consumed in Merak *Gewog* (Table 1). The plants belong to different genera and different families. This finding indicates a diversity of wild edible plants in the study area. The relatively high diversity of the wild edible plants in the study area may be due to diverse agroecology and the local communities' more intensive utilization of the plants.

Growth forms (habit) and parts used

Wild edible plants' habit/growth form consists of herbs, shrubs, and trees. The largest numbers of edible wild plant species were found to be herbs, followed by shrubs and trees (Figure 2A), comprising 14 species and 1 species, respectively. Similar findings were reported by Thakur et al. (2020) from a tribal community in the western Himalayas. However, this result conflicts with the works of Laloo et al. (2007), Ashagre et al. (2016), Berihun and Molla (2017), and Dema and Dolkar (2022). They have reported trees and shrubs as the highest growth forms/habit of wild edible plants.

Regarding parts used, 6 edible parts were recorded, such as shoot, leaves, flower, rhizome, root, and whole plant. This finding implies that the people of Merak consumed more than one part of a plant species. The most widely used edible parts are leaves (8 species), followed by the flower (4 species), shoots and whole plant (with 3 species each), rhizome, and root (1 species each) (Figure 2B). The result concurs with the works of Narzary et al. (2013), Berihun and Molla (2017), and Thakur et al. (2020). However, this finding conflicts with the work of Ashagre et al. (2016), Al-Fatimi (2021), and Dema and Dolkar (2022), who have reported stem and fruit as the most common edible plant parts followed by the leaves.

Table 1. Wild edible plants consumed by the indigenous people of Merak *Gewog*, Bhutan

Botanical name	Family	Local name	Habit	part(s) used	Mode of used
Bambusa balcooa Roxb.	Poaceae	Shey (Shar)	Tree	Shoot	The outer cover of young shoots is removed and chopped into small pieces and eaten as curry.
Centella asiatica (L.) Urb	Apiaceae	Mon (shar)	Herb	Leaves	Leaves are dried and used as a condiment.
Chenopodium album L.	Amaranthaceae	Mon (shar)	Herb	leaves and flower	Flowers are separated from the plant, dried, cooked, and consumed.
Colocasia esculenta (L.) Schott	Araceae	Bozong (Shar)	Herb	Rhizome	Scales on the rhizome are removed and cooked, and consumed.
Cymbidium grandiflorum Giff.	Orchidaceae	Olochotao (Shar)	Herb	Flower	Flowers are directly cooked as a curry.
Diplazium maximum (D.Don) C.Chr.	Athyriaceae	Dha-Wai (shar) Nakay (Dzo)	Herb	Young shoot or young leaves	Frond and young leaves are sorted and cooked, and consumed.
Drymaria cordata (L.) Willd. ex Roem. & Schult.	Caryophyllaceae	Mon (shar)	Herb	Leaves	Leaves are cooked as curry or sometimes as a condiment.
Elatostema lineolatum Wight	Urticaceae	Dumroo (Dzo), Demom (shar)	Herb	Whole plant	Whole plants, except roots, are chopped into small pieces and cooked as a curry.
Gentiana urnula Harry Sm.	Gentianaceae	Panjen meto (Shar and Dzo)	Herb	Flower	Flowers are directly cooked or dried for future consumption.
Houttuynia cordata Thunb.	Saururaceae	Nombaring, Mombering (shar)	Herb	Root and leaves	Root and Leaves are chopped and cooked.
Justicia adhatoda L.	Acanthaceae	Khatsarim (shar), Bashaka (dzo)	Shrub	Flower	Flowers are separated from sepals and sometimes dried, then directly cooked.
Nasturtium officinale R.Br.	Brassicaceae	Ashi mom (shar)	Herb	Leaves	Fresh and young leaves are cooked directly as curry.
Oxalis corniculata L.	Oxalidaceae	Echa mon (Shar)	Herb	Leaves	Leaves are directly consumed or dried and then cooked.
Paris polyphylla Sm.	Melanthiaceae	Thok sam pa (shar)	Herb	Whole plant	Young plants without inflorescence are directly cooked.
Plantago major L.	Plantaginaceae	Mon (shar)	Herb	Whole plant	Young plants are directly cooked.
Pteridium aquilinum (L.) Kuhn	Dennstaedtiaceae	Dha-wai (shar), Na kay (Dzo)	Herb	Young shoot or young leaves	Frond and young leaves are sorted and cooked, and consumed.

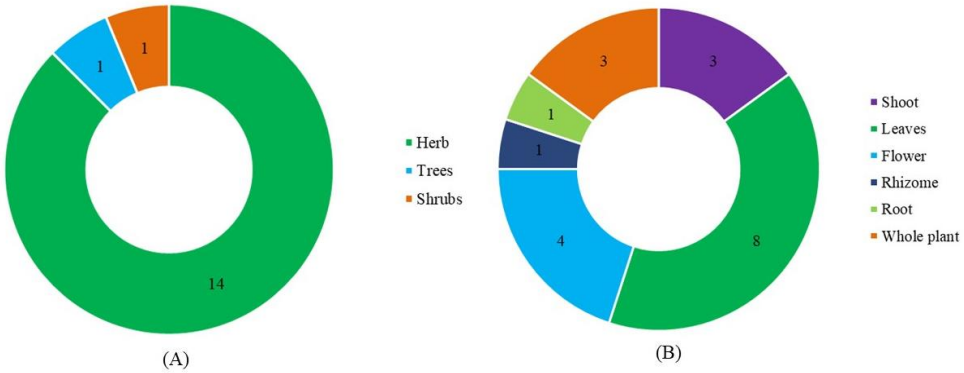

Figure 2. A. Growth forms of WEPs, B. Plant part(s) used

Classification of WEP

As reported in the earlier section, the different plant parts are consumed by people in the Merak. Therefore, depending on the different plant parts consumed, the WEPs in Merak are categorized into five types of wild vegetables: floral vegetables, foliage (leafy) vegetables, stem vegetables, root vegetables, and fruit vegetables (Kar 2004). The maximum of WEPs falls under foliage (leafy) vegetables, followed by the stem, floral, and root vegetables. The informants reported no fruit vegetable during the study period (Figure 3).

Seasonal availability of WEP

According to Chhoeda and Yangchen (2017), different plants have different growth patterns and maturity seasons. Thus, the abundance of wild vegetables changes from season to season. The study discovered that different edible plants were accessible throughout the year in the study region. The availability of the WEPs in the study area increased as the season transcended from winter to summer, and then it gradually decreased as the season transcended to winter (Figure 4). Therefore, the maximum of wild edible plants is harvested in the summer, followed by the spring, autumn, and winter. Because during the summer seasons, the climatic conditions become suitable for the growth of WEP, and the maximum number of WEPs such as *Bambusa balcooa* Roxb., *Centella asiatica* (L.) Urb., *Chenopodium album* L., *Colocasia esculenta* (L.) Schott, *Cymbidium grandiflorum* Giff., *Diplazium maximum* (D.Don) C.Chr., *Gentiana urnula* Harry Sm., *Houttuynia cordata* Thunb., and *Paris polyphylla* Sm. can be seen in these seasons. However, in the winter, the climatic conditions are not favorable for the growth of WEPs, except for *C. grandiflorum*, which starts flowering in the late winter to spring.

Diversity of use

The knowledge that the local communities possess about WEPs is what makes them put these plants to use in their daily lives. These communities collect various parts of these plants, like roots, leaves, shoots, stems, fruits, and flowers, as well as whole plants for daily household consumption, medicinal properties, and commercial purposes. In this study, the majority of the WEPs (14 species) are collected for household consumption and followed by medicinal properties (4 species) and commercial purposes (3 species) (Figure 5). Some of the plants such as *D. maximum* (collected for household consumption and commercial purpose), *Elatostema lineolatum* Wight (collected for household consumption and commercial purpose), *G. urnula* (collected for household consumption and medicinal purpose in Figure 6), and *P. polyphylla* (collected for medicinal purpose and commercial purpose) are collected for multiple purposes.

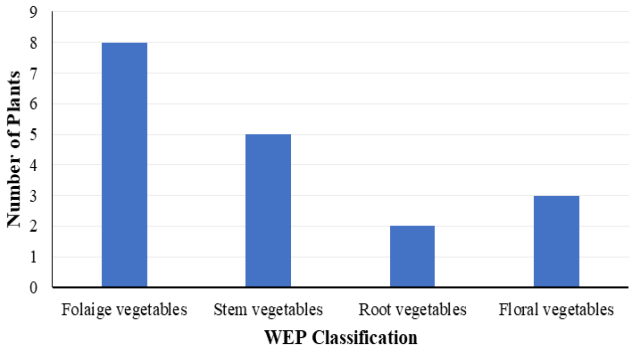

Figure 3. Classification of WEPs

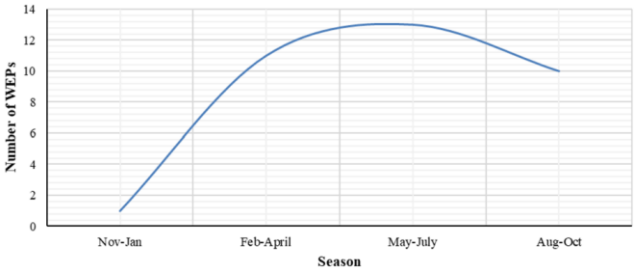

Figure 4. Seasonal availability of WEPs

The harvesting of wild vegetables in Merak remains significant because this community has limited cultivated crops, and wild edible plants are collected to add variety to their diet and generate some cash income. Similar findings are reported by Berihun and Molla (2017), Dema and Dolkar (2022), Chhoeda and Yangchen (2017), and Narzary et al. (2013). The most frequently collected WEPs for household consumption are *B. balcooa, C. asiatica, C. album, C. esculenta, C. grandiflorum, H. cordata, Justicia adhatoda* L., *Nasturtium officinale* R.Br., *Oxalis corniculata* L., and *Pteridium aquilinum* (L.) Kuhn. These WEPs significantly enhance these communities' food security and nutritional needs.

WEPs such as *D. maximum, E. lineolatum,* and *P. polyphylla* are sold in the market to generate cash income, while other WEPs such as *Drymaria cordata* (L.) Willd. ex Roem. & Schult., *G. urnula, P. polyphylla,* and *Plantago major* L. are utilized for medical purpose. The *D. cordata* treats cough and cold, and *P. polyphylla* treats diarrhea, dysentery, fever, stomachache, and wounds. The *G. urnula* is said to have a muscle-relaxing property, and the pregnant woman consumes it during maternity. The leaves of *P. major* are applied to blisters, sores, and stings. Tea prepared from *P. major* treats cough, cold, and diarrhea.

Threats to WEPs

The threat to the wild edible plants comes from agricultural land expansions, unsustainable harvesting, fuelwood collection, habitat destruction, overgrazing, and forest fire. Berihun and Molla (2017) identify similar factors and Dema and Dolkar (2022) stated that these factors threaten the availability of wild edible plants.

The priority ranking was employed to determine the threats on the WEPs based on their level of destructive effects. Of these factors, overgrazing ranks first, followed by habitat destruction and unsustainable harvesting, and the least destructive factors are agricultural land expansion and fuel/firewood collection (Table 2). Because of the large number of cattle, the people of Merak believe that overgrazing is one of the most threatening factors to the availability of WEPs. They are highlanders who rely on livestock to make a living. They raise livestock including Yaks, Sheep, Goats, and Horses. Therefore, high livestock density has resulted in overgrazing in the community. Simultaneously, introducing new grazing ground due to high livestock density may have led to the overgrazing of huge areas. The cattle grazing of nearby forest areas either consumes or stomps the WEPs. It has resulted in the non-availability and non-sightings of some of the WEPs that were previously seen. For example, people must travel a long distance to collect the *E. lineolatum,* which is only found in areas that cattle have not reached.

Similarly, they highlighted that habitat destruction due to new developmental activities such as road construction and houses is another hazardous factor in threatening wild edible plant species because habitat destruction reduces the species' natural population. For example, orchid species are sensitive to habitat changes, and species are threatened worldwide due to habitat loss and fragmentation induced by anthropogenic activity (Dema and Dolkar 2022).

Unsustainable harvesting is also equally hazardous as overgrazing and habitat destruction. Respondents mentioned that the plants found abundantly a few years ago were hardly seen nowadays. For example, *P. polyphylla,* which used to be a popular and commonly found plant species, is hardly available where it was found before. The *P. polyphylla* is said to have significant therapeutic potential and is in considerable demand in the illegal market. Therefore, the availability of this plant species has greatly decreased due to overharvesting and commercial exploitation by the people in the community.

The people also highlighted that forest fire is another major threat to wild edible plants. Forest fires usually affect woody plant species. Forest fires have seriously impacted many woody species, with tree and shrub stands declining, and some destroyed entirely. Others are dried and collected as firewood, while freshly formed vegetative portions of woody species are over-browsed and stomped by overgrazing, causing significant damage to the species.

The people have rated agriculture land expansion and fuelwood collection as the least threats to the availability of the WEPs compared to other factors. Merak is at an elevation of 3,000 to 4,000 m above sea level, making agriculture activities difficult. Therefore, there is minimal agricultural land expansion, and it does not have a significant impact on the availability of WEPs. Similarly, the use of firewood for cooking and heating their homes has decreased dramatically due to electricity. Recently, this *Gewog* has been connected to electricity, and only a few villagers rely on firewood for cooking and heating their homes. In addition to electricity, some houses utilize Liquid Petroleum Gas (LPG) for cooking. As a result, the villagers have substantially reduced firewood consumption. Therefore, the firewood collection has a minimal impact on the availability of wild edible plants in the area.

Table 2. Priority ranking of threats to wild edible plants used on their degree of destructive effects

Threats	Total score	Rank
Overgrazing	146	1
Habitat destruction	141	2
Unsustainable harvesting	128	3
Forest fire	126	4
Fuel wood collection	105	5
Agriculture land expansion	98	6

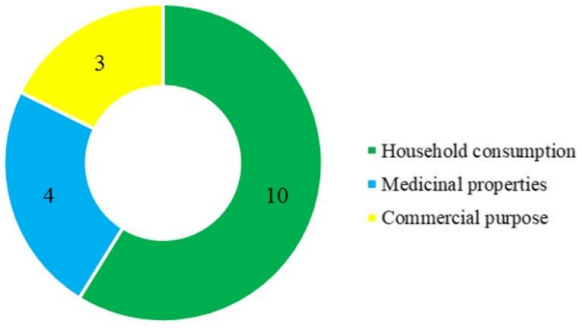

Figure 5. Diversity of use of WEPs

Figure 6. *Gentiana urnula* collected for the consumption

In conclusion, an ethnobotanical study on wild edible plants used by ethnic people was conducted in Merak *Gewog* under Tashigang *Dzongkhag*. Merak is the home of *Brokpa* and relies primarily on animal products and wild edible plants for nourishment. The current study has recorded 16 wild edible plant species belonging to 16 genera and 16 families, indicating remarkable floral diversity. These plants are utilized for different purposes. Most WEPs are used for household consumption, while others are used for medical purposes, and some are sold in the market to generate income. Different parts of the WEPs are consumed, such as leaves, flowers, shoots, roots, rhizomes, and whole plants. This result indicates that the people of Merak have plentiful traditional knowledge of using wild edible plants with diversified eating parts and purposes. These WEPs have played a significant role in *Brokpas'* existence, depicting the strong relationship between the indigenous people and nature. However, many of the wild edible plants in the study area are under growing pressure due to anthropogenic and socioeconomic factors such as overgrazing by cattle, habitat destruction, unsustainable harvesting, and forest fire. This has resulted in the degradation of WEP species and the underlying indigenous knowledge. Therefore, the local regulatory system should be developed with the participation of the local people, considering their social practices and norms. Such a system might establish community-based harvesting sites and provide sustainable harvesting advice to the community to achieve food security in the future.

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Ethnobotanical relevance and conservation of medicinal plants used to treat human diseases in Ifedore, Ondo-State, Nigeria

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Abstract. *Olanipekun MK. 2023. Ethnobotanical relevance and conservation of medicinal plants used to treat human diseases in Ifedore, Ondo-State, Nigeria. Asian J Ethnobiol 6: 7-19.* An ethnobotanical study of medicinal plants used by the local people in Ifedore Local Government Area, Nigeria, was conducted to document indigenous knowledge of the importance of medicinal plants. Eighty-four respondents were selected randomly from four villages, and 20 key informants were selected with the help of local administrators, elders, and other community members. Semi-structured interviews, group discussions, and field observation were used for data collection. Descriptive statistics were used for ethnobotanical data analysis. In this study, 98 medicinal plant species belonging to 47 families were collected, identified, and documented. Asteraceae and Solanaceae were the highest families. Most plants were collected from the wild, and herbs were the most growth form. Leaf (63.2%) was the most frequently utilized part. The majority of the identified plants were herbs (55 species, 56%); followed by trees (36 species; 36.7%); climbers (4 species, 4%), and shrubs (3 species, 3%), respectively. The plants were not cultivated (70.4%). The most popular modes of preparation and route of administration were decoction and oral route, respectively. The medicinal plants were reportedly used mostly for treating respiratory tract infections 41 (41.8%). The local people believed that heart disease, liver disease, and urinary tract incontinence had no effective modern medication like herbal mixtures. *Ocimum basilicum* L. was highly effective in treating diarrhea. Agricultural expansion and building purposes, amongst others, were the most common factors for diminishing the number of medicinal plants. Training and supporting traditional healers with incentives increase their interest in conserving medicinal plants.

Keywords: Conservation, cultivated, ethnobotany, indigenous knowledge, medicinal plant

INTRODUCTION

Medicinal plants are considered rich resources of ingredients that can be used in drug development and synthesis. Medicinal plants have been used in virtually all cultures as a source of medicine since times immemorial Togola et al. (2005), Etongo et al. (2017), Arowosegbe et al. (2018) and Olanipekun et al. (2020). Plants have been used traditionally as a source of medicine to control various ailments afflicting humans. In addition, traditional medicine has been used as an alternative medicine for thousands of years with great contributions made by practitioners to human health, particularly as primary health care providers at the community level, and has maintained its popularity worldwide. It was reported by Park et al. (2012) that about 60-85% of the population in every country of the developing world has to rely on traditional medicine. Unfortunately, despite the undoubted success of herbal treatment in the study area, the medicinal plants, knowledge, and experience of the traditional health practitioners have not been validated and well documented in the literatures.

The practice of traditional medicine is widespread in China, India, Japan, Pakistan, Sri Lanka, Thailand, and Korea. For example, in China, traditional medicine accounts for around 40% of all health care delivered and is used to treat roughly 200 million patients annually (WHO 1999). In many parts of Africa, herbal medicine still plays a vital role in their inhabitants' health care, especially in remote places where clinics and hospitals are sparsely located (Etongo et al. 2017; Olanipekun et al. 2020). For example, plants have been used as a source of medicine from time immemorial to treat different ailments due to their long history of remarkable results in Ethiopia, and traditional medicine has become an integral part of the culture (Regassa et al. 2017). These traditional medical practices and remedies are recorded in oral tradition, early medico-religious manuscripts, and traditional pharmacopeias, which, according to some historians' estimates, date back to the 15th century AD (WHO 2001).

In rural areas, traditional health practitioners operate closer to the people, taking advantage of plant species' biodiversity to cure different types of diseases and ailments (Togola et al. 2005). Herbal medicine is well-established in many cultures and traditions in the study area. Unfortunately, information on herbal medicine in many rural communities of the world has been dominated by oral tradition rather than documentation of the traditional information for sustainability (Gouwakinnou et al. 2018). Considering the current rate of deforestation with the concurrent loss of biodiversity, there is an urgent need for accurate documentation of the knowledge and experience of traditional herbalists. It is necessary to make an effort to avoid erosion of this knowledge in the study area by conserving information on useful plants. This paper reported information gathered from traditional healers,

herbalists, and rural dwellers on plants used to treat human diseases.

MATERIALS AND METHODS

Ethical considerations

A supportive and introductory letter was obtained from the Department of Plant Science and Biotechnology, Ekiti State University, Nigeria, and submitted to leaders of the communities. The leaders discussed, agreed, and wrote a permission letter. The local communities were approached honestly, openly, and informed about the research objectives. They were told that the results were used for academic purposes and that no commercialization was involved.

Study site and informant selection

The study was conducted in four villages in Ifedore Local Government Area, Ondo-State, using an ethnobotanical survey study design. The villages are Ilara-Mokin, Ero-Ibuji, Ibule, and Ijare. We selected 100 respondents, who were traditional practitioners, experts of plant science, and elders who were custodians of the information related to the distribution of available plants in the study area, consisting of 48 males and 52 females, randomly selected from the different villages in the study area. Also, 20 key or secondary informants who were expected to supply particularly relevant and detailed information were selected purposively with the help of local administrators, elders, and other community members, considering that these people had the potential to provide insight and understanding about traditional medicinal plants in the area.

Ethnobotanical data collection

Ethnobotanical data were collected from March 2020 to June 2021. The techniques employed for the data collection were semi-structured interviews and field observations (Alexiades 1996). In addition, medicinal plant species identification, collection**,** and processing were made based on ethnobotanical information provided by the informants using basic botanical collecting tools (Vogl et al. 2004).

Voucher specimen collection

The samples of the identified plants were collected and pressed to prepare the voucher specimens. First, however, preliminary identification was conducted in the field. Also, identifying unidentified specimens was done by comparison with authentic specimens in the herbarium, illustrations and taxonomic keys in Books of 'Flora of Nigeria and with the assistance of the curator from the Herbarium unit of the Department of Plant Science and Biotechnology, Ekiti State University, Ado-Ekiti, Nigeria. The plant specimens were collected, numbered, pressed, and dried using a plant press tool.

Ethnobotanical data analysis

Software Package for the Social Science (SPSS 2010) version 20 was used to analyze the ethnobotanical data. Descriptive statistics methods, namely percentage and frequency, were employed to summarize the data on medicinal plants used and the associated knowledge. Information on the knowledge of medicinal plants and the socioeconomic status of the respondents were determined. Direct matrix ranking was done for seven plants on the plant species' multipurpose use categories according to the informants' information (Ayyanar and Ignacimuthu 2011). The fidelity level specifies the informants claiming to use certain plant species for the same major purpose, which was calculated for the most frequently reported diseases or ailments using this formula: FL = Np/N x100. Where Np is the number of informants that claim to use a plant species to treat a particular disease, and N is the number of informants that use the plant as a medicine to treat any given disease.

Intellectual property agreement statement

Before the interviews, a two-time visit was made to the study area where the Kings, the traditional rulers, and elders were duly informed about the objectives of the research work with a verbal agreement that the information gathered during the research shall be protected and that the research shall not be used for commercial purposes. Furthermore, the research was also used to train and enlighten the students on using medicinal plants to treat various diseases to conserve our heritage; thus, the interview was granted.

RESULTS AND DISCUSSION

Relationship between medicinal plant knowledge and age, gender, and level of education

The females had more knowledge and responded better than the male respondents during the survey (Table 1). This could be because women are closer to the family members' welfare than men. Schunko et al. (2016) also reported a similar result that in Grosses Walsertal, Vorarlberg, the western province of Austria, women knew more medicinal plants because they were in charge of food and medicine. Furthermore, in rural communities near Chapada Diamantina National Park in Bahia, Brasil, women also knew more medicinal plants than men (Voeks 2007).

Table 1. Medicinal plants knowledge among the respondents in the study area

Variables		Number of respondents	% number of respondents
Gender:	Male	48	48
	Female	52	52
Age:	15-24	8	8
	25-35	22	22
	36-50	32	32
	50-90	38	38
Educational status:	Can not read and write	49	49
	Able to read and write	21	21
	Primary school	15	15
	Secondary school	8	8
	College and above	7	7

In Rejang Tribe, in Bengkulu, Indonesia, women significantly new plant names and uses than men (Wiryono et al. 2019a). However, some studies reported the opposite result, i.e., men knew more botanical knowledge than women. For example, in Zegie Peninsula, Northwestern Ethiopia, males had more medicinal plants than females because, in this community, the father passed the traditional knowledge to his first son (Teklehaymanot and Giday 2007). Similarly, De Melo et al. (2011) also reported that in the community of Fulni-ô in north-eastern Brazil, males knew more medicinal plants than females. In Semende Tribe, in Bengkulu, Indonesia, males had more botanical knowledge than females because males spent more time in the garden (Wiryono et al. 2019b).

The old people among the respondents in this study also had more knowledge than young ones because they have accumulated more experiences and knowledge with natural resources over time than younger respondents. Thus, the younger generation (22%) had lower knowledge of medicinal plants than the middle age (32%) and elders (38%) respondents, respectively. Young people's lack of traditional knowledge could be strongly influenced by several factors, such as age, civilization, disbelief, and lack of interest (Yineger and Yewhalaw 2007; Ayantunde et al. 2016). The decline of local botanical knowledge among young generations has been reported from the studies in rural communities in Mato Grosso, Brazil (Miguéis et al. 2019), in Garifuna, Nicaragua (Coe and Anderson 1996), in Western Himalaya (Uniyal et al. 2006), and Indonesia (Wiryono et al. 2017; Wiryono et al. 2019b). However, this result was in contrast with the results provided by Yineger and Yewhalaw (2007), which showed no correlation between medicinal plant knowledge and the age of respondents.

Oral transmission of medicinal plant knowledge to both the elderly and the younger people is the most common way of transferring indigenous knowledge in the study area, though the system is not sustainable. Indigenous knowledge transfer through oral transmission could be eroded through generation unless it is written and documented. During this study, some informants said emphatically that "we used to know many medicinal plant recipes for various ailments before, but now we have forgotten most of them." This might be a sign of losing indigenous knowledge of the use of medicinal plants.

The plants used as medicine

In this study, ninety-eight plant species belonging to forty-eight families were used by the respondents in managing various human health problems in the study area. The identified plants' family names, common and local names, were documented. The family Asteraceae had the largest numbers of species, namely, *Acanthospermum hispidum*, *Ageratum conyzoides*, *Aspilia africana*, *Bidens pilosa*, *Chromolaena odorata*, *Helianthus annuus*, *Melanthera scandens*, *Tithonia diversifolia*, *Vernonia amygdalina* followed by the families Euphorbiaceae and Solanaceae, while several other families were represented by just one or few numbers of species each (Tables 2 and 3).

Table 2. List of plants used in managing various diseases in the study area

Botanical name (Auth.)	Family name	Local name	Common name
Abrus precatorius L.	Fabaceae	Oju ologbo	Crab's eye
Adansonia digitata L.	Bombaceae	Igi ose	African baobab
Acanthus montanus (Nees) T.Anderson	Acanthaceae	Ahon-ekun	White ginger/false thistle
Acanthospermum hispidum DC.	Asteraceae	Dagunro-gogoro	Bristle starbur
Aframomum melegueta (Roscoe)	Zingiberaceae	Atare	Grains of paradise
Ageratum conyzoides (Delile)	Asteraceae	Imi-Eshu	White Weed
Albizia adianthifolia (Schumach.) W.Wight	Fabaceae	Abo	Albizia
Alchornea laxiflora (Benth.) Pax & K.Hoffm.	Leguminoceae	Ube	Counting sticks
Aloe arborescens (Mill)	Asphodelaceae	Alon erin	Torch aloe
Aloe barteri Baker	Liliaceae	Ida egun	Aloe
Aloe vera (L)	Liliaceae	Eti erin	Aloe
Allium cepa L.	Liliaceae	Alubasa	Onion
Allium sativum L.	Liliaceae	Garlic	Ayuu
Alstonia boonei (De.Wild.)	Apocynaceae	Ahun	Stool wood
Amaranthus spinosus (L)	Amaranthaceae	Tete elegun	Spiny amaranth
Anacardium occidentale (L.)	Anacardiaceae	Kasu	Cashew
Ananas comosus (L.)	Bromeliaecea	Ope oyinbo	Pineapples
Aristolochia indica L.	Aristolochiaceae	Ako-igun	Flower
Aspilia africana (Pers.) C.D.Adams	Asteraceae	Yunriyun	Heamorrhage plant
Asystasia gangetica L.	Acanthaceae	Lobiri	Chinese violet
Azadirachta indica (A.Juss)	Meliaceae	Dongoyaro	Neem Tree
Bambusa vulgaris (Schrad)	Poaceae	Opaarun	Bamboo
Barleria buxifolia L.	Acanthaceae		
Bidens pilosa L.	Asteraceae	Abere oloko	Blackjack
Boerhavia diffusa L.	Nyctaginaceae	Etupa elila	Hogweed
Bridelia ferruginea Benth.	Phyllanthaceae	Ira	
Calotropis procera(Aiton)	Apocynaceae	Bomubomu	Sodom apple
Capsicum annuum (L.)	Solanaceae	Ata wewe	Pepper

Carica papaya (L.)	Caricaceae	Ibepe	Pawpaw
Cassia fistula (DC.)	Fabaceae	Kasia	Golden Shower
Celosia argentea L.	Amaranthaceae	Celosia	Celosia
Chasmanthera dependens (PROTA)	Menispermaceae	Atoo	Chasmanthera
Chromolaena odorata (L.) R.M.King	Asteraceae	Akintola	Siam weed
Citrus aurantifolia (Christin)	Rutaceae	Osan Wewe	Lime
Citrus aurantium (L.)	Rutaceae	Osan Gaingain	Sour Orange
Citrus sinensis (L.)	Rutaceae	Osan	Orange
Cocos nucifera (L)	Euphorbiaceae	Agbon	Coconut palm
Coccinia grandis (L.) Voigt	Cucurbitaceae	Gwanduwa	Little gourd
Combretum periculatum Vent.	Combretaceae	Ogan	fire vine
Crinum jagus (J. Thomps) Dandy	Amaryllidaceae	Ogede omimi	Crinum
Curcuma longa (L.)	Zingiberaceae	Ajo	Turmeric
Cymbopogon citratus L.	Poaceae	Ewe tea	Lemon grass
Datura metel L.	Solanaceae	Apikan	Devil's trumpet
Elaies guineensis (L)	Arecaceae	Ope	Oil palm
Euphorbia hirta L.	Euphorbiaceae	Emi-ile	Asthma weed
Euphorbia heterophylla L.	Euphorbiaceae	Ifobia	Mexican fire plant
Ficus exasperate (Vahl.)	Moraceae	Eepin	Sand paper
Flueggea virosa (Roxb. Ex Willd)	Euphorbiaceae	Eyin eye	White-berry bush
Garcinia kola L.	Clusiaceae	Orogbo	Bitter kola
Glyphaea brevis (Spreng)	Tiliaceae	Atori	Masquerade stick
Gossypium hirsutum (L.)	Malvaceae	Igi-Owu	Cotton Wood
Helianthus annuus (L.)	Asteraceae	Fufulele	Sunflower
Heliotropium indica (L.)	Boraginaceae	Apari igun	Helitropium
Jatropha curcas L.	Euphorbiaceae	Lapalapa pupa	
Jatropha gossypiifolia (L)	Euphorbiaceae	Lapalapa funfun	
Jatropha multifida (L.)	Euphorbiaceae	Ogege	Coral plant
Mangifera indica L.	Anacardiaceae	Mangoro	Mango
Melanthera scandens (Schum. and Thonn)	Asteraceae	Agbugbo	Black-stamened-one
Momordica charantia L.	Curcubitaceae	Ejinrin were	Bitter gourd
Morinda lucida (Benth)	Rubiaceae	Ohio, Oruwo	Brimstone
Moringa oleifera (Lam.)	Moringaceae	Ewe igbale	Moringa
Mucuna sloanei (Fawc.)	Fabaceae	Yerepe	Horseeye bean
Newbouldia laevis (P. beauv)	Bignoniaceae	Akoko	African tulip
Nicotiana tabacum (L)	Solanaceae	Taba	Tobacco
Ocimum gratissimum (Forssk.)	Labiatea	Efinrin	Scent Leaf
Parkia biglobosa (Benth)	Fabaceae	IgiIru	African Locust Beans
Parquetina nigrescens (Wennberg) Bullock	Apocynaceae	Ogbo	Africa parquetina
Pergularia daemia (Forssk.) Chiov.	Ascepiadaceae	Atufa	Pergularia
Phyllanthus amarus (Schum. and Thonn.)	Phyllanthaceae	Ehinolubisowo	Black catnip
Phyllanthus muellerianus (Kuntze)	Phyllanthaceae	Egun-eja	Myrobalan
Phyllanthus nummulariifolius Schumach. &Thonn.	Phyllanthaceae	Iranje	Leaf-flower
Piper guineense (L.)	Pipereceae	Iyere	African black pepper
Psidium guajava (L.)	Myrtaceae	Gurofa	Guava
Pycanathus angolensis (SIDA)	Myristiaceae	Akomu	African Nutmeg
Raphia farinifera Hyl.(Gaertn.)	Palmae	Oguro	Palm
Saccharum officinarum L.	Gramineae	Ireke	Sugarcane
Senna alata (L.) Roxb.	Fabaceae	Asunwon oyinbo	Ringworm bush
Sida acuta (Burn)	Malvaceae	Iseketu	Common wireweed
Solanum americanum (Mill.)	Solanaceae	Odu	Small-flower night shade
Solanum nigrum (L.)	Solanaceae	Efo-odu	Black-night shade
Sorghum bicolor (L.) Moench	Poaceae	Poroporo oka	Millet
Spondias mombin L.	Anacardiaceae	Okinkan	Hog mombin
Syzygium aromaticum L.	Myrtaceae	Kanafuru	Clove-tree
Telfaria occidentalis (Hook. F)	Cucurbitaceae	Agboroko	Fluted pumpkin
Tithonia diversifolia Hemsl.	Asteraceae	Tree marigold	Jogbo-agbale
Trema orientalis (L.)	Ulmaceae	Afefe	charcoal tree
Tribulus terrestris L.	Zygophyllaceae	A small herb	Cat-head or devils weed.
Tridax procumbens (L)	Compositae	Sabaruma	Tridax
Triumfetta rhomboidea Jacq.	Tiliaceae	Ito igbin	Burweed
Vernonia amygdalina (Delile)	Asteraceae	Ewuro	Bitter Leaf
Vitellaria paradoxa C.F.Gaertn.	Sapotaceae	Ori	Shea Butter
Vitex agnus-castus (L)	Lamiaceae	Efo oriri	Chase tree
Vitis vinifera (L)	Vitaceae	Girepu	Grape vine
Xylopia aethiopica (Dunal) A. Rich	Annonaceae	Arunje	Ethiopian pepper
Xylopia quintasii (Engl and Diels)	Annonaceae	Eru awonka	Negro pepper
Zea mays (L)	Poaceae	Agbado	Corn
Zingiber officinale (Roscoe)	Zingiberaceae	Atale	Ginger
Ziziphus mauritiana Lam.	Rhamnaceae	Ekanesi-adie	Chinese-apple

Table 3. Frequency of occurrence of plant species within their families in the study area

Family name	Frequency	Percent	Plant species
Acanthaceae	3	3.1	*Acanthus montanus, Asystasia gangetica, Barleria buxifolia*
Amarantheceae	2	2.0	*Amaranthus spinosus, Celosia argentea*
Amaryllidaceae	1	1	*Combretum periculatum*
Anacadiaceae	3	3.1	*Anacardium occidentale, Mangifera indica, Spondias mombin*
Annonaceae	2	2.0	*Xylopia aethiopica, Xylopia quintasii*
Apocynaceae	3	3.1	*Alstonia boonei, Calotropis procera, Parquetina nigrescens*
Arecaceae	1	1	*Elaies guineensis*
Aristolochiaceae	1	1	*Aristolochia indica*
Ascepiadaceae	1	1	*Pergularia daemia*
Asteraceae	9	9.2	*Acanthospermum hispidum, Ageratum conyzoides, Aspilia africana, Bidens pilosa, Chromolaena odorata, Helianthus annuus, Melanthera scandens, Tithonia diversifolia, Vernonia amygdalina*
Bignoniaceae	1	1	*Newbouldia laevis*
Boraginaceae	1	1	*Heliotropium indica*
Bombaceae	1	1	*Adansonia digitata*
Bromeliaecea	1	1	*Ananas comosus*
Caricaceae	1	1	*Carica papaya*
Clusiaceae	1	1	*Garcinia kola,*
Combretaceae	1	1	*Combretum periculatum,*
Compositae	1	1	*Tridax procumbens*
Cucurbitaceae	1	1	*Coccinia grandis, Momordica charantia, Telfaria occidentalis*
Euphorbiaceae	7	7.1	*Cocos nucifera, Euphorbia hirta, Euphorbia heterophylla, Flueggea virosa, Jatropha curcas, Jatropha gossypiifolia, Jatropha multifida*
Fabaceae	6	6.1	*Abrus precatorius, Albizia adantifolia, Cassia fistula, Mucuna sloanei, Parkia biglobosa, Senna alata*
Gramineae	1	1	*Saccharum officinarum*
Lamiaceae	2	2	*Ocimum gratissimum, Vitex agnus-*
Leguminoceae	1	1	*Alchornea laxiflora*
Liliaceae	2	2	*Allium cepa, Allium sativum*
Malvaceae	2	2	*Gossypium hirsutum, Sida acuta*
Meliaceae	1	1	*Azadirachta indica,*
Menispermae	1	1	*Chasmanthera dependens*
Moraceae	1	1	*Ficus exasperate*
Moringaceae	1	1	*Moringa oleifera*
Myrtaceae	2	2	*Psidium guajava, Syzygium aromaticum*
Myristiaceae	1	1	*Pycanathus angolensis*
Nyctaginaceae	1	1	*Boerhavia diffusa*
Palmae	1	1	*Raphia farinifera*
Phyllanthaceae	4	4	*Bridelia ferruginea, Phyllanthus amarus, Phyllanthus muellerianus, Phyllanthus nummulariifolius*
Piperecea	1	1	*Piper guineense*
Poaceae	4	4	*Bambusa vulgaris, Cymbopogon citratus, Sorghum bicolor, Zea mays,*
Rhamnaceae	1	1	*Ziziphus mauritiana*
Rubiaceae	1	1	*Morinda lucida*
Rutaceae	3	3	*Citrus aurantifolia, Citrus aurantium, Citrus sinensis,*
Sapotaceae	1	1	*Vitellaria paradoxa*
Solanaceae	5	5	*Capsicum annuum, Datura metel, Nicotiana tabacum, Solanum americanum, Solanum nigrum*
Tiliaceae	2	2	*Glyphaea brevis, Triumfetta rhomboidea*
Ulmaceae	1	1	*Trema orientalis*
Vitaceae	1	1	*Vitis vinifera*
Xanthorrhoeaceae	3	3	*Aloe barteri, Aloe vera, Aloe aborescens*
Zingeberaceae	3	3	*Aframomum melegueta, Curcuma longa, Zingiber officinale*

Diversity of growth forms and habitat of medicinal plants in the study area

Most of the identified plants were herbs in nature (55 species, 56%), followed by trees (36 species; 36.7%), climbers (4 species, 4%), and shrubs (3 specie, 3%) respectively (Figure 2). The use of herbs as the most mentioned plants might be because herbs are more effective and relatively more available than other plant growth forms in the study area (Lulekal et al. 2008; Megersa et al. 2013).

Plant parts used to treat various diseases

People in the study area harvest different plant parts (i.e., leaf, seed, seed, bark, latex, and fruit) to prepare herbal remedies (Figure 1). Leaf was the most harvested plant part, with 63 species (63.2%), followed by fruit, 13 species (12.2%), stem bark, 10 species (10%), seed, 6 species (6%), root, 2 species (2.4%), and latex, 4 species (4.3%), respectively (Figure 3, Table 4). Obviously, some tendencies contain more concentration of both micro and macronutrients of bioactive ingredients than the other

plants. In addition, many metabolic and photosynthetic activities usually occur on the leaves (Eddouks et al. 2002; El-Hilaly et al. 2003; Gidey et al. 2011; Olanipekun et al. 2020). However, the use of the leaf as the major plant part for the medicinal purpose than other plants parts is contrary to the findings of Hunde et al. (2006), in which the root (31.4%) was reported as the most widely used plant part followed by leaf (24.4%). Also, the study by Yineger and Yewhalaw (2007) showed that root constituted the major plant part (42%) used. Furthermore, Teklehaymanot and Giday (2007) also documented root as a major plant part (35.8%) used in treating human ailments.

The method of preparation of the plants and ways of administration

The methods of preparing the identified plants locally vary from herbalists to herb sellers, indigenous people, and others, and this could be generally classified into various categories, namely decoction, infusions, squeezing, cutting, pounding, and grinding (Figure 4, Table 4). The parts of plants used for the preparation were either fresh or dried materials, though the fresh materials were reportedly more effective and preferred to the dry specimens. This could be because the bioactive ingredients in dry specimens have been reduced or volatilized due to exposure to the sun and air during drying (Regassa et al. 2017). Usually, two, three, or more species of plants were combined and used in more than one preparation method. This result confirms the synergistic effects of the plant preparation when combined (Mukazayire et al. 2008; Atul and Ray 2014; Khuankaew et al. 2014). The number of species used for herbal preparation by decoction and infusion, respectively, was 10 (23%) each. Other preparation methods were grinding (4 species, 9.3%) and concoction, squeezing, squeezing/decoction (3 species, 6.9% each). Other less frequently used methods were cutting, pounding, crushing, pounding/squeezing, crushing/ pounding, squeezing/infusion, i.e., one species (2.3%) each (Figure 3). Respiratory tract infections, various skin diseases and conditions such as pains and inflammations, respectively, were the most commonly treated diseases and conditions by traditional medicine, as reported by the informants. Oral administration was the most frequently used herbal healing method (Table 4). Oral administration easily targets disease organisms to ensure a quick recovery and prevent disease attack (Mukazayire et al. 2008; Khuankaew et al. 2014; Woldeab et al. 2018).

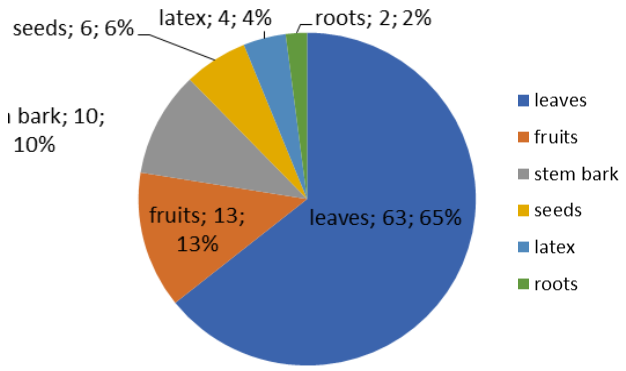

Figure 1. The plant parts of the identified plants

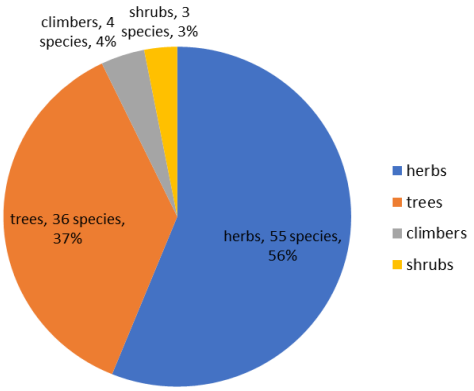

Figure 2. The plant forms of the identified plants

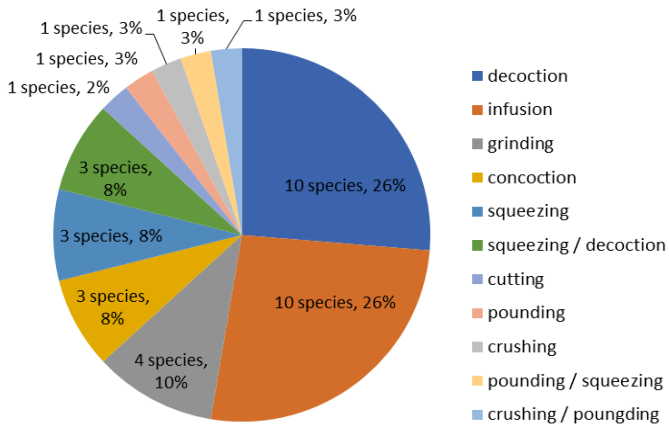

Figure 3. The methods of preparation of the identified plants

Table 4. List of the methods of preparation and mode of administration of the plants used in the management of various diseases in the study area

Species name	Plant form	Part used	Disease treated	Mode of preparation	Route of administration
Abrus precatorius	Climber	Leaf	Malaria	Decoction	Oral
Adansonia digitata	Tree	Leaf, stem bark	Malaria	Decoction	Oral
Acanthus montanus	Herb	Leaf	Respiratory tract infection	Infusion	Oral
Acanthospermum hispidum	Herb	Leaf	Bacterial and fungal, skin ailments, fever.	Infusion	Oral, dermal application
Aframomum melegueta	Herb	Seed	Respiratory tract infection	Grinding	Oral/inhaling
Ageratum conyzoides	Herb	Leaf	Cramps; Wounds, Skin rashes	Squeezing	Dermal, oral
Albizia adianthifolia	Tree	Leaf/bark	Cramps	Decoction	Oral
Alchornea laxiflora	Herb	Leaf	Pile, eczema, Respiratory tract infection	Grinding	Dermal, oral
Aloe arborescens	Herb	Leaf	Acne, burns	Squeezing	Dermal
Aloe barteri	Herb	Leaf	Burns	Infusion	Dermal
Aloe vera	Herb	Leaf	Acne, burns, acne pimples, eczema, scabies	Infusion	Dermal
Allium cepa	Herb	Leaf	Respiratory tract infection	Cutting	Inhaling
Allium sativum	Herb	Leaf	Respiratory tract infection	Pounding	Eating/inhaling
Alstonia boonei	Tree	Leaf/bark	Malaria, Respiratory tract infection; Dysentery	Decoction	Oral
Amaranthus spinosus	Herb	Leaf	Respiratory tract infection; Boils, eczema	Infusion	Inhaling
Anacardium occidentale	Tree	Leaf/bark	Malaria, respiratory tract infection	Decoction	Oral
Ananas comosus	Herb	Fruit	Respiratory tract infection	Concoction/ crushing	Oral
Aristolochia indica	Climber	Leaf	Cough, inflammation	Squeezing/ Infusion	Oral
Aspilia africana	Herb	Leaf	Wounds, itch, Rheumatic pains	Crushing/ pounding	Dermal
Asystasia gangetica	Herb	Leaf	Respiratory tract infection	Squeezing	Oral
Azadirachta indica	Tree	Leaf/seed	Malaria, Respiratory tract infection; Skin itching, eczema,	Decoction Infusion	Itching, eczema, ringworm
Bambusa vulgaris	Tree	Leaf	Diabetes; Rashes	Decoction/pounding	Oral
Barleria buxifolia	Shrub	Leaf	Diabetes and respiratory diseases, anaemia, toothache and cough.	Concoction	Oral
Bidens pilosa	Herb	Leaf	Diarrhea/inflammation	Squeezing/ Decoction	Oral
Boerhavia diffusa	Herb	Leaf	Skin infection	Squeezing/ Decoction	Dermal
Bridelia ferruginea	Tree	Leaf/bark	Respiratory tract infection/malaria	Decoction	Oral
Calotropis procera	Herb	Leaf	Skin infection/inflammation	Squeezing/ Decoction	Oral/dermal
Capsicum annuum	Herb	Leaf/fruit	Respiratory tract infection/inflammation	Pounding	Oral
Carica papaya	Shrubs	Leaf/seed	Respiratory tract infection, constipation, pain	Pounding/ Squeezing	Oral
Cassia fistula	Tree	Leaf	Respiratory tract infection	Decoction	Oral
Celosia argentea	Herb	Leaf	Diarrhea, wounds and skin eruption, antidote for poison.	Pounding/ Squeezing	Oral/dermal
Chasmanthera dependens	Tree	Leaf	Respiratory tract infection	Pounding/ Squeezing	Oral
Chromolaena odorata	Herb	Leaf	Respiratory tract infection; Wounds, rashes	Decoction	Oral/dermal
Citrus aurantifolia	Tree	Leaf/fruit	Respiratory tract infection	Decoction/ Squeezing	Oral
Citrus aurantium	Tree	Fruit	Measles/inflammation	Decoction/ Squeezing	Dermal/oral
Citrus sinensis	Tree	Fruit	Respiratory tract infection; Ringworm	Decoction/ Squeezing	Oral
Cocos nucifera	Herb	Bark	Rheumatism, Eczema,	Concoction	Oral

Coccinia grandis	Climber	Leaf	Reduce high blood pressure and abscesses.	Infusion	Oral
Combretum paniculatum	Tree	Leaf	Respiratory tract infection; worms, skin spot	Decoction	Oral
Crinum jagus	Herb	Leaf	Respiratory tract infection/inflammation	Infusion	Oral
Curcuma longa	Herb	Leaf/root	Respiratory tract infection/inflammation	Grinding	Oral
Cymbopogon citratus	Herb	Leaf	Respiratory tract infection/inflammation	Infusion	Inhalation/oral
Datura metel	Herb	Leaf	Diabetes	Grinding	Oral
Elaeis guineensis	Tree	Fruit	Respiratory tract infection; skin infection	Decoction	Oral/dermal
Euphorbia hirta	Herb	Leaf	Eczema, wounds	Infusion	Dermal
Euphorbia heterophylla	Herb	Leaf	Skin problems, fungal diseases, and abscesses.	Infusion/ concoction	Dermal
Ficus exasperata	Tree	Leaf	Respiratory tract infection; Boils, ringworm	Pounding/ Decoction	Dermal
Flueggea virosa	Tree	Leaf	Respiratory tract infection	Pounding/ Decoction	Dermal
Garcinia kola	Tree	Seed	Respiratory tract infection	Pounding/ Decoction	Oral
Glyphaea brevis	Tree	Leaf	Cramp	Grinding	Oral
Gossypium hirsutum	Herb	Leave/seed	Respiratory tract infection; Skin rash	Pounding/ Decoction	Oral/dermal
Helianthus annuus	Herb	Leaf	Respiratory tract infection	Infusion	Oral
Helitropium indicum	Herb	Leaf	Respiratory tract infection, pains, Small pox, wounds	Concoction/ Infusion	Oral, dermal
Jatropha curcas	Herb	Leaf/latex	Skin spots/ diarrhea	Squeezing latex	Dermal/oral
Jatropha gossypiifolia	Herb	Leaf/latex	Pile, Respiratory tract infection	concoction	Dermal/oral
Jatropha multifida	Herb	Leaf/latex	Pile, Respiratory tract infection	Squeezing latex	Oral
Mangifera indica	Tree	Fruit/leaf	Malaria, Respiratory tract infection; Bleeding, piles	Decoction	Oral
Melanthera scandens	Herb	Leaf	Skin infection, wounds	Decoction	Dermal
Momordica charantia	Herb	Leaf	Pile, indigestion, Respiratory tract infection; Rashes, sores	Concoction	Dermal/oral
Morinda lucida	Tree	Leaf	Fever, Respiratory tract infection/skin infection	Decoction	Oral/dermal
Moringa oleifera	Tree	Leaf	Respiratory tract infection; Skin infection, pain, insomnia	Concoction	Oral/dermal
Mucuna sloanei	Herb	Leaf	Itching/inflammation	Boiling	Dermal
Newbouldia laevis	Tree	Leaf	Respiratory tract infection	Boiling	Oral
Nicotiana tabacum	Herbs	Leaf	Rheumatic swelling, piles, heart diseases and depression	Infusion	
Ocimum gratissimum	Herb	Leaf	Pile, diarrhea, dysentery, Respiratory tract infection	Concoction	Oral
Parkia biglobosa	Tree	Seed	Fever, Respiratory tract infection	Decoction	Oral
Parquetina nigrescens	Herb	Leaf	Pile, Skin lesions Respiratory tract infection	Infusion	Dermal/oral
Pergularia daemia	Herb	Leaf	Pile/constipation	Concoction	Oral
Phyllanthus amarus	Herb	Leaf	Skin spot, dysentery, wounds	Squeezing	Dermal
Phyllanthus muellerianus	Herb	Leaf	Wound dressing, skin eruption, liver problem	Concoction	Dermal
Phyllanthus nummulariifolius	Herb	Leaf	Respiratory tract infection, diabetes	Concoction	Oral
Piper guineense	Herb	Fruit/seed	Respiratory tract infection/inflammation	Concoction	Oral

Psidium guajava	Tree	Fruit/leaf	Respiratory tract infection	Cooking/ Squeezing	Oral
Pycanathus angolensis	Tree	Leaf/seed	Respiratory tract infection	Cooking/ grinding	Oral
Raphia farinifera	Tree	Leaf	Respiratory tract infection/skin infection	Concoction	Oral
Saccharum officinarum	Herb	Leaf/fruit	Malaria/	Squeezing	Oral
Senna alata	Tree	Leaf	Cramp, Ringworm, scabies, eczema, craw-craw	Boiling	Dermal
Sida acuta	Herb	Leaf	Whitlow, liver, dysentery	Squeezing	Dermal/oral
Solanum americanum	Herb	Leaf	Malaria, stomachache	Squeezing	Oral
Solanum nigrum	Herb	Leaf	Respiratory tract infection	Concoction	Oral
Sorghum bicolor	Herb	Leaf	Diarrhea	Concoction	Oral
Spondias mombin	Tree	Leaf/fruit	Dysentery, malaria	Cooking	Oral
Scyzgium aromaticum	Herb	Clove	Respiratory tract infection/inflammation	Concoction	Oral
Telfairia occidentalis	Herbs	Leaf	Anaemia	Decoction	Oral
Tithonia diversifolia	Herb	Leaf	Malaria/pains	Concoction	Oral
Trema orientalis	Tree	Leaf	Respiratory tract infection	Infusion	Oral
Tribulus terrestris	Herb	Leaf	Urinary tract infection and swelling.	Concoction	Oral
Tridax procumbens	Herb	Leaf	Urinary tract infection and swelling, Skin spots, wound healing.	Concoction	Oral/dermal
Triumfetta rhomboidea	Herbs	Leaf	Urinary tract infection and swelling.	Decoction	Oral
Vernonia amygdalina	Tree	Leaf	Respiratory tract infection, pains, malaria, Ringworm, rashes and eczema, small pox, measles	Concoction	Oral/dermal
Vitellaria paradoxa	Tree	Leaf/bark	Respiratory tract infection	Decoction	Oral
Vitex agnus- castus	Tree	Leaf	Acne, burns, dry skin, eczema/ Depression	Concoction	Dermal
Vitis vinifera	Tree	Leaf	Small pox, inflammation, depression	Concoction/ Squeezing	Dermal/oral
Xylopia aethiopica	Herb	Leaf	Respiratory tract infection	Crushing	Oral
Xylopia quintasii	Herb	Leaf	Urinary tract infection and swelling.	Maceration	Oral
Zea mays	Herb	Fruit	Urinary tract infection and swelling.	Crushing	Oral
Zingiber officinale	Herb	Seed	Respiratory tract infection/ Inflammation	Pounding/ Powdering	Oral
Ziziphus mauritiana	tree	Leaf	Anticancer, antidote, expectorant.	Concoction	Oral

The wild and cultivated plants species identified in the study area

A total of 98 plants species were collected and documented from the study area. The plants were mostly wild and not cultivated (70.4%), while few are cultivated and available (29.6%) in the study area (Table 5). Some cultivated plants were *Aframomum melegueta*, *Aloe arborescens*, *Aloe barteri*, *Aloe vera*, *Allium cepa*, *Allium sativum*, *Aristolochia indica*, *Anacardium occidentale*, *Ananas comosus*, *Capsicum annuum*, *Carica papaya*, and *Citrus aurantifolia*, while others were wild and not cultivated in the study area. These plants were noted for their effectiveness and disease resistance. However, it was difficult to get some of the uncultivated plants; unfortunately, many of them are eroded and yet to be documented in the study area.

The plant species are frequently used for several purposes

Medicinal plants in this study area were not only used for medicinal value but also used for different purposes. The informants frequently used seven plant species in the multipurpose use categories other than medicinal purposes. The plants were used as firewood, furniture, food, charcoal, fencing, etc. *Adansonia digitata* was the most multipurpose plant, followed by *Alstonia boonei* (Table 6).

The local people harvested multipurpose species mostly for furniture, firewood, food, and fencing (Alemayehu et al. 2015). The diversity of the multipurpose plants was highly diversified in the study area. This could be because there was an intense plantation of different trees in the government forest reserve areas in the past ten years. Though, it was reported by Maydeu-Olivares and Bockenholt (2005) and Geng et al. (2016) that the plants

have decreased in number, becoming rare and needing attention before totally lost.

Users of and marketability of the medicinal plants

Most traditional medicinal plant users were community members with lower incomes. Even if there are modern medications, the inhabitants of the study area were not rich enough to afford the purchase of synthetic drugs. Besides, sometimes the native people preferred traditional medicine because they believed that they were affordable, effective, disease to micro-organisms, less toxic, and lasted longer than modern medication. For example, *Ocimum basilicum* was used as a fast curative for diarrhea, while *A. hispidum, A. conyzoides, A. africana, B. pilosa, C. odorata, H. annuus, M. scandens, T. diversifolia, V. amygdalina* were all herbs in the family Asteraceae used effectively for various diseases in the study area (Megersa et al. 2013). Seventy-eight point nine percent (78.9%) of informants reported that traditional medicine or herbal mixtures had no specific market, but they were found as an integral part of the main market of each of the study areas. Medicinal plants were also marketed in a local community for food, and economic purposes as well for medical value based on cultural activity (Fandohan et al. 2010). For example, *Abrus precatorius*, *A. digitata*, and *A. boonei* were economic plants used for building purposes, furniture purposes and local canoe and bridge constructions, respectively. *Parkia biglobosa* serves as a condiment for soup preparation, while, *A. occidentale*, *A. comosus*, *C. papaya*, etc., were used as fruit as well as food.

Informant Consensus Factor (ICF)

The various diseases and the number of plant species used to manage them were documented in the study area (Table 7). This was further grouped into various categories based on the site of occurrence of the disease, condition of the disease, and treatment resemblance of the disease to the local people to determine their informant consensus. The informant consensus factors were calculated for each category where the highest ICF (0.94) value was obtained for diseases related to hypertension and the least one (0.64) was associated with Anaemia and Worms (Table 8).

Table 5. The list of the wild and cultivated plants species identified in the study area

Identified wild plants	**Percentage**
Abrus precatorius, Adansonia digitata, Acanthus montanus, Acanthospermum hispidum, Ageratum conyzoides, Albizia adianthifolia, Alchornea laxiflora, Alstonia boonei, Amaranthus spinosus, Aspilia africana, Azadirachta indica, Bambusa vulgaris, Barleria buxifolia, Bidens pilosa, Boerhavia diffusa, Bridelia ferruginea, Calotropis procera, Cassia fistula, Celosia argentea, Chasmanthera dependens, Chromolaena odorata, Coccinia grandis, Combretum periculatum, Datura metel, Euphorbia hirta, Euphorbia heterophylla, Ficus exasperate, Flueggea virosa, Garcinia kola, Glyphaea brevis, Gossypium hirsutum, Helianthus annuus, Heliotropium indica, Jatropha gossypiifolia, Jatropha multifida, Lactuna virosa., Momordica charantia, Morinda lucida, Moringa oleifera, Newbouldia laevis, Ocimum gratissimum, Parkia biglobosa, Parquetina nigrescens, Pergularia daemia, Peperomia pellucida, Phoenix dactylifera, Phyllanthus muellerianus, Piper guineense, Pycanathus angolensis, Prunus dulcis, Raphia farinifera, Senna alata, Sida acuta, Spondias mombin, Scoparia dulcis, Sparganophorus sparganophora, Tithonia diversifolia, Trema orientalis, Tribulus terrestris, Tridax procumbens, Triumfetta rhomboidea, Tylophora glauca, Vitellaria paradoxa, Vitex agnus-castus, Vitis vinifera, Xylopia aethiopica, Xylopia quintasii, Ziziphus mauritiana	70.4 %
Identified cultivated plant species	
Aframomum melegueta, Aloe arborescens, Aloe barteri, Aloe vera, Allium cepa, Allium sativum, Aristolochia indica., Anacardium occidentale, Ananas comosus, Capsicum annuum, Carica papaya, Citrus aurantifolia, Citrus aurantium, Citrus sinensis, Cocos nucifera, Crinum jagus, Curcuma longa, Cymbopogon citratus, Elaies guineensis, Mangifera indica, Psidium guajava, Saccharum officinarum, Solanum erianthum, Sorghum bicolor, Syzygium aromaticum, Vernonia amygdalina, Zea mays, Zingiber officinale	29.6 %

Table 6. Selected seven medicinal plant species used for several purposes

Plant species	**Use categories**								
	Firewood	**Furniture**	**Food**	**Charcoal**	**Fencing**	**Medicine**	**Forage**	**Total**	**Rank**
Adansonia digitata	5	5	5	5	1	5	3	29	1st
Alstonia boonei	5	3	5	5	1	2	4	25	2nd
Anacardium occidentale	4	2	5	2	4	4	3	24	3rd
Ananas cosmosus	1	1	5	1	1	3	3	15	7th
Bridelia ferruginea	3	3	2	4	2	5	3	22	5th
Spondia mombin	4	2	2	4	4	5	2	23	4th
Vernonia amygdalina	3	2	2	3	4	5	3	18	6th

Threats to medicinal plants and conservation practices in study area

The influences of humans on the natural habitat where plants grow seem to be very high and the effort to conserve medicinal plants in the study area was very little. Thus, there is a need to conserve medicinal plants and associated knowledge (Lulekal et al. 2008; Gouwakinnou et al. 2018). However, it was reported by some participants that they had started cultivating some medicinal plants at home gardens, though the efforts needed to be improved. About 29.6 % of the medicinal plants collected were reportedly found cultivated at home gardens, and these include plants like *A. melegueta, A. arborescens, A. barteri, A. vera, A. cepa, A. sativum, A. indica, A. occidentale, A. comosus, C. annuum, C. papaya, C. aurantifolia, Citrus aurantium, Citrus sinensis, Cocos nucifera, Crinum jagus, Curcuma longa, Cymbopogon citratus, Elaies guineensis Mangifera indica, Psidium guajava, Saccharum officinarum, Solanum erianthum, Sorghum bicolor, Syzygium aromaticum, V. amygdalina*.

This observation supports the report of Okigbo et al. (2008) that the local people conserve some of the wild medicinal plants that were relatively difficult to survive in the study area when cultivated. Also, the result of (Schippmann et al. 2002) indicated that only 5.7% of medicinal plants were cultivated in home gardens, showing the minimal effort of medicinal plant conservation. An increase in conservation efforts could ensure the availability of the plants both for the present and future generations (Ceríaco et al. 2011). Also, agricultural officers reported various efforts to teach the community members about conservation consciousness and systematically planned to conserve plants by establishing an association that keeps the destruction of natural resources under check. Even though some medicinal plants are cultivated, still conservation efforts are gingered towards wild medicinal plants because their accessibility is decreasing yearly and they are in danger of extinction (Lulekal et al. 2008; Eshete et al. 2016). Some of the factors decreasing the accessibility of these medicinal plants were the destruction of their habitats, their conversion to agricultural expansion, various constructions, overgrazing, urbanization, and over-harvesting (Cunningham 1992; Roberson 2008). Therefore, conscious efforts and appropriate actions are needed. The full participation of societies and stakeholders involved in the conservation, production, and management as well as the wise exploitation of medicinal plants are, needed to be improved. Conservation and sustainable use of medicinal plants need the involvement of various sectors and greater public support and public awareness (Schippmann et al. 2002; Megersa et al. 2013).

Table 7. Lists of health problems and number of medicinal plant species used for treatment

Disease treated	No. of plant species used
Respiratory tract infection	41
Skin diseases	19
Inflammation	12
Pains	9
Diarrhea	8
Malaria	8
Depression	6
Eczema	6
Pile	6
Urinary tract infection	6
Diabetes	4
Dysentery	4
Ringworm	4
Worms	4
Bleeding	3
Boil	3
Crams	3
Wounds	3
Acne	2
Anaemia	2
Burns	2
Cough	2
Hypertension	2
Itches	2
Liver problems	2
Measles	2
Poison	2
Rashes	2
Rheumatism	2
Fever	1
Heart disease	1
Insomnia	1
Pimples	1
Scabies	1

Table 8. Informant consensus factor by categories of diseases in the study area

Disease categories	No. of species	Use citation	ICF
Malaria, fever, insomnia, pains	8	54	0.87
Respiratory tract infection, cough, inflammation, urinary tract infection	17	61	0.73
Skin infection, crams, wounds, eczema, acne, burns, pimples, scabies, boil, itches, ringworm, pile	16	48	0.74
Anaemia, worms	11	29	0.64
Poison, measles, heart disease, liver problems, diabetes	13	38	0.73
Rheumatism	2	16	0.93
Hypertension	2	18	0.94
dysentery, diarrhea	12	38	0.70

In conclusion, the communities in the study area traditionally used various types of plants available as medicine for treating human diseases. Surprisingly, traditional medicine was believed to be highly effective when used to treat various diseases in the study area. The largest number of the plants encountered were used to manage respiratory tract infections. Besides their medicinal value, the identified medicinal plants were used for different functions such as food, shelter, construction and condiments in soup making. Elderly informants had more knowledge of medicinal plants than younger ones. Unfortunately, several plants were not found; if special and urgent attention is not given to the conservation of these plants under threat, they will be eroded due to high deforestation activities for various purposes.

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Utilization of medicinal plants by the Lintang Tribe Community in Talang Baru Village, Empat Lawang District, Indonesia

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Abstract. *Mawadha NR, Febryano IG, Tsani MK, Duryat. 2023. Utilization of medicinal plants by the Lintang Tribe Community in Talang Baru Village, Empat Lawang District, Indonesia. Asian J Ethnobiol 6: 20-25.* The use of plants as medicine is still maintained for generations. This study aimed to determine the plant species, parts, and habitus used as medicine by the Lintang Trible, Empat Lawang District, South Sumatra, Indonesia. Data were collected using a qualitative approach through in-depth interviews involving observations and documentation studies. Data analysis was carried out descriptively to determine the use of plants in traditional medicine. The results showed that 57 species of plants belonging to 35 families were used as medicine. The most widely used plant family was Zingiberaceae because they can grow easily and are widely used as cooking spices by the people in Talang Baru Village. The plant parts used were root, stem, fruit, flower, leaf, shoot, rhizome, sap, bark, and fruit skin. The leaf was the most widely used part of the plant because it is easy to obtain, has many properties, and removing several leaves will not damage the plants. The plants used can be found in various habitus, namely herb, vine, fern, palm, shrub, tree, and succulent plants. Herbs were the most used plants for medicine. The government should support the conservation of these medicinal plants by creating special places to cultivate medicinal plants so that they remain sustainable.

Keywords: Local knowledge, medicinal ingredients, medicinal plants, plant properties

INTRODUCTION

Ethnobotany is the study of the use of plants by the community from generation to generation over time to fulfill basic needs, such as clothing, food, shelter, and medicine (Hadijah et al. 2016; Dwi et al. 2019). The contribution and role of ethnobotany in the present and future generations will be very broad and varied, especially in the role of new drug discovery (Hakim 2014). One branch of science to discover new chemical compounds in the manufacture of modern medicines is ethnomedicine (Silalahi 2016). Ethnomedicine is a study of the perceptions and conceptions of local people about health by utilizing medicinal plants (Syarifuddin and Amalia 2021). It includes activities such as finding, selecting and determining, then developing plant materials into a new drug (Diliarosta et al. 2021). Ethnomedicine is a branch of health anthropology that studies the origin of a disease, methods of treatment, and causes of disease based on certain groups of people. In the field of health anthropology, various terms have appeared, such as traditional medicine (Rona and Pramono 2015).

Traditional medicine is a treatment that has been carried out for generations by utilizing medicinal plants (Sari et al. 2021). This treatment is still being used today despite the rapid development of government health service centers (Fitriani and Eriyanti 2020) because it is used as a safe option and has been clinically proven by many medical institutions (Ihsan et al. 2016; Silalahi et al. 2018; Syarifuddin and Amalia 2021). Their continuous use by the community has proved the efficacy of medicinal plants, so it has become a culture of using medicinal plants (Auliani et al. 2014).

Medicinal plants are used in whole or in part as medicinal ingredients (Jafar and Djollong 2018; Siregar et al. 2020; Kastanja and Patty 2022) that have traditionally been used for treatment (Jumiarni and Komalasari 2017). Traditional medicinal substances are still simple, pure, and unprocessed (Hildasari and Hayati 2021). Parts of plants that are commonly used are leaf, root, stem, rhizome, fruit and flower (Musaicho et al. 2021; Adriadi et al. 2022). The community can use these parts to be mixed according to their needs and can be used as medicine in traditional medicine (Hardianti 2021). Medicinal plants are now a concern because many community groups have begun to divert the use of modern medicines to herbal medicines (back to nature) due to concerns about the side effects of the modern medicines (Supriyanto et al. 2014; Sembiring et al. 2015; Mirza et al. 2017; Mayangsari et al. 2019).

Each ethnic group has its knowledge and way of using plants as medicinal ingredients. Each ethnic group in Indonesia, such as Village Dayak tribes in Pakak Village, Sintang District, utilize 25 species of medicinal plants (Supiandi et al. 2019), Dayak Kanayant tribes in Mamek

Village, Landak District, 40 species (Riadi et al. 2019), Dayak Iban Villages Tekalong and Bejabang Kapuas Hulu District, 21 species (Yusro et al. 2019), and the Malays in Durian Sebatang Village, Kayong Utara District 93 species (Wulandara et al. 2018). One community group that still maintains medicinal plants is the Lintang Tribe.

The Lintang tribe is a community group that is still practicing traditional customs and is rich in local knowledge. This local knowledge appears as a culture of using plants as medicine (Nurrani et al. 2015; Andika et al. 2020). Knowledge of medicinal plants is currently declining due to cultural changes caused by modernization and the lack of written documentation (Napagoda et al. 2018). This knowledge is considered no longer valid and the younger generation is less interested in learning local knowledge by utilizing plants. There is a concern that this heritage will gradually become extinct. Documentation of this knowledge is very helpful in preserving the diversity of plants utilized by the community (Kandari et al. 2012; Setiawan and Qiptiyah 2014). This study aimed to determine the plant species, parts, and habitus used as medicines by the Lintang Trible in Empat Lawang District, South Sumatra, Indonesia.

MATERIALS AND METHODS

The data collection for this research was conducted in September-October 2022 in Talang Baru Village, Muara Pinang Sub-district, Empat Lawang District, South Sumatra Province, Indonesia. Talang Baru Village is an old village formerly known as Tanjung Lenting, which is administratively bordered on the west by Muara Pinang Baru Village and on the east by Sapapanjang Village. This village is located in a series of Barisan Hills, with altitudes ranging from 300 m to 2500 m. The climate is a tropical rainforest with high rainfall throughout the year, with an average of 2700-3000 mm. The temperature in this area ranges from 18°C to 30°C. The fertile area makes various plants planted by the community grow well.

This research used a qualitative approach with a case study method. Data were collected through in-depth interviews and observation. Eleven key informants were determined purposely, i.e., traditional healers or *battra* (5 people), patients (5 people), and community leaders (1 person). *Battra* is a native of the Lintang Tribe who can treat diseases using plants and is trusted by the local community to carry out the treatment. The collected data were processed without a mixture of researchers' thoughts and analyzed qualitatively, i.e., by making data transcripts, coding, data categorization, provisional inferences, final triangulation, and inferences to find out the species, parts, and habitus of medicinal plants used by the community of Lintang Tribe.

RESULTS AND DISCUSSION

The Lintang Trible in Talang Baru Village, who own land close to village settlements, tend to develop their gardens using an agroforestry system. Agroforestry is a land management system aimed at solving food problems, combining agricultural crops and plantation crops (trees) (Salampessy et al. 2015; Rajagukguk et al. 2018). In line with the research of Afifah et al. (2021) agroforestry is a type of land use by mixing woody plants (forestry) with plantations, agriculture or plantations.

The garden with an agroforestry system in this village is called "umo." The community use umo as the main source of income to fulfill their daily needs. The informants mentioned that many plants were used as medicine in the village garden or forest far from home. Gardens with an agroforestry system can make a major contribution to people's lives in direct income but with small capital. (Rajagukguk et al. 2018; Wanderi et al. 2019). Agroforestry optimizes land productivity with various species in one land management system (Puspasari et al. 2018).

The composition of plant species in the agroforestry garden in this village consisted of tree and non-tree species, producing vegetables, fruits, tubers, and seeds. The trees often found on agroforestry land in community gardens were *bambang lanang* (*Michelia campaca*), merambung (*Vernonia arborea*), *sengon* (*Albizia chinenshis*), *jati* (*Tectona grandis*), *durian* (*Durio zibethinus*), *jengkol* (*Pithecellobium lobatum*), *petai* (*Parkia speciosa*), macang (*Mangifera foetida*), *sokon* (*Artocarpus communis*), and *mileng* (*Aleurites moluccanus*). The species of non-tree plants often found on agroforestry land include banana (*Musa acuminata*), areca nut (*Arenga pinatta*), coconut (*Cocos nucifera*), robusta coffee (*Coffea canephora*), cocoa (*Theobroma cacao*), areca (*Areca catechu*), and papaya (*Carica papaya*).

The plants used for medicine by the Lintang Tribe community in Talang Baru Village consisted of 57 plant species from 35 families (Table 1). Land management for the Lintang Trible increases income not only through trees but also other plants, such as medicinal plants. Management with this system is considered more profitable because the community can harvest medicinal plant commodities simultaneously with trees as canopy. Plants with high crowns can be protective for lower plants (Febryano et al. 2017). Some research results show that plants grown in the shade of trees provide several advantages for farmers compared to plants grown under the full sun (Febryano 2008). This plantation pattern produces diverse and sustainable yields (Larassati et al. 2019), increasing crop productivity and reducing the risk of crop failure (Dewi et al. 2017).

Plants used by the community are divided into two: cultivated and wild. There were 55 species of cultivated plants, utilized by the community both for personal consumption and for sale. There were two wild species, namely *Ageratum conyzoides* (Dutch grass) and *Stenochlaena palustris* (brother fern). The high species diversity of medicinal plants in this village is due to the high soil fertility. The habit of the local people who still use plants as medicine in traditional medicine for generations also has an impact on the presence of plants in this village. The composition of plant families used by the community is given in Figure 1.

Table 1. Species of medicinal plants used by the community

Plant family	Latin name	Local name
Zingiberaceae	*Kaempferia galanga*	Kencur
Zingiberaceae	*Zingiber montanum*	Mengelai
Acoraceae	*Acorus calamus*	Jegangau
Blechnaceae	*Stenochlaena palustris*	Paku abang
Amaranthaceae	*Celosia cristata*	Bungo abang
Balsaminaceae	*Impatiens balsamina*	Pacar ayek
Moraceae	*Artocarpus communis*	Sokon
Caricaceae	*Carica papaya*	Gedang
Zingiberaceae	*Curcuma zedoaria*	Kunyit putih
Zingiberaceae	*Curcuma zanthorrhiza*	Temulawak
Zingiberaceae	*Curcuma aeruginosa*	Temuireng
Acanthaceae	*Strobilanthes crispa*	Pecah beling
Lamiaceae	*Orthosiphon aristatus*	Kumis kucing
Euphorbiaceae	*Aleurites moluccanus*	Mileng
Annonaceae	*Annona muricata*	Serkayo
Moringaceae	*Moringa oleifera*	Kelor
Asphodelaceae	*Aloe vera*	Lidah buaya
Cactaceae	Cactaceae	Lidah badak
Zingiberaceae	*Curcuma longa*	Kunyit
Zingiberaceae	*Zingiber officinale*	Jahe abang
Poaceae	*Cymbopogon nardus*	Serai
Zingiberaceae	*Alpinia galanga*	Kuas
Pandanaceae	*Pandanus amaryllifolius*	Pandan
Basellaceae	*Anredera cordifolia*	Binahong
Menispermaceae	*Cyclea barbata*	Pupuk jadi
Crassulaceae	*Kalanchoe pinnata*	Cocor bebek
Rubiaceae	*Morinda citrifolia*	Mengkudu
Arecaceae	*Cocos nucifera*	Niogh
Arecaceae	*Arenga pinnata*	Belulok
Lauraceae	*Persea americana*	Jambu mentega
Fabaceae	*Indigofera suffruticosa*	Timbok pipet
Anacardiaceae	*Mangifera foetida*	Macang
Rutaceae	*Citrus x aurantiifolia*	Jeruk nipis
Asteraceae	*Ageratum conyzoides*	Rumput belanda
Poaceae	*Oryza sativa*	Padi
Euphorbiaceae	*Claoxylon indicum*	Daun tepu
Fabaceae	*Senna alata*	Ketepeng
Annonaceae	*Annona squamosa*	Benonok
Fabaceae	*Leucaena leucocephala*	Lamtoro
Euphorbiaceae	*Acalypha hispida*	Jamar tali
Myrtaceae	*Psidium guajava*	Jambu biji
Rubiaceae	*Coffea* sp.	Kopi
Araceae	*Colocasia esculenta*	Talas
Magnoliaceae	*Michelia champaca*	Bambang lanang
Malvaceae	*Ceiba pentandra*	Kapok
Zingiberaceae	*Elettaria cardamomum*	Perlako
Asteraceae	*Vernonia amygdalina*	Afrika
Musaceae	*Musa acuminata*	Pisang
Sapotaceae	*Manilkara zapota*	Semilo
Apiaceae	*Apium graveolens*	Gudung sop
Myrtaceae	*Eugenia polyantha*	Salam
Piperaceae	*Piper betle*	Sirih
Euphorbiaceae	*Ricinus communis*	Jarak
Malvaceae	*Gossypium*	Kapas
Oxaldaceae	*Averrhoa bilimbi*	Belimbing besi
Piperaceae	*Piper longum*	Cabe akar
Piperaceae	*Piper nigrum*	Sahang

The most widely used medicinal plants by the community come from the Zingiberaceae family (9 species), because they can grow easily, do not need much care, and has many benefits (Gunawan et al. 2022; Nasution et al. 2020), such as for cooking spice. This family, according to *Battra*, is also used because people consume it to maintain health.

The species of medicinal plants found in this study were more numerous than those used by the same tribe in a different location, i.e., 49 species from 32 families in Rantau Kasai Village, Empat Lawang District (Andika et al. 2020). The difference in the number of types of medicinal plants was due to differences in knowledge and experience of the community in using plants as medicine passed down from generation to generation (Takoy et al. 2013; Sembiring et al. 2015; Royyani and Rahayu 2016). The local knowledge is influenced by the environmental conditions or forests close to where people live Yuana et al. (2016).

Parts of plants used by the community in traditional medicine include root, stem, fruit, flower, leaf, shoot, rhizome, latex, bark, and fruit skin (Figure 2). The most part of the plant was the leaf. Similar research conducted by Andika et al. (2020) in the Lintang Tribe community also found that leaf is the most widely used. Leaves are the most widely used part as medicine because they are easy to obtain, easy to use, not so damaging to plant when some of them are harvested, and easy to process to treat diseases (Arniawati 2018). Other factors influencing the use of medicinal plants by a community are efficacy and social relations (Menendez et al. 2015). The high utilization of this leaf is a good form of community wisdom because using the leaves alone does not disturb the growth of these plants.

The plants used by the community had 46 properties for treating various diseases (Figure 3). Plants are used as medicine by the community because they have different benefits and are considered to have no harmful side effects for users (Mayangsari et al. 2019). Diseases experienced by the community can be caused by changes in the environment (weather), wrong eating and interference from spirits. These diseases, according to *battra*, are relatively mild and usually people do self-medication without their help. The community will ask for *battra*'s assistance if their illness cannot be handled by themselves, such as bladder stones, diabetes, and shortness of breath. People can do the treatment at any time, but people usually do treatment at night because treating at night is considered more effective, and the *battra* has more time at night, free from other work activities.

Pelokang et al. (2018) state that medicinal plants can cure chronic, infectious, and non-communicable diseases, and maintain health. Examples of non-communicable diseases are internal fever, wounds, warts, and cancer. The chronic diseases include kidney disease, high blood pressure, ulcers, and cancer. Health maintenance includes treating problems of body odor, bad breath, toothache, and yellow teeth.

In general, in the field of medicine, diseases are categorized into two, namely degenerative diseases and infectious diseases. Infectious disease is a disease that easily attacks the body (Besung and Kerta 2009). Many people in this village experience infectious diseases because these diseases are the most health problems in developing countries (Novard et al. 2019). The infectious

diseases that usually attack the community are malaria, ringworm, diarrhea, and scabies. Degenerative disease is a disease that is difficult to repair characterized by degenerative (deterioration of function) of cells and organs that are influenced by lifestyle (Notoatmojo 2007). These diseases, such as diabetes and high blood pressure, are treated by using various plants. All medicinal plants do contain natural chemical compounds, which have pharmacological effects and important activities as anti-disease agents (Rahmawati et al. 2012). The World Health Organization (WHO) recommends using traditional medicines including herbal medicines in maintaining public health, prevention, and treatment of diseases, especially for chronic, degenerative diseases and cancer (Setiawati et al. 2016).

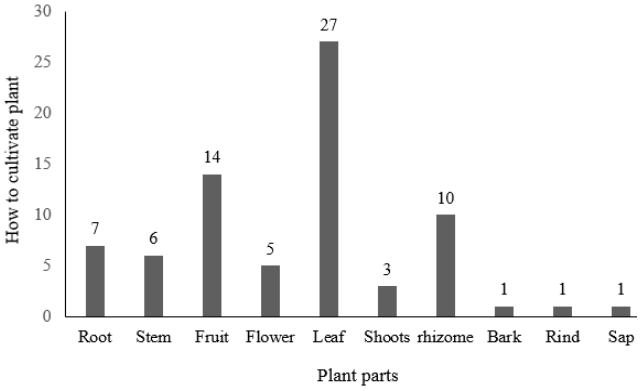

Figure 2. Parts of plants used as medicine

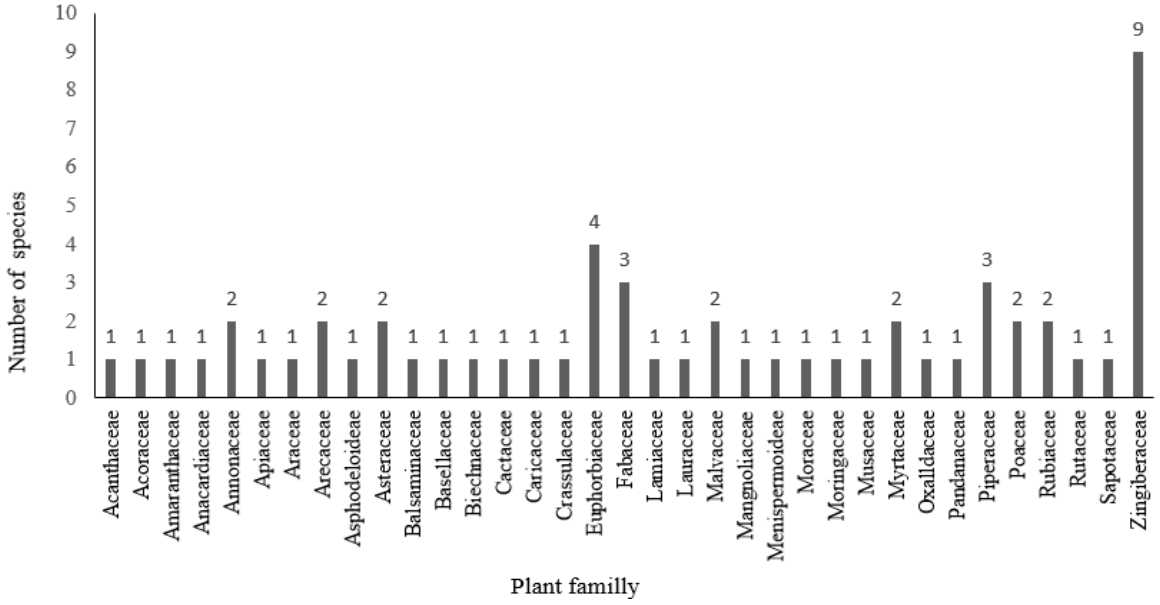

Figure 1. Medicinal plants by family

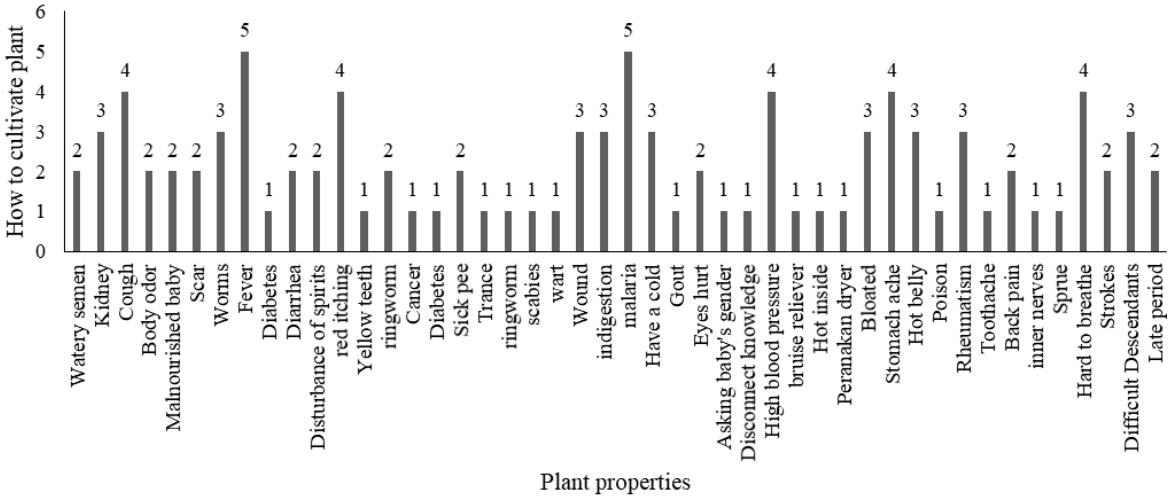

Figure 3. Plants based on efficacy

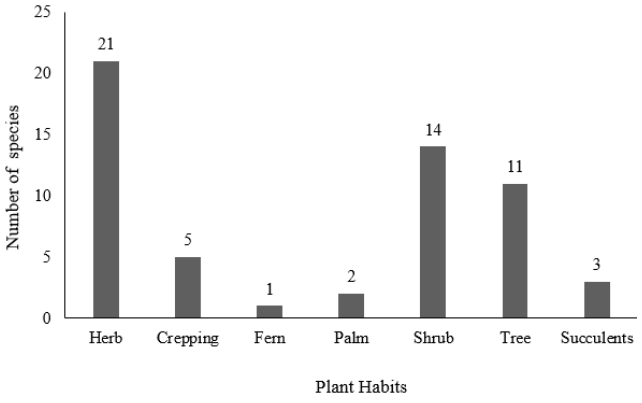

Figure 4. Habitus of plants

The vine known as betel (*Piper betle*) is widely used by the community to treat various health problems such as yellow teeth, body odor and sore eyes. Red ginger (*Zingiber officinale*) is also widely used by local people because this plant is considered capable of treating several diseases at once, such as malaria, fever after giving birth, colds, and gout. The succulent plant known as *Cocor Bebek/sedingen* (*Kalanchoe pinnata*) is widely used by the community to treat various health problems such as a hot stomach, fever, difficulty getting pregnant, and malnourished babies. In addition, lime (*Citrus x aurantiifolia*) is this village's most popular plant species because it treats various disorders, such as disturbances by spirits, colds, and stomachaches. The use of lime in the world of traditional medicine in this village has become a necessity; even people who will come for treatment will automatically bring the fruit to be used as initial medicine before doing the treatment.

The species of plants used as medicine come from various habitus, namely herbs, vines, ferns, palms, shrubs, trees, and succulent plants (Figure 4). The habitus of the plants most widely used as medicine by the community was an herb, 21 species, because herbs are easy to find and are planted in the yard of the house. Riconadi et al. (2020) and Hidayah et al. (2022) also that herbs are commonly found in yards owned by the community. Another habitus often used by the community is shrubs because many are planted in the gardens. Nurchayati and Ardiyansyah (2018) also found in their research on the Using Tribe community in Banyuwangi District the community most widely used that shrub.

This study concluded that the Lintang Tribe in Talang Village used 57 plant species consisting of 35 families for medicine; the frequently used family was Zingiberaceae, the most frequently used part was a leaf, and the most frequently used habitus was an herb. Therefore, the use of medicinal plants as part of the culture of this tribal community must be preserved to maintain the diversity of medicinal plant species and maintain local community knowledge about medicinal plants.

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Ethnobotanical survey and utilization of medicinal and food plants of Panjgur, Balochistan, Pakistan

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Abstract. *Ayoub M, Saeed S, Ahmed A, Ahmed M. 2023. Ethnobotanical survey and utilization of medicinal and food plants of Panjgur, Balochistan, Pakistan. Asian J Ethnobiol 6: 26-35.* The present study observes the ethnobotanical and ethnopharmacological of indigenous rural communities' knowledge of the Panjgur District of Balochistan, Pakistan. The rural community of Panjgur utilizes different plants as medicine and food, and wild food plants play a secondary role in dietary supplementation. The study aimed to document medicinal plants and traditional herbal medicines used by rural people in the area. Plant specimens were collected, and plant uses were recorded by semi-structured interviews and group discussions of 120 informants, of which 90 were males and 30 were females under different age groups. A total of 63 species were used as medicine or food by local communities. Most species reported were herbs (56%), followed by shrubs (24%). The major preparation mode was fresh use (36%), and leaves were the main parts used. The total use citations for all the plant species used to cure various ailments were reported. The highest use citation for stomachic problems followed by a throat infection, anti-acne, skin allergy, and joint pain. The Use Value (UV) ranged from 0.03 to 3 by *Cannabis sativa*, followed by *Aloe vera*, *Arundo donax*, *Chenopodium album*, *Citrullus colocynthis*, *Convolvulus arvensis*, *Prosopis juliflora*, *Phoenix dactylifera*, *Lactuca sativa*, *Ziziphora clinopodioides*, and *Cestrum nocturnum*. This study is the first initiative for ethnobotanical investigation in the Panjgur District of Balochistan. The local community not only uses these medicinal and food plants as food and for herbal treatments but also considers them a source of income. The information generated from this study will also provide a baseline for future investigation to be carried out to evaluate the nutritional and bioactive properties of wild medicinal and food plants.

Keywords: Balochistan, ethnobotany, medicinal plants, Pakistan, Panjgur, wild food plants

INTRODUCTION

Ethnobotany studies human-plant interrelationships (Martin 1995; Balick et al. 1996). Plants have been utilized for food, medicines, religious practices, social life, and many other purposes since ancient times (Cunningham 2001). Indigenous knowledge and traditional primary health care systems are common among communities worldwide. Eighty percent of the world's population, including Pakistan, depends on wild plants for their food and healthcare system (Niroula and Singh 2015). In Pakistan, the local communities rely on wild edible plants for daily food and herbal treatments for various ailments. These communities utilize these plants in their daily use and as a source of income. In developing countries, 60–80% of the population depends on plant-based medicines because they are an economical and safe alternative to often inaccessible allopathic medicine (HAQ et al. 2021; Aziz et al. 2022).

Recent research reported on phytochemicals, essential oils, and other biochemical compounds (Mustafa and Verpoorte 2007; Ntie-Kang et al. 2016; Ahmed et al. 2020b; Ahmed et al. 2020a). These compounds can be isolated from different parts of plants. They can treat diseases like cough, stomach disorder, headache, joint pains, cardiovascular diseases, diuretics, and inflammation and are successfully used against cancer and diabetes. (Nantongo et al. 2018; Le et al. 2020; Pudziuvelyte et al. 2020). Wild food plants constitute an important part of the food habits of diverse ethnic communities worldwide. Further, these plants fulfill the food requirement in developing countries, reducing hunger issues (Sulaiman et al. 2022). Pakistan, however, is one of the world's hot spots for biodiversity but still faces huge challenges of preservation and sustainable use of biological resources. Pakistan's geographical region has diverse climatic zones and unique biodiversity, including approximately 6000 plant species, of which 400-600 are considered medicinally important (Hamayun et al. 2003a,b). Balochistan, the largest Province of Pakistan, has arid to semi-arid ecological regions ranging from cool temperate to coastal tropics (Ahmed et al. 2020a). The diverse ecological conditions increase the floral diversity of the region. Previously, several ethnobotanical studies have been conducted to document folk medicinal plants, therapeutical values, phytochemicals, and their herbal recipes from Balochistan, Pakistan (Baloch et al. 2017; HAQ et al. 2021; Aziz et al. 2022). However, little work is documented on the studied area's floral diversity and ethnobotanical knowledge (Ahmed et al. 2020a). The area was not much

investigated, maybe because of its remoteness, law and order situation, and cultural restrictions.

We hypothesized that due to the area's remoteness along with the villages investigated, there would be a considerable variation in the flora and ethnobotanical knowledge of the people from other areas of the province. Thus the major objective of the current study was to document the indigenous knowledge about the diverse flora and wild medicinal plants used for primary healthcare, particularly focusing on methods of preparation and administration of herbal recipes. Moreover, these valuable wild plants can be utilized as a food source besides the cultivated plants, including the major fruiting and economically important plants.

MATERIALS AND METHODS

The study area and the people

Panjgur District is the 7th largest district in Balochistan with an area of 16891 sq Km, located about 519 km southwest of Quetta, Balochistan, Pakistan. The district is located at 26.976779°N Latitude, 64.083632°E Longitude, towards the southwest region of Balochistan. It is surrounded by the Republic of Iran on the west, Awaran and Kech on the south, and Washuk District on the north. Baloch, Brahvi, Pashtun, and Punjabi are the main tribes. The Baloch tribe is the major tribe and speaks the Balochi language. Geographically, the area is located in the mountainous Siahan range (North) and Makran range (South). The temperature in Panjgur District is warm in summer (maximum 45°C) and cool in winter (minimum -4°C), and the annual rainfall is 25 mm.

Field survey and plant collection

Ethnobotanical data were collected through semi-structured interviews and questionnaires among 12 different communities of the Panjgur District from 2019 to 2020. Group discussions were arranged with key informants, especially the older men and women were focused at their gathering places and homes, respectively. The information about medicinal and edible flora and its utilization pattern was discussed in detail in their local Balochi language. Ethnobotanical information was gathered from 120 local informants, including 90 men and 30 women. The key informants included: medicinal plant collectors, traditional healers, farmers, and old age males and females. Ethnographic information about their names, age groups (Table 1), ethnic backgrounds, qualifications, and occupations was recorded (Tables 2 and 3). In addition, the informants were interviewed in detail about the vernacular names of plants, parts used as food or medicines, and methods of preparation and administration were discussed.

Data were collected through discussions with local people willing to share their folk knowledge about the use of plants. The pictures of ethnobotanical uses were also captured during the field survey. Permission for field survey and consent was obtained from each of the informants. Plants were collected and identified by Author two. Details of information provided by informants were recorded (Table 4). Plants were further identified with the help of Plants of the World Online (POWO 2021). The voucher specimens were submitted to the Eco-Taxonomy Lab (ETL), University of Balochistan Quetta Pakistan.

Quantitative analysis

Ethnobotanical data were analyzed by using quantitative methods as follow:

Use Value (UV)

The UV of plants was calculated by using the method of Gazzaneo et al. (2005) with the help of the following formula:

$$UV = Ui/ N$$

Ui is the preferred number of mentioned species uses, and N is the number of informants.

Informant consensus factor (ICF)

The ICF was calculated by the method of Heinrich et al. (1998) using the following formula:

$$ICF = Nur –Nt / Nur – 1$$

Where, Nur is the number of usage reports for a particular ailment category, and Nt is the number of plants used for a particular ailment category by all informants. The value of ICF ranges from 0 to 1. A high value (close to 1.0) indicates that many informants use relatively few plants. A low value indicates that the informants disagree with the plant used to cure particular illnesses.

Table 1. Age and gender characteristics of informants interviewed in the study area

	Age (Years)				
Gender	**15-30**	**31-45**	**46-60**	**61-above**	**Total**
Male	40	18	22	10	90
Female	07	14	06	03	30

Table 2. Qualification of informants interviewed at the study site

	Qualification							
Gender	**Uneducated**	**Middle**	**Matric**	**Intermediate**	**Bachelor**	**Master**	**M.Phil**	**Total**
Male	37	05	18	09	06	14	01	90
Female	15	03	06	03	0	03	0	30

Table 3. Occupation of informants

Male		Female	
Teacher	05	Housewife	25
Businessman	04	Teacher	02
Govt Servant	10	Tailor	02
Agricultural Officer	01	Female Health Worker	01
Farmer	22		
Labor	11		
Levies Constable	02		
Student	10		
Butcher	01		
Retired Army man	02		
Driver	04		
Shop keeper	16		
Vaccinator	01		
Doctor	01		
Total	90	Total	30

RESULTS AND DISCUSSION

The present study is the first report of quantitative ethnobotanical investigation on the Panjgur District, Balochistan, Pakistan flora. The study was conducted between 2018 and 2021 using semi-structured interviews and group discussions with 120 informants. A total of 90 males and 30 females of different age groups were interviewed. The local inhabitants of the Panjgur District used various plant parts, as shown in Figure 1. Parts commonly used are listed as seeds, roots, stem, bark, whole plant, and fruits. The utility value of the leaves predominates (32%) all other parts, followed by fruits (19%) and stem (13%).

Collected plants included herbs (56%), followed by shrubs (24%), trees (16%), climbers and creepers (2% each) (Figure 2). The plants are used in different ways. Their mode of preparation included fresh (36%), cooked (17%), dry and powder (14% each), infusion (9%), decoction (6%), and heat (4%). Infusion is prepared by suspending plant material in cold and warm water, whereas decoction is made by boiling plant material in water. The powder is made by finely grinding the dried plant parts. Vegetables are fried in cooking oil, and fruit is taken in fresh and dried form. Twenty-seven species had single use and represented 44% of the total species. Like *Chenopodium album* has a single use, it is used for the fodder of animals. *Convolvulus arvensis* also has single use as fodder, while *C. spinosus* single use as fuel. A total of 26 species representing 42%, had dual uses; these plants are used for treating different ailments and sometimes used as food. A total of nine species representing 14%, had multiple uses, including *Phoenix dactylifera,* used as a fruit and sweet dish, which is also used for treating blood deficiency. Its leaves are used for fodder and making different products like baskets etc. Some vegetables are also used as food that also used to treat any ailment. For example, *Mentha piperita* is used as salad, and it is also used for treating stomach disorders.

In Figure 3, most plant species recorded are from the family Fabaceae with 7 species, then by Brassicaceae with 5 species, Asteraceae, Poaceae, and Solanaceae with 4 species of each. The recorded numbers of Apocynaceae, Lamiaceae, and Zygophyllaceae were three species. After that, Amaranthaceae, Amaryllidaceae, Arecaceae, Convolvulaceae, Moraceae, Plantaginaceae, and Rutaceae with two species each. The remaining 16 families were monotypic for medicinal taxa, including Apiaceae, Asphodelaceae, Cannabaceae, Combretaceae, Cucurbitaceae, Euphorbiaceae, Lythraceae, Myrtaceae, Nitraceae, Oleaceae, Rhamnaceae, Rosaceae, Tamaricaceae, Typhaceae, Verbenaceae, Vitaceae.

Use Value (UV)

Use value was calculated to evaluate the importance of plant species in terms of their traditional use in the study area (Table 4). This study revealed the relative importance of each plant species based on its relative use among informants. Use value was used to assess the relative importance of reported plant uses. Use value (UV) is an index widely used to quantify the relative importance of useful plants. The Use Value (UV) ranged from 0.03 (*Zygophyllum fabago*) to 3 (*Cannabis sativa*). Two (2) UV is reported for *Aloe vera* and *A. donax.* While, *C. album 1.83, Citrullus colocynthis* 1.3, *C. arvensis, P. juliflora, P. dactylifera, Lactuca sativa, Ziziphora clinopodioides, Cestrum nocturnum,* also reported with high UV values 1. The plants found during the study were grouped into wild and cultivated types. While their uses are divided into different categories such as Food, Fodder, Medicinal, Ornamental, Cosmetic, Timber, and other usages of wood. Some plants are reported for their single use, while some are used in multiple ways by the area's local people.

Multiple uses of plant (medicinal)

The *P. dactylifera* is one of the most abundant plants. Different varieties are found wild as well as cultivated in the area. It is medicinally very important and used to cure blood deficiency. Also, it is reported for various pharmacological activities like: analgesic, anti-inflammatory, hepatoprotective, anticancer, and antioxidant. Their high nutritional value increased their use to improve health, and they considered adding a full diet supplement. *Allium cepa* bulb is used to treat Hepatitis (B) by the area's local people. The *A. sativum* to control cholesterol level, blood pressure, and blood sugar. *Calotropis procera* leaves extract in water is taken to treat skin allergies. Latex is also used to treat insect bites and remove thorns and wounds. *Rhazya stricta* treats piles, teeth worms, abdominal worms, and eye swelling, and their pollen grain with lemon to treat skin allergies. The *A. vera* is used to cure foot pain and face wrinkles. Its gel is used to treat stomach ulcers. *Raphanus raphanistrum* (Jangli muli) is good for the liver; it treats hepatitis and kidney problems. The *C. sativa* is used to treat cough, and its anxiety-reducing effect is used for relaxing. The *C. colocynthis* is used for gastrointestinal disorders, antidiabetics, and foot pain. *Euphorbia helioscopia* paste is used to remove WATS. While *Plantago amplexicaulis, Z. clinopodioides, Ocimum basilicum, Peganum harmala,* and *M. piperita* are used for abdominal pain, diarrhea, and peptic ulcer. The *P.*

harmala is also used to treat fever. The *Plantago major* is used for rabbit chest infections, cough, and asthma. *Olea europaea* oil is used in cooking, while their fruit is used as a pickle; Their oil is also used for skin and hair massage and as a blood purifier and thinner; It is also used to treat stomach issues like constipation. *Punica granatum* fruit is used to treat blood deficiency, and the Dry peel of the fruit treats abdominal pain. *Fagonia* sp. is used to treat old fever and abdominal pain. The *Z. fabago* and *Zygophyllum* sp. treat body aches, diarrhea, high fever, and vomiting.

Tamarix dioica is used for cough. *Ficus carica* is a medicinally important fruit for treating piles, cough, and chest problems. *Morus alba* fruit is also used to treat cough and constipation. *Withania coagulans* treat abdominal pain, ulcer, diarrhea, and vomiting. It is also considered a blood purifier and used to treat skin disorders and weight loss.

Food plants (vegetables and fruits)

Eighteen wild and cultivated plants are collected and used as vegetables and fruits. These plants are consumed locally, maybe as raw food, fresh fruit, dry fruits, or different products are made. One of the most economically important plants is *P. dactylifera;* fruit is taken (fresh and dry). The local people also prepare sweet dishes. Some other important fruits are *F. carica, O. europaea, Ziziphus mauritiana, M. alba, P. granatum, Malus domestica,* and *Vitis vinifera*.

The *A. cepa* and *A. sativum* bulb is used for cooking curry. It is usually served raw as a salad or part of a prepared savory dish. It can also be used to make pickles and chutneys. The *L. sativa* leaves are taken raw as salad. *Launaea nudicaulis* and *Launaea* sp. are also taken raw as salad. *Helianthus annuus* is a commercially important plant oil used for cooking, and its seeds are used as dry fruit. *Brassica napus* (Shalghum) and *Pisum sativum* a vegetables cooked as food and salad. The *R. raphanistrum* Jangli muli, *Brassica* sp. (Jarjeer), *Brassica* sp. (Roath (thrup), *Lepidium aucheri*, *Medicago sativa,* and *M. polymorpha* are also taken raw as salad. *Citrus lemon* and *C. medica* fruit juice are used for making drinks and adding taste to different vegetables. It can also be used to make pickles. *Triticum aestivum* is another economically important crop cultivated in the area. *Coriandrum sativum* fresh leaves are used as condiments. Fresh leaves of *C. sativum* mixed with *M. piperita* and green chilies are used to make the sauce. Seeds of *C. sativum* are used as spices in cooking different dishes.

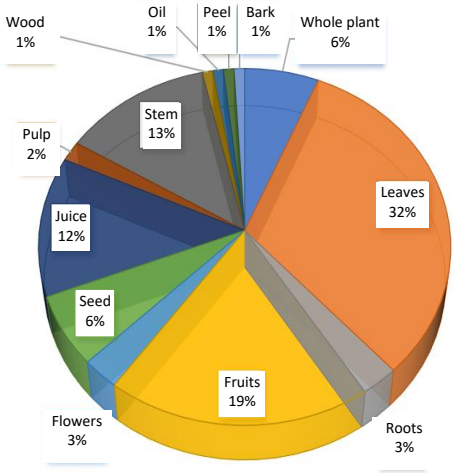

Figure 1. Plant parts used by the indigenous people

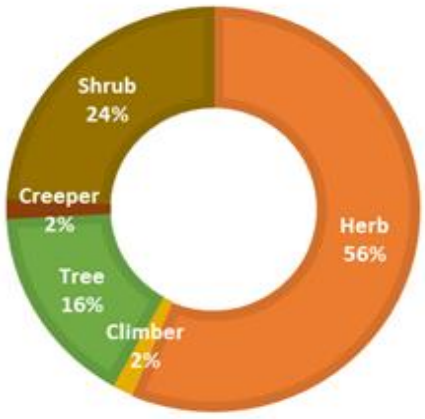

Figure 2. Life form of plants used for ethnobotanical practices

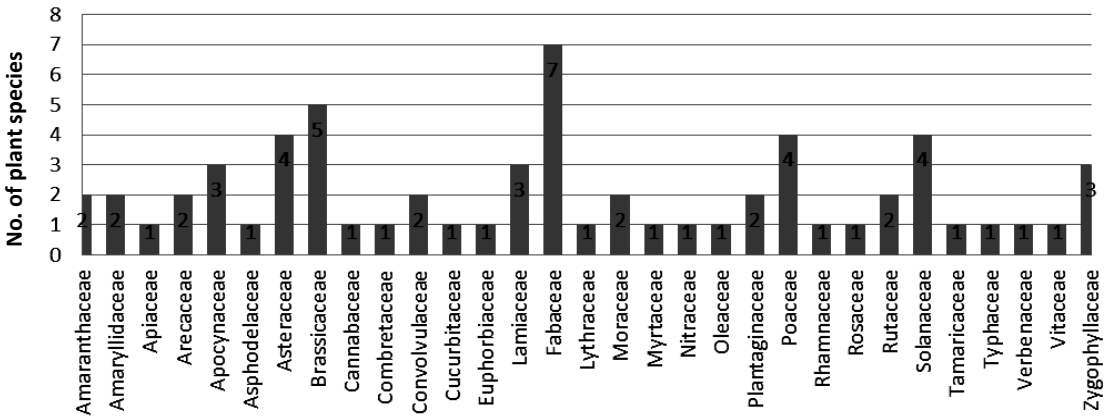

Figure 3. Representation of the plant families and the number of species in the study area

Fuel wood and hedges

One of the important uses of plants is their wood as fuel. The plants used as biofuel are *Convolvulus spinosus, Nannorrhops ritchieana, Prosopis juliflora, Typha domingensis, Eucalyptus camaldulensis, Zygophyllum sp., Z. mauritiana,* and *Vitex agnus-castus. V. agnus-castus* is also planted for flood control near gardens. *E. camaldulensis* is also used in making huts. *Senegalia senegal* is commonly used as fuel but also for making shades. *Conocarpus erectus* is also used for hedging. *Alhagi maurorum* and *Z. clinopodioides* are spread on huts for cooling purposes.

Different products

Traditional carpets, prayer mats, baskets, brooms, and bed ropes are made with leaf and *N. ritchieana*. Local people of the area made the *w*ooden pen and flute with *A. donax*. Handles of utensils and mats are made with the *Tripidium ravennae* and used in making huts.

Fodder

One of the important uses of plants in the Panjgur District is livestock. Local people feed their animals on these plants. The plants used as fodder are *C. album, Launaea* sp., *C. arvensis, Crotalaria persica, M. sativa, T. aestivum, Z. mauritiana, Cynodon dactylon, A. donax, Zygophyllum sp.,* and *Withania somnifera.* The *P. major* is the best fodder used for the rabbit.

Ornamental

Some plants are cultivated in the area for ornamental purposes. These plants include *O. basilicum, A. vera, C. nocturnum,* and *Nerium oleander.*

Cosmetic products

The valuable plants are used in cosmetic products. Local women in the area have used these plants daily for centuries. The oil extract of *O. basilicum* is used in making scents and perfumes. The *A. vera* gel is used for making creams and lotions. Gel is also used in making soaps. The *E. camaldulensis* oil is used on the face for smooth acne prone.

Fertilizers and pesticides

The *C. procera* and *R. stricta* are used as fertilizers for land in the area, especially for the date palm. The *R. stricta* extract in water is used as a pesticide.

Informant consensus factor

The ICF shown in Table 5 reveals the use of plant species to treat different ailments. The highest ICF values were recognized as more effective and commonly used to treat certain diseases. Lower ICF values indicated that the informants disagreed on the taxa for treatment within the disease category. The total use of citations for all the plant species used to cure various ailments was the highest for stomachic problems (171). followed by Throat infection (71), Anti-acne and skin allergy (49), Joint Pain (33), Anti-diabetics and blood pressure (31).

Discussion

Traditionally, women are recognized as housekeepers with greater knowledge of medicinal and edible plants daily. They are familiar with more species and have used them differently for centuries. In addition, the elder women share more information with each (Camou-Guerrero et al. 2008; da Costa et al. 2021). Talking about the age of interviewees over 18 and that studies related to model selection concerning sex are more related to the stage of childhood (Torres-Avilez et al. 2019). In our study, most informants were 15-30 years old. This is similar to the percentage of young people in the community. Plants are used in different ways. Some are used for just single use, some are dual, and some are for multiple uses; Our finding is similar to earlier studies (Ahmad and Husain 2008; Abbasi et al. 2010; Ajaib et al. 2014).

This study showed that most plant parts were consumed fresh and cooked. Wild edible plants are mainly consumed in many ways according to local traditions (Ali-Shtayeh et al. 2008). This study also showed that leaves were the most consumed plant parts, followed by fruits, flowers, and stems. Green leafy vegetables are good sources of calcium (Misra et al. 2008). The *T. aestivum* is an important cultivated crop of the area; seeds are heated, dried, ground, and then mixed with sugar and water to make a paste called "Pesht," a delicious traditional recipe.

Edible plant parts included leaves, fruits, and seeds. The majority of plants recorded are eaten raw. For example: *A. cepa, A. sativum, C. sativum, L. sativa, B. napus, Mentha* sp., *F. carica, M. alba, P. granatum, Z. mauritiana, C. lemon, C. medica,* and *V. vinifera*. The results of this study are consistent with that of earlier reports (Ahmed et al. 2019, Ajaib et al. 2014, Ali et al. 2019). People use various methods to preserve plants and food for long-term storage and during the off-season. Drying in plastic bags, handmade baskets made up of leaves of *N. ritchieana*, and rubber bottles were the most common preservative method. For example, the fruits of *P. dactylifera* are shade-dried and kept inside handmade baskets, plastic bags or rubber bottles, and Tin. Other methods of preserving date fruit included refrigeration and freezing. Other plants, such as fruits of *F. carica*, *P. granatum*, and *V. vinifera*, are dried and then stored in glass utensils and plastic bags. Similar preservative methods had been reported in earlier studies (Aziz et al. 2016; Al-Dashti et al. 2021).

This study revealed that 25% of plants recorded had medicinal properties. For example, the decoction of *P. harmala* and *P. major* seeds was used to treat fever and cough, respectively, consistent with earlier reports (Nasab and Khosravi 2014; Koleva et al. 2015). Padal et al. (2013) reported medicinal uses of *C. lemon* and *C. medica* for treating various diseases, such as fever, indigestion, liver disease, and diarrhea. Some studies recorded the uses of fruit jams and juices of *C. lemon*, *C. medica*, and *Z. mauritiana* (Das and Teron 2014). Wagay (2014) reported that *C. sativa* and *F. carica* were used as narcotics for treating cough, respectively.

Table 4. List of plants collected from the study area, their use value, and relevant details

Plant family and botanical name	Local name	Plant type (cultivated or wild)	Habit	Part used	Uses	Mode of use	Use value
Amaranthaceae							
Chenopodium album L.	Kalper	Wild	H	L	Fodder	Fresh	1.83
Spinacia oleracea L.	Paalik	Cultivated	H	L	Food	Cooked	0.47
Amaryllidaceae							
Allium cepa L.	Peemaz	Cultivated	H	L, ST	Food, medicinal	Cooked, fresh	0.12
A. sativum L.	Serk	Cultivated	H	L, ST	Food, medicinal	Cooked, infusion	0.4
Apiaceae							
Coriandrum sativum L.	Dhanya (Gehneech)	Cultivated	H	L, Fr	Food	Fresh	0.08
Arecaceae							
Nannorrhops ritchieana (Griff.) Aitch.	Daaz	Wild	T	L, Fr, R, SD, ST	Fuel	Fresh, dry	0.42
Phoenix dactylifera L.	Hurmag, Mach, Khajur	Wild, cultivated	T	L, Fr, R, SD, ST	Food, medicinal	Fresh, dry	1
Apocynaceae							
Calotropis procera (Aiton) W.T. Aiton	Kark	Wild	S	L	Medicinal, fertilizer	Heat	0.31
Nerium oleander L.	Jor	Cultivated	S	WP	Medicinal, ornamental	Infusion, powder	0.33
Rhazya stricta Decne.	Eshark	Wild	S	ST, L,	Medicinal, fertilizer, pesticide	Powder, infusion, decoction	0.35
Asphodelaceae							
Aloe vera (L.) Burm.f.	Alovera	Wild, cultivated	H	L	Medicinal, cosmetics, ornamental	Decoction	2
Asteraceae							
Helianthus annuus L.	Roch gardan (saahig gardan)	Cultivated	H	ST	Food	Dry	0.6
Lactuca sativa L.	Salaad (Grencho)	Cultivated	H	L	Food	Fresh	1
Launaea nudicaulis (L.) Hook.f.	Mary halakko	Wild	H	L	Food, medicinal	Cooked	0.04
Launaea sp.	Brinj-o-gosht (Naan-o-gosht)	Wild	H	L, ST	Food, fodder	Fresh	0.25
Brassicaceae							
Brassica napus L.	Shalghum	Cultivated	S	L, ST	Food	Cooked, fresh	0.12
Brassica sp.	Jarjeer	Cultivated	H	L	Food	Fresh	0.33
Brassica sp.	Roath (thrup)	Cultivated	H	L	Food	Fresh	0.09
Lepidium aucheri Boiss	Garbusk	Wild	H	L	Food	Cooked	0.09
Raphanus raphanistrum L.	Jangli muli	Wild	H	L, ST	Food, medicinal	Cooked	0.18
Cannabaceae							
Cannabis sativa L.	Bhang	Wild	H	L, Fr	Medicinal	Infusion, powder	3
Combretaceae							
Conocarpus erectus L.	Mustafa kamal	Cultivated	S	WP	Ornamental		0.16
Convolvulaceae							
C*onvolvulus arvensis* L.	Bakkar walli	Wild	H	WP	Fodder	Fresh	1
C. spinosus Burm. f.	Delko	Wild	H	WP	Fuel	Dry	0.5
Cucurbitaceae							
Citrullus colocynthis (L.) Schrad.	Kolkolushtag	Wild	CR	Fr	Medicinal	Fresh, powder, infusion	1.3

Euphorbiaceae							
Euphorbia helioscopia L.	Gorbagund	Wild	H	L	Medicinal fodder	Fresh	0.5
Fabaceae							
Alhagi maurorum Medik.	Shenz	Wild	S	WP	Medicinal, fodder	Infusion	0.5
Crotalaria persica (Burm. f.) Merr.	Latoo	Wild	H	WP	Fodder	Fresh	0.5
Medicago sativa L.	Sposth	Cultivated	H	L	Food, fodder	Fresh	0.05
M. polymorpha L.	Shemsh	Cultivated	H	L	Food	Cooked, fresh	0.10
Pisum sativum L.	Matar	Cultivated	H	F, SD	Food	Cook	0.04
Prosopis juliflora (Sw.) DC.	Babbur	Wild	T	WP	Fuel	Dry	1
Senegalia senegal (L.) Britton	Kahoor	Wild	T	ST, R	Fuel	Dry	0.08
Lamiaceae							
Mentha piperita Linn.	Podina	Cultivated	H	L	Food	Fresh, cook, powder	0.3
Ocimum basilicum L.	Naaz bow	Cultivated	H	L	Medicinal, ornamental, aromatic	Fresh, powder	0.42
Ziziphora clinopodioides Lam.	Purchenk	Wild	H	L	Medicinal, food	Grind, fresh	1
Lythraceae							
Punica granatum L.	Anaar	Cultivated	S	Fr, ST	Food, medicinal	Fresh, heat, Powder	0.07
Moraceae							
Ficus carica L.	Enjeer	Cultivated	S	Fr	Food, medicinal	Fresh, dry	0.07
Morus alba L.	Tooth	Cultivated	T	L, Fr, ST	Food, fodder, fuel	Fresh, dry	0.06
Myrtaceae							
Eucalyptus camaldulensis Dehnh.	Baam	Cultivated	T	L, ST	Cosmetic, wood, fuel	Powder	0.07
Nitraceae							
Peganum harmala L.	Spantan	Wild	S	SD, L	Medicinal	Powder, heat	0.36
Oleaceae							
Olea europaea L.	Zetoon	Cultivated	T	Fr, L, SD	Medicinal, food	Powder, oil extract, cook, decoction	0.21
Plantaginaceae							
Plantago amplexicaulis Cav.	Daanichk (Spaghol)	Wild	H	Fr	Medicinal, cosmetic	Infusion, powder	0.45
P. major L.	Hari gosh	Wild	H	L, Fr, SD	Medicinal, fodder	Decoction	0.45
Poaceae							
Arundo donax L.	Nall	Wild	H	L, ST	Wood, fuel, fodder	Fresh, dry	2
Cynodon dactylon (L.) Pers.	Chadd	Wild	H	L	Fodder	Fresh	0.07
Tripidium ravennae (L.) H.Scholz	Kaash	Wild	H	L	Fodder	Fresh, dry	0.66
Triticum aestivum L.	Heeth	Cultivated	H	L, Fr	Food, fodder	Cooked	0.04
Rhamnaceae							
Ziziphus mauritiana Lam.	Konar	Cultivated	T	R, Fr, ST, B, L	Food, fuel, fodder	Fresh	0.06
Rosaceae							
Malus domestica (Suckow) Borkh.	Soap (small)	Cultivated	T	F	Food	Fresh	0.07
Rutaceae							
Citrus lemon (L.) Osbeck.	Lembo (lemon)	Cultivated	T	F	Food, medicinal	Cooked, fresh, dry, powder	0.09
C. medica L.	Thrunj	Cultivated	T	F	Food	Cook, fresh	0.2

Solanaceae							
Cestrum nocturnum L	Rath ki rani	Cultivated	S	WP	Ornamental	Fresh	1
Lycium shawii Roem. & Schult	Tolangoor	Wild	S	Fr	Medicinal	Fresh	0.5
Withania coagulans (Stocks.) Dunal.	Paner baad	Wild	H	Fr, SD	Medicinal	Powder, dry	0.25
W. somnifera (L.) Dunal.	Kaakenk	Wild	H	L	Fodder	Fresh	0.33
Tamaricaceae							
Tamarix dioica Roxb. ex Roth	Gazz (taa gazz, goo gazz, saakodi, syah gazz, shinger, kawachar, porant	Wild	S	ST	Medicinal, fuel	Dry, decoction	0.05
Typhaceae							
Typha domingensis Pers.	Kull	Wild	H	L	Fuel, fodder	Fresh	0.25
Verbenaceae							
Vitex agnus-castus L.	Gwanikk	Wild	S	W	Wood	Fresh	0.5
Vitaceae							
Vitis vinifera L.	Angoor	Cultivated	CL	F	Food	Fresh, dry	0.05
Zygophyllaceae							
Fagonia sp.	Karkawag	Wild	H	WP	Medicinal	Grind, infusion	0.6
Zygophyllum fabago L.	Banklek	Wild	S	Fr	Food	Heat, cooked	0.03
Zygophyllum sp.	Kerech	Wild	S	R, L, Fr	Medicinal, fodder, fuel	Decoction, infusion, dry	0.12

Note: Habit: H: Herb, S: Shrub, T: Tree, CL: Climber, CR: Creeper. Part used: B: Bark, Fr: Fruit, L: Leave, R: Root, SD: Seed, ST: Stem, W: Wood, WP: Whole Plant

Table 5. Categories of ailments and Informant Consensus Factor (ICF) for each category

Use categories	Number of plants (Nt)	Number of use report (Nur)	ICF
Stomach disorder	153	171	0.1
Throat infection	50	71	0.3
Anti-acne and skin allergy	34	49	0.3
Joint Pain	26	33	0.2
Anti-diabetics, blood pressure	18	31	0.4
Gynecological and female hormonal problems	12	21	0.5
Kidney problems	3	21	0.9
Cardiovascular disorder	13	20	0.4
Hepatitis	11	16	0.3
Fever	12	13	0.1
Male fertility	4	12	0.7
Live Stock	7	12	0.5
Teeth and gum infection	6	9	0.4
Bone fracture	2	8	0.9
Typhoid	6	7	0.2
Obesity	3	7	0.7
Toxic sting and thorn treating	4	6	0.4
Asthma	3	5	0.5
Malaria and Dengue fever	3	5	0.5
Paralysis	2	3	0.5
Ear problems	1	3	0.0
Navel disorder	1	2	1.0

The literature revealed that the plant had been used to cure different diseases. For example, *Z. clinopodioides* treat stomach disorders (Koleva et al. 2015). Some studies reported multiple uses of *P. harmala* (Hamidi et al. 2014; Hayta et al. 2014), which was consistent with the results of this study. The pharmacological review of this plant showed that it had been used as: antiseptic, anthelmintic, antidiabetic, antihypertensive, emmenagogue, antivenom, digestiveand cutaneous problems, diarrhea, nausea, fever, asthma, headache, stomachic, anti-inflammatory, antimalarial, cooling purposes, and intestinal worms. The secondary metabolites in these plants increase milk production and protect the animals against different diseases (Ahmed et al. 2020a; Mahmood et al. 2020; Afzal et al. 2021). The *P. harmala*, *F. carica*, and *P. major are* used in multiple uses. The same plant has been reported to be used against abdominal problems, asthma, blood pressure, and jaundice. Medicinal plants have previously been shown to be commonly used by rural communities in Pakistan Balochistan (Durrani and Hussain 2005; Tareen et al. 2010; Sarangzai et al. 2013; HAQ et al. 2021).

In conclusion, the present study is the first report on the ethnobotanical inventory of wild food plants and wild medicinal plants of the Panjgur District. The most used life forms were herbs (56%). The results of this study revealed valuable information about the ethnobotanical uses of medicinal and wild food plants, and thus help to preserve indigenous knowledge and attract younger generations toward such traditional and unique practices of disease treatments. However, there has been a gradual loss of traditional knowledge among younger generations. Thus, it is imperative to document and reconstitute the remains of the ancient practices in the study area and other parts of the region and preserve this traditional knowledge for future generations. In addition, there is a need for further analysis of the phytochemical and pharmacological properties of the recorded medicinal plants. Finally, this study result could be used to explore their potential plants for herbal drug discovery.

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An ethnobotanical survey of traditional medicinal plants used against tuberculosis and symptoms associated in Abidjan, Côte d'Ivoire

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Abstract. *Kande B, Grah ZM, Moyabi AGA, Soro Y, Kone WM. 2023. An ethnobotanical survey of traditional medicinal plants used against tuberculosis and symptoms associated in Abidjan (Côte d'Ivoire). Asian J Ethnobiol 6: 36-45.* Infectious diseases, including tuberculosis, are responsible for one-third of the world's mortality due to the mechanism of resistance to antibiotics. Faced with this alarming situation, the search for active principles from natural substances is a primordial need. In this study, semi-structured questionnaires conducted an ethnobotanical survey of medicinal plants used against tuberculosis and associated symptoms in Abidjan. Information was gathered from 171 herbalists. The respondents were asked questions regarding their use of medicinal plants to treat tuberculosis and associated symptoms. Information entailing plants used to treat tuberculosis, associated symptoms, plant parts used, mode of preparation, and dosage was recorded. The results showed that it is known among traditional medicine practitioners to cure tuberculosis but is better understood by its associated symptoms. These surveys revealed a diversity of 41 species of medicinal plants against this disease and its associated symptoms. They are mostly trees. *Alchornea cordifolia* (Schumach. & Thonn.) Müll.Arg. (Euphorbiaceae), *Bombax costatum* Pellegr. & Vuillet (Bombacaceae), *Ficus sur* Forssk. (Moraceae), *Kigelia africana* (Lam.) Benth. (Bignoniaceae), *Nephrolepis bisserata* (Sw.) Schott (Nephrolepidaceae), *Terminalia glaucescens* Planch. ex Benth. (Combretaceae) and *Vitellaria paradoxa* C.F.Gaertn. (Sapotaceae) are the most cited plant species. Leaves are the most used organs, decoction is the main mode of preparation, and the oral route is the main way to administer the remedies.

Keywords: Côte d'Ivoire, ethnobotanical survey, herbalists, medicinal plants, tuberculosis

INTRODUCTION

Humans are often confronted with two types of diseases. These are transmittable diseases and not transmittable diseases. Non-transmissible diseases are non-infectious diseases that cannot be transmitted between people. Transmissible diseases are carried by a pathogen, which releases toxins and deploys its genetic material in the human body, thus affecting the immune system. This is the case of bacterial germs responsible for infectious diseases (Van-Hoek et al. 2011). Respiratory infections are many; among them, Tuberculosis (TB) is responsible for one-third of global mortality (WHO 2017).

Tuberculosis is a transmissible infectious disease that causes the largest number of deaths worldwide and is one of the most important causes of mortality resulting from antimicrobial resistance (Alexander et al. 2010). *Mycobacterium tuberculosis* causes this disease (Agus et al. 2022), responsible for 98-99% of pulmonary TB and 80-90% of all TB diseases. In addition, TB is one of the top 10 causes of death worldwide and the leading cause of death from a single infectious agent, ranking ahead of HIV/AIDS (WHO 2016a,b).

Treating bacterial infections has become more complicated due to drug-resistant strains. In addition, many developing countries, particularly in rural areas, have less developed, less equipped, or even non-existent health structures. In addition, the duration of the treatment becomes very restrictive for the patient. Due to the limited success of current drugs, there is an urgent need to identify new treatments for this disease. Statistics from the World Health Organization (WHO 2002), still in effect according to Mangambu et al. (2014), show that more than 80% of the African and even Ivorian populations resort to traditional medicine for their health problems. This recourse to traditional medicine is conducted as a first resort for proximity, availability, and accessibility to plant resources (Adjet et al. 2017). It is done as a last resort when the therapy administered at the hospital does not show signs of healing more quickly (Ayéna 2012). Then, populations complement the care they receive in hospitals with treatment with medicinal plants (Kolling et al. 2010).

Medicinal plants are a good source of drugs, and the search for new drugs from plants is now a well-justified issue (Balunas and Kinghorn 2005). In addition, bacterial antibiotic resistance has become a real concern (Akoua et al. 2004). This general antibiotic resistance phenomenon

concerns all bacterial species and constantly increases. This study aims to gather information from herbalists on traditional medicinal plants that treat tuberculosis and associated symptoms in Abidjan (Côte d'Ivoire).

MATERIALS AND METHODS

Study area

Ethnobotanical surveys were conducted in three large communes based on population density, Abobo (1,340,083 inhabitants), Port-Bouët (618,795 inhabitants), and Yopougon (1,571,065 inhabitants) in the autonomous district of Abidjan. The district of Abidjan (Côte d'Ivoire) where this study took place is located between 5°20'27" N and 4°01'41" W (Figure 1). The population of these communes is very diversified, cosmopolitan, and composed of several peoples and ethnic groups from various regions of the country but also from neighboring countries (INS 2021).

Herbalist survey

Data were collected between April and September 2019. They consisted of semi-structured interviews based on a questionnaire. The recorded information included the age group and gender of the persons interviewed, the plants used in the different recipes, parts of the plants used, the mode of preparation, forms of administration of the medicinal plants, and posology. Plants were collected with the assistance of herbalists. Voucher specimens were prepared, and botanists identified plant species at the University Nangui Abrogoua. The authentification was compared with the voucher specimens of the National Center of Floristics (University Felix Houphouët Boigny). The APG IV (2016) nomenclature system was adopted for the names of taxa.

Data analysis of botanical and ethnobotanical characteristics of the identified plants

The plants used to treat tuberculosis, and associated symptoms were characterized by their biological, morphological, and biogeographical types. The data analysis focused on determining each species, the Relative Frequency of Citation (RFC), plant contribution in the Constitution of the Recipes (CPr), and the specificity of the recipes concerning the symptoms.

Relative frequency of citation of plant species in the treatment of tuberculosis and associated symptoms

To determine the most cited plant species for treating tuberculosis and associated symptoms, we used the Relative Frequency of Citation (RFC). It is used to evaluate the importance of the plants and the credibility of the information received. It was determined for each species by formula 1 (Dassou et al. 2015):

$$RFC = NP/NT \times 100 \quad (1)$$

Where:
NP: Number of times the plant was used
NT: Total number of herbalists

Contribution of each plant species in the recipes in the treatment of tuberculosis and associated symptoms

The CPr measures the frequency of a plant's involvement in the recipes. It was determined for each species by formula 2 (Dassou et al. 2015):

$$CPr = Nr \times 100/Nt \quad (2)$$

Where:
Nr: Number of recipes involving the plant
Nt: Total number of recipes

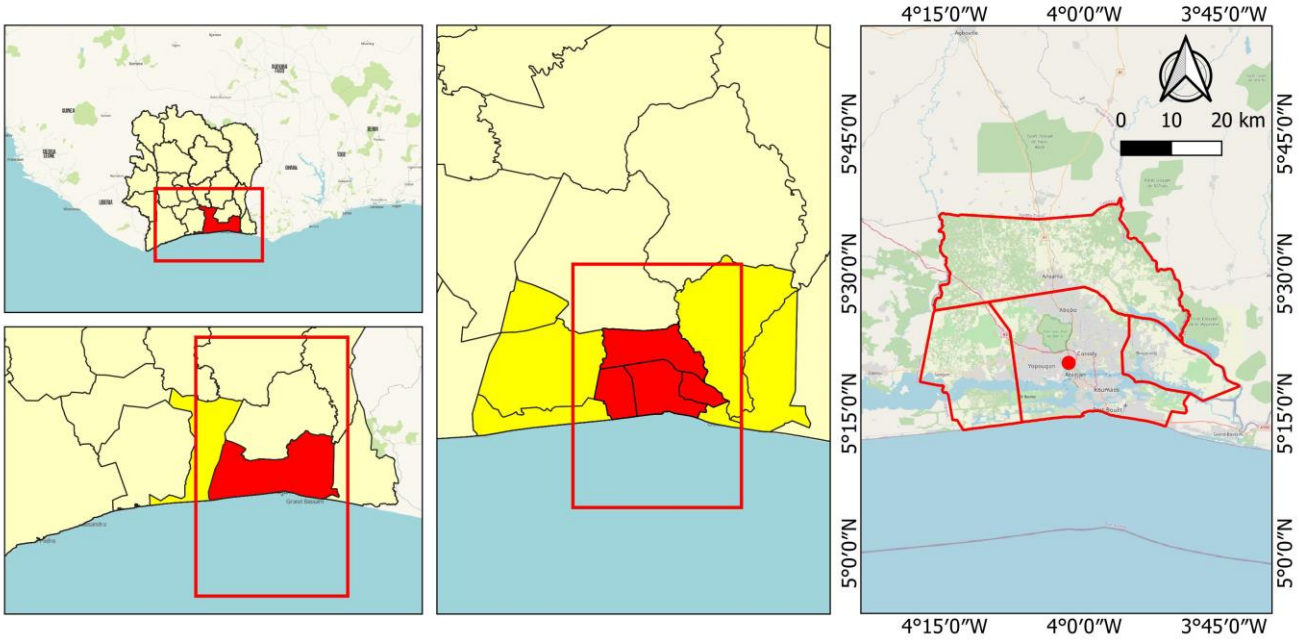

Figure 1. Location of the study area in Côte d'Ivoire

Specificity of the recipes concerning symptoms associated with tuberculosis

Therefore, to estimate the specificity of each plant recipe concerning TB-associated symptoms, its Frequency (Fr) of citation was calculated by the following formula 3:

$$FR = n/(N) \times 100 \quad (3)$$

Where:

n: Number of times a recipe treats the symptom

N: Number of citations of symptoms associated with tuberculosis.

Informant Consensus Factor (ICF) has been used to assess the degree of consistency of information in therapy data (Heinrich et al. 1998). In addition, it is used to assess informants' agreement on the reported therapies for each type of use (Formula 4).

$$ICF = (Nur - Nt)/(Nu - 1) \quad (4)$$

Where:

Nur: Number of use citations in each symptom was mentioned

Nt: Number of species plant(s) used for this symptom

The ICF ranges from 0 (plants are randomly selected, or informants have different views on the treatment for a given disease and do not exchange information on their use) to 1 (there is a well-defined selection criterion in the community and/or if the information is exchanged between informant (Heinrich et al. 1998).

Data analysis

Survey data were entered using Epidata 3.1 software and then transferred to SPSS 20.0 software for analysis. The tables were carried out with SPSS 20.0 and Excel software to establish a relationship to appreciate better and explain the socio-demographic characteristics of the respondents, the floristic diversity of plants used to treat pulmonary tuberculosis and associated symptoms, and the therapeutic modalities.

RESULTS AND DISCUSSION

Socio-demographic characteristics of the herbalists surveyed (Autonomous District of Abidjan)

A total of 171 herbalists were interviewed on the therapeutic use of medicinal plants in the Autonomous District of Abidjan to treat TB-related symptoms. The majority of herbalists interviewed were women (92.40%). Based on the age range proposed by Assogbadjo et al. (2008), three age groups were obtained (Table 1), young people under 29 years of age (22.22%), adults between 30 and 59 years of age (73.68%), and older people over 60 years of age (4.09%). Two levels of schooling are more represented than others, i.e., illiterate (52.05%) and primary school (30.99%).

Herbalists' knowledge of tuberculosis and associated symptoms

In the markets, all herbalists interviewed know tuberculosis. For example, the local names for TB most commonly used in the markets were *socôsocôgbê* (53.80%) in Malinké and *tangôhoufoué* (42.11%) in Baoulé. Herbalists mentioned several causes of tuberculosis, the highest being caused by microbes (81.87%). Others, such as witchcraft, heredity, housing, and diet, account for 18.13%.

Diversity of plant species and importance of plants used in the treatment of tuberculosis and associated symptoms

The survey identified 41 plant species belonging to 26 families and 39 genera. These medicinal species are mainly represented by dicots (97.56%) and a single monocot, *C. citratus* (Poaceae). The most represented families are Fabaceae (14.63%), Annonaceae (7.32%), and Euphorbiaceae (7.32%) (Table 2).

Morphological types of the antituberculosis and its associated symptoms plants according to the herbalists' survey

The plant species marketed to treat tuberculosis and its associated symptoms are, for the most part, shrubs (43.90%), followed by trees (29.27%), herbaceous plants (19.51%), and lianas (7.32%). Seven biological types mostly belong to microphanerophytes (41.46%) and mesophanerophytes (24.39%) (Figure 2).

Biogeographic types of antituberculosis and its associated symptoms plants according to the herbalists' survey

At the level of phytogeographical affinities, the species of the transition zone of the Sudano-Zambezian regions (SZ) are the most numerous (41.46%). They are followed by species from the Guinean-Congolese (GC) regions with a percentage of 19.51 and Sudano-Guinean (SG) with 17.07%. On the other hand, introduced species (Int), Sudano-Zambezian (SZ), Sudanian (S), and Pantropical (Pt) are the least represented with 7.32%, 7.32%, 4.88%, and 2.44%, respectively.

Table 1. Demographic profile of the herbalists surveyed in Autonomous District of Abidjan, Côte d'Ivoire

Parameters	Proportions (%)
Gender	
Women	92.4
Men	7.6
Total	100
Age group	
Youth [23 to 29]	22.22
Adults [30 to 59]	73.68
Elders ≥ 60	4.09
Total	100
Education degree	
Not enrolled in school	30.99
Primary school	52.05
Secondary school	5.26
Islamic school	11.70
Total	100

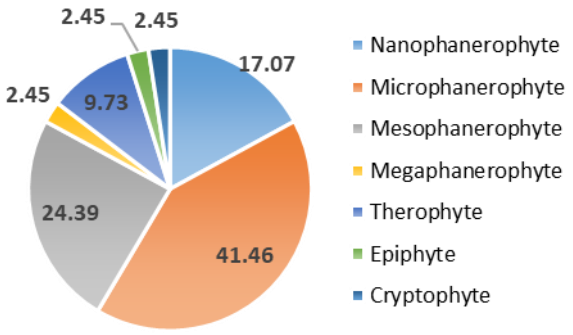

Figure 2. The spectrum of biological types of plant species used in the treatment of tuberculosis and associated symptoms

Ethnobotanical characteristics of the antituberculosis and its associated symptoms plants according to the herbalists' survey

Of the various plant parts inventoried, the leaves (44.63%) are the most used, followed by the bark (28.93%) and the roots (25.62%), and Fruits (0.83%) are used very less in the treatment of this disease and its associated symptoms. The plants identified are used in 63 medicinal recipes to treat tuberculosis and its associated symptoms (Table 3). The relative frequencies of citation of the inventoried species vary from 0.58% to 25.14%. The species most cited by herbalists are, in descending order of their relative frequency of citation (RFC), *A. cordifolia* (25.14%), *H. rotundifolia* (15.20%), and *Z. zanthoxyloides* (8.77%). Among the commercialized species, two are present on the International Union for Conservation of Nature (IUCN) list, i.e., *K. senegalensis* and *V. paradoxa* are vulnerable species.

Table 2. Botanical and ethnobotanical characteristics of plant species used in the treatment of tuberculosis and associated symptoms

Species	Family	CF (%)	Biolo. type	Morpho. type	Chorol. type
Abrus precatorius L.	Fabaceae	0.58	mph	Liana	GC-SZ
Ageratum conyzoides L.	Asteraceae	1.17	Th	Herbaceous	GC-SZ
Alchornea cordifolia (Schumach. & Thonn.)	Euphorbiaceae	25.15	mph	Shrub	GC-SZ
Annona muricata L.	Annonaceae	1.75	nph	Shrub	Int
Annona senegalensis Pers.	Annonaceae	0.58	nph	Shrub	SZ
Bidens pilosa L.	Asteraceae	2.34	Th	Herbaceous	GC-SZ
Bombax costatum Pellegr. & Vuillet.	Bombacaceae	0.58	mph	Shrub	SZ
Bridelia ferruginea Benth.	Euphorbiaceae	1.17	mph	Shrub	GC-SZ
Cassia nilotica (L.) Willd.	Fabaceae	0.58	mPh	Tree	SZ
Cassia occidendalis L.	Fabaceae	0.58	nph	Shrub	GC-SZ
Ceiba pentandra (L.) Gaertn.	Bombacaceae	1.75	MPh	Tree	GC-SZ
Citrus aurantifolia (Christm.) Swingle	Rutaceae	2.34	mph	Shrub	Int
Cleistopholis patens (Benth.) Engl. & Diels.	Annonaceae	0.58	mPh	Tree	GC
Crossopteryx febrifuga (Afzel.) Benth.	Rubiaceae	1.75	mph	Shrub	GC-SZ
Cymbopogon citratus (DC.) Stapf.	Poaceae	0.58	Hc	Herbaceous	GC-SZ
Desmodium adscendens (Swartz) D.C.	Fabaceae	2.34	nph	Shrub	GC
Eucalyptus camaldulensis Dehnhardt.	Myrtaceae	0.58	mPh	Tree	Int
Ficus sur Forssk.	Moraceae	2.34	mph	Shrub	GC
Harungana madagascariensis Auct.	Hypericaceae	0.58	mph	Shrub	GC
Heliotropium indicum L.	Boraginaceae	0.58	Th	Herbaceous	SG
Heterotis rotundifolia (Sm.) Jacq. - Fél	Melastomataceae	15.20	Th	Herbaceous	At
Khaya senegalensis (Desr.) A Juss	Meliaceae	3.51	mph	Tree	GC
Kigelia africana (Lam.) Benth.	Bignoniaceae	0.58	mPh	Tree	SG
Morinda lucida Benth.	Rubiaceae	2.34	mph	Shrub	GC-SZ
Nephrolepis bisserata (Sw.) Schott.	Nephrolepidaceae	1.17	Ep	Liana	GC-SZ
Newbouldia laevis (P. Beauv.) Seeman	Bignoniaceae	0.58	mph	Shrub	SG
Ocimum gratissimum L.	Lamiaceae	2.9	nph	Herbaceous	GC-SZ
Palisota hirsuta (Thunb.) K. Schum.	Commelinaceae	0.58	nph	Herbaceous	GC
Parkia biglobosa (Jacq.) R. Br.	Mimosaceae	1.75	mPh	Tree	S
Paullinia pinnata L.	Sapindaceae	0.58	mph	Liana	GC-SZ
Piliostigma thonningii (Schum.) Milne-Red.	Fabaceae	1.17	mph	Shrub	GC-SZ
Pterocarpus erinaceus Poir.	Fabaceae	0.58	mPh	Tree	S
Rauvolfia vomitoria Afzel.	Apocynaceae	0.58	mph	Shrub	GC-SZ
Ricinodendron heudelotii (Baill.) Pierre.	Euphorbiaceae	1.17	mPh	Tree	GC
Scoparia dulcis L.	Plantaginaceae	1.75	nph	Herbaceous	Pt
Spondias mombin L.	Anacardiaceae	3.51	mph	Shrub	GC-SZ
Terminalia brownii Fresen.	Combretaceae	1.75	mPh	Tree	SG
Terminalia glaucescens (Planch.)	Combretaceae	1.17	mPh	Tree	SG
Trema orientalis (L.) Blume	Ulmaceae	1.75	mph	Shrub	GC-SZ
Vitellaria paradoxa C.F.Gaertn.	Sapotaceae	0.58	mPh	Tree	SG
Zanthoxylum zanthoxylloides (Lam.)	Rutaceae	8.77	mph	Shrub	SG

Note: Morph. type : morphological type; Chorol. type: chorological type; GC: taxon from the Guineo-Congolese region; SZ: taxon from the Sudan-Zambezi region; GC-SZ: taxon from the transition region and the Guineo-Congolese and Sudan-Zambezi regions; i: introduced and cultivated taxon; Biolo. type: biological type; nph: nanophanerophyte species; mph: microphanerophyte species; mPh: mesophanerophyte species; MPh: megaphanerophytes species; Th: therophyte species; Ep: epiphyte; Cr: cryptophyte; CF: citation frequency

Table 3. List of recipes of plant species used in the treatment of tuberculosis and associated symptoms delivered by the herbalists surveyed

Types of recipes		Plant species and Parts used	Posology
Bispecific recipes (2 species)	R1	*Nephrolepsis bisserata* (leaves); *Bombax costatum* (stems bark)	2 cups (35cl) / morning and evening
	R2	*Cleistopholis patens* (stems bark); *Morinda lucida* (roots)	1 cup (35cl) / morning and evening
Multispecies recipes (3 species)	R3	*Vitellaria paradoxa* (stems); *Terminalia glaucescent* (stems)	2 cups (35cl) / morning and evening
	R4	*Zanthoxylum zanthoxylloides* (roots); *Annona muricata* (leaves); *Abrus precatorius* (stems bark)	2 cups (35cl) / morning and evening
	R5	*Cassia occidentalis* (leaves); *Heterotis rotundifolia* (whole plant); *Ficus sur* (stems bark)	2 cups (35cl) / morning and evening
	R6	*Khaya senegalensis* (stems bark); *Scoparia dulcis* (leaves); *Paullinia pinnata* (roots)	1 cup (50cl) / morning and evening
	R7	*Alchornea cordifolia* (roots); *Terminalia brownii* (roots); *Palisota hirsuta* (leaves)	2 cups (35cl) / morning and evening
Multispecies recipes (3 species)	R8	*Bidens pilosa* (leaves); *Bombax costatum* (stems bark); *Piliostigma thonningii* (leaves)	1 cup (35cl) / morning, noon, and evening
	R9	*Alchornea cordifolia* (roots); *Vitellaria paradoxa* (stems bark); *Terminalia glaucescent* (stems bark)	2 cups (35cl) / morning and evening
	R10	*Alchornea cordifolia* (leaves); *Rauvolfia vomitoria* (roots); *Ricinodendron heudelotii* (stems bark)	2 cups (35cl) / morning and evening
	R11	*Alchornea cordifolia* (roots); *Pterocarpus erinaceus* (stems bark); *Nephrolepsis bisserata* (leaves)	2 cups (35cl) / morning and evening
	R12	*Zanthoxylum zanthoxylloides* (roots); *Paullinia pinnata* (roots); *Bridelia ferruginea* (stems bark)	1 cup (35cl) / morning and evening
	R13	*Zanthoxylum zanthoxylloides* (roots); *Palisota hirsuta* (leaves); *Ageratum conyzoides* (leaves)	2 cups (35cl) / morning and evening
	R14	*Zanthoxylum zanthoxylloides* (roots); *Kigelia africana* (stems bark); *Trema orientalis* (leaves)	2 cups (35cl) / morning and evening
Multispecies recipes (3 species)	R15	*Heterotis rotundifolia* (whole plant); *Heliotropium indicum* (whole plant); *Terminalia brownii* (root)	2 cups (35cl) / morning and evening
	R16	*Heterotis rotundifolia* (whole plant); *Harungana madagascariencis* (stems bark); *Parkia biglobosa* (root)	2 cups (35cl) / morning and evening
	R17	*Heterotis rotundifolia* (whole plant); *Eucalyptus camaldulencis* (leaves); *Crossopteryx febrifuga* (stems bark)	2 cups (35cl) / morning and evening
	R18	*Ocimum gratissimum* (leaves); *Cymbopogon citratus* (leaves); *Ceiba pentandra* (stems bark)	2 cups (35cl) / morning and evening
	R19	*Khaya senegalensis* (stems bark); *Cleistopholis patens* (stems bark); *Annona muricata* (leaves)	2 cups (35cl) / morning and evening
	R20	*Morinda lucida* (root); *Ricinodendron heudelotii* (root); *Cassia occidentalis* (leaves)	2 cups (35cl) / morning and evening
	R21	*Spondias mombin* (leaves); *Heterotis rotundifolia* (whole plant); *Ageratum conyzoides*(whole plant)	2 cups (35cl) / morning and evening

Multispecies recipes (3 species)	R22	*Desmodium adscendens* (whole plant); *Annona senegalensis* (leaves); *Piliostigma thonningii* (leaves)	1 cup (50cl) / morning and evening
	R23	*Citrus aurantifolia* (root); *Parkia biglobosa* (root); *Newbouldia laevis* (leaves)	1 cup (35cl) / morning, noon, and evening
	R24	*Ficus sur* (stems bark); *Trema orientalis* (leaves); *Pterocarpus erinaceus* (stems bark)	1 cup (35cl) / morning, noon, and evening
	R25	*Annona muricata* (leaves); *Scoparia dulcis* (whole plant); *Desmodium adscendens* (whole plant)	1 cup (50cl) / morning, noon, and evening
	R26	*Ceiba pentandra* (stems bark); *Morinda lucida* (root); *Heliotropium indicum* (whole plant)	2 cups (35cl) / morning and evening
	R27	*Crossopteryx febrifuga* (leaves); *Bidens pilosa* (leaves); *Rauvolfia vomitoria* (root)	2 cups (35cl) / morning and evening
	R28	*Parkia biglobosa* (root); *Khaya senegalensis* (stems bark); *Eucalyptus camaldulensis* (leaves)	2 cups (35cl) / morning and evening
Multispecies recipes (3 species)	R29	*Scoparia dulcis* (whole plant); *Palisota hirsuta* (leaves); *Heterotis rotundifolia* (whole plant)	2 cups (35cl) / morning and evening
	R30	*Terminalia brownie* (root); *Alchornea cordifolia* (root); *Annona senegalensis* (leaves)	2 cups (35cl) / morning and evening
	R31	*Trema orientalis* (leaves); *Zanthoxylum zanthoxylloides* (root); *Cleistopholis patens* (stems bark)	2 cups (35cl) / morning and evening
	R32	*Ageratum conyzoides* (whole plant); *Ocimum gratissimum* (leaves); *Kigelia africana* (stems bark)	2 cups (35cl) / morning and evening
	R33	*Bridelia ferruginea* (stems bark); *Desmodium adscendens* (whole plant); *Cassia nilotica* (fruits)	2 cups (35cl) / morning and evening
	R34	*Piliostigma thonningii* (leaves); *Morinda lucida* (root); *Cassia occidentalis* (leaves)	2 cups (35cl) / morning and evening
	R35	*Ricinodendron heudelotii* (roots); *Khaya senegalensis* (stems bark); *Abrus precatorius* (leaves)	2 cups (35cl) / morning, noon, and evening
Multispecies recipes (3 species)	R36	*Terminalia glaucescent* (stems bark); *Spondias mombin* (leaves); *Paullinia pinnata* (roots)	2 cups (35cl) / morning and evening
	R37	*Abrus precatorius* (leaves); *Alchornea cordifolia* (roots); *Annona muricata* (leaves)	1 cup (50cl) / morning and evening
	R38	*Annona senegalensis* (leaves); *Zanthoxylum zanthoxylloides* (roots); *Ceiba pentandra* (stems bark)	1 cup (50cl) / morning and evening
	R39	*Bombax costatum* (stems bark); *Heterotis rotundifolia* (whole plant); *Crossopteryx febrifuga* (leaves)	2 cups (50cl) / morning and evening
	R40	*Cassia nilotica* (fruits); *Ocimum gratissimum* (leaves); *Parkia biglobosa* (roots)	2 cups (50cl) / morning and evening
	R41	*Cassia occidentalis* (leaves); *Khaya senegalensis* (stems bark); *Scoparia dulcis* (whole plant)	2 cups (35cl) / morning and evening
	R42	*Cymbopogon citratus* (leaves); *Spondias mombin* (leaves); *Ageratum conyzoides* (whole plant)	2 cups (35cl) / morning and evening
Multispecies recipes (3 species)	R43	*Eucalyptus camaldulensis* (leaves); *Bidens pilosa* (leaves); *Terminalia brownii* (roots)	2 cups (35cl) / morning and evening
	R44	*Harungana madagascariensis* (stems bark); *Citrus aurantifolia* (roots); *Trema orientalis* (leaves)	2 cups (35cl) / morning and evening

	R45	*Heliotropium indicum* (leaves); *Bridelia ferruginea* (stems bark); *Desmodium adscendens* (leaves)	2 cups (35cl) / morning and evening
	R46	*Kigelia africana* (stems bark); *Ficus sur* (stems bark); *Nephrolepsis bisserata* (leaves)	2 cups (35cl) / morning and evening
	R47	*Newbouldia laevis* (leaves); *Bidens pilosa* (leaves); *Heterotis rotundifolia* (leaves)	2 cups (35cl) / morning and evening
	R48	*Palisota hirsuta* (leaves); *Ocimum gratissimum* (leaves); *Ageratum conyzoides* (whole plant)	2 cups (35cl) / morning and evening
	R49	*Paullinia pinnata* (roots); *Khaya senegalensis* (stems bark); *Parkia biglobosa* (roots)	2 cups (35cl) / morning and evening
Multispecies recipes (3 species)	R50	*Pterocarpus erinaceus* (stems bark); *Desmodium adscendens* (whole plant); *Annona muricata* (leaves)	2 cups (35 cl) / morning and evening
	R51	*Rauvolfia vomitoria* (roots); *Alchornea cordifolia* (roots); *Ocimum gratissimum* (leaves)	1 cup (50 cl) / morning and evening
	R52	*Pterocarpus erinaceus* (stems bark); *Alchornea cordifolia* (roots); *Terminalia brownii* (roots)	2 cups (35 cl) / morning and evening
	R53	*Harungana madagascariensis* (stems bark); *Trema orientalis* (leaves); *Bridelia ferruginea* (stems bark)	2 cups (35 cl) / morning, noon, and evening
	R54	*Palisota hirsuta* (leaves); *Ocimum gratissimum* (leaves); *Alchornea cordifolia* (roots)	2 cups (35 cl) / morning, noon, and evening
Multispecies recipes (4 species)	R55	*Alchornea cordifolia* (roots); *Ageratum conyzoides* (whole plant); *Ocimum gratissimum* (leaves); *Cassia occidentalis* (leaves)	2 cups (35 cl) / morning, noon, and evening
	R56	*Ocimum gratissimum* (leaves); *Ceiba pentandra* (stems bark); *Bombax costatum* (stems bark); *Bidens pilosa* (leaves)	2 cups (50 cl) / morning and evening
	R57	*Morinda lucida* (roots); *Citrus aurantifolia* (roots); *Bridelia ferruginea* (stems bark); *Cassia nilotica* (fruits)	1 cup (50 cl) / morning, noon, and evening
	R58	*Bidens pilosa* (leaves); *Abrus precatorius* (leaves); *Ficus sur* (stems bark); *Citrus aurantifolia* (roots)	2 cups (35cl) / morning and evening
	R59	*Bidens pilosa* (leaves); *Morinda lucida* (roots); *Khaya senegalensis* (stems bark); *Zanthoxylum zanthoxylloides* (roots)	2 cups (35cl) / morning and evening
	R60	*Rauvolfia vomitoria* (roots); *Alchornea cordifolia* (roots); *Ageratum conyzoides* (leaves); *Newbouldia laevis* (leaves)	2 cups (35cl) / morning and evening
Multispecies recipes (5 species)	R61	*Scoparia dulcis* (whole plant); *Palisota hirsuta* (leaves); *Terminalia brownii* (roots); *Ceiba pentandra* (stems bark); *Piliostigma thonningii* (leaves)	2 cups (35cl) / morning and evening
	R62	*Heliotropium indicum* (whole plant); *Bridelia ferruginea* (stems bark); *Desmodium adscendens* (leaves); *Khaya senegalensis* (stems bark); *Kigelia africana* (stems bark)	1 cup (50 cl) / morning and evening
	R63	*Kigelia africana* (stems bark); *Ficus sur* (stems bark); *Nephrolepsis bisserata* (leaves); *Vitellaria paradoxa* (stems bark); *Terminalia glaucescent* (stems bark)	2 cups (35 cl) / morning and evening

Notes**:** The method of preparation and administration are decoction and taken orally; cl: centiliter; R: recipes

The plant species most used by herbalists in the different recipes, in decreasing order of frequency of contribution (CPr), are *A. cordifolia* (CPr = 17.46%), *H. rotundifolia* (CPr = 12.69%), *K. senegalensis* (CPr = 12.69%), *O. gratissimum* (CPr = 12.69%), *A. conyzoides* (CPr = 11.11%), and *B. pilosa* (CPr = 11.11%) (Table 4).

Agreement on the therapy and use of medicinal plants against the symptoms associated with tuberculosis

The agreement on the treatment of the symptoms associated with tuberculosis showed that the associated symptoms have a high consensus. These are chronic cough (0.84), fever (0.82), asthenia (0.80), bloody cough (0.80), muscle pain (0.78), pain thoracic (0.73), and chronic weight loss (0.60). The most cited species in the treatment of these symptoms are *A. cordifolia*, *T. brownii*, *P. hirsuta*, *K. senegalensis*, *S. dulcis*, *P. pinnata*, *C. occidentalis*, *H. rotundifolia*, *F. sur*, *Z. zanthoxylloides*, *A. muricata*, *A. precatorius*, *V. paradoxa*, *T. glaucescent*, and *C. patens* (Table 5).

Discussion

The present study collected information on the plants marketed in the autonomous district of Abidjan and used to treat tuberculosis and associated symptoms. In the markets of the communes of Abobo, Yopougon, and Port-Bouët, this study was conducted among 171 herbalists, the majority of whom were women (92.40%). The predominance of women among herbalists has already been reported by similar studies conducted in Côte d'Ivoire by Ambé et al. (2015) in the markets of Abidjan with 96.00% women. This same finding was made by Hermans et al. (2004) in the markets of southern Benin, where 100% of herbalists are women. This can be explained by the fact that in Côte d'Ivoire, selling in markets is an activity usually undertaken by women. In contrast, in the markets of Dakar, Senegal (Dasylva 2001), Burkina Faso (Sanon et al. 2003), and Mali (Togola et al. 2005), men are the most numerous in the medicinal plant trading. This could be due to environmental and socio-cultural differences between these regions and the Abidjan district.

Regarding age, herbalists over 30 years old are the most numerous because they have more knowledge of the uses of medicinal plants, and their properties are usually acquired as a result of long-accumulated experience. In addition, plant virtues are ancestral knowledge transmitted from generation to generation (Benlamdini et al. 2014). This study shows that 52.02% of those surveyed have a minimum level of primary education. This demonstrates the professionalism of these herbalists, which is gradually gaining ground. This education could promote the adoption of good practices in storing and delivering commercialized medicinal plants. On the other hand, previous studies conducted in other regions of Côte d'Ivoire by Gnagne et al. (2017), Sidio et al. (2020), and Koman et al. (2021) show that this activity is practiced mostly by uneducated people.

The ethnobotanical survey led to 41 plant species marketed to treat tuberculosis and its associated symptoms. These inventoried plant species reflect their diversity in treating these pulmonary diseases and denote the richness of knowledge acquired in the field. Among the species identified in this study, the Fabaceae (14.63%) is the most numerous. That can be explained by the new nomenclature adopted by APG IV (2016), which combines, within this family, the Mimosaceae and Ceasalpiniaceae.

Table 4. Some ethnobotanical parameters of plants used against tuberculosis and associated symptoms in the District of Abidjan, Côte d'Ivoire

Species	[1]RFC (%)	[2]CPr (%)
Alchornea cordifolia (Schumach. & Thonn.)	25.14	17.46
Heterotis rotundifolia (Sm.) Jacq. - Fél	15.2	12.69
Zanthoxylum zanthoxyloides (Lam.)	8.77	11.11
Khaya senegalensis (Desr.) A Juss	3.5	12.69
Spondias mombin L.	3.5	4.76
Ocimum gratissimum L.	2.92	12.69
Bidens pilosa L.	2.33	11.11
Citrus aurantifolia (Christm.) Swingle	2.33	6.349
Desmodium adscendens (Swartz) D.C.	2.33	9.52
Ficus sur Forssk.	2.33	7.93
Morinda lucida Benth.	2.33	9.52
Annona muricata L.	1.75	7.93
Ceiba pentandra (L.) Gaertn.	1.75	7.93
Crossopteryx febrifuga (Afzel.) Benth.	1.75	4.76
Parkia biglobosa (Jacq.) R. Br.	1.75	7.93
Scoparia dulcis L.	1.75	7.93
Terminalia brownii Fresen.	1.75	9.52
Trema orientalis (L.) Blume	1.75	7.93
Ageratum conyzoides L.	1.16	11.11
Bridelia ferruginea Benth.	1.16	9.52
Nephrolepis bisserata (Sw.) Schott.	1.16	6.34
Piliostigma thonningii (Schum.) Milne-Red.	1.16	6.34
Ricinodendron heudelotii (Baill.) Pierre.	1.16	4.76
Terminalia glaucescens (Planch.)	1.16	6.34
Abrus precatorius L.	0.58	6.34
Annona senegalensis Pers.	0.58	4.76
Bombax costatum Pellegr. & Vuillet.	0.58	6.34
Cassia nilotica (L.) Willd.	0.58	4.76
Cassia occidendalis L.	0.58	7.93
Cleistopholis patens (Benth.) Engl. & Diels.	0.58	4.76
Cymbopogon citratus (DC.) Stapf.	0.58	3.17
Eucalyptus camaldulensis Dehnhardt.	0.58	4.76
Harungana madagascariensis Auct.	0.58	4.76
Heliotropium indicum L.	0.58	6.34
Kigelia africana (Lam.) Benth.	0.58	7.93
Newbouldia laevis (P. Beauv.) Seeman	0.58	4.76
Palisota hirsuta (Thunb.) K. Schum.	0.58	9.52
Paullinia pinnata L.	0.58	6.34
Pterocarpus erinaceus Poir.	0.58	6.34
Rauvolfia vomitoria Afzel.	0.58	6.34
Vitellaria paradoxa C.F.Gaertn.	0.58	4.76

Note: RFC = Relative frequency of citation; CPr = Contribution of plants in recipes

Table 5. Consensus and floristic richness in the treatment of symptoms associated with tuberculosis in the District of Abidjan, Côte d'Ivoire

Symptoms treated	Number of species used	ICF	Plant species mentioned
Chronic coughs	41	0.84	*Alchornea cordifolia*, *Terminalia brownii*, *Palisota hirsuta*, *Khaya senegalensis*, *Scoparia dulcis*, *Paullinia pinnata*, *Cassia occidentalis*,
Fever	38	0.82	
Asthenia (exaggerated fatigue)	37	0.80	*Heterotis rotundifolia*, *Ficus sur*, *Zanthoxylum zanthoxylloides*,
Bloody cough	26	0.80	*Annona muricata*, *Abrus precatorius*, *Vitellaria paradoxa*, *Terminalia*
Muscle aches	32	0.78	*glaucescent*, *Cleistopholis patens Morinda lucida*, *Nephrolepsis*
Chest pain	27	0.73	*bisserata*, *Bombax costatum*, *Bidens pilosa*, *Piliostigma thonningii*,
Nocturnal sweating	6	0.61	*Rauvolfia vomitoria*, *Ricinodendron heudelotii*, *Pterocarpus*
Chronic weight loss	26	0.60	*erinaceus*, *Bridelia ferruginea*, *Ageratum conyzoides*, *Kigelia*
Loss of appetite	13	0.56	*africana*, *Trema orientalis*, *Heliotropium indicum*, *Harungana*
Weakness	10	0.33	*madagascariencis*, *Parkia biglobosa*, *Eucalyptus camaldulencis*,
A general feeling of discomfort	3	0.11	*Crossopteryx febrifuga*, *Ocimum gratissimum*, *Cymbopogon citratus*, *Ceiba pentandra*, *Spondias mombin*, *Desmodium adscendens*, *Annona senegalensis*, *Citrus aurantifolia*, *Newbouldia laevis*, *Cassia nilotica*.

Note: ICF = Informant Consensus Factor

Among the species listed, phanerophytes are the most numerous (80.49%). These results reflect the state of the vegetation of tropical and equatorial zones, whose proportion in phanerophytes is estimated between 80 and 90% (Koko et al. 2009; Ambé et al. 2015). Regarding morphological types, the high frequency of shrubs (43.90%) would be explained by the fact that shrubs are frequently found in users' immediate environment, and one has easy access to the organs (Gnagne et al. 2017). Finally, the proportions of the species' phytogeographic distribution recorded the predominance from the Sudan-Zambezi zone (41.46%). On the other hand, species from the Sudano-Zambezian and Guinean-Congolian transition zone are regularly used in phytotherapy by Ivorian practitioners (Dro et al. 2013).

The analysis of the specific frequency of quotation and their contribution in the different recipes shows that *A. cordifolia*, *H. rotundifolia*, *Z. zanthoxylloides*, *K. senegalensis*, *O. gratissimum*, *A. conyzoides*, and *B. pilosa* are the most quoted species. Which is also the most used in the different recipes to treat pulmonary tuberculosis by the herbalists in Abidjan. However, most other species listed seem to be more or less known, given their frequency of quotation and their contribution to the different recipes, which are not negligible. This could be explained by the diversity of species used in the different treatments of symptoms, and the combination of several plants or organs could reinforce the healing power of the preparations.

Leaves are the most used organs (44.63%), followed by barks and roots. The predominance of leaves in recipes by practitioners could be justified by the abundance of chemical groups they contain, as they are known as the site of synthesis of secondary plant metabolites (Lumbu et al. 2005). Authors such as Zirihi (1991) and Diatta et al. (2013) have also shown that leaves are the most used plant organs in traditional medicine to treat various ailments. All of these organs mentioned above are prepared mainly by decoction. Decoction allows for the collection of the most active ingredients and mitigates or negates the toxic effect of some recipes (Salhi et al. 2010). These preparations are all prescribed as a drink or oral route. This prescription can be explained by the disease being related to bacterial infections localized in the deep organs. Therefore, to reach them, any compound must pass through the digestive system to facilitate assimilation and action (Tra et al. 2008).

This study has shown that multi-specific recipes (100%) are the most used to treat tuberculosis and associated symptoms. This could be explained by the fact that the association of plants reinforces the activity of the remedies. In addition, it allows creating a dynamization of the curative effects of various constituents to achieve a therapeutic synergy fighting both the bacteria responsible for the disease and also acting against certain symptoms such as fatigue, lack of appetite, fever, etc. (Betti 2003; Bla et al. 2015). This study researched the Ivorian flora for plant species used against tuberculosis and associated symptoms. These surveys revealed a diversity of 41 plant species belonging to 26 families. Fabaceae (14.63%), Annonaceae (7.32%), and Euphorbiaceae (7.32%) are the most represented. The level of knowledge of the plant species used against this pathology and its associated symptoms varies from one species to another, being higher for *A. cordifolia*. As a result of this survey, six plants species, i.e., *N. bisserata*, *V. paradoxa*, *T. glaucescens*, *A. cordifolia*, *F. sur*, and *K. africana*, are commonly used in combination in the treatment of tuberculosis and its associated symptoms.

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An ethnobotanical study on across different ethnic groups from high-altitude areas of the Northwestern Himalayas

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Abstract. *Khoja AA, Andrabi SAH, Mir RA. 2023. An ethnobotanical study on musculoskeletal disorders across different ethnic groups from high-altitude areas of the Northwestern Himalayas. Asian J Ethnobiol 6: 46-57.* Musculoskeletal Disorders (MSDs) are injuries and disorders that affect the human body's movements. In traditional medicine variety of plant species across the globe are used to treat these diseases. The present study examined to document the plant taxa used for the said diseases in the remote and frontier area (Kupwara) of the union territory of Jammu and Kashmir-India. Extensive surveys were conducted using simple stratified sampling from April 2020 to July 2022. Three different quantitative ethnobotanical indices (Use value, Informant Consensus Factor (ICF), and family use values) were used to interpret the results. A total of N=46 plant species from N=32 families were identified. Asteraceae (N=4) was the dominant family recognized; among the total enlisted species (N=37) were herbs, accounting for most of the life form contributing to treating the maximum number of diseases (80%). Leaf accounted for the majority of all plant parts (N=11), followed by root (N=10); the most popular and effective preparation techniques listed were decoction and paste; maximum UV was calculated for *Geranium wallichianum* D.Don ex Sweet (0.73) and the lowest UV for *Phytolacca acinosa* Roxb. (0.28). The highest FUV was conceived for Geraniaceae (0.68). Joint pain was treated by most species (N=26), and the highest value of ICF was recorded for inflammation (0.45), followed by Muscular pain (0.43). The cross-cultural analysis showed that all commonly used 13 species said selected ethnic groups (Gujjar, Bakarwal, and Kashmiri).

Keywords: Ethnic groups, Musculoskeletal Disorders (MSDs), Northwestern Himalayas

INTRODUCTION

Non-communicable diseases like Musculoskeletal Disorders (MSDs) rapidly increase throughout developed and developing nations (Puntumetakul et al. 2011). These illnesses affect more than 1.7 billion people worldwide and are a leading cause of disability and death (Hignett et al. 2010). According to a recent World Health Organization (WHO) report, MSDs, including osteoarthritis, arthritis, back and neck discomfort, and bone fractures, are the second-most prevalent cause of disability worldwide (Musculoskeletal Conditions 2019). Approximately 20-33% of people worldwide have endured excruciating and incapacitating muscular-skeletal illnesses (Malik et al. 2018). In addition, MSDs can cause impaired mobility and skill, resulting in job loss and diminished social role performance (Musculoskeletal Conditions 2019). Every country in Asia has a high prevalence of arthritis, but India and China are particularly affected (Brennan et al. 2017). One of the world's leading causes of chronic morbidity and disability, Musculoskeletal Disorders (MSDs), which include more than 150 conditions affecting the bones, muscles, ligaments, and other connective tissues, are a significant contributor to the global disease burden, making up 1.7% to 3.4% of it. Because they tend to produce fatigue, which forces workers to leave their jobs before fully recovering, discomfort, and joint deformity, MSDs are the primary cause of activity restriction, loss of function, and long-term disability (De Costa and Vieira 2010). The most incapacitating MSDs include back and neck pain, Osteoarthritis (OA), Rheumatoid Arthritis (RA), and fractures. These conditions significantly impair healthy aging by lowering physical, mental, and functional capabilities (Rabiei et al. 2012). According to the International Labor Organization (ILO), around 2 million women and men worldwide die from illnesses related to their jobs each year, which equates to more than 5,480 fatalities each day. Worldwide, WMSDs are regularly cited as one of the major reasons why workers complain (Lima and Coelho 2011). Moreover, these conditions are the most common health issues experienced by workers in developed countries (Bevan 2015).

Nonetheless, cultural change, particularly the impact of industrialization and the Western worldview, appears to be the greatest threat to local knowledge of therapeutic plants (Haq et al. 2020). In addition, the spread of modern schooling, which has aided in weakening traditional values among the young, may have also contributed to knowledge loss on therapeutic plants (Giday et al. 2002). Numerous medicinal plants have been used to treat various diseases, including muscular discomfort, rheumatism, broken bones, etc., connected to MSDs. In the modern era, ethnobotanical investigations have gained a global reputation due to the selection of plants to treat diseases and develop natural drugs (Haq et al. 2022).

Traditional ethnobotanical knowledge is transmitted orally from generation to generation (Az-Zahra et al. 2021).

This knowledge is vital in primary health care across local communities, especially ethnomedicine (Pieroni and Quave 2005). In India, more than 75% of people in many regions use this knowledge as their primary source of medical care (Qureshi and Abrams 2007; Mahmood et al. 2011). For example, in the valley of Kashmir, which lies in the bosom of the Himalayas, traditional medicine has been practised for centuries, having a vital role in primary healthcare (Hassan et al. 2022; Mir et al. 2022a,b). However, with the ongoing urbanization and the changing mode of life, allopathic medicine is prioritized over traditional medicine. That becomes a potential cause of eroding traditional knowledge. In this regard, our study tried to enlist the taxa used in MSDs from the remotes areas of the frontier administrative district Kupwara with the following objectives: (i) The number of plant species utilized to treat MSDs, (ii) Plant species and families most crucial for treating MSDs. (iii) Plant parts and preparation techniques for treating MSDs.

The results of this study may make it easier to identify and select plant species that can be evaluated for the pharmacological profile so possible molecules or compounds can be obtained with potent medical attribution.

MATERIALS AND METHODS

Study area

Kupwara is an administrative district in the Union territory of Jammu and Kashmir (India) with a population of 870,354. As per the latest census records, the region has a population density of 368 people per km^2, further the area is divided into three tehsils and 362 villages (available at https://www.census2011.co.in, accessed on 11 June 2022). The topography includes high mountains, hills, and plain areas with many high-altitude grassland pastures. Hence, the area mostly has a high altitude. However, a variation is seen across the region, and the average altitude is almost 1,800 m. According to the Köppen classification, the climate is of the *cfa* (Humid subtropical climate) type (Aadil and Andrabi 2021; Hassan et al. 2022). The major water bodies include Talri and Mawar Rivers; Talri originates from the famous Lolab valley and flows from east to west. Agriculture is central to the regional economy, principal crops grown in the area are maize, wheat, and rice, along with beans and peas. According to Haq et al. (2020), the area is known for its dense forests (Himalayan dry-temperate to subalpine forest types), a wide variety of floral species, and abundant medicinal plants.

Ethnobotanical data collection

From April 2020 to August 2022, extensive surveys were carried out in the research region to collect medicinally significant plants used to treat MSD disorders following the International Classification of Primary Care, Second Edition (ICPC-2); disorders were also classified according to specific body systems. Village chiefs were contacted before the study to gain the trust and assistance across the region. A total of 59 visits were made to the selected places in the region (Figure 1): (Sadna top (3,000-3,500 m), Farkan (2,500-3,000 m), Tee-Pee (2,000-2,500 m), Bungus valley (3,000 m), Langate (1,600 m), Tangdar (1,400-2,800 m), Keran (1,400-2,200 m), Rashanpora Dutt (2,800-3,200 m), Thandipora (1,900-2,200 m), and Budnamal (2,100-2,700 m).

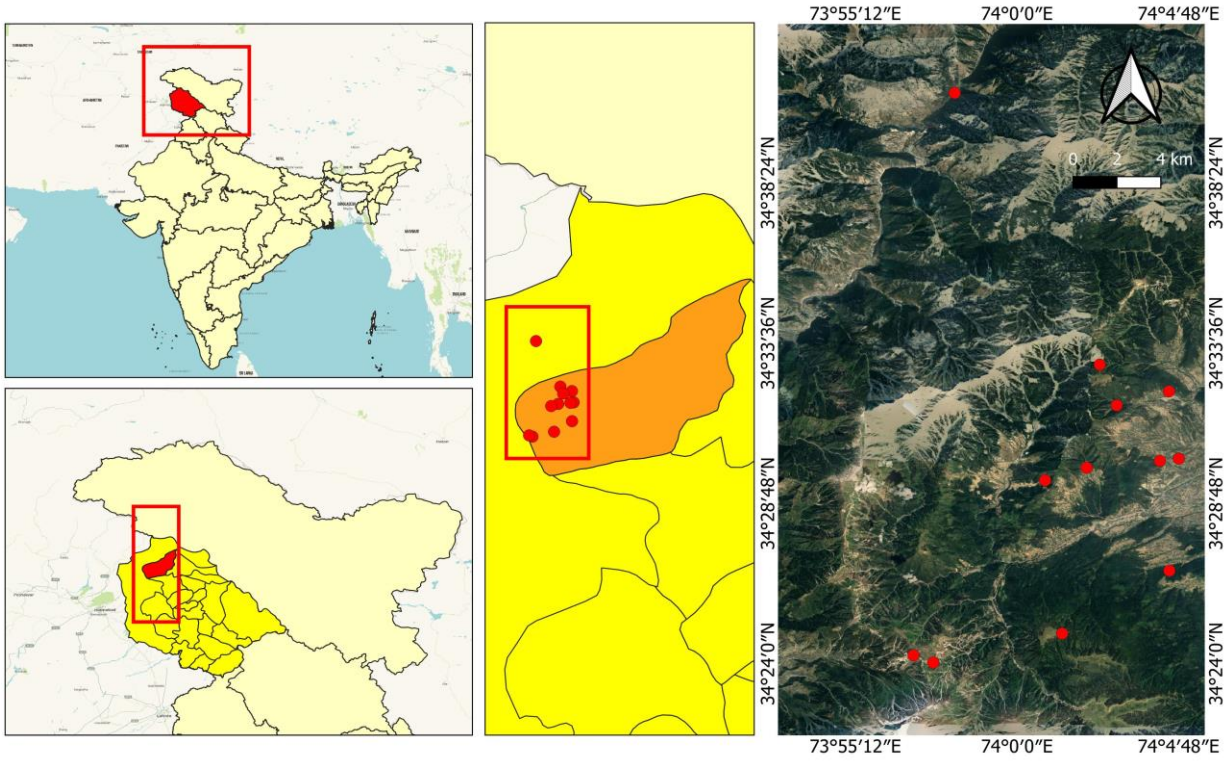

Figure 1. Map of Kupwara District, Jammu and Kashmir, India, showing surveyed villages

Therefore, utilizing simple stratified sampling, informants were questioned employing semi-structured interviews and group discussions (Martin 1995). A translator was hired from the respective places to improve data collecting because the chosen villages are primarily inhabited by the Gujjar, and Bakarwal, with few Kashmir who spoke different languages. Additionally, the gathered data was compared to the existing literature (Gairola et al. 2014; Haq et al. 2019). The International Society of Ethnobiology established rules throughout the study.

For herbarium specimens, plants with fully developed stems, roots, and blooms were gathered, and identification was carried out by comparing the voucher specimens with previously identified specimens placed at the Herbarium University of Kashmir, Srinagar (Acronym KASH). According to The Plant List, the botanical names of the plant species are confirmed.

Data analysis

Three different quantitative ethnobotanical indices, such as species Use Value (UV), Informant Consensus Factor (ICF), and Family Use Values (FUV), were carried out to interpret the obtained results.

Use Value (UV)

The relative importance of the recorded taxa was calculated through the Use Value (UV) (Phillips et al. 1994). It was calculated through the following formula:

$$UV = \Sigma Ui/Ni$$

Where, Ui indicates the number of use reports mentioned by informants for given plant taxa, and Ni is the total number of informants that participated in the study. Use Value is high when there are many use reports for a given medicinal plant species, and use value is low when there are few reports associated with its use.

Informant Consensus Factor (ICF)

ICF highlights plants of particular cultural relevance and agreement in using taxa. It helps to identify the variability of the medicinal plants and determine the plant taxa of particular interest. The diseases treated by the enlisted plant taxa were grouped into categories to analyze ICF; hence more ethnopharmacological interesting plant taxa might be identified. ICF was calculated using the formula proposed by (Heinrich et al. 1998), which is used to test the hypothesis of knowledge homogeny as follows:

$$ICF=Nur-Nt/Nur-1$$

Where, Nur is the number of use reports (citations) in each ailment category, and Nt is the number of plant taxa employed for particular ailments. The ICF always ranges from 0 to 1. A high range (nearest to 1) means many people employ relatively few taxa. In contrast, a low range means participants disagree on the taxa employed within a particular category of diseases (Gazzaneo et al. 2005).

Family Use Value (FUV)

FUV helps to identify and signify the use-value of a given medicinal plant family used as a medicine flora in a particular locality. The family use-value was calculated using the formula of Hoffman and Gallaher (Nadaf et al. 2019): High FIV value demonstrates rich knowledge among the informants, while low FIV values show less awareness regarding the use of the family.

$$FUV \quad \sum UVs/ns$$

Where; UVs is the species use value of the plants cited by informants and ns represents the total number of plant taxa documented in the family.

RESULTS AND DISCUSSION

Demographic characteristics of the respondents

Furthermore, 90 informants from three ethnic groups (Gujjar, Bakarwal, and Kashmiri) were selected, among which the majority were males (58 males and 32 women). The dominance of male informants in the study was due to cultural limitations (young females are reluctant to meet unknown males due to religious obligations), which can be ascribed to the possible bias of the current study. The selected informants were categorized into different professional groups and age groups. Their education status was also comprised, although younger individuals have higher levels of education than older ones (Table 1). Urdu, Kashmiri, Phari, and Gujri are the four different types of languages spoken in the study area.

Table 1. Demography of respondents from the study area

Demographic features	Number	Percentage
Ethnic groups	Gujjar, Bakarwal, Kashmiri	
Language	4 (Urdu, Kashmiri, Phari, Gojeri)	
Education		
Illiterate	48	53.33
Primary education	22	24.44
Secondary education	12	13.34
Higher education	8	8.89
Age range		
Young (18-26)	16	17.78
Middle (27-50)	30	33.33
Old (51-85+)	44	48.89
Profession		
Hakeem (traditional healers)	11	12.22
Skilled/semi-skilled worker	14	15.56
Cultivator/agricultural laborer	20	22.22
Herders	17	18.89
Govt. Employees	8	8.89
Housewives	15	16.67
Shopkeepers	5	5.56
Gender		
Male	58	64.44
Female	32	35.56
Religion	Islam	100

Medicinal plant diversity used to treat musculoskeletal disorders

A total of N=46 plant species from N=32 families were identified and used to treat musculoskeletal problems (Table 2). Most of the enlisted species belonged to the family: Asteraceae (N=4, 9%), followed by Ranunculaceae, Polygonaceae, and Solanaceae families (N=3, 7% each), Berberidaceae, Lamiaceae, Geraniaceae, Plantaginaceae, and Liliaceae families (N=2, 4% each), while the remaining 24 families only contribute (N=1, 2% each). The relationship between species and families (Y= 0.024x + 1.848; R^2=0.085) can be seen in (Figure 2A). Table 2 contains information on the examined species, including botanical names, families, common names, life forms, parts used, preparation and administration methods, and diseases treated. The dominance of families was also analogous to research done in other Himalayan regions, where numerous studies noted that the main family was Asteraceae (Abdullah and Andrabi 2021; Altaf et al. 2021; Asif et al. 2021; Nafeesa et al. 2021). According to Haq et al. (2023a), Asteraceae family members adapt to arid, dry environments quickly and easily due to their vast ecological.

Among the total enlisted species (N=36) were identified as herbs, accounting for most of the life forms; it contributed to treating a maximum number of diseases (80%). Next, followed by shrubs (9%), trees (7%), and climbers (4%) (Figure 2B). The maximum usage of herbs can be attributed to the easy collection, traditional faith in ethnomedicine, and maximum familiarity from Pakistan, (Adnan et al. 2014; Haq et al. 2021; Khoja et al. 2022a,b,c) from Kashmir Himalayas revealed that the maximum usage of herbs is due to high amount of bioactive chemicals and stronger medical effects than other plants form.

Plant parts used in the preparation of Herbal recipes

The present study recorded different plant parts employed to treat various ailments. Leaf accounted for the majority of all plant parts (N=11, 26%), followed by root (N=10, 24%), tuber use (N=6, 14%), seed, whole plant (N=4, 10% each), aerial part use (N=3, 7%), fruit (N=2, 5%), bark use (N=1, 2%) and stem (N=1, 2% each) (Figure 3). Our results are in line with (Hassan et al. 2022; Khoja et al. 2022 a, b). In addition, the difference in plant part consumption could be due to differences in species variety and bioactive compounds found in different plant parts (Appiah 2019).

Therefore, different approaches are employed in producing and administering herbal medicines depending on the ailment being treated. The most popular and effective preparation techniques listed were decoction (35%), paste (28%), followed by infusion and oil (11% each), tea (6%), vegetable (7%), and powder (2%). (Figure 4). Our results of the most preferred method of preparation and utilization are consistent with comparable ethnobotanical studies abroad from District Mastung of Balochistan Province-Pakistan and Turkey (Gürdal and Kültür 2013; Bibi et al. 2014). Most herbal medications have a bitter flavor, so certain sweet components like honey and sugar are included when making the medications to lessen the bitterness (Ayyanar and Ignacimuthu 2011; Balangcod and Balangcod 2011). Most medicinal plants (*Saussurea costa, Geranium wallichianum, Aconogonon rumicifolium, Rumex nepalensis* are boiled in water. The obtained water is used for cooking rice. In the whole process, the usage of plants is maximum; however, in the case of *S. costa*, the usage of the part is very less; this less usage is due to the belief that maximum usage can cause paralysis (Khoja et al. 2022a,b,c). The total documented plant species from the study area were found to inhibit in different altitudes; the maximum species were reported from the area with an altitude ranging between 2,000-2,500 m followed by an altitude range of 1,501-2,000 m (Figure 4B, Table 2). Some of the plant preparations are mostly used to treat MSDs in the study area are shown in Figure 5. Figure 5A is the paste of *Trigonella foenum-graecum*, which is applied topically on fractured bone, Figure 5B describes the crushing of medicinal plants used to treat MSDs, as most of the medicinal plants are crushed before use. Cooking medicinal plants using the extract of *Rheum webbianum, G. wallichianum,* and *R. nepalensis* to Cook rice (Figure 5E). Then, which is taken later on along with vegetables or a non-vegetarian diet, dhesi ghee is mixed with rice while eating it.

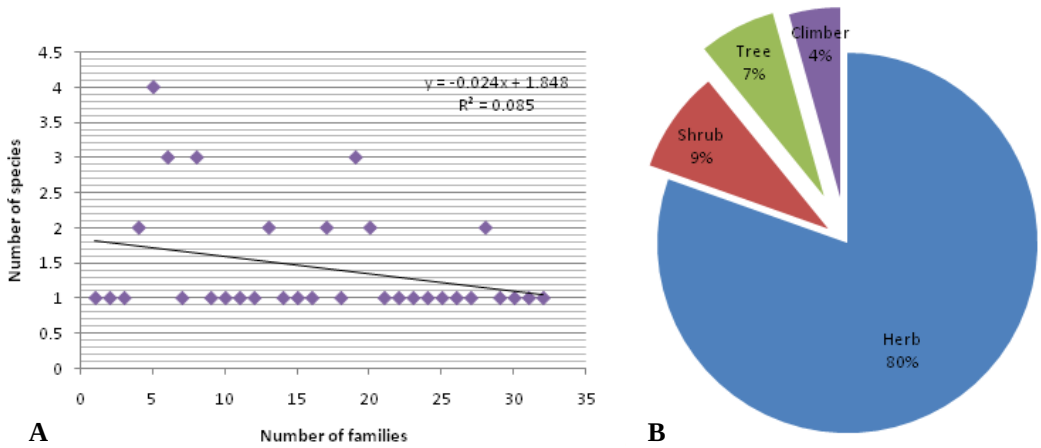

Figure 2. A. Contribution of various families to ethnomedicinal flora in the study area. B. Contribution of life forms in the study area

Table 2. Medicinal plants used to treat Musculoskeletal Disorders (MSDs) in the northern part of Kashmir Himalayas, India

Scientific name	Coll. code	Family	Common name	Part used	Life form	Altitudinal range	Preparation	Mode of administer.	Disease treated	∑U	UV	Ethnic groups		
												G	B	K
Abies pindrow (Royle ex D.Don) Royle	2965-KASH	Pinaceae	Bunder	Bark	Tree	2100-2800	Bark of the tree is boiled for a half hour to make tea	Internal	Rheumatic pain, inflammation	38	0.42	Y	Y	N
Aconitum heterophyllum Wall. ex Royle	4049-KASH	Ranunculaceae	Patris	Tuber	Herb	2500-3200	Dried tubers are soaked in water overnight to make an infusion	Oral	Back pain	42	0.47	Y	Y	Y
Aconitum violaceum Jacquem. ex Stapf	-	Ranunculaceae	Itees	Tuber	Herb	2500-3000	Bark of the tree is boiled for a half hour to make an infusion	Oral	Rheumatic pain	35	0.39	Y	Y	N
Aconogonon rumicifolium (Royel ex Bab.) Hara	7091-KASH	Polygonaceae	Safeed-abij	Roots	Herb	2900-3500	Roots are boiled in water and later cooked along with rice	Oral	Rheumatic pain, joint pain	60	0.67	Y	Y	Y
Actaea spicata var *acuminata* H.Hara	6242-KASH	Ranunculaceae	Hapat fal	Roots	Herb	2000-2500	Dried roots are boiled in water and taken upon cooling	Oral	Arthritis, joint pain	40	0.44	Y	N	N
Adiantum venustum D.Don	4104-KASH	Pteridaceae	Guewtheer	Whole plant	Herb	1500-2000	Whole frond is soaked in water and kept outside overnight	Oral	Muscular pain	35	0.39	N	Y	N
Aesculus indica Colebr. ex Wall	4111-KASH	Sapindaceae	Handoon	Fruits	Tree	2000-2500	Fruits are crushed to extract oil	External	Rheumatic pain	41	0.45	Y	Y	N
Ajuga parviflora Benth	4095-KASH	Lamiaceae	Jain-adam	Whole plant	Herb	1500-2000	Leaves are soaked in water overnight	External	Arthritis	46	0.51	N	Y	Y
Allium victorialis L.	3812-KASH	Amaryllidaceae	Jungle-rohan	Aerial part	Herb	2000-2500	Leaves are cooked as a vegetable	Oral	Joint pain	37	0.41	Y	Y	N
Amaranthus caudatus L.	6245-KASH	Amaranthaceae	Ganhar	Leaves, seeds	Herb	1000-2000	Leaves and seeds are cooked as a vegetable	Oral	Joint pain, back pain	46	0.51	N	N	Y
Artemisia absinthium L.	4020-KASH	Asteraceae	Tethwan	Aerial part	Herb	1500-2500	Dried leaves are crushed into a paste	External	Inflammation, bone fracture	53	0.59	Y	Y	Y
Aralia cachemirica Decne	4245-KASH	Araliaceae	Kutki	Roots	Herb	2000-2300	Roots are boiled in water to collect the extract, later used to cook rice	Oral	Rheumatic pain	30	0.33	Y	N	N
Atropa acuminate Royle ex Lindl.	4252-KASH	Solanaceae	Brand	Leaves	Herb	2000-2500	Paste of leaves is mixed with mustard oil	External	Rheumatic pain, muscular pain	36	0.40	N	Y	N
Berberis lyceum Royle	4102-KASH	Berberidaceae	Chockchrey	Roots	Shrub	1500-2000	Roots are crushed into powder and taken along with water	Oral	Arthritis, muscular pain	46	0.51	Y	Y	N
Berberis aristata DC.	6247-KASH	Berberidaceae	Sumbal	Roots	Shrub	1500-2000	Roots are crushed into powder and taken along with water	Oral	Joint pain, bone fracture	39	0.43	N	Y	Y
Bergenia ciliate (Haw.) Sternb.	4213-KASH	Saxifragaceae	Palfort	Roots	Herb	2500-3200	Dried roots are used to make tea	Oral	Joint pain, bone fracture	56	0.62	Y	Y	Y
Cascuta reflexa Roxb.	4082-KASH	Convolvulaceae	Kukliport	Whole plant	Climber	1500-2000	Whole plant is crushed into a paste along with dhesi ghee	External	Joint pain, inflammation	29	0.32	Y	N	Y

Capsella bursa pastoris L.	4250-KASH	Brassicaceae	Kralmond	Leaves	Herb	1000-2000	Leaves are crushed into a paste and mixed with mustard oil	External	Inflammation, muscular pain	41	0.45	Y	N	Y
Cynoglossum nervosum Benth.	7109-KASH	Boraginaceae	Richola	Roots	Herb	2000-2200	Roots are boiled in water, and the extract is used for cooking rice	External	bone fracture	48	0.53	Y	Y	N
Cichorium intybus Linn.	4222-KASH	Asteraceae	Hand	Leaves	Herb	1000-2000	Dried leaves are boiled and crushed into a paste and then fried	External	Inflammation, bone fracture	65	0.72	Y	Y	Y
Colchicum luteum Baker	6251-KASH	Colchicaceae	Virkumpoash	Tuber	Herb	2000-2800	Dried tubers are crushed into powder and mixed with mustard oil	External	Joint pain	42	0.46	Y	Y	N
Cynodon dactylon (Linn)	7101-KASH	Poaceae	Druab	Whole plant	Herb	1000-2000	Whole plant is crushed into a paste	External	Muscular pain, inflammation	34	0.38	N	Y	Y
Datura stramonium L.	4085-KASH	Solanaceae	Datur	Leaves	Herb	1000-1500	Leaves are crushed into a paste along with water	External	Inflammation	37	0.41	Y	Y	N
Dioscorea deltoidea Wall. ex Griseb.	6237-KASH	Dioscoreaceae	Shingle-mingle	Roots	Climber	1500-2000	Roots are boiled in water	Oral	Joint pain	43	0.48	Y	Y	N
Fragaria nubicola Lindl. ex Lacaita	4087-KASH	Rosaceae	Ringrish	Roots	Herb	1500-2300	Dried roots are boiled for a half hour to make tea	Oral	Joint pain	48	0.53	Y	Y	Y
Fritillaria roylei Hook.	-	Liliaceae	Sheetkhar	Tuber	Herb	3000-.3500	Dried tubers are crushed into powder and taken along with water	Oral	Joint pain, arthritis	64	0.71	Y	Y	Y
Geranium wallichianum D.Don ex Sweet	4112-KASH	Geraniaceae	Ratanjog	Roots	Herb	1500-2500	Dried roots are boiled in water, and the extract is used for cooking rice	Oral	Arthritis, back pain, joint pain	66	0.73	Y	Y	Y
Geranium pretense L.	4098-KASH	Geraniaceae	Ratanjog	Roots	Herb	2000-3000	Dried roots are boiled in water, and the extract is used for cooking rice	Oral	Joint pain, back pain	57	0.63	Y	Y	N
Hypericum perforatum L.	4089-KASH	Hypericaceae	Chai-kul	Roots	Herb	1000-1500	Roots are boiled in the water	Oral	Joint pain	41	0.45	N	N	Y
Hyoscyamus niger L.	4107-KASH	Solanaceae	bazarbang	Leaves	Herb	2000-2300	Leaves are crushed into a paste and mixed with mustard oil	External	Inflammation, joint pain	38	0.42	N	Y	N
Juglans regia L.	-	Juglandaceae	Doon	Seeds	Tree	1000-2300	Seeds are crushed to extract oil	External	Arthritis, joint pain	49	0.54	Y	N	Y
Lilium polyphyllum D.Don	6236-KASH	Liliaceae	Pland	Tuber	Herb	2000-2300	Dried tubers are boiled in water, and the extract collected is used to make rice	Oral	Joint pain	37	0.41	Y	Y	N
Parrotiopsis jacquemontiana (Decne.) Rehder.	6258-KASH	Hamamelidaceae	Poah	Stem	Shrub	1500-2300	A dried stem is put in the utensil, and a small hole is made at the bottom. Another utensil is placed under and buried in the soil. Then a fire is burnt outside to collect the oil	External	Joint pain, arthritis	31	0.34	Y	N	N

Phytolacca acinosa Roxb.	4253-KASH	Phytolaccaceae	Hapat brand	Leaves	Herb	1500-2000	Leaves are boiled in water and dried, later cooked as a vegetable	Internal	Joint pain	26	0.28	Y	Y	N
Plantago lanceolata L.	6249-KASH	Plantaginaceae	Gull	Seeds	Herb	1000-2000	Seeds are crushed to collect oil	External	Joint pain, inflammation	34	0.38	N	Y	Y
Plantago major L.	4118-KASH	Plantaginaceae	Boad gull	Seeds	Herb	1000-2000	Seeds are crushed to collect oil	External	Inflammation, muscular pain	46	0.51	Y	N	Y
Polygonatum cirrhifolium (Wall.) Royle	4229-KASH	Asparagaceae	Salapmesri	Tuber	Herb	1500-2000	Tubers are crushed into powder and taken along with water	Oral	Rheumatic pain	35	0.39	Y	N	Y
Rhododendron arboreum Sm.	7097-KASH	Ericaceae	Rantola	Leaves	Shrub	3000-3400	Leaves are boiled in water	Oral	Rheumatic pain	31	0.34	N	Y	N
Rheum webbianum Royle	4212-KASH	Polygonaceae	Pambchalan	Roots	Herb	2800-3200	Roots are boiled in water, and the extract collected is used for cooking rice	Oral	Back pain, joint pain	58	0.64	Y	Y	Y
Rumex nepalensis Spreng.	6261-KASH	Polygonaceae	Abij	Roots	Herb	1000-2500	Roots are boiled in water, and the extract collected is used for cooking rice	Oral	Joint pain, arthritis, bone fracture	60	0.67	Y	Y	Y
Saussurea costa (Falc.) Lipsch.	4211-KASH	Asteraceae	Kouth	Roots	Herb	2800-3300	Roots are boiled in water, and the extract collected is used for cooking rice	Oral	Joint pain, bone fracture	63	0.70	Y	Y	Y
Stellaria media (L.) Vill.	4249-KASH	Caryophyllaceae	Nick-haakh	Aerial part	Herb	1000-1500	The aerial part is crushed into a paste	External	Bone fracture, rheumatic pain	41	0.46	Y	N	N
Taraxacum officinales (L.) Weber ex F.H.Wigg	6259-KASH	Asteraceae	Heand	Leaves	Herb	1000-2000	Dried leaves are boiled and crushed into a paste and then fried.	External	Joint pain, bone fracture, rheumatic pain	62	0.69	Y	Y	Y
Trigonella foenum-graecum L.	4248-KASH	Lamiaceae	Meath	Seeds	Herb	1000-1500	Dried seeds are roasted and then crushed into powder and mixed with egg white, and applied	External	Bone fracture, joint pain, inflammation	59	0.66	Y	N	Y
Urtica dioica L.	4219-KASH	Urtiaceae	Soi	Roots	Herb	1000-3000	Roots are boiled in the water, and the extract is used for cooking rice	Oral	Arthritis, joint pain	46	0.51	Y	Y	Y
Verbascum thapsus L.	4242-KASH	Scrophulariaceae	Badur-tond	Leaves	Herb	1000-2800	Leaves are boiled, and water and the extract are used for cooking rice	Oral	Rheumatic pain	39	0.43	Y	Y	N

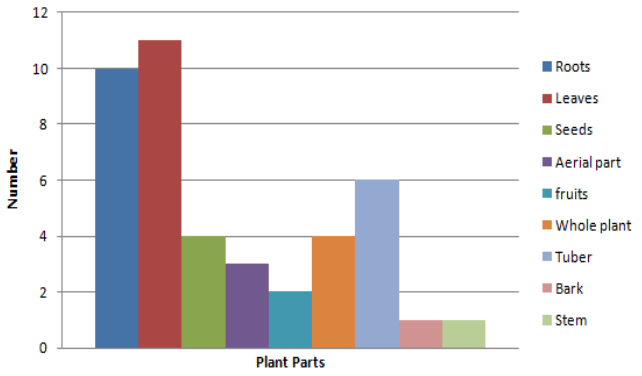

Figure 3. Contribution of plant parts used to treat musculoskeletal diseases

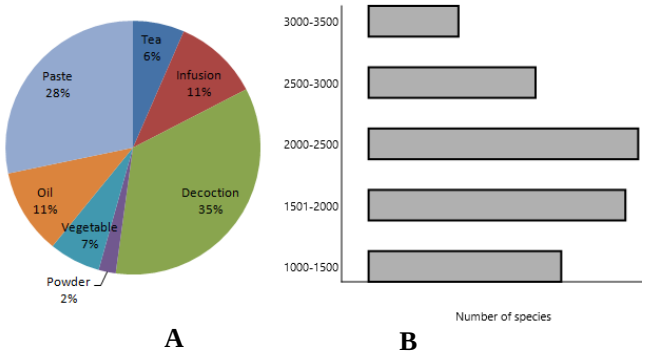

Figure 4. A. Modes of preparation of medicinal plants in the study area. B. Altitude level of the documented species

Use Value (UV)

The value (UV) reveals the significance of the plant species to the informants and the traditional medicinal system in the region. In the present study, UV ranged between 0.28 to 0.73. The species with the maximum UV was *G. wallichianum* (0.73), and the lowest UV was *Phytolacca acinosa* (0.28). The highest UV values of *G. wallichianum* are due to its widespread distribution and the fact that the local population is well aware of its therapeutic applications (Khoja et al. 2022a,b,c). Additionally, it's simple to use, and a wide range of medicinal benefits are some other reasons for maximum UV. The complete inventory of UV is presented in Table 2. For example, the low UV of *P. acinosa* may be caused by a lack of awareness about its medicinal applications and availability in other study areas. Also, the fact that it is toxic and has serious adverse effects. The leaves of *P. acinosa* must first be dried, then boiled, and finally dried once more and kept for 2-4 months before being eaten as a vegetable.

Family Use Value (FUV)

The most ethnobotanically significant plant family in any given region is represented by Family Usage Value (FUV). Table 3 enlists the usage values of the families represented by more than one plant Taxon. The highest FUV was observed for Geraniaceae (0.68), followed by Asteraceae (0.67), Polygonaceae (0.67), Solanaceae (0.61), and Ranunculaceae (0.43). Many significant informants also highlighted these taxa because of their high importance in folkloric medicine. Similar results were reported by (Nadaf et al. 2019; Khoja et al. 2022a,b,c).

Quantitative ethnomedicinal analysis

Based on the informants' information, we categorized the different diseases into seven categories by following the international classification of primary care with certain modifications. Joint pain was treated with most species (N=26), followed by bone and rheumatic pain and inflammation (N=14, 14% each), arthritis and bone fracture (N=10 each), back pain (N=5), and muscular pain (N=5) (Fig. 6). Similar results were reported by (Asif et al. 2021) from Kashmir Himalayas. According to numerous research completed in the past (Haq et al. 2020, Haq et al. 2021), topical application is a significant way of herbal medicine administration used in the treatment of various external ailments, including MSDs diseases.

The ICF demonstrates the ascension among informants on using plants for a particular disease category, highlighting taxa that can potentially treat a specific disease. In the current study, we grouped all documented diseases into seven categories, presented in Table 4. The ICF values ranged from 0.33 to 0.45. The highest value of ICF was recorded for inflammation (0.45), followed by Muscular pain (0.43), arthritis (0.40), joint pain (0.38), bone fracture (0.36), and rheumatic pain (0.35). In addition, the lowest ICF values were recorded for back pain (0.33) (Table 4).

Cross-cultural usage

The present study evaluated the use of documented species across three ethnic communities (Gujjar, Bakarwal, and Kashmiri). The cross-cultural analysis showed that all commonly used 13 (*R. nepalensis, Bergenia ciliata, Fritillaria roylei, Artemisia absinthium, A. rumicifolium, Aconitum heterophyllum, Fragaria nubicola, Taraxcum officinale, Cichorium intybus, Urtica dioica, G. wallichianum, Saussurea costus*, and *R. webbianum*) were commonly used by all said ethnic groups (Figure 7, Table 2). This common usage was due to a wide distribution in all valley areas. Also, the faith of local people in traditional medicinal systems uses various species of flora to treat health disorders (Figure 6). A total of four species (*Actaea spicata* var *acuminata, Stellaria media, Parrotiopsis jacquemontiana,* and *Aralia cachemirica*) were idiosyncratic to Gujjar, four species (*Atropa acuminata, Rhododendron arboreum, Hyoscyamus niger,* and *Adiantum venustum*) to Bakarwal and two species (*Hypericum perforatum* and *Amaranthus caudatus*) to Kashmiri (Figure 7, Table 2). The highest number of characteristic species for Gujjar and Bakarwal is because both communities are less urbanized and mostly depend upon natural resources and traditional medicinal systems. The said communities lack health facilities; both communities are backward, listed by Govt of India.

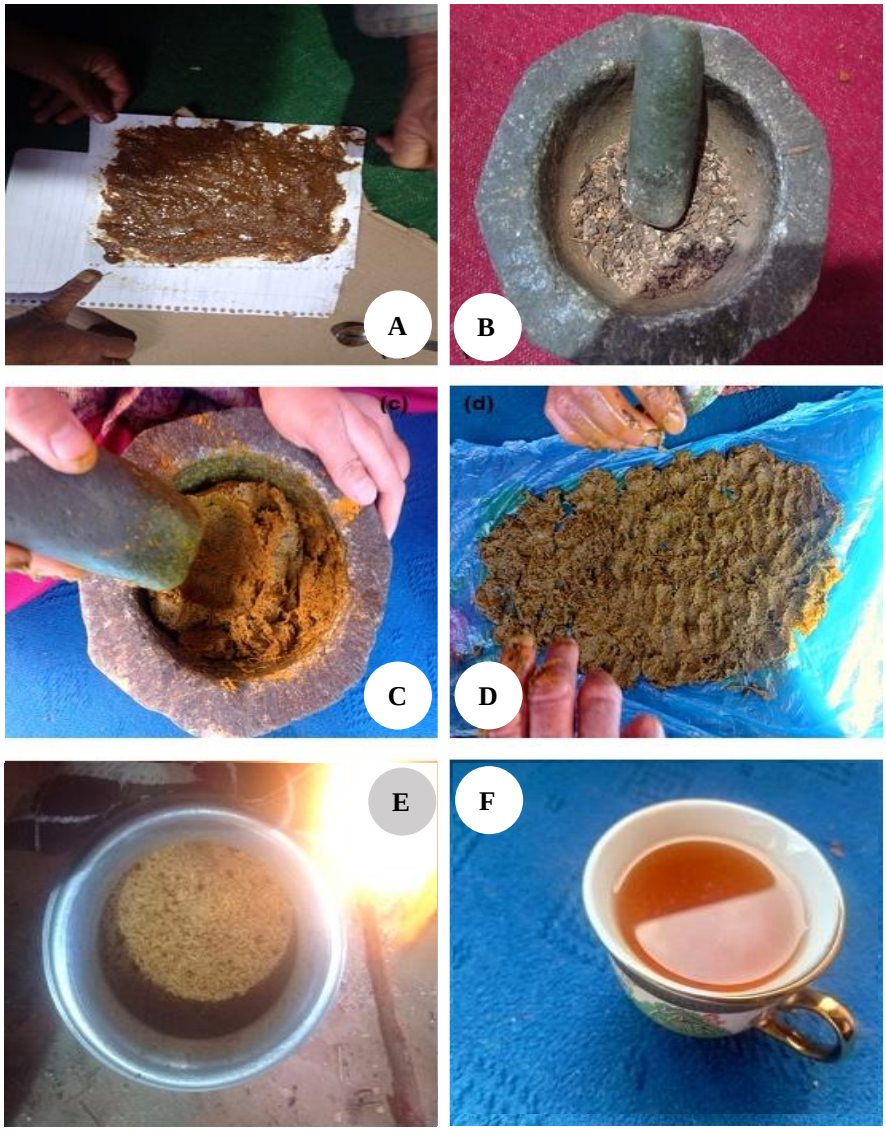

Figure 5. A. Paste of *Trigonella foenum-graecum*, B. The crushing of medicinal plants, C. Paste of *Taraxacum officinales*, D. Paste of *Cichorium intybus*, E. Extract of *Rheum webbianum, Geranium wallichianum, Rumex nepalensis* Cooked along with rice, F. Tea of *Bergenia ciliate*

Table 3. Family use value (FUV) of the documented species in the study area

Family	Taxon	Total use reports (URs)	Use value (UV)	Family use value (FUV)
Ranunculaceae	*Aconitum heterophyllum* Wall. ex Royle, *Aconitum violaceum* Jacquem. ex Stapf, *Actaea spicata* var *acuminata* H.Hara	117	1.30	0.43
Polygonaceae	*Aconogonon rumicifolium* (Royle ex Bab.) Hara, *Rheum webbianum* Royle, *Rumex nepalensis* Spreng.	178	1.98	0.66
Lamiaceae	*Ajuga parviflora* Benth, *Trigonella foenum-graecum* L.	105	1.17	0.58
Asteraceae	*Artemisia absinthium* L., *Cichorium intybus* Linn., *Saussurea costa* (Falc.) Lipsch., *Taraxacum officinales* (L.) Weber ex F.H.Wigg,	243	2.70	0.67
Solanaceae	*Atropa acuminate* Royle ex Lindl., *Datura stramonium* L., *Hyoscyamus niger* L.	111	1.23	0.61
Berberidaceae	*Berberis aristata* DC., *Berberis lyceum* Royle	85	0.94	0.47
Liliaceae	*Fritillaria roylei* Hook., *Lilium polyphyllum* D.Don	101	1.12	0.56
Geraniaceae	*Geranium wallichianum* D.Don ex Sweet, *Geranium pretense* L.	123	1.36	0.68
Plantaginaceae	*Plantago lanceolata* L., *Plantago major* L.	80	0.89	0.44

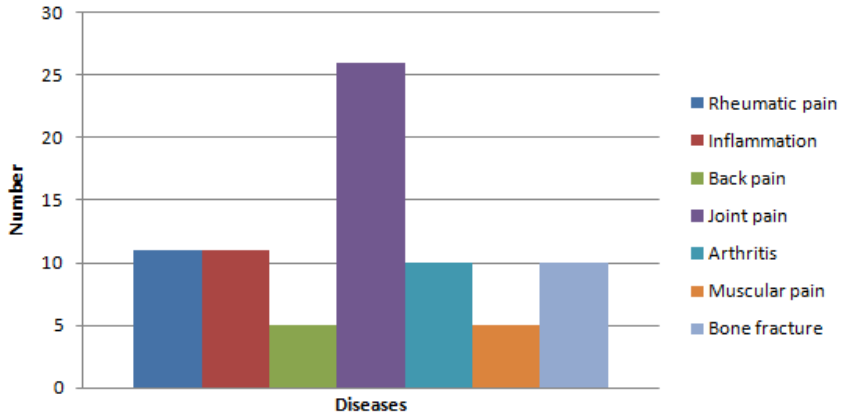

Figure 6. Plants used for the treatment of various disorders in the district of Kupwara, India

Table 4. Recorded ICF for musculoskeletal disorders in the Northern part of Kashmir Himalayas

Disease categories	No. of plant species used (nt)	Use citations (nur)	ICF
Rheumatic pain	11	318	0.35
Inflammation	11	247	0.45
Back pain	5	149	0.33
Joint pain	26	682	0.38
Arthritis	10	253	0.40
Muscular pain	5	117	0.43
Bone fracture	10	280	0.36

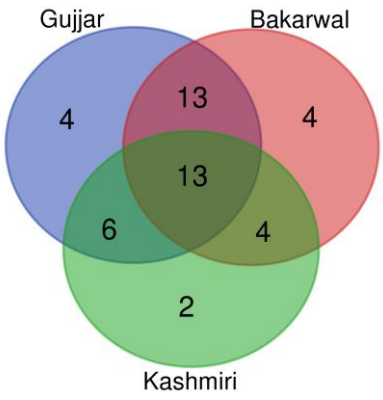

Figure 7. Venn diagram showing the cross-cultural uses of species

While evaluating the similarity between the ethnic groups (Figure 7), In between three groups, maximum homogeneity was between Gujjar and Bakarwal ethnic groups (13 species), followed by Gujjar and Kashmiri (6 species) and Bakarwal and Kashmiri (4 species). And have same activities: graze their animals in pastures, engage in extensive transhumance pastoralism, and travel through various ecological landscapes, gaining sufficient experience with certain plants and retaining more knowledge. In addition, the Bakarwal and Gujjars raise animals and have extensive traditional ecological knowledge of natural resources. They are particularly closely connected to nature due to their greater economic disadvantage and reliance on medicinal plants. The Bakarwal and Kashmiri ethnic groups show an overlap in-plant use. The dissimilarity in medicinal plants in terms of use reports may indicate certain sociocultural gaps. This has prevented the sharing of traditional knowledge among the respective ethnic groups, especially since they do not intermarry (even though they share the same faith). This study found that Gujjar and Bakarwal were more similar in species use; we listed 13 common species for ethnic uses. That includes (*Aesculus indica*, *Colchicum luteum*, *Geranium pretense*, *Datura stramonium*, *Berberis lycium*, *Cynoglossum nervosum*, *P. acinosa*, *Verbascum thapsus*, *Dioscorea deltoids*, *Lilium polyphyllum*, *Allium victorialis*, *Aconitum violaceum*, and *Abies pindrow*). In comparison, the least similarity was found between Bakarwal and Kashmiri, with only four species (*Plantago lanceolata*, *Cynodon dactylon*, *Berberis aristata*, and *Ajuga parviflora*) common. The maximum similarity between Gujjar and Bakarwal is because both communities are associated with the same livelihood and are exogamous to each other. Furthermore, one of the important deciding factors, i.e., Religion, is also the same between both groups, which has an important role in the selection of the species for various purposes in today's life (Table 1). The last similarity between Bakarwal and Kashmiri can be ascribed to communities having socioeconomic, language, and geographic (Table 1) and reported the similarity of Gujjar and Bakarwal on the plant usage from Jammu and Kashmir. The decreased traditional knowledge in the Kashmiri ethnic group is due to less knowledge, economic and social transition, and they feel inferior in using traditional medicine.

In conclusion, the study reveals that the high-altitude areas of the Northwestern Himalayas have traditional repositories directly produced from nature, having the potential to treat bone-related disorders. Local people have developed a potent relationship with nature via generations and have developed vital assets of knowledge, which is very important to present in the scientific domain due to the ongoing cultural encroachments across the globe. Furthermore, the said knowledge can be used to elucidate some novel compounds with potent medicinal attribution. At the same time, the obtained knowledge can be verified

by employing the scientific approach; hence can be proven more beneficial by regulating the basic criteria like dosage and lethality. The present study further reveals the association of cultures with nature, disclosing that Gujjar and Bakarwal are more associated with natural resources than Kashmiri. Therefore, our study will further help the locals to cherish their natural wealth.

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Ethnomedicinal knowledge of the rural communities of Gulmarg, Jammu and Kashmir, India

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Abstract. *Ji A, Hamid A, Andrabi SAH. 2023. Ethnomedicinal knowledge of the rural communities of Gulmarg, Jammu and Kashmir, India. Asian J Ethnobiol 6: 58-64.* In the current study, 60 medicinal plants have been collected from Gulmarg, Jammu and Kashmir (India), belonging to 34 families. The plant parts used were dominated by roots (36%), and the collection of roots has depleted the population of certain plant and may endanger the survival of the rare and slowly reproducing medicinal plants. It was found that the old people possessed a good wealth of traditional information as compared to younger generation Therefore, it is imperative to document the medicinal plants and associated information and to require necessary measures for the conservation of those resources. Herbs dominated all other life forms (49 species). The most typical way to consume the medications was by decoction, 32% (22 species). According to the current study the most prevalent disease addressed by the medicinal plants included was gastrointestinal disorders (25 species). *Artemisia absinthium* L. had the highest Use Value (UV), i.e., 0.58, while *Viscum album* L. had the lowest UV (0.17). Locals continue to value herbal treatments as a trustworthy means of curing a variety of ailments.

Keywords: Ethnomedicine, Gulmarg, medicinal plants, traditional knowledge

INTRODUCTION

A rich source of therapeutic compounds for illness prevention, medicinal plants have a long history dating back thousands of years. Herbal medicine is essential for the treatment of illnesses. Many local groups in impoverished nations still use plant-based medicines today, and modern healthcare systems rely on plant-based components. Plants have been a crucial component of human civilization since humans learned to survive on the earth. Since the beginning of time, mankind has relied on plants to provide for all of their essential requirements. Approximately 70% of the recognized medicinal plants in the Indian Himalayas are subject to opportunistic harvesting (Dhar et al. 2000) 80% of the world's population still relies on conventional medicinal plants today (Dar et al. 2001). The usage of herbal medicine, especially in rural areas where many locally made international medications are still utilised as home cures for a variety of illnesses, continues to be significant (Az-Zahra et al. 2021).

Kashmir Himalayas are home to a vast collection of medicinal plants (Singh et al. 2019). Due to their significance for social, cultural, and economic survival, forests play a significant role in the viability and survival of indigenous households in India (Phondani et al. 2010). The use of these plants' resources for medicine, fuelwood, food, housing, agriculture, timber, furniture, fodder, and religious rituals is the subject of ethnobotanical surveys (Khan et al. 2003). Kashmir is no exception. Rural inhabitants in the Himalayan region, particularly those living close to forested areas, rely more heavily on the use of forest resources. About 800 plant species are thought to be eaten in India as food and medicine, primarily by the tribal people (Venkatachalapathi and Paulsamy 2017) and there are numerous reports on ethno-botanical and ethno-medical knowledge available in the region by different workers (Abdullah and Andrabi 2021, Asif et al. 2021; Haq et al. 2021b; Hassan et al. 2022; Khoja et al. 2022a).

Ethnobotany has been experimenting with new techniques over the past few decades while continuing the dual objectives of recording and preserving ancient human uses of plants and describing and striving to improve human lifestyle (Mir et al. 2020). Consequently, gathering information on plant applications related to health, especially medical and food uses, though other uses are also relevant, dominates ethnobotanical study. Many drugs have been developed based on their ethnobotanical foundation in light of the significance of folk local knowledge to protect and improve health, including the antiviral oseltamivir and the antimalarial artemisinin, to name just two well-known and recent examples (Abdullah and Andrabi 2021; Haq et al. 2021a). One of the major pillars of the field is ethnopharmacology (Haq et al. 2021b).

Due to increased population and highway construction, medicinal plants are frequently included into new commercial endeavours. Because of modern healthcare facilities, the remoteness of the area and a strong cultural belief in the efficacy of folk medicines, the traditional medicinal system serves as the primary provider of primary healthcare services in the tribal areas (Haq et al. 2023b).

The loss of related traditional knowledge could be caused by the extinction of multiple taxa (Lamsal et al.

2017). Because of this, it is crucial to comprehend the ecological behavior of these therapeutic plants, such as their flowering phenology, in order to comprehend their reproductive success (Liu et al. 2021).

Ethno-medicinal plants have significantly aided in the development of innovative treatments for diseases like cancer. Studies on natural products have recently regained popularity due to their biological significance and the role that their structural variety plays in these products (Khoja et al. 2022b). Within the Kashmiri tribal areas, forest resources serve as a source of livelihood, employment, housing, food, fuel, vegetables, medicine, fertiliser, etc. Less research has been done on Gulmarg potential for ethnomedicine. Therefore, an effort has been undertaken to archive the ethnobotanical information of Gulmarg therapeutic plants with the help of the locals, including herbalists, shepherds, and knowledgeable elders.

MATERIALS AND METHODS

Study area

The Gulmarg is home to ethnic groups including the Gujjars and Bakerwals (India), who have a long history of traditional knowledge, particularly connected to medicinal plants. The Gulmarg also has a rich heritage of traditional medicinal plants. It extends between 74°.17' and 74°.79' N latitude and 34°.55' to 34°.60' E longitude, at an altitude of 2400-4300 m, and drops 26 kilometers southwest of District Baramulla. It is divided into 20 compartments, numbered from 31 to 41 and 50 to 58. Although it had been suggested in 1981 to be designated as a Biosphere Reserve, it became a Wildlife Sanctuary in 1987. (Notified vide S.R.O.147, Dated: 14-03-1987). The Ferozpur Nallah top watershed and the woodlands encircling the Gulmarg Bowl are all included in the 180 km^2 that make up the Gulmarg Wildlife Sanctuary (GWLS). Additionally, the region is bordered by the Jhelum Valley Forest Division-Baramulla in the north and the Forest Divisions of Poonch and Pir-Panjal in the south. Village of Drang and Badrakoot forests of Special Forest Division - Tangmarg border the east, and Baba Reshi and Special Forest Division Tangmarg border the west. For their subsistence, the locals of the GWLS depend on raising cattle and gathering non-timber forest products from the surrounding areas. For a variety of ethnic groups, including the Gujjars and Bakerwal, who have a rich heritage of traditional knowledge, particularly regarding the use of plants for human and animal health care, and who transmitted this knowledge orally from time immemorial, the Gulmarg is a paradise, the area is known as the Himalayas of India. However, such priceless wisdom is now only available to the elderly due to ignorance, industrialisation, and urbanisation. Documenting this knowledge now, before it is lost, is therefore imperative.

Data collection

The information on medicinal plants was gathered using the following method: field surveys, ethnobotanical knowledge obtained from informants, photography and inventory, preservation and taxonomic verification of specimens, botanical identification, and quantitative ethnobotanical analysis. Between May 2020 and August 2021, information was gathered from informants about Gulmarg's traditional knowledge of its therapeutic herbs. One hundred twenty-nine informants in all were questioned (90 male and 39 females). To gather the traditional knowledge of the locals regarding medicinal plants, field conversations, questionnaires, and personal interviews were done. The informants provided information about the applications, plant parts used, diseases treated, preparations, and administration methods of medicinal plants. To confirm identification, the most information possible was gathered, and the data provided by the local informants during initial field visits were double checked, routine field surveys were conducted during the majority of the medicinal plants' flowering seasons. The veracity of the information gathered was verified throughout the course of several visits and interviews with the informants.

The snowball sampling approach was used to pick 129 knowledgeable individuals to learn more about the utilisation of medicinal plants in Gulmarg, Jammu and Kashmir (Table 1). From 20 to 85 years old, these volunteers represented various age groups. In terms of information sharing, the selected male participants (N=90) had more experience than the selected female participants (N=39). The majority of the volunteers that were chosen were illiterate (N=63), and just a tiny proportion had schooling above the upper secondary level (N=12). Due to their extensive knowledge of ethnomedicine, participants were chosen. Continuous communication with the local population was maintained throughout the study to ensure the reliability of traditional knowledge.

Demographic status of Informants:

A total of 90 informants from three ethnic groups (Gujjar, Bakarwal and Kashmiri) were selected, most of whom were males (58 males and 32 women). The dominance of male informants in the study was due to the cultural limitations (young females are reluctant to meet unknown male due to religious obligations) which can be ascribed to the possible bias of the current study. The selected informants were categorised into different professional groups, age groups, and the education status. Younger individuals have higher levels of education than older ones (Table 1). Urdu, Kashmiri, Phari and Gujri are the four different types of languages spoken in the study area.

Table 1. Demography of respondents from the study area

Variable	Demographic category	No. of informants	Percentages
Gender	Male	90	69.77
	Female	39	30.23
Age	20-40	29	22.48
	41-60	40	31.01
	60 and above	60	46.51
Education	Illiterate	63	48.84
	Primary	35	27.13
	Middle	19	14.73
	Higher	12	9.30

Data analysis

Utilizing quantitative indicator, the Use Value (UV), indicating the relative importance of locally recognised species, was calculated with the following formula (Phillips et al. 1994):

$$UV = \Sigma U/n$$

Where: "n" denotes the total number of informants and "U" denotes the total number of reports referenced by each informant for a particular plant species. Use value increases with the number of use reports for a plant, showing the significance of the plant species. However, the UV does not differentiate between a plant's single or numerous uses (Khoja et al. 2022c).

RESULTS AND DISCUSSION

Floristic characteristics of medicinal plants

A total of 60 medicinal plant species belonging from 34 different families, have been gathered from the study area. The majority of them are members of the Asteraceae family (9 species), which is followed by the Lamiaceae (N=4), Apiaceae, Berberidaceae, and Polygonaceae families (3 species each), and the Boraginaceae, Amaranthaceae, Geraniaceae, Malvaceae, Plantaginaceae, Ranunculaceae, and Solanaceae families (2 species each). For the other 22 families, each contributes just one species (Figure 1). The family Asteraceae is dominant because its members are noted for their fragrant qualities and are widely distributed across nature. Its herbaceous life form, widespread distribution, and abundance in the research area may also have a role (Abdullah and Andrabi 2021; Asif et al. 2021). Asteraceae family members adapt to arid, dry environments quickly and easily due to their vast ecological amplitude (Haq et al. 2021b).

Life form

Herbs (N=49 species, 82%) are the most common type of plant life in the current study, followed by shrubs (N=3, 5%), trees (N=4, 7%), climbers (N=2, 3%), ferns, and fungus (N=1, 1, 2% each) (Figure 2). Depending on the ailment being treated, the plants obtained from the study region were applied topically or orally to affected body parts. The ease with which they may be collected, their greater quantity, and their superior efficiency in treating illnesses when compared to other life-forms may account for the higher use of herbs for therapeutic purposes in the studied region (Adnan et al. 2012; Haq et al. 2023a).

Plant part used

For the preparation of medicinal recipes, the locals most frequently use roots (N=22, 36%), followed by leaves (N=16, 26%), seeds, latex and tubers (N=5, 8%), whole plants (N-3, 5% each), and stem and oil (N=2, 3% each). The remaining ingredients include bark, flowers, fruits and fruiting bodies, which each contribute (N=1, 2%) (Figure 3). The most typical techniques of preparation for the use of medicinal plants are drying the live plants and crushing them into powder or using them raw to produce tea, extract juice, paste, infusion, decoction, or vegetables. In a large portion of the world where herbs are used as medicines, grinding, crushing, and boiling are the most popular and efficient techniques of extracting active ingredients (Singh et al. 2019), and this method is also most popular among the locals in the research area. Previous studies that were conducted reported findings that were similar (Abdullah and Andrabi 2021; Asif et al. 2021).

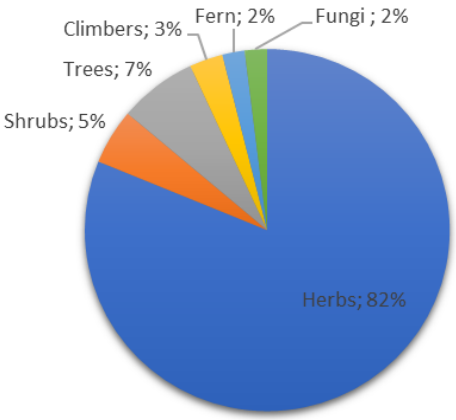

Figure 2. Percentage of life form of medicinal plants used

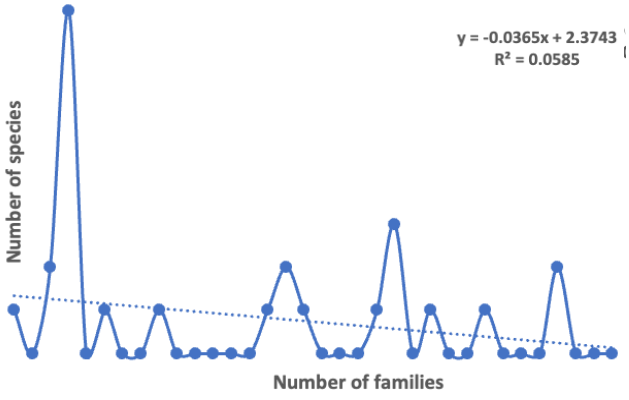

Figure 1. Species contribution of different families

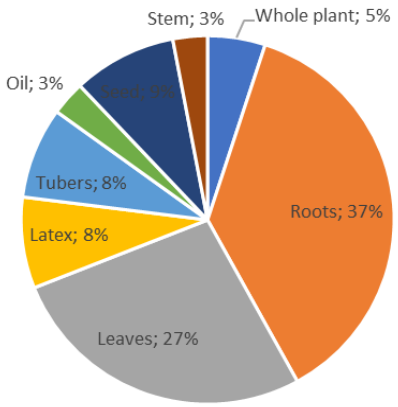

Figure 3. Percentage contribution of various plant parts used in the ethnomedicinal preparations

Plant preparations

Seven categories were used to categorise the medicinal plants used in herbal remedies (Figure 4). Decoction (N=22, 34%), Raw (N=11, 17%), Infusion (N=9, 14%), Paste (N=10, 15%), Poultice (N=8, 12%), Vegetable (N=3, 5%), and Oil (N=2, 3%) were the most popular ways to prepare herbal treatments. Khoja et al. (2022a,b,c) indicated that the same outcomes were obtained and that the majority of plants were used in decoctions, followed by juice and powder. Because they are simple to manufacture, decoctions are commonly cited as the primary types of preparation in ethnopharmacological investigations Haq et al. 2023a). The paste is made by blending fresh or dried plant parts with oil or water, and the powder is made by crushing plant parts after drying them in the shade (Khoja et al. 2022a,b,c). A considerable amount of components are produced during extraction, making it one of the main forms of ethnobotanical techniques since they can be employed to quickly treat illnesses (Haq et al. 2023b).

Diseases treated

Based on information provided by informants, gastrointestinal illnesses were treated by the greatest number of species (25 species), followed by bone and joint diseases (MSDs) (21 species), and urinary diseases by the least number of species (Figure 5). This distribution of applications is consistent with another research, such as those by (Kaur et al. 1997, Miya et al. 2020, and Monigatti et al. 2013). The most frequently mentioned plants by the informants for the treatment of gastrointestinal disorders were *A. absinthium, L. jacquemontiana, A. heterophyllum, A. parviflora, T. linearis, F. roylei, U. dioica, P. major, M. neglecta*, and *A. calamus*.

Use Value (UV)

A species' importance to the informants and the regional ethnomedical system is shown by its Use Value (UV). The primary species in the current study's Table 2 had the greatest UV reported for *A. absinthium* (0.58) and the lowest UV reported for *V. album* (0.17). The other important species with high UV values were *A. calamus* (UV=0.50), *A. heterophyllum* (0.57), *S. costa* (0.47), *G. wallichianum* (0.54), and *R. webbianum* (0.53). Due to their widespread distribution and widespread knowledge of their therapeutic applications by the local population, medicinal plant species in the study region have high UV levels (Rahman et al. 2016). From *A. absinthium*, several phytochemicals have been extracted and reported, including sesquiterpene lactones, a class of natural compounds with several proven medicinal effects, guanolide dimmers such as absinthin and its isomers anabsin, artabsin, and absintholide (Beauhaire et al. 1984), germacrene type such as artabin (Akhmedov et al. 1970), (Perez-Souto et al. 1992). These phytochemical components have been linked to a variety of plant properties, including hypersecretory activity (Blumberger and Glatzel 1966), neuroprotective activity (Wake et al. 2000), anthelminthic activity (Abdullah and Andrabi 2021), neurotoxic activity (Donald 1981), antiprotozoal activity (Valdes et al. 2008), antifungal activity (Kordali et al. 2005).

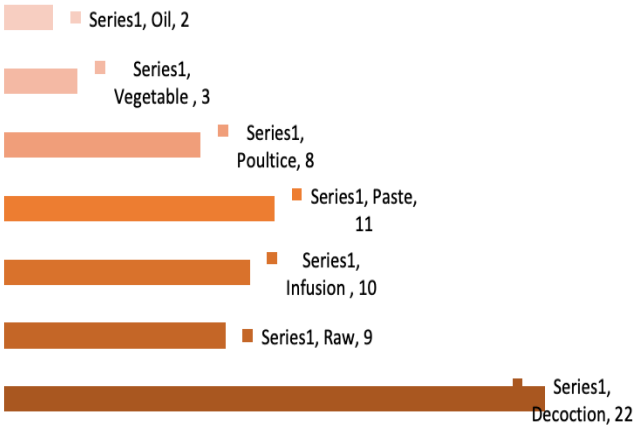

Figure 4. Mode of preparation of medicinal plants

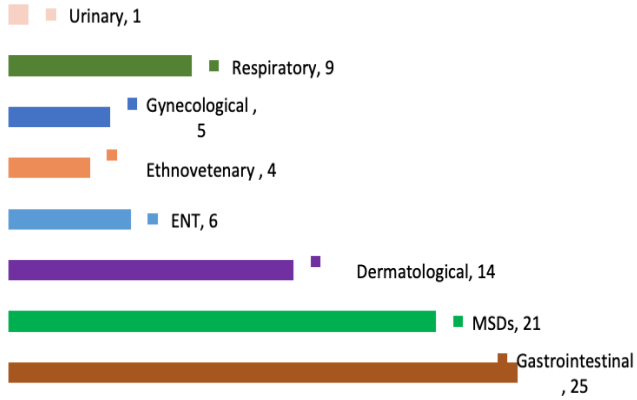

Figure 5. Percentage of plants used to treatment of various disorders in the study area

Table 2. Enumeration of medicinal plants used to treat various diseases in Gulmarg of Jammu and Kashmir, India

Family	Medicinal plant	Common name	Source	Part used	Life form	Preparation	Adm.	Disease treated	No. of use reports	Use value
Amaranthaceae	*Amaranthus viridis* L.	Ganhar	C	Seeds	H	Cooked	O	Back pain	35	0.27
	Amaranthus caudatus L	Krey kul	W	Seeds	H	Cooked	O	Constipations	39	0.30
Acoraceae	*Acorus calamus* L	Vai	W	Roots	H	Raw	O	Stomach cramps, abdominal pain	65	0.50
Araceae	*Arisaema jacquemontii* Blume	Hapat-makai	W	Tuber	H	Paste	T	Skin burns	39	0.30
Apiaceae	*Coriandrum sativum* L.	Dainwal	C	Seeds	H	Paste	T	Abdominal pain	46	0.36
	Angelica glauca Edgew.	Chora	W	Roots	H	Infusion	O	Blot, constipations	58	0.45
	Eryngium billardieri F. Delaroche	Dawamool	W	Roots	H	Infusion	O	Stomach cramps, jaundice	37	0.29
Berberidaceae	*Berberis lycium* Royle	Chockchrey	W	Roots	S	Decoction	O	Joint pain, Abdominal pain	46	0.36
	Berberis aristata DC.	Sumbal	W	Roots	S	Decoction	O	Joint pain, inflammation	38	0.29
	Podophyllum hexandrum Royle	Wanwagun	W	Roots	H	Infusion	O	Joint pain	40	0.31
Asparagaceae	*Polygonatum verticillatum* (L.) All	Salapmesri	W	Tuber	H	Raw	O	Gynaecological disorders	45	0.35
Asteraceae	*Achillea millefolium* L.	Phalgass	W	Leaves	H	Raw	O	Toothache, dysentery	49	0.38
	Artemisia absinthium L.	Tethwan	W	Leaves	H	Infusion Paste	O	Abdominal pain, cramps, diarrhoea, intestinal worms, bone facture	75	0.58
	Centaurea iberica Trevir. ex Spreng	Krech	W	Leaves	H	Decoction	O	Joint pain, skin diseases	30	0.23
	Cichorium intybus L.	Saz hand	W	Leaves	H	Poultice	T	Bone fracture, gynaecological disorders, diarrhoea	38	0.29
	Inula racemosa Hook. f.		W	Roots	H	Decoction	O	Abdominal pain	28	0.22
	Ligularia jacquemontiana (Decne.)	Musthum	W	Roots	H	Raw	O	Intestinal worms, abdominal pain	42	0.33
	Jurinea dolomiaea Boiss,	Doop	W	Roots	H	Poultice	T	Skin burns, wound healing, stomach cramps	55	0.43
	Saussurea costus (Falc.) Lipsch.	Kuth	W	Roots	H	Decoction	O	Joint pain, back pain	60	0.47
	Taraxacum officinale F.H. Wigg	Heand	W	Leaves	H	Poultice	T	Bone fracture, gynaecological disorders	51	0.40
Betulaceae	*Betula utilis* D. Don	Burz	W	Bark	T	Decoction	O	Asthma	41	0.32
Boraginaceae	*Arnebia benthamii* Wall. ex G.Don	Khazaban	W	Roots	H	Decoction	O	Dry throat, fever, joint pain, dysentery	56	0.43
	Cynoglossum glochidiatum Wall. Ex Benth.	Chur	W	Roots	H	Paste	T	Wound healing	32	0.24
Balsaminaceae	*Impatiens glandulifera* Royle	Truil	W	Leaves	H	Paste	T	Skin burns	29	0.22
Convolvulaceae	*Convolvulus arvensis* L.	Razgass	W	Whole plant	Cl	Paste	T	Wound healing	45	0.35
Cannabaceae	*Cannabis sativa* L.	Charas	W	Leaves	H	Infusion	O	Toothache	39	0.30
Dioscoreaceae	*Dioscorea deltoidea* Wall. ex Griseb.	Shingle-mingle	W	Roots	Cl	Decoction	O	Joint pain, diarrhoea	40	0.31
Euphorbiaceae	*Euphorbia wallichii* Hook.f.	Herib	W	Latex	H	Poultice	T	Warts, skin diseases	42	0.33
Hypericaceae	*Hypericum perforatum* L.	Chaikul	W	Roots	H	Raw	O	Diarrhoea	29	0.22
Equisetiaceae	*Equisetum arvense* L.	Gandamgud	W	Whole frond	Fe	Infusion	O	Kidney stones	33	0.26
Liliaceae	*Fritillaria roylei* Hook.	Sheetkhar	W	Tuber	H	Raw	O	Abdominal pain, abdominal bloating	61	0.47
Gentianaceae	*Gentiana khuroo* Royle	Khutki	W	Roots	H	Decoction	O	Back pain	51	0.39

Geraniaceae	*Geranium pretense* L.	Ratanjog	W	Roots	H	Decoction	O	Joint pain, back pain	47	0.36
	Geranium wallichianum Oliv.	Ratanjog	W	Roots	H	Decoction	O	Joint pain, arthritis , bone facture	70	0.54
Juglandaceae	*Juglans regia* L.	Doon	C	Fruits, bark	T	Paste	T	Foot and mouth disease, toothache	62	0.48
Lamiaceae	*Ajuga parviflora* L.	Jainadam	W	Leaves	H	Infusion	O	Abdominal pain, fever	69	0.53
	Prunella vulgaris L.	Kalyuth	W	Leaves	H	Decoction	O	Fever, foot fever	58	0.45
	Origanum vulgare L.	Meth	C	Seeds	H	Poultice	T	Bone fracture	46	0.37
	Thymus linearis Benth	Javind	W	Leaves	H	Infusion	O	Abdominal pain, stomach cramps	53	0.41
Malvaceae	*Malva neglecta* Wall.	Souchal	W	Leaves	H	Raw	O	Stomach cramps, blot	44	0.34
	Lavatera cashmeriana Camb.	Jungle souchal	W	Flowers	H	Infusion	O	Fever, joint pain, Cough and cold	35	0.27
Moraceae	*Ficus carica* L.	Anjeer	C	Latex	T	Raw	T	Skin disorders, Diarrhoea	49	0.38
Morchellaceae	*Morchella esculenta* Fr.	Gucchi	W	Fruiting body	F	Cooked	O	Wound healing,	42	0.33
Oxalidaceae	*Oxalis acetosella* L.	Chokcfrdey	W	Whole plant	H	Decoction	O	gynaecological disorders	39	0.30
Plantaginaceae	*Plantago lanceolata* L.	Gull	W	Leaves	H	Decoction	O	Abdominal bloating	42	0.33
	Plantago major L.	Bead-gull	W	Leaves	H	Decoction	O	Abdominal bloating	53	0.41
Pinaceae	*Cedrus deodara* (Roxb.)	Deodar	W	Latex, oil	T	Paste	T	Wound healing, foot and mouth disease	59	0.46
Polygonaceae	*Bistorta amplexicaulis* (D.Don) Greene	Manchrichai	W	Roots	H	Decoction	O	Fever, cough and cold	49	0.38
	Rheum webbianum Royle	Pambchalan	W	Roots	H	Decoction	O	Joint pain, Stomach cramps	68	0.53
						Poultice	T	wound healing		
	Rumex nepalensis Spreng.	Abuj	W	Roots	H	Decoction	O	Arthritis, joint pain	60	0.47
Poaceae	*Cynodon dactylon* (L.) Pers.	Dramun	W	Leaves	H	Poultice	T	Skin disorders	45	0.35
Ranunculaceae	*Aconitum heterophyllum* Wall.	Patrees	W	Tuber	H	Raw	O	Abdominal pain, intestinal worms	73	0.57
	Aconitum chasmanthum Stapf ex Holmes	Mohand	W	Tuber	H	Raw	O	Toothache	56	0.43
Scrophulariaceae	*Verbascum thapsus* L	Buder-tund	W	Stem	H	Decoction	O	Skin burns	50	0.39
Saxifragaceae	*Bergenia ciliata* (Haw.) Sternb.	Palfort	W	Roots	H	Decoction	O	Joint pain, respiratory disorders,	63	0.49
						Poultice	T	wound healing		
Santalaceae	*Viscum album* L.	Kambaikul	W	Leaves	H	Paste	T	Wound healing	22	0.17
Solanaceae	*Atropa acuminata* Royle ex Lindl	Brand	W	Leaves	H	Raw	O	Blot	26	0.20
	Datura stramonium L.	Datur	W	Seeds	H	Paste	T	Toothache	37	0.29
Urticaceae	*Urtica dioica* L	Soi	W	Roots	H	Decoction	O	Arthritis, joint pain	46	0.36
Viburnaceae	*Viburnum grandiflorum* Wall. ex DC	Kilmich	W	Stem	S	Oil	T	Joint pain	40	0.31
Violaceae	*Viola odorata* L.	Vanposh	W	Whole plant	H	Decoction	O	Cough and cold	30	0.23

Note: W: Wild, C: Cultivated, S: Shrub, H: Herb, T: Tree, CL: Climber, F: Fumgi, Fe: Fern, O: Orally, T: Topical

The study concluded that the rural communities of Gulmarg, Jammu and Kashmir, India, still used many species of plants to treat many health problems. The results of this research further aid in a better understanding of traditional medicines, their relationship to the region's ecological and socioeconomic values, biodiversity protection, and plant resource management techniques for long-term use.

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Plants as herbal medicine at Nguter Traditional Market, Sukoharjo, Central Java, Indonesia

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Abstract. *Mardiyanto MB, Foresty RS, Arlysia V, Chorunissa ZFN, Nugroho GD, Yasa A, Setyawan AD. 2023. Plants as herbal medicine at Nguter Traditional Market, Sukoharjo, Central Java, Indonesia. Asian J Ethnobiol 6: 65-74.* In Indonesia, herbal medicine (*jamu*) is a traditional medicine found in traditional markets, including the Nguter Traditional Market. This research aims to identify the species of herbs and plants sold at the Nguter Traditional Market and provide readers with useful information should they purchase them. The study was conducted from December 2022 to January 2023 at the Nguter Traditional Market in the Sukoharjo District of Central Java, Indonesia. The method employed involved direct interviews with the market administration staff and 36 herbal medicine traders at the Nguter Traditional Market. Primary data was obtained through interviews, while secondary data was sourced from literature studies. The data were analyzed descriptively. The research revealed that the Nguter Traditional Market sells as many as 40 herbal plant species from 23 families. The most common herbal plants sold at the market include *cipir* (*Psophocarpus tetragonolobus* (L.) DC.), *dawung* (*Parkia timoriana* (DC.) Merr), *kunir* (*Curcuma longa* L.), *jahe* (*Zingiber officinale* Rosc.), and *kencur* (*Kaempferia galanga* L.). The most expensive medicinal plants sold at the market are *mesoyi* (*Cryptocarya massoia* (Oken) Kosterm.), *pekak* (*Illicium verum* Hook.fil.), and *kapulaga* (*Elettaria cardamomum* (L.) Maton), which are sold for IDR 300,000 per kilogram. The stem is the most commonly used part of herbal medicine. Herbal plants are widely used to treat coughs, inflammation, and flu. Overall, the research provides valuable information for readers interested in purchasing herbal medicine at the Nguter Traditional Market.

Keywords: Herbs, *jamu*, medicine, traders, traditional market

INTRODUCTION

Indonesia is one of the countries in Southeast Asia, it has more than 30,000 species of medicinal plants, around 6,000 species of which have various biological activities, and 1,000 species are traditionally used as herbal medicine or were called "*jamu*" (Widyowati and Agil 2018). The term "*jamu*" comes from the Javanese word "*jampi*" (magical herb) (Kurniawan and Ikhsanudin 2020). *Jamu* is a traditional Indonesian medicine made from native sources, such as roots, bark, flowers, seeds, leaves, and fruit (Eff et al. 2020). This traditional medicine is made from a mixture of several plants, called ''*empon-empon*'' to increase body resistance and cure disease (Ramadhani et al. 2021). *Empon-empon* is some species of Zingiberaceae, such as ginger, kencur, turmeric, temulawak, lempuyang, and galangal, used as herbal medicine ingredients (Sulaiman et al. 2022). It is usually consumed to relieve pain and inflammation and even treat chronic diseases like rheumatism and cancer (Harmayani et al. 2019). The Indonesian Basic Health Research (Riskesdas 2018) noted that 59.12% of Indonesians still consume herbal medicine, and more than 95.6% recognize the benefits of herbal medicine for health (Ariantini and Solehah 2021). The herbal medicine species that are widely consumed are ginger (50.36%), kencur (48.77%), and temulawak (39.65%), which are used in the form of liquid concoctions (48.0%) (Kusuma et al. 2020). The Indonesian people utilized traditional herbal medicine for generations until now, so herbal medicine has become part of the culture and is one of Indonesia's assets (Az-Zahra et al. 2021). *Jamu* is widespread in the Indonesian and global markets and easily accessible to consumers through markets. Moreover, the market demand for herbal medicine continues to increase so that herbal medicine increasingly provides economic and clinical benefits (Suparmi et al. 2021).

Jamu is an Indonesian traditional medicine, can be easily obtained in the market, where buying and selling transactions occur. The market reflects the economic and socio-cultural activities of the community (Landra 2019). According to Runtu et al. (2018), there are generally two types of markets: modern and traditional. The modern market is a place to sell at a fixed price, with a self-service system and no bargaining activity. In comparison, traditional markets with a buying and selling bargaining system. These markets are built/managed by the

government, regional government, private sector, state-owned enterprises, and regionally-owned enterprises, including cooperation with the private sector with places of business in the form of shops, kiosks, or tents owned by traders (Soelistiyono et al. 2018). Traditional markets have become an important part of the life of Indonesian people (Nelwan et al. 2017), especially for the lower/middle classes (Landra 2019). The important role of traditional markets is as an outlet for local community products and job opportunities for some people (Purwanto et al. 2021). In general, traditional markets in Indonesia sell daily necessities such as groceries, foodstuffs (seasonings, vegetables, fruit, meat, fish, eggs, etc.), clothing, household appliances such as cutlery, and other necessities (Runtu et al. 2018; Udjianto et al. 2021). However, several traditional markets specifically sell certain commodities or products, such as herbal markets, fruit markets, animal markets, bird markets, etc. Traditional markets that specifically sell herbs or traditional herbal medicines are also called herbal markets or *jamu* markets (Ahmad et al. 2018)

One market with the main herbal medicine sales in Indonesia is the Nguter Traditional Market. The Nguter Traditional Market is located in Sukoharjo District, Central Java, Indonesia, and has been established since 1965 (Nuraini and Kurnianingsih 2021). The Nguter Traditional Market sells various *empon-empon*, spices, and instant herbs. *Empon-empon* and spices are ingredients used to make traditional or herbal medicine (Sumarni et al. 2019). The habits and culture of the Indonesian people, especially the Javanese, to drink herbal medicine to maintain health and for treatment (Astuti et al. 2021) made herbal medicine demanded by the public until recently. In addition, according to Ahmad et al. (2018), various herbs or medicinal plants traded will represent the diversity of an area. Therefore, the purpose of this research is to observe the species of herbs and plants sold and provide information for readers if they want to find herbs and plants that are suitable for sale.

MATERIALS AND METHODS

Study area

This study was conducted from December 2022 to January 2023. The study site is located at the Nguter Traditional Market, a traditional market managed under the Department of Trade, Cooperatives, and SMEs, Sukoharjo District, Central Java, Indonesia. In the Nguter Traditional Market, various types of merchandise are sold, such as herbs, clothing, groceries, meat, vegetables, and other traditional merchandise. The Nguter Traditional Market is located along Street Solo - Wonogiri, Nguter, Sukoharjo District, in Central Java, Indonesia. Its location is at coordinates 7°44'26.6"S, 110°52'36.2"E (Figure 1). The Nguter Traditional Market has great potentially developed to be the herbal medicine market.

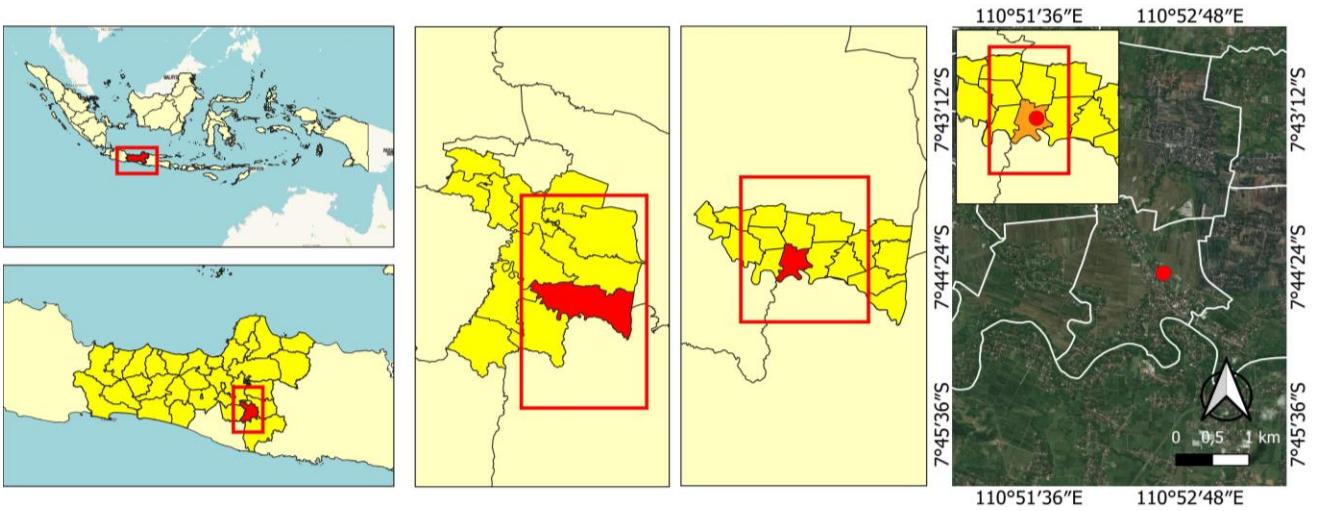

Figure 1. Map of the study site at the Nguter Traditional Market, Sukoharjo, Central Java, Indonesia

Figure 2. A. Nguter Traditional Market Building, B. Herbal medicine stall in the Nguter Traditional Market

Data collection procedures

The data searching in this study is divided into primary and secondary data. Primary data was obtained through interviews and questionnaire spreading (Isthiaq et al. 2022) to herbal medicine traders and an administrator in Nguter Traditional Market (36 persons). Data collection included local names, parts of plants, the basic ingredients for herbal medicine, the benefits of the plants, the herbal medicine process, supply, and prices of the medicinal plants. Meanwhile, secondary data was obtained through literature studies to support the field data research. In addition, a few sample of the herbal medicine sold in the Nguter Traditional Market made documentation.

Data analysis

Data analysis was done by identifying medicinal plants to find their scientific names and explaining the data descriptively, then arranging them in tables, pictures, and graphs.

RESULTS AND DISCUSSION

Short history of Nguter Traditional Market

Nguter Traditional Market is known as a Javanese herbal (*jamu*) market because the majority sell herbal medicine in the Nguter Village, Sukoharjo, Central Java, Indonesia (Figure 2). According to Gardjito et al. (2018), the Nguter Traditional Market is known as a market in Indonesia devoted to herbal medicine. Based interview with an administrator, the Nguter Traditional Market before 1938 had no traders selling herbal medicine; after one year, Mrs. Yoso Hartono moved to Nguter Village, and he started selling herbal medicine such as kencur rice, turmeric tamarind, bitterness, and other processed herbal medicine at the Nguter Traditional Market. Other herbal medicine traders followed her success in selling herbal medicine in the village of Nguter and its surroundings. After that, the herbal medicine trade increased rapidly until now, and the Nguter Traditional Market is known as the herbal medicine market. Seven herbal products are widely sold in stalls: WISNU JKW (Joglo Kresno Wisnu), Gujati, Sabdopalon, Bisma, Anoman, Puntodewo, and Narododi. Mrs. Yoso Hartono died in 1983, and his children could continue this business.

The commodity arrangement at the Nguter Traditional Market is a zoning system to make it easier for buyers. Nguter Traditional Market has two floors; the 1st floor has 69 stalls measuring 3x4 m and 142 stalls measuring 2x2 m, while the 2nd floor has 41 stalls measuring 3x4 m, 173 stalls measuring 2x2 m, and an additional 41 stalls for new tenant traders. The main services of Nguter Traditional Market are service and cleanliness so that this market becomes a comfortable and enjoyable shopping place.

Respondent characteristics

Respondents in this study were herbal medicine traders, totaling 36 people with an age range of 20-70 (Table 1). Most respondents are female because most sellers are women and are more active in obtaining information related to plants for health. According to Ismarani (2013), women know more about the benefits of plants because of the many benefits of herbal medicine for beauty, maintaining body fitness, and slimness.

Diversity of medicinal plants in Nguter Traditional Market

Observation data of medicinal plants in the study site was reported 23 families of herbal plants sold in the Nguter Traditional Market with the number of species of each family difference. Families with one species were found in Apiaceae, Faboideae, Lamiaceae, Meliaceae, Menispermaceae, Myristicaceae, Oleaceae, Phyllanthaceae, Poaceae, Rosaceae, Rutaceae, Santalaceae, Schisandraceae, Solanaceae, Thymelaeaceae, and Usneaceae. The families with two species were found Acanthaceae and Apocynaceae. The family with three species are Lauraceae, Myristicaceae, and Piperaceae; the family with four species is Fabaceae; and the family with six species is Zingiberaceae (Figure 3).

Diversity of herbal plants in Nguter Traditional Market

The total number of herbal medicines sold in the Nguter Traditional Market is 40 species. The medicinal plants sold are supplied from several areas in Central Java, namely Boyolali, Wonogiri, Sukoharjo, and Purworejo. Herbal plants that are often found in every trader, namely winged bean/*cipir* (*Psophocarpus tetragonolobus* (L.) DC.), *dawung* (*Parkia timoriana* (DC.) Merr), turmeric/*kunir* (*Curcuma longa* L), ginger/*jahe* (*Zingiber officinale* Rosc.), and *kencur* (*Kaempferia galanga* L). The plant parts used for herbal medicine include roots, stems, leaves, flowers, fruits, and seeds. The herbal medicine sold in this market is usually herbal decoction. In addition, processed herbal medicine relieves colds, coughs, and inflammation, treats female problems, increases appetite, and many more (Table 2). Based on the selling price of each species of herbal medicine, the price range is IDR 20,000/kg to IDR 300,000/kg (Table 2). Several medicinal herb species sold in the Nguter Traditional Market have been documented (Figure 4).

Table 1. Characteristics of herbal medicine sellers in Nguter Traditional Market, Sukoharjo, Central Java, Indonesia (n=36)

Variable	Count	Percetage
Age		
20-30	1	3%
31-40	4	11%
41-50	10	28%
51-60	18	50%
61-70	3	8%
Gender		
Male	7	19%
Female	29	81%
Education		
Elementary	2	6%
Junior High School	9	25%
Senior High School	20	56%
University	5	14%

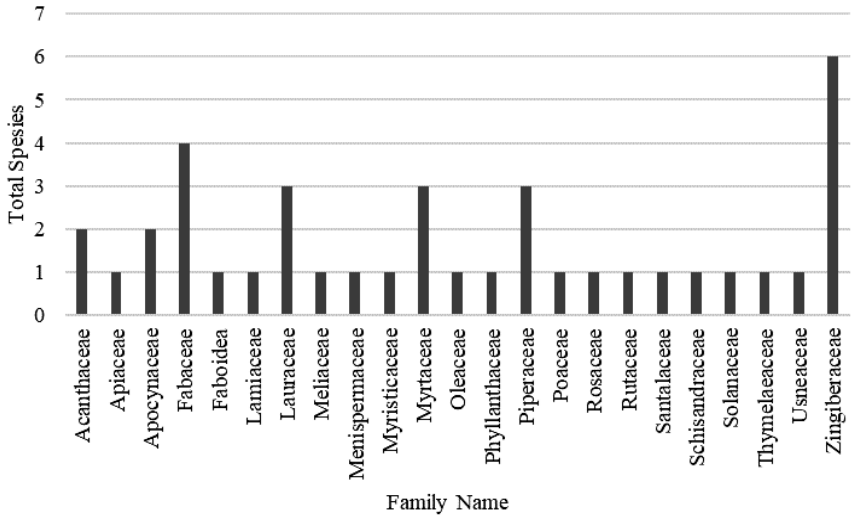

Figure 3. The number of species in the herbal plant families at the study site

Part of medicinal plants

The utilization percentage of medicinal plant parts sold in Nguter Traditional Market barks 24%, leaves 21%, roots 18%, seeds 16%, flowers 13%, and fruits 18% (Figure 5).

Benefits of herbal medicine

Based on the benefit of medicinal plants, the percentage of species diversity for treating coughs, inflammation, and flu by 30%, treating female problems by 17%, maintaining heart health, lowering cholesterol, and digestive disorders have the same by 9%, treating fever was by 8%, lowering blood pressure by 6%, treating urinary tract infections were 4%, and asthma by 2% (Figure 6).

Discussion

In this study, 40 species and 23 families of medicinal plants were found in the Nguter Traditional Market. In addition, a study by Silalahi et al. (2015) in the Kabanjahe Traditional Market in North Sumatra, Indonesia, found 344 species and 90 families of medicinal plants. Irwanta et al. (2015) also found 126 species consisting of 54 families of medicinal plant species traded in the Pati District, Central Java, Indonesia. In another study, in 5 main markets in Antananarivo, Madagascar, Africa, 89 species of medicinal plants were found (Randriamiharisoa et al. 2015). Furthermore, 160 species and 57 families of medicinal plants were found in research conducted at several traditional markets in Loja Province, Ecuador, South America (Tinitana et al. 2016). Finally, research by Nguyen et al. (2019) showed 99 species and 57 families of medicinal plants from research in several traditional markets in Son La Province, Vietnam. Some of these studies show that the Nguter Herbal Medicine Market has a low diversity of medicinal plants.

The herbal plant families found in the study were dominated by Zingiberaceae (Table 2). The Zingiberaceae family is intensively cultivated in home gardens, especially in Indonesia, as medicinal plants, herbs, spices, and for economic purposes (Zahara et al. 2018). These results follow research conducted by Iskandar et al. (2020), which states that plant species from the Zingiberaceae family are widely used as raw materials for herbal medicine in Central Java, Indonesia. Zingiberaceae is widely used for medicinal purposes because of its properties that can cure many diseases. According toIvanović et al. (2021), plant species belonging to the Zingiberaceae family can be a good natural source of antioxidant components widely used in the pharmaceutical, food, nutraceutical, and cosmetic industries. Therefore, plants are widely used, affecting their demand for goods and availability. In addition, antioxidants are important in increasing the body's immunity, repairing cell damage, and preventing disease.

The plant part most widely used in herbal medicine is the stem, including the bark, with a percentage of 24% (Figure 5). Therefore, many parts of the plant stem are sold because they contain properties or natural chemical compounds that suit customers' needs. In addition, processing the bark into herbal or traditional medicine is not difficult, namely by simply boiling or brewing it after washing and drying. The second most widely used part of several plant species is the leaves (Figure 5). Leaves are the main place for metabolic processes, so the content of complex compounds in the leaves is relatively large. Several studies have stated that plant parts, namely fruits and leaves, are naturally perishable products with a relatively short post-harvest shelf life (El Khetabi et al. 2022). However, most of the products at the Nguter Traditional Market are sold in dry form, so they have a relatively long shelf life and can be supplied from anywhere (Jusu and Sanchez, 2013). In addition, taking leaves from live plants for traditional medicinal ingredients does not damage or kill plants, so plant leaves can be harvested sustainably (Iskandar et al. 2020).

Table 2. Diversity of medicinal plants sold at Nguter Traditional Market, Sukoharjo, Central Java, Indonesia

Family	Scientific name	Local Name	Herbal Ingredients	Part used	Making process	Benefit	Supply	Price
Acanthaceae	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	*Sambiroto*	Bitter	Leaves, stems	Boiled	Relieves cold and lowers blood pressure	Boyolali, Wonogiri, Sukoharjo, Purworejo	20,000/kg
Acanthaceae	*Strobilanthes crispa*	*Keji Beling*	Herbs	Leaf	Boiled	Treat diabetes	Wonogiri	30,000/kg
Apiaceae	*Foeniculum vulgare* Mill.	*Adas*	Herbs	Stems, leaves, seeds	Boiled	Relieve cough, prevent cancer, treat heart disease	Boyolali, Wonogiri, Sukoharjo, Purworejo	60,000/kg
Apocynaceae	*Parameria laevigata* (Juss.) Moldenke	*Kayu Rapet*	Herbal Spice Cebokan	Bark	Washed, dried, then boiled with boiling water	Eliminates leucorrhoea, Sari rapet female genitals, improves blood circulation, dysentery, wounds	Sukoharjo	110,000/kg
Apocynaceae	*Alyxia Stellata* (JRForst. & G. Forst.) Roem. & Schult.	*Pulosari*	Herbs	Bark	Brewed	Overcome irregular menstruation, canker sores, coughs, and increased appetite.	Sukoharjo	60,000/kg
Fabaceae	*Psophocarpus tetragonolobus* (L.) DC.	*Cipir*	Bitter	Seed	Boiled	Treats inflammation and ulcers, medicine sore	Boyolali, Wonogiri, Sukoharjo, Purworejo	25,000/kg
Fabaceae	*Parkia timoriana* (DC.)Merr	*Dawung*	Saffron-colored rice	Seed	Pounded, then boiled	Treat inflammation, relieve pain stomach, fever medicine	Boyolali, Wonogiri, Sukoharjo, Purworejo	60,000/kg
Fabaceae	*Senna Alexandrina* Mill.	*Jati Cina*	Herbs	Leaf	Brewed	Lose weight, treat gout and constipation, and treat the skin.	Sukoharjo	50,000/kg
Fabaceae	*Biancaea sappan* (L.) Tod.	*Secang*	Herbs	Bark	Boiled, brewed	Overcoming inflammation, blood sugar, diarrhea, malaria drugs	Boyolali, Wonogiri, Sukoharjo	25,000/kg
Fabaceae	*Clitoria ternatea* L.	*Bunga telang*	Beverages, teas, herbal remedies	Flower	Boiled	Relieve symptoms of depression, reduce inflammation	Wonogiri	180,000/kg
Lamiaceae	*Orthosiphon aristatus* (Blume) Miq.	*Kumis kucing*	Herbs	Leaf	Dried soaked in boiling water	Resolve anyang-anyangan, diabetes, and rheumatism	Wonogiri	15,000/kg
Lauraceae	*Cinnamomum zeylanicum* Blume	*Manis jangan*	Herbs	Stem	Boiled	Fight HIV, reduce blood pressure, prevent cancer, fight infection	Wonogiri	100,000/kg
Lauraceae	*Cryptocarya massoia* (Oken) Kosterm.	*Mesoyi*	Saffron-colored rice	Stem	Boiled	Treat inflammation, abdominal pain, and fever	Wonogiri, Purworejo	300,000/kg
Lauraceae	*Litsea cubeba* (Lour.) Press.	*Krangean*	Herbs	Seeds, stems	Boiled	Launching defecation and treat cough	Wonogiri	60,000/kg
Meliaceae	*Swietenia mahagoni* (L.) Jacq.	*Mahoni*	Herbs	Seed	Pounded, then boiled	Lowers cholesterol, maintain heart health and increase appetite	Wonogiri, Boyolali, Sukoharjo, Purworejo	40,000/kg
Menispermaceae	*Tinospora cordifolia* (Willd.) Miers	*Brotowali*	Herbs	Stem	Boiled	Overcome fever, dysentery, skin problems, to diabetes	Wonogiri	50,000/kg
Myristicaceae	*Myristica fragrans* Houtt.	*Pala*	Herbal medicine, cooking seasoning	Seed	Brewed	Relieve stomach acid, toothache, overcome nausea and colds, diarrhea	Wonogiri	150,000/kg
Myrtaceae	*Syzygium aromaticum* (L.) Merr. & Perry	*Cengkeh*	Herbal Medicine,	Flower	Boiled	Maintain oral health, help stop diarrhea, and relieve stomach pain or nausea. Increase immunity	Wonogiri	210,000/kg

Myrtaceae	*Eucalyptus alba* Reinw. ex Blume	*Cupliksari*	Herbs	Flower	Boiled	Relieves coughs, stuffy nose, and headaches	Wonogiri	15,000/kg
Myrtaceae	*Melaleuca leucadendra* (L.) L.	*Kayu Putih*	Herbs	Leaf	Boiled	-	Wonogiri	20,000/kg
Oleaceae	*Jasminum sambac* (L.) Aiton	*Melati*	Herbal Spice Cebokan	Flower	Washed, dried, boiled with water	Eliminate leucorrhoea, Sari rapet female genitals	Sukoharjo	50,000/kg
Phyllanthaceae	*Phyllanthus urinaria* L.	*Meniran*	herbal medicine	Leaf	Boiled	Reduce cholesterol	Purworejo	30,000/kg
Piperaceae	*Piper retrofractum* Vahl	*Cabe Jawa*	Herbs	Fruit	Cut into small pieces, then boiled	Fever, flatulence, heartburn, vomiting, distraction digestion, stimulate appetite eat, and impotence.	Wonogiri	100,000/kg
Piperaceae	*Piper betle* L	*Sirih*	Herbal Spice Cebokan	Leaf	Washed, dried, blanched with boiling water	Eliminate leucorrhoea, Sari rapet female genitals	Sukoharjo	60,000/kg
Piperaceae	*Piper cubeba* L.fil.	*Kemukus*	Herbs	Seed	Brewed	Overcoming asthma, eliminating bad breath, sputum laxative, dysentery medicine	Sukoharjo	200,000/kg
Poaceae	*Imperata cylindrica* (L.) P. Beauv.	*Alang-alang*	Herbs	Root	Boiled	Reduce cholesterol	Purworejo	30,000/kg
Rosaceae	*Rosa damascena* Mill.	*Mawar*	Herbal Spice Cebokan	Flower	Washed, dried, then boiled with boiling water	Eliminate leucorrhoea, Sari rapet female genitals	Sukoharjo	160,000/kg
Rutaceae	*Citrus hystrix* DC.	*Daun jeruk*	Herbs	Leaf	Boiled	Smooth digestion, and treat flu.	Purworejo	200,000/kg
Santalaceae	*Santalum album* L	*Kayu Cendana*	Herbal Spice Cebokan	Stem	Washed, dried, then boiled	Eliminate leucorrhoea, female genital traction, and prevent dysentery.	Sukoharjo	160,000/kg
Schisandraceae	*Illicium verum* hook. fil.	*Pekak*	Herbs	Fruit	Boiled	Facilitate defecation/ small, prevent flu, treat aches	Wonogiri	300,000/kg
Solanaceae	*Physalis angulata* L	*Ceplukan*	Herbs	Leaf	Boiled	Calming at the same time speed up the healing process	Wonogiri	35,000/kg
Thymelaeaceae	*Phaleria macrocarpa* (Scheff.) Boerl.	*Mahkota Dewa*	Herbal medicine, herbal tea	Fruit	Brewed	Reducing cholesterol, migraines, for the body's immune system, diabetes medication	Purworejo	55,000/kg
Usneaceae	*Usnea* sp.	*Rasuk Angin*	Herbs	Root	Boiled	Prevent urinary and respiratory tract infections	Wonogiri	50,000/kg
Zingiberaceae	*Curcuma longa* L.	*Kunir*	Sour turmeric	Root	Washed, pounded	Treat inflammation, reduce menstrual pain, increased power hold on	Boyolali, Wonogiri, Sukoharjo, Purworejo	20,000/kg
Zingiberaceae	*Elettaria cardamomum* (L.) Maton	*Kapulaga*	Herbs	Seed	Boiled	Lower cholesterol and maintain heart health	Boyolali, Wonogiri, Sukoharjo, Purworejo	300,000/kg
Zingiberaceae	*Zingiber officinale* Rosc.	*Jahe*	Herbs	Root	Pounded, then boiled	Warms the body, strengthens the immune system, lose weight body	Boyolali, Wonogiri, Sukoharjo, Purworejo	25,000/kg
Zingiberaceae	*Curcuma zanthorrhiza* Roxb.	*Temulawak*	Herbs	Root	Pounded, then boiled	Maintain stomach health	Boyolali, Wonogiri, Sukoharjo, Purworejo	30,000/kg
Zingiberaceae	*Kaempferia galanga* L.	*Kencur*	Saffron-colored rice	Root	Pounded, then boiled	Treat cough, add appetite, relieve colds and inflammation	Boyolali, Wonogiri, Sukoharjo, Purworejo	20,000/kg
Zingiberaceae	*Zingiber zerumbet* (L.) Roscoe ex Sm.	*Lempuyang*	Herbs	Root	Shredded, then boiled	Overcoming constipation, overcoming joint inflammation, overcoming appetite, overcoming diabetes	Sukoharjo	20,000/kg

Figure 4. Some plants are used as herbal medicine at the Nguter Traditional Market, Sukoharjo, Central Java, Indonesia. A. *Rasuk Angin* (*Usnea* sp.), B. *Kumis Kucing* (*Orthosiphon aristatus*), C. *Dawung* (*Parkia timoriana*), D. *Secang* (*Biancaea sappan*), E. *Manis Jangan* (*Cinnamomum zeylanicum*), F. *Kapulaga* (*Elettaria cardamomum*), G. *Kencur* (*Kaempferia galanga*), H. *Mesoyi* (*Cryptocarya massoia*), I. *Jahe* (*Zingiber officinale*), J. *Sambiroto* (*Andrographis paniculata*), K. *Keji Beling* (*Strobilanthes crispus*), L. *Adas* (*Foeniculum vulgare*), M. *Cupliksari* (*Eucalyptus alba*), N. *Cipir* (*Psophocarpus tetragonolobus*), O. *Kayu Cendana* (*Santalum album*), P. *Temulawak* (*Curcuma zanthorrhiza*), Q. *Kunyit* (*Curcuma longa*), R. *Cabe Jawa* (*Piper retrofractum*), S. *Kayu Putih* (*Melaleuca leucadendra*), T. *Ceplukan* (*Physalis angulata*)

Based on the research results, the processing plants' method to make herbal medicine at the Nguter Traditional Market is generally by boiling/boiling (Table 2). The Nguter community chooses processing by boiling because this processing knowledge is obtained from generation to generation. The community also believes boiling processing is more efficacious than other methods. Boiling is believed to be more effective because it is generally used as internal medicine treatment and has a fast reaction; boiling can dissolve all the nutritious substances in the plants' ingredients into the boiled water (extraction process) (Sumarni et al. 2019). In addition, processing by boiling is also said to be safer because it can kill contaminant microorganisms found in plants (Milana and Juliar 2022).

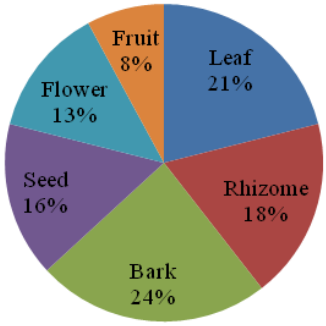

Figure 5. Plant parts used as herbal medicine

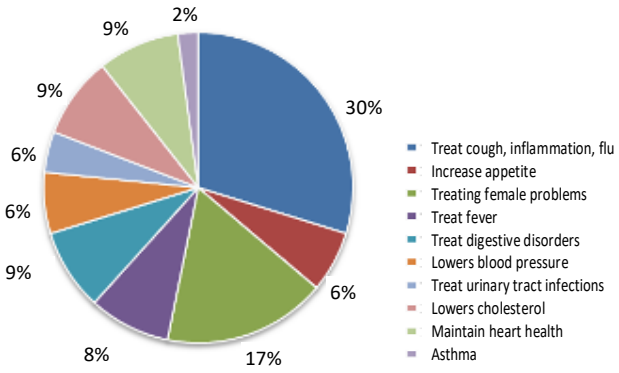

Figure 6. There are many benefits of herbal medicine

According to the research results of Falyauma et al. (2022), the most commonly used processing is by boiling because most respondents consume plants as medicine by drinking. Therefore, almost all the compounds contained in the potion when the potion is drunk. Furthermore, drinking is believed to cure the disease quickly because the compounds will directly enter the digestive tract, and the juices resulting from the boiling will immediately grow and react with the disease. In addition, processing by boiling is very easy and economical because it can be used repeatedly (Harismayanti and Gratitude 2022). Polar, semi-polar, and non-polar compounds will be extracted optimally by boiling and adding heat. That happens because a solvent's polarity indicates the solubility level in a material. Compounds of material are polar if they are more soluble in water, while materials are non-polar if they tend to dissolve in organic solvents (Falyauma et al. 2022).

Boiling also aims to change the permeability of the cell membrane so that secondary metabolites can be released from the cell; the heating process can degrade cell membranes. Sodirun et al. (2016) added that the cell membrane limits the transfer of substances involved in reactions that occur within the cell and the entry of substances from outside the cell. Chemical analysis shows that the cell membrane comprises 60% protein and 40% lipid. Several layers make up the cell membrane; in the middle, a layer of lipids is covered by a protein layer. Several types of protein have a high sensitivity to changes in the surrounding environment. Noncovalent changes in protein molecules' secondary or tertiary structure are often defined as protein denaturation (Anema 2020). Suppose there is a change in the protein molecule, for example, due to changes in pH, temperature, or reactions with other compounds, metals, or ions. In that case, it will reduce its biochemical activity. In addition, the protein will experience coagulation while heated to a 50°C temperature and higher (Tenorio et al. 2016).

This research revealed the many benefits of plants from herbal medicine for the body's health. The greatest benefit obtained is to treat coughs, inflammation, and flu by 30% (Figure 6). These benefits are obtained from plants such as *kencur* (*K. galanga*), *jahe* (*Z. officinale*), *kunyit* (*C. longa*), *dawung* (*P. timoriana*), *cengkeh* (*S. aromaticum*), *kayu putih* (*M. leucadendra*), *adas* (*F. vulgare*), *sambiroto* (*A. paniculata*), *kemukus* (*P. cubeba*), *secang* (*B. sappan*), *rasuk angin* (*Usnea* sp.), and *daun jeruk* (*C. hystrix*). Rhizomes, such as *jahe* (*Z. officinale*), *kencur* (*K. galanga*), and *kunyit* (*C. longa*), contain many useful substances because it is an important part of the plant that functions as a food reserve (Dosoky and Setzer 2018). *Jahe* (*Z. officinale*) contains essential oils with active chemical compounds so that they have properties for preventing and treating various diseases (Mao 2019). The compound species found in *jahe* (*Z. officinale*) include a-sitosterol, caprylic acid, capsaicin chlorogenic acid, phellandrene, gingerol, limonene, oleoresin, sesquiterpene, citral, zingiberene, zingerone, zingiberal, 1,8 cineole, and guanico. These compounds in jahe (*Z. officinale*) can cure diseases, such as 1.8 cineole for fever and dizziness, limonene as a cold medicine, and guanicol as a cough suppressant (Atmojo 2013). *Kencur* plant (*K. galanga*) can be used to treat coughs (Ammar et al. 2021) because it contains essential oils (ethyl p-methoxycinnamate, ethyl cinnamate followed by 3-carene, pentadecane, borneol, bornyl acetate, δ-selinene, camphor and α-pinene) (Kumar 2020). *Kunyit* (*C. longa*) has herbal effects because it contains essential oils, arabinose, fructose, glucose, starch, tannins, curcumin, dimethoxy, curcumin, iron, magnesium, calcium, potassium, and sodium. These ingredients have anti-inflammatory, antioxidant, and maintain stamina properties. *Kunyit* (*C. longa*) powder can treat coughs and colds in toddlers.

According to Suryanti et al. (2022), *dawung* (*P. timoriana*) phytochemically found alkaloids, saponins, tannins, flavonoids, and triterpenoids by treating the seeds with different extracts using standard procedures. *Dawung* (*P. timoriana*) is efficacious as a medicine for flatulence, while the leaves are efficacious as a cough medicine. *Cengkeh* (*S. aromaticum* is a spice plant that contains phenolic compounds such as eugenol (Parham and Kharazi 2022). Eugenol has active compounds such as flavonoids, saponins, tannins, and essential oils, which make cengkeh (*S. aromaticum*) a source of antioxidants, which are useful as cough medicines, nausea, vomiting, and other ailments (El-Saber Batiha et al. 2020). *Kayu Putih* (*M. leucadendra)* contains active compounds, such as valeric aldehydes, butyrate, benzoate, ceneole, eucalyptol, L pinene, 44-45% cineol, terpineol, and limonene. The essential oil in kayu putih (*M. leucadendra*) provides a mucolytic effect (thinning phlegm), anti-inflammatory, and cough suppressant. The community uses *F. vulgare*, or adas, as

cough medicine. *Adas* (*F. vulgare*) has functioned as an anti-inflammatory, antioxidant, antibacterial, and antifungal because it contains active compounds, such as acetin, rosmarinic acid, aglycons flavonoids, kaempferol, and quercetin. Sambiroto (*A. paniculata*) is often found, and its leaves are used as a medicinal plant because it has several antibacterial ingredients, such as andrographolide, tannins, flavonoids, alkaloids, steroids, saponins, phenols, terpenoids, and glycosides (Brigitta et al. 2021). The content of andrographolide as an immunomodulator and tannins as an antidiarrheal; sambiroto leaves function as anti-inflammatory, anti-inflammatory, and various other benefits.

Kemukus (*P. cubeba*) is a plant with functions as an antioxidant, antiulcer, antibacterial, antifungal, hepato-protector, anticytotoxic, nephroprotective, and antiparasitic so that it can shed phlegm and treat other diseases. *Secang* (*B. sappan*) contains secondary metabolites that act as drugs. The metabolites are brazilin as the main compound, alkaloids, flavonoids, saponins, and tannins (Sucita et al. 2019). This content can be an antioxidant, blood cough medicine, anti-tetanus, and inflammation. *Rasuk angin* (*Usnea* sp.) can be used to treat the respiratory tract because it contains a variety of secondary metabolites. This *Usnea* species contains specific secondary metabolites, such as lecanoric acid and usnic acid, used for antioxidants and antimicrobials. According to Sari et al. (2018), the *rasuk angin* (*Usnea* sp.) also contains usnic acid, with antibacterial, antifungal, and anti-inflammatory properties used as medicine. Finally, *daun jeruk* (*C. hystrix*) is efficacious in relieving headaches, colds, and nasal congestion due to the flu. This is because there is a very dominant citronellal essential oil content. In addition, there are also a small amount of other essential oils, such as citronellol, limonene, and nerol.

The most expensive medicinal plant is *mesoyi* (*C. massoia*), *kapulaga* (*E. cardamomum*), and *pekak* (*I. verum*) at IDR 300.000/kg. *Mesoyi* (*C. massoia*) is a plant endemic to Maluku and Papua, which has many benefits, including as an antimicrobial, anti-inflammatory, antioxidant, and so on, beneficial to human life. However, *mesoyi* (*C. massoia*) is a very difficult plant to cultivate even though the demand in the market is quite high. According to Hastatanti and Noya (2018), *mesoyi* (*C. massoia*) is a plant with a high failure rate, a fairly long harvest period, and harvesting techniques that tend to be destructive by cutting down trees. That causes the price of the *mesoyi* (*C. massoia*) to be more expensive than other medicinal plants. At the same time, *kapulaga* (*E. cardamomum*) has seeds that taste spicy similar to *jahe* (*Z. officinale*) and is used as an aromatic spice to treat stomachache, fever, and cough. However, according to Yasni (2013), data on the production and trade of the *kapulaga* is still very small and has many variations, making it difficult to classify. That resulted in *kapulaga* (E. cardamomum) being expensive compared to other medicinal plants. Likewise, *pekak* (*I. verum*), this plant is considered expensive because it has a high demand in medicine manufacturing. In addition, the flower extraction process carried out on this plant to make essential oil takes a long time, up to 1 year.

This study concluded that 40 species of medicinal plants with 23 families were sold at the Nguter Traditional Market. The herbal plants that dominate in the Nguter Traditional Market are *cipir* (*P. tetragonolobus*), *dawung* (*P. timoriana*), *kunir* (*C. longa*), *jahe* (*Z. officinale*), and *kencur* (*K. galanga*). The most expensive medicinal plant is *mesoyi* (*C. massoia*), *pekak* (*I. verum*), and *kapulaga* (*E. cardamomum*), with a price of IDR 300,000/kg. At the same time, the cheapest herbal medicine is *sambiloto* (*A. paniculata*), *kayu putih* (*M. leucadendra*), *kunir* (*C. longa*), *kencur* (*K. galanga*), and *lempuyang* (*Z. zerumbet*) at IDR 20,000/kg. The part of the herbal medicine most widely used as a basic ingredient for herbal medicine is the stem. The greatest benefits of herbal plants are to treat coughs, inflammation, and flu.

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