Ethnobotanical Study of Medicinal Plants in Hades Forest, Doba Wereda, West Hararghe, Ethiopia, and Their Associated Indigenous Knowledge

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Abstract

Background

Medicinal plants have long held historical significance and are recognized for their essential role in both traditional and modern healthcare systems. In Ethiopia, where access to formal medical services is limited, traditional medicinal practices remain crucial. This study documents medicinal plant species, their traditional uses, and associated indigenous knowledge in Hades and the surrounding communities of Doba district, West Hararghe, Ethiopia, to support conservation planning and sustainable use.

Methods

Data were collected from 105 general informants selected via simple random sampling and 15 key informants selected via snowball sampling. Descriptive statistics were used to summarize demographic and plant-use data. In contrast, quantitative ethnobotanical indices, including preference ranking, direct matrix ranking, informant consensus factor (ICF), relative frequency of citation (RFC), and fidelity level (FL), were employed to assess the cultural importance and consensus regarding medicinal plants.

Results

This study documented 49 medicinal plant species belonging to 31 families used to treat human ailments, with Asteraceae and Lamiaceae as the dominant families. Shrubs were the most common growth form, and leaves were the most frequently used plant part. Remedies were prepared mainly by crushing and pounding (59.1%) and were administered orally (70.6%). *Vernonia amygdalina*, *Cissampelos mucronata*, and *Croton macrostachyus* were the top-ranked species for treating intestinal parasites. Informant consensus was highest for reproductive/urinary (ICF = 0.97), gastrointestinal (ICF = 0.96), and dermatological disorders (ICF = 0.96). Twenty-one species achieved complete fidelity (FL = 100%), and *Croton macrostachyus* had the highest relative frequency of citation (78.3%), indicating its prominence in local ethnomedicine. Ethnomedicinal knowledge was transmitted primarily orally and was significantly greater among key informants (mean = 14.47) than general informants (mean = 7.25; $p < 0.001$), and among elders compared with middle-aged participants ($p = 0.045$). No significant differences were observed by gender ($p = 0.758$) or educational status ($p = 0.57$). Overgrazing, overharvesting, and weak intergenerational knowledge transfer were identified as the major threats to both plant resources and traditional knowledge.

Conclusion

The study highlights the vital role of medicinal plants in local healthcare in the study area and the cultural knowledge associated with their use. Conserving plant diversity and sustaining indigenous knowledge through community-based initiatives, public awareness, and sustainable harvesting practices are essential to ensure their continued availability and contribution to both biodiversity and local well-being.

BACKGROUND

The use of medicinal plants has a long history and is widely recognized for its value in healthcare systems worldwide [23]. Since ancient times, these plants have served as effective and safe sources of medicine. Traditional medicinal plants are the primary means of treating diseases and combating infections globally [1]. Countries such as Thailand,

Sri Lanka, China, India, Pakistan, and Japan have a long tradition of practicing traditional medicine. However, the extensive use of these therapeutic plants is especially prominent in developing and resource-poor nations [27]. Between 70% and 95% of people living in developing countries rely primarily on medicinal plants for their healthcare [21]. In Africa, the preference for medicinal plants over modern medicine is well documented [12].

Ethiopia is one of the most biodiversity-rich countries in the world, harboring approximately 6,027 species of vascular plants, including about 887 medicinal plants [4]. Ethnobotanical studies emphasize the important role of medicinal plants in primary healthcare in Ethiopia, where 80% of the human population and 90% of livestock depend on these plants [14, 63, 22]. This high reliance on medicinal plants is attributed to their cultural acceptance, availability, and affordability compared with modern medicine [20]. The utilization, management, and conservation of medicinal plants are inseparably linked to indigenous knowledge that has been developed and transmitted across generations. Such knowledge guides plant identification, harvesting methods, preparation techniques, dosage determination, and seasonal use in the treatment of human and livestock ailments [61]. Indigenous practices also play a key role in regulating sustainable harvesting and conserving plant resources within local communities.

Despite their importance, both medicinal plants and the associated indigenous knowledge are increasingly threatened in Ethiopia. Habitat destruction, deforestation for timber extraction, agricultural expansion, urbanization, and climate change have significantly reduced the availability of medicinal plant resources [24, 39, 5, 14]. Concurrently, indigenous knowledge is eroding due to secrecy, cultural shifts, globalization, industrialization, increased access to modern healthcare, and declining interest among younger generations [1, 62, 45]. Oral transmission, weak intergenerational transfer, and limited documentation further exacerbate this loss, posing serious challenges to the sustainability of traditional healthcare systems.

Hades and the surrounding area harbor a rich diversity of medicinal plants used by local communities; however, both the medicinal plant species and the indigenous knowledge associated with their identification, medicinal uses, and management remain largely undocumented. To address these gap therefore, the present study documents medicinal plant species and their associated indigenous knowledge, analyze the threats affecting these resources, and document conservation practices.

METHODS

Study design and study area

This ethnobotanical cross-sectional study was conducted in Hades Forest and the surrounding rural communities in Doba District, West Hararghe Zone, Oromia Regional State, Ethiopia. This study aimed to document medicinal plant species and their traditional uses, identify the threats affecting these resources, and document existing conservation practices. Doba district lies 371 kilometers east of Addis Ababa and 45 kilometers from Chiro, the zonal capital. The area has an average elevation ranging from 1600 to 3100 m above sea level and covers approximately 618 hectares [15] (Fig. 1).

Doba District has a total population of 213,715, of which 103,802 are men, and 109,913 are women [15]. The area has a tropical highland climate with a distinct rainy season from June to September. The annual rainfall ranges from 300 to 800 mm, and the mean annual temperature varies between 16°C and 18°C [13]. Vegetation varies with altitude. Lower and mid-altitudes are dominated by *Podocarpus falcatus*, and higher elevations are composed mainly of *Juniperus procera*, interspersed *with Croton macrostachyus* and other woody species, such as *Mytenus* species and *Gymnosporia obscura* [13]. Soils are composed of mixed textures of sand, clay, and silt [18].

2.2 Sampling and Data Collection Methods

A reconnaissance survey was conducted in February 2025 to obtain preliminary information on population characteristics, the distribution of medicinal plant resources, the locations of traditional healers, and knowledgeable elders in the study area. Based on this survey, three kebeles, Bekelecha Biftuu, Ifa Haqaa, and Tokuma Jaalalaa, were purposively selected from the 44 kebeles of Doba district based on the presence of traditional medicine practitioners, medicinal plant availability, natural vegetation density, and recommendations from knowledgeable elders.

Ethnobotanical data were collected from a total of 120 informants (84 men, 36 women; 40 per kebele) using snowball sampling for knowledgeable individuals, including traditional healers and elders [11], and random selection for general informants. Prior to data collection, official permission was obtained from the Doba District Administrative Office. The participants were informed about the purpose of the study, and oral consent was obtained from each participant. Data collection was conducted from February to March 2025 in accordance with established ethnobotanical survey methods [10]. Multiple data collection techniques were employed, including semi-structured interviews, group discussions, and guided field walks.

Semistructured interviews were used to gather information on respondents' sociodemographic characteristics (gender, age, education, marital status, religion, occupation, and economic status), medicinal plant species used to treat human ailments, vernacular plant names, plant parts utilized, methods of preparation, routes of administration, additional uses, and local conservation practices. Community perceptions of threats to medicinal plants and their associated indigenous knowledge were assessed via a five-point Likert scale, in which respondents indicated their level of agreement with predefined statements describing major anthropogenic and environmental threats, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). A total of 30 informants participated in this assessment, comprising 15 purposively selected elders and 15 randomly selected community members. Group discussions and guided field walks were conducted with key informants to ensure accurate identification of medicinal plant species and to verify the information obtained during the interviews. Voucher samples were collected following standard herbarium procedures and deposited at the Haramaya University Herbarium. Plant identification was then performed through comparison with authenticated herbarium samples and further verified by existing descriptions from the relevant volumes of the Flora of Ethiopia and Eritrea.

2.3 Data analysis

The data were organized in Microsoft Excel (2010) and analyzed using R software (version 4.5.1). Descriptive statistics, percentages, and frequencies were used to summarize data related to medicinal plant species, plant parts used, preparation methods, administration routes, and ailment categories.

Informant consensus factor was calculated to assess the agreement among the informants on medicinal plant use [31] using the following formula:

$$ICF = \frac{Nur - Nt}{Nur - 1}$$

where *Nur* is the number of use reports from informants for a specific use category and *Nt* is the number of species used for that category.

Fidelity level (FL) was computed to determine the relative importance of each medicinal plant species in treating specific ailments [17]. It was calculated via the following equation:

$$FL\,(\%) = \backslash\text{raisebox}1ex\$Ip\$/\backslash\text{raisebox}-1ex\$Iu\$\,x\,100$$

where *Ip* is the number of informants who independently reported the use of a species for the same specific ailment and *Iu* is the total number of informants who mentioned the species for any ailment.

Preference ranking was conducted following [31] to evaluate the perceived efficacy of medicinal plants used to treat intestinal parasites. Nine key informants were randomly selected to rank eight medicinal plant species on the basis of their relative effectiveness. Each informant is assigned scores ranging from 1 (least effective) to 5 (most effective). The scores assigned to each species were summed, and the plants were ranked according to their total scores.

Relative frequency of citation (RFC) was calculated to assess the local importance of each medicinal plant species [52]:

$$RFC = \ \raisebox{1ex}{\$}FC\$/\raisebox{-1ex}{\$}N\$$$

where *Fc* is the number of informants citing a species and *N* is the total number of informants.

Direct matrix ranking (DMR) was employed to evaluate the relative importance of multipurpose medicinal plants following [10]. From the total recorded medicinal plants, five tree species were purposely selected on the basis of their multiple uses. These species were assessed across six major use categories: soil erosion control, goat feed, timber, edible fruit, firewood, and fencing. Nine knowledgeable key informants scored the usefulness of each plant within each category via a five-point scale, where a score of 5 represented the highest level of use, and a score of 1 represented the lowest.

To analyze differences in indigenous knowledge among informant groups, normality and homogeneity assumptions were tested via the Shapiro–Wilk test and Levene's test, respectively [16]. To compare knowledge scores between key informants and general informants, a Welch two-sample t test was employed, as it accounts for unequal variances and sample sizes [59]. Knowledge differences between male and female informants were examined via an independent samples t test. Similarly, differences in medicinal plant knowledge between educational levels (nonliterate vs. literate) were analyzed via an independent samples t test. Differences among age groups were evaluated via one-way ANOVA followed by Tukey's HSD post hoc test [27, 57]. Statistical significance was set at $p < 0.05$.

RESULTS

Demographic Status of the Informants

A total of 120 informants participated in this study. A large proportion of the informants were male, with females making up a smaller share of the participants. Farming was the most dominant occupation. Most participants were above the age of 46 and were primarily engaged in farming. The majority were married and nonliterate. All the informants reported a monthly income above 5,000 ETB (Table 1).

Table 1
Sociodemographic characteristics of the respondents

Category	Subcategory	Count	Percentage
Occupation	Farmer	46	38.30
	Farmer and trader	7	5.80
	Farmer and traditional healer	13	10.80
	Farmer, Forest guardian	2	1.70
	Housewife	6	5.00
	Police	4	3.30
	Student (college students)	14	11.70
	Trader	5	4.20
	Traditional healer	2	1.70
Gender	Female (F)	36	30.00
	Male (M)	84	70.00
Age	> 46	69	57.50
	25–35	18	15.00
	36–45	33	27.50
Marital Status	Married	111	92.5
	Single	9	7.50
Education Status	Nonliterate	90	75.00
	Literate	30	25.00
Income (Monthly)	> 5000 birr	120	100

Medicinal plant resources of the study area used for treating human ailment

A total of 49 medicinal plant species belonging to 47 genera and 31 families were documented in the study area for the treatment of human ailments. Asteraceae was the most represented family, comprising five species, followed by Lamiaceae, with four species, and Rosaceae and Fabaceae, with three species each. Five families (Apocynaceae, Primulaceae, Solanaceae, Salicaceae, and Scrophulariaceae) were represented by two species each, whereas the remaining 14 families were represented by a single species (Table 2).

Table 2
Medicinal plant resources of the study area used to treat human ailments

Voucher No	Botanical Name/Habit	Family	Vernacular Name	Disease Treated	PU	PM & AM
AT015	*Afrocarpus falcatus* (Thunb.) C.N. Page/Tree	Podocarpaceae	Birbirsa	Insect repellent, Heart Disease, Fever	L, Sd	Crushed and rubbed on skin; boiled with apple leaf and drunk with coffee; crushed and boiled to drink (Oral/Dermal)
AT012	*Aloe pubescens* Reynolds/Succulent Herb	Asphodelaceae	Ret	Diabetes, Gastric	L	Inner jelly like part extracted, mixed with Beso and eaten (Oral)
				Dandruff	Sap	Inner jelly like part extracted and applied to scalp (Topical)
AT011	*Alysicarpus rugosus* (Wild.) Dandy/Herb	Fabaceae	Alii-hanqaa	Gonorrhea, Cough	B, L	Dried, crushed, boiled with water and oil to drink (Oral)
AT009	*Asparagus africanus* Lam./Climbing Shrub	Asparagaceae	Hiddii saree	Menorrhagia,	L	Crushed, mixed with water, left overnight and drunk
				Tufa	L	pounded and wrapped on wound (Oral/Dermal)
AT044	*Astropanax abyssinicus* (Hochst. ex A. Rich.) Seem/Tree	Araliaceae	Gatama	Skin irritation	L	Pounded and rubbed over affected area (Dermal)
AT026	*Bidens pilosa* L./Herb	Asteraceae	Xiyyee	Back pain, Stomach disorder, Headache	L	Boiled and drunk (Oral)
AT020	*Caesalpinia decapetala* (Roth) Alston/Shrub	Fabaceae	Qajima	Ascariasis	R	Crushed with leaves of Plectranthus ecklonii and drunk with water (Oral)
AT032	*Calpurnia aurea* (Aiton) Benth./Shrub	Fabaceae	Ceekaa	Jaundice, Detoxification	L	Crushed with leaves of Verbascum sinaiticum and Plectranthus ecklonii and drunk with water (Oral)

Voucher No	Botanical Name/Habit	Family	Vernacular Name	Disease Treated	PU	PM & AM
AT017	*Carissa spinarum* L./Shrub	Apocynaceae	Agamsa	Wound	B	Wrapped on the wound (Dermal)
AT001	*Cissampelos mucronata* A. Rich./Perennial Climber	Menispermaceae	Bal-Toke	Stomach ache, Cough, Diarrhea	L	Crushed and mixed with water to drink; (Oral)
				Snake bite	R	Pounded and applied to affected area (Dermal)
AT045	*Combretum molle* G. Don/Shrub	Combretaceae	Maldhissa	Fever, Constipation	R	Boiled and drunk (Oral)
AT031	*Croton macrostachyus* Hochst. ex Delile/Tree	Euphorbiaceae	Bekenissaa	Bloating, Hemorrhoids, Gonorrhea	L, Sd, St, R	Crushed and drunk with water (Oral)
AT008	*Cucumis ficifolius* A. Rich./Annual Climber	Cucurbitaceae	Hare goge	Diarrhea, Kidney disease, Bloating, Gonorrhea	L	Crushed and drunk with water (Oral)
AT023	*Cymbopogon citratus* (DC.) Stapf/Grass	Poaceae	Cita fura	Evil spirit, Common cold	Ap	Burned to fumigate the patient (Inhalation)
AT040	*Datura stramonium* L./Herb	Solanaceae	Qomaxeri	Dhandacha (O)	L	Crushed and squeezed on scalp (Topical)
				Bloating	B	crushed and drunk with water (Oral)
				Toothache	Sd	held on aching tooth (Buccal)
AT043	*Dovyalis abyssinica* (A. Rich.) Warb./Shrub	Salicaceae	Shimbirkoli	Intestinal parasite	L	Pounded and drunk with water (Oral)
AT038	*Echinops kebericho* Mesfin/Shrub	Asteraceae	Qabariicho	Intestinal worms, Urine retention, Evil eye, Tonsillitis, Fever	R	Pounded, mixed with water and drunk; crushed with oil and drunk (Oral)
AT030	*Embelia schimperi* Vatke./Shrub	Primulaceae	Hanquu	Tapeworm	F	Dried, pounded and drunk with water (Oral)
AT047	*Ficus sur* Forssk./Tree	Moraceae	Harbuu	Jaundice, Anemia,	L	Crushed and drunk with water (Oral)

Voucher No	Botanical Name/Habit	Family	Vernacular Name	Disease Treated	PU	PM & AM
				Ringworms	L	Crushed and applied on the affected body part (Dermal)
AT003	*Foeniculum vulgare* Mill./Perennial Herb	Apiaceae	Kemona	Kidney disease, Vomiting, Urinary retention	L, R	Roasted, crushed and drunk with milk; crushed and drunk with water (Oral)
AT007	*Hagenia abyssinica* (Bruce) J.F. Gmel./Tree	Rosaceae	Heexoo	Tapeworm, Back pain	L, R, Sd	Crushed, dried and consumed; root soaked and consumed (Oral)
AT034	*Hoffmannanthus abyssinicus*/Shrub	Asteraceae	Muka adi	Cataracts	L	Crushed and squeezed to extract liquid into eye (Ocular)
AT028	*Jasminum grandiflorum* L./Shrub	Oleaceae	Bilu	Tufa, Bleeding, Body swelling	L	Crushed and applied to affected body part (Dermal)
AT027	*Juniperus procera* Hochst. ex Endl./Tree	Cupressaceae	Gatiraa habashaa	Uterus problem,	Sd, L	Pounded and drunk with water (Oral)
				Toothache	Sd	Held by aching teeth (Buccal)
AT046	*Justicia schimperiana* (Hochst. ex Nees) T. Anderson/Shrub	Acanthaceae	Dhummuga	Rabies	L	Dried with leaf of *Phytolacca dodecandra*, crushed and drunk with water (Oral)
AT018	*Kalanchoe marmorata* Baker/Shrub	Crassulaceae	Phiphii	Ear disease	L	Heated and squeezed to extract liquid into ear canal (Otic)
AT013	*Lippia adoensis* Hochst. ex Walp. var./Shrub	Verbenaceae	Sukee	Fungal skin infection, Body swelling	L	Roasted, powdered and mixed with butter or oil to apply (Dermal)
AT049	*Myrica salicifolia* Hochst./Shrub	Myricaceae	Macheensso	Dermatitis	L	Dried, crushed, mixed with water and applied (Dermal)
AT021	*Myrsine africana* L./Shrub	Primulaceae	Qacuu	Stomach ache, Back pain	R	Crushed, roasted, drunk with goat milk (Oral)

Voucher No	Botanical Name/Habit	Family	Vernacular Name	Disease Treated	PU	PM & AM
AT036	*Myrtus communis* L./Shrub	Myrtaceae	Hades	Stomach ache	L	Pounded and drunk with water (Oral)
AT014	*Ocimum lamiifolium* Hochst. ex Benth./Shrub	Lamiaceae	Anchebi	Mich, Common cold	L	Rubbed by hand and squeezed into coffee to drink (Oral)
AT025	*Olea africana* Mill./Tree	Oleaceae	Ejersa	Headache, Common cold	L, St	Crushed and burned to fumigate the patient (Inhalation)
AT048	*Oncoba spinosa* Forssk./Tree	Salicaceae	Garabagosh	Dermatitis	L	Pounded and applied to affected area (Dermal)
AT041	*Osyris quadripartita* Decne./Shrub	Santalaceae	Wato	Evil eye	L, R	Dried, crushed, powdered, burned and smoke inhaled (Inhalation)
AT022	*Periploca linearifolia* Quart. Dill. & A. Rich./Perennial Climber	Apocynaceae	Hidda aanaannoo	Eye disease	R	Dried and burned for fumigation (Inhalation)
AT037	*Phytolacca dodecandra* L'Hér./Shrub	Phytolaccaceae	Handoode	Intestinal parasite	Sd	Pounded and drunk with water (Oral)
				Itching	L	crushed and used for washing(Dermal)
AT035	*Plantago media* L./Herb	Plantaginaceae	Asandabo	Hemorrhoid	L	Crushed and drunk with water (Oral)
AT033	*Plectranthus ecklonii* Gürke/Shrub	Lamiaceae	Muka ajawa	Mich	L	Crushed and placed in cloth to squeeze into eye (Ocular)
AT024	*Premna schimperi* Engl./Shrub	Lamiaceae	Urgessa	Body swelling, Toothache	L	Crushed with leaves of Jasminum grandiflorum and Podocarpus falcatus and applied; chewed and held with affected teeth (Dermal/Buccal)
AT042	*Rosa abyssinica* Lindl./Shrub	Rosaceae	Goraa	Toothache, Wound	R, L	Chewed and held on teeth;

Voucher No	Botanical Name/Habit	Family	Vernacular Name	Disease Treated	PU	PM & AM
						dried, crushed and applied to wound (Buccal/Dermal)
AT005	*Rubus apetalus* Poir./Shrub	Rosaceae	Gora gallo	Digestive issues	F, R, L	Unprocessed eaten; dried, boiled, and drunk (Oral)
AT002	*Rumex abyssinicus* Jacq./Herb	Polygonaceae	Meyemeqo	Gofla (O), Cancer	R	Crushed and boiled to drink (Oral)
AT004	*Salvia merjamie* Forssk./Herb	Lamiaceae	Muka aroo	Spider poison	L, R	Pounded and applied to affected body part (Dermal)
AT016	*Scolopia theifolia* Gilg./Tree	Salicaceae	Qillisaa	Ascariasis	R	Crushed and drunk with water (Oral)
AT010	*Solanecio nandensis* Oliv./Herb	Asteraceae	Jiniirsaas	Spider poison Fungal skin infection	L, Ap	Crushed and applied on the affected body part (Dermal)
				Febrile illness	L	Crushed and mixed with water to drink (Oral)
AT019	*Verbascum schimperi* Skan./Herb	Scrophulariaceae	Muka Loni	Stomach ache	L	Crushed with Plectranthus ecklonii and apple leaf, mixed with water (Oral)
AT039	*Verbascum sinaiticum* Benth./Herb	Scrophulariaceae	Gura hare	Gonorrhea, Cancer	R	Crushed and drunk with water or coffee (Oral)
AT029	*Vernonia amygdalina* Del./Shrub	Asteraceae	Ebicha	Diarrhea, Intestinal parasite	L	Pounded and drunk with water (Oral)
AT006	*Withania somnifera* (L.) Dunal/Shrub	Solanaceae	Hide-budei	Bloating, Evil eye, Heart problem, Diabetes	R, L	Pounded and drunk with water; dried, powdered, and eaten or drunk (Oral)
L- leaf, R- root, B-bark, Sd-seed, St- stem, Ap-all part						

Growth Forms and Plant Parts Used

Different growth forms of medicinal plants were recorded in the study area. Shrubs were the most dominant growth form, followed by herbs and trees, whereas climbers and grasses were the least represented (Fig. 2). Seven different

plant parts were reported for use in remedy preparation. Leaves were the most frequently used plant part, followed by roots and seeds. Other parts, such as stems, bark, fruits, whole plants, and sap, were used less frequently (Fig. 3).

Methods of Remedy Preparation and Additives

The local communities in the study area employ various traditional methods for remedy preparation. Crushing and pounding were the most commonly used techniques, followed by fluid extraction and concoction. The less frequently used techniques were fumigation or burning, direct consumption, and infusion, whereas infusion and other minor methods (e.g., fermentation, poultry, soaking in oils, steaming, and sun-drying) are rarely used (Table 3).

Table 3
Methods of remedy preparation for treating human and livestock ailments in the study area

Preparation Methods	Total Use Reports	%
Crushing and pounding	1,149	59.14
Fluid extraction	309	15.90
Concoction	290	14.93
Fumigation or burning	91	4.68
Direct consumption	91	4.68
Infusion	10	0.51
Other minor methods	3	0.15

Routes of Remedy Administration

Medicinal plant remedies are administered through multiple routes. Oral administration was the most common route, followed by dermal, inhalation, buccal, topical, and ocular routes (Table 4).

Table 4
Route of the administration of remedies for treating human ailments in the study area

Administration	No. of Preparations	%
Oral	1,373	70.64
Dermal	248	12.76
Inhalation	134	6.89
Buccal	103	5.30
Topical	58	2.98
Ocular	27	1.39

Dosage measurement

Dosages in the study area were determined through various local measurement units. These included counts of leaves, seeds, fruits, and flowers; finger lengths for roots and stem bark; pinches for powdered plant parts; and cups for decoctions and infusions.

Preference Ranking of Medicinal Plants

Preference ranking analysis revealed that *Vernonia amygdalina* was the most effective agent for treating intestinal parasites in humans. It was followed by *Cissampelos mucronata* and *Croton macrostachyus*, which were ranked second and third, respectively. The remaining plants, *Myrtus communis*, *Echinops kebericho*, and *Phytolacca dodecandra*, were perceived as less effective than the top-ranked plants (Table 5).

Table 5
Preference ranking of the top medicinal plants for their effectiveness in treating intestinal parasites in humans in the study area

No	Plant name	A	B	C	D	E	F	G	H	I	Score	Rank
1	*Vernonia amygdalina*	5	5	5	5	5	5	4	5	5	44	1
2	*Cissampelos mucronata*	4	4	4	3	4	3	4	5	4	35	2
3	*Croton macrostachyus*	5	3	4	3	3	5	3	3	4	33	3
4	*Hagenia abyssinica*	4	4	5	4	3	3	2	3	4	32	4
5	*Verbascum sinaiticum*	3	3	3	3	3	3	3	5	5	28	5
6	*Myrtus communis*	3	3	3	3	3	2	3	3	3	26	6
7	*Echinops kebericho*	2	3	2	2	3	2	2	2	2	20	7
8	*Phytolacca dodecandra*	3	2	2	1	2	2	2	1	2	17	8

Informant Consensus Factor (ICF)

The ICF values for medicinal plant use across disease categories ranged from 0.83–0.97. The highest consensus was observed in the categories of reproductive/urinary, gastrointestinal, dermatological, and neurological disorders, with values ranging from 0.95 to 0.97 (Table 6).

Table 6
ICF values of medicinal plants for treating human ailments in the study area

Disease Category	Nur	Nt	ICF Value
Reproductive/Urinary Disorders	360	9	0.97
Gastrointestinal Disorders	479	19	0.96
Dermatological Disorders	382	17	0.96
Neurological & Head-related Disorders	220	10	0.95
Hepatic (Liver) Disorders	22	2	0.95
Cancer & Tumors	44	2	0.95
Musculoskeletal Disorders	61	3	0.95
Respiratory Disorders	157	9	0.94
Spiritual Disorders	120	4	0.93
Circulatory/Cardiovascular Disorders	34	4	0.91
Poisoning and Envenomation	54	6	0.89
Endocrine/Metabolic Disorders	7	2	0.83

Fidelity level (FL)

Fidelity level values among the 49 medicinal plant species ranged from complete agreement (100%) to much lower levels of consensus. Twenty-one species achieved an FL of 100% (Table 7). Several other species had lower fidelity values, including *Cissampelos mucronata* (for cough, snake poison and toothache), *Jasminum grandiflorum* (body swelling), *Echinops kebericho* (evil eye), *Bidens pilosa* (headache), Afrocarpus *falcatus* (fever), *Hagenia abyssinica* (back pain), *Foeniculum vulgare* (vomiting), Aloe *pubescens* (gastric), *Ocimum lamiifolium* (common cold) and *Withania somnifera* (heartproblem). The complete FL values for all 49 species are presented in Additional Table 1.

Table 7
Fidelity level (FL) of the top five species for treating human ailments in the study area

Species	Disease Treated	Np	N	FL (%)
Astropanax abyssinicus	Skin Irritation	6	6	100
Caesalpinia decapetala	Ascariasis	12	12	100
Carissa spinarum	Wound	26	26	100
Datura stramonium	Psoriasis	23	23	100
Dovyalis abyssinica	Intestinal parasite	6	6	100
Embelia schimperi	Tapeworm	11	11	100
Hoffmannanthus abbotianus	Cataracts	4	4	100
Justicia schimperian	Rabies	6	6	100
Kalanchoe marmorata	Ear disease	48	48	100
Myrica salicifolia	Dermatitis	13	13	100
Myrtus communis	Stomach ache	11	11	100
Oncoba spinosa	Dermatitis	7	7	100
Plantago media	Hemorrhoid	3	3	100
Plectranthus ecklonii	Febrile illnesses	23	23	100
Rubus apetalus	Digestive issues	96	96	100
Rumex nervosus	Gofla (O)/Cancer	35	35	100
Salvia merjamie	Spider poison	16	16	100
Scolopia theifolia	Ascariasis	3	3	100
Verbascum sinaiticum	Stomach ache	8	8	100
Periploca linearifolia	Eye disease	4	4	100
Osyris quadrripartita	Evil eye	13	13	100
Ocimum lamiifolium	Febrile illnesses	64	71	90.14085
Rosa abyssinica	Wound	9	10	90
Hagenia abyssinica	Tapeworm	34	40	85
Aloe pubescens	Dandruff	35	43	81.39535

Relative frequency of citation (RFC)

Relative frequency of citation values in this study ranged from 0.25 to 0.78. *Croton macrostachyus* emerged as the most culturally prominent species, with an RFC value of 78.33%, followed by *Echinops kebericho, Withania somnifera, Bidens pilosa*, and *Cucumis ficifolius* (Table 8). Several other species, including *Myrtus communis, Embelia schimperi, Rosa abyssinica, Verbascum schimperi, Oncoba spinosa, Astropanax abyssinicus, Dovyalis abyssinica,*

Justicia schimperiana, and *Hoffmannanthus abyssinicus, presented relatively low RFC values*. The full list of RFC values for all 49 species is provided in Additional Table 2.

Table 8
Top five medicinal plant species with the highest relative frequency of citation

Plant Species	Nur	RFC (%)
Croton macrostachyus	94	78.33
Echinops kebericho	83	69.17
Withania somnifera	77	64.17
Bidens pilosa	75	62.50
Cucumis ficifolius	72	60.00

Additional Uses of Medicinal Plants

According to the direct matrix results, *Croton macrostachyus* was the highest-ranked multipurpose medicinal plant, followed by *Rubus apetalus*, *Carissa spinarum*, *Justicia schimperian*, and *Podocarpus falcatus* (Table 9). Among the evaluated use categories, soil erosion control and firewood received the highest scores, whereas timber and edible fruit had lower overall scores.

Table 9
Direct matrix ranking of five medicinal plants across multiple use categories

Use categories	*Croton macrostachyus*	*Rubus apetalus*	*Carissa spinarum*	*Justicia schimperian*	*Podocarpus falcatus*	Total	Rank
Soil erosion	5	5	5	5	5	25	1st
Goat feed	5	1	0	5	0	11	3rd
Timber	4	0	0	0	5	9	4th
Edible fruit	0	5	5	0	1	11	3rd
Fence	5	5	5	5	3	23	2nd
Firewood	5	5	5	5	5	25	1st
Total	24	21	20	20	19		
Rank	1st	2nd	3rd	3rd	4th		

Local Medicinal Knowledge in the Study Area

Comparison of knowledge between key informants and general informants

Welch's two-sample t test revealed a statistically significant difference in ethnomedicinal knowledge between key and general informants. The mean knowledge score was 14.47 for the key informants and 7.25 for the general informants (Table 10).

Table 10
Comparison of ethnic knowledge between key and general informants

Characters	Informant groups	N	Mean ± SD	t value	p value
Knowledge Score	Key informants	15	14.47	-8.16	< 0.001
	General informants	105	7.25		
* Significant at p < 0.05					

Comparison of ethnic knowledge among different age groups

One-way ANOVA revealed a significant difference in knowledge scores among the three age groups (F = 3.758, p = 0.026) (Table 11). Post hoc analysis via Tukey's HSD revealed that the elderly group presented significantly greater knowledge than did the middle-aged group did, whereas no statistically significant differences were detected between the young adult group and the elderly group or between the young and middle-aged groups (Table 12).

Table 11
One-way ANOVA summary of ethnomedicinal knowledge scores among different age groups.

Source	Df	Sum Sq	Mean Sq	F value	p value
Age Group	2	120.9	60.46	3.758	0.0262
Error	117	1882.4	16.09		
* Significant at p < 0.05					

Table 12
Tukey HSD post hoc comparison of ethnomedicinal knowledge among age groups

Age Group	N	Mean ± SD	Post hoc Comparison (Tukey HSD)
Young adults (25– 35)	18	9.28 ± 4.88	vs. Elders: p = 0.27 (NS) vs. Middle-aged: t = -2.75, p = 0.056 (NS)
Middle-aged (36– 45)	32	6.53 ± 2.88	vs. Elders: p = 0.045 (Significant)

Comparison of Knowledge between Genders

The independent t-test revealed no significant difference in ethnomedicinal knowledge between male and female informants (t = − 0.31, df = 118, p = 0.758) (Table 13).

Table 13
Comparison of ethnic knowledge between genders in the study area

Gender	N	Mean ± SD	t	df	p value	Significance
Male	84	8.23 ± 4.47	-0.31	118	0.758	Not significant
Female	36	7.97 ± 3.14				
* Significant at p < 0.05						

Comparison of knowledge between education levels

A comparison of knowledge scores by education level revealed no significant difference between nonliterate and literate informants (t = − 0.58, P = 0.57) (Table 14).

Table 14
Comparison of knowledge between education levels in the study area

Educational Status	N	Mean MPK ± SD	T value	P value
Nonliterate	90	8.01 ± 3.86		
Literate	30	8.57 ± 4.80	−0.58	0.57
* Significant at p < 0.05				

Threats to Medicinal Plants and Their Associated Indigenous Knowledge

Informants reported several threats to the survival of medicinal plants in the study area, including both human and environmental factors. Overgrazing and overharvesting were identified as the most serious threats, whereas threats such as lodging and landslides were reported to be the least serious (Table 15). In addition to threats to plant species, the informants highlighted risks to the continuity of indigenous knowledge. Weak intergenerational transmission was reported as the most serious threat limiting the transmission of indigenous knowledge in the study area, followed by secrecy among healers, lack of interest among youth, and modernization (Table 16).

Table 15
5-Point Likert Scale Results for Threats to Medicinal Plants

Threats	Mean Score	Priority
Overgrazing	4.7	High
Overharvesting	4.43	High
Agricultural expansion	3.43	Medium
Climate variability	3.5	Medium
Soil erosion	2.73	Low
Lack of funding	2.63	Low
Low awareness	2.43	Low
Lesser threats	1.73–2.23	Very Low

Table 16
5-Point Likert scale results of threats to indigenous knowledge in the study area

Factors affecting IK Transmission	Mean Score	Priority
Weak transmission to younger generations	4.5	High
Secrecy among healers limiting knowledge sharing	4.2	Medium
lack of interest in younger generations	3.5	Medium
Modernization reducing transmission	3	Medium

DISCUSSION

Asteraceae and Lamiaceae were the most prominent families in the study area, which is consistent with findings from other relevant studies in Ethiopia [2, 23, 5]. The widespread use of these plant families may be due to the presence of bioactive phytochemicals that increase therapeutic efficacy [41, 42], ease of preparation, and accessibility, particularly from leaves and aerial parts. [50] also highlighted the importance of Asteraceae in traditional medicine, noting that species within these families often share similar phytochemical compositions that contribute to their medicinal value. These results highlight the potential cultural and therapeutic significance of key plant families and the importance of understanding and protecting these valuable botanical resources.

Shrubs were the dominant growth form used for remedies, suggesting their prominent role in traditional healthcare practices. Similar preferences for shrubs have been reported in other ethnobotanical studies [54, 32, 39]. Their prominence is likely due to their greater accessibility, perennial growth habits, and relative resilience to environmental stresses such as drought and competition from invasive species. Unlike many herbaceous plants, shrubs could provide a more reliable and continuous source of traditional medicinal remedies throughout the year [7]. The contribution of herbs and trees further suggests that traditional medicinal practices in the area are influenced by the reliability and availability of local plant resources. In addition, leaves are the most frequently used plant parts for remedy preparation in the treatment of various human ailments. This preference reflects the use of plant parts that are abundant, easily harvested, and collected without causing permanent damage to the plant. This pattern aligns with other studies, which commonly report leaves as the dominant plant part used in traditional medicine, followed by roots [31, 26, 27]. Furthermore, the widespread use of leaves highlights their importance in traditional healthcare systems, driven by practical harvesting considerations and perceived therapeutic benefits. Although less frequently used, roots remain an important component of traditional remedies in the study area, as they persist in the soil year-round and contain stable, long-lasting medicinal compounds. These results highlight how traditional practices are shaped by both ecological availability and cultural knowledge, ensuring a sustainable and effective supply of medicinal resources throughout the year.

Simple preparation techniques, particularly crushing and pounding, are predominantly used by traditional healers for remedy preparation, which indicates a reliance on simple and accessible techniques that do not require specialized equipment or complex procedures. Such methods facilitate the release of active compounds. Freshly harvested plant parts are typically crushed, whereas dried parts are usually pounded. These findings are consistent with previous ethnobotanical studies. For example, [31], [20], and [4] reported that crushing was the most frequently used method, accounting for 49 instances (29.87%), followed by pounding with 39 instances (23.78%). Informants also reported the use of additives such as water, oil, sugar, salt, milk, butter, honey, tea, and coffee to increase taste, reduce potential side effects (e.g., vomiting, diarrhea), and improve the overall effectiveness of the treatment. This practice provides a holistic understanding of treatment, in which palatability, patient compliance, and therapeutic outcomes are considered together. Similar practices have been reported among the Gamo people [62] and among communities in Yeki District [7], where herbalists routinely use additives to improve both nutritional value and palatability. This consistent pattern across different communities suggests that these simple physical preparation methods are widely recognized as effective ways to prepare remedies for immediate use.

Oral administration was the most commonly reported route of remedy use, followed by dermal application, which was mainly employed for localized conditions, such as skin infections or wounds. These preferences likely reflect cultural familiarity, ease of use, and suitability for treating a wide range of ailments, suggesting that the community prioritizes practical effectiveness and culturally accepted methods when choosing routes of administration. Previous studies in Ethiopia have similarly reported the predominance of oral administration; for example, oral administration accounted

for 52.2% of reported remedies in Dibatie District, followed by dermal and fumigation methods [3], whereas it accounted for 46.6% of reported remedies in Bita District [6]. These similarities highlight a well-established body of indigenous knowledge that guides the selection of appropriate and effective administration routes based on experience and cultural practice.

Traditional healers in the study area reported that dosages are determined via flexible, context-specific methods, reflecting the reliance of traditional practitioners on experiential knowledge rather than standardized measurements. Quantities are adjusted considering patient-specific factors such as age, pregnancy, comorbidities, and the nature or severity of the ailment. This practice suggests a deep understanding of the therapeutic properties of plants and an individualized approach to treatment in the community. Comparable approaches have been documented in other Ethiopian ethnobotanical studies, where local healers also employ nonstandardized units and adjust dosages on the basis of patient-specific factors [7, 37]. Such flexible dosing practices demonstrate the healer's experience, knowledge, and careful observation of the patient, which helps ensure that the remedies are effective.

Preference rankings for medicinal plants used to treat intestinal parasites revealed *Vernonia amygdalina* as the most effective species, receiving the highest rank, highlighting its significant role in the traditional management of this disease. *Cissampelos mucronata* and *Croton macrostachyus* were also frequently mentioned for their effectiveness. These preferences likely reflect healers' empirical experience and the perceived reliability and efficacy of these plants. Similar findings have been reported by [5] and [50], who documented the traditional use of *Vernonia amygdalina* for the treatment of intestinal parasites. The high degree of consensus among healers emphasizes the cultural importance of these species and highlights their potential as priority candidates for future phytochemical and pharmacological investigations.

The high ICF values in this study indicate that a limited number of medicinal plants are repeatedly cited by multiple informants for treating certain disease categories, suggesting consistent recognition of their therapeutic roles. This pattern has also been observed in other regions of the country [2, 3, 4], reflecting the accumulation of local knowledge and shared experience. In contrast, lower ICF values in some ailment categories may reflect less common diseases, complex or poorly defined symptoms, or variations in cultural beliefs and ecological conditions, leading to the use of multiple plant species and lower informant agreement [40].

Similarly, fidelity level analysis identified species that are particularly valued within the community's traditional healthcare system. Species with the highest FL values, such as *Astropanax abyssinicus*, *Caesalpinia decapetala, Carissa spinarum, Datura stramonium*, *Myrtus communis*, and *Plectranthus ecklonii*, demonstrate consistent effectiveness, accessibility, and cultural familiarity. These findings align with previous ethnobotanical research showing community consensus for plants used to treat gastrointestinal disorders, wound healing, and helminth infections [30, 56, 53]. This pattern suggests the persistence of ethnomedicinal knowledge across generations. In contrast, species with lower FL values, such as *Salvia merjamie* and *Withania somnifera*, indicate more variable or generalized use among healers. Plants with broader therapeutic applications often show reduced FL because they are employed across multiple ailments rather than being dedicated to a single condition, reflecting a flexible and adaptive ethnomedicinal knowledge system.

High relative citation frequencies indicate species that are widely recognized, commonly used, and deeply embedded in the cultural and medicinal traditions of the community. These plants often have long-standing reputations for effectiveness, encouraging repeated use across generations and reinforcing their importance in traditional healthcare systems. This pattern is consistent with other relevant studies in Ethiopia, which similarly reported that species with elevated RFC values are those most frequently consulted for diverse ailments and serve as key pillars of local healthcare practices [8]. Conversely, species with lower RFC values may indicate medicinal plants with more

specialized, localized, or eroding uses, possibly due to the limited transmission of traditional knowledge or cultural shifts [9]. This ethnobotanical evidence underscores a dual imperative: to conserve widely used species that hold high cultural recognition and support local healthcare systems, and to document lesser-known medicinal plants that are at risk of disappearing owing to generational shifts, thereby preserving the full spectrum of ethnobotanical heritage for both human and animal health applications.

The direct matrix ranking revealed that *Croton macrostachyus* has the widest range of nonmedicinal uses in the study area. This finding is consistent with [33, 7, 20, 35], who also recognized *Croton macrostachyus* as a key multipurpose species valued for soil erosion control, goat feed, fencing, and firewood. The multipurpose value of these species may be attributed to their abundance, fast growth, and long-standing cultural familiarity, which facilitate their integration into daily household activities. These multifunctional roles contribute to local livelihoods and maintain ecosystem stability. However, extensive exploitation may compromise their availability and increase conservation risks, particularly for plants that rely on fuelwood, construction materials, and livestock feed. For example, species such as *Croton macrostachyus*, which is widely used for soil erosion control and firewood, also play a key role in maintaining ecosystem stability. The diverse applications of these plants highlight the need for integrated conservation approaches, including sustainable harvesting, community awareness, and the active participation of governmental and nongovernmental organizations, to safeguard these species for future generations. Without such measures, overharvesting could lead to biodiversity loss and weaken local healthcare systems that depend on medicinal plants [36, 2].

Indigenous medicinal knowledge in the study area is transmitted primarily orally, mostly within families, with eldest sons often serving as the main custodians. The present findings correspond with earlier Ethiopian ethnobotanical reports [19, 7], indicating that knowledge is transmitted mostly within families. There is a limited knowledge exchange among trusted neighbors and relatives, however, substantial information remains confidential, especially among traditional healers. This secrecy might be due to beliefs that disclosure diminishes medicinal efficacy or economic value, a trend that is consistent with reports from other studies [45, 61]. The persistence of such confidential knowledge systems, coupled with increasing exposure to formal healthcare, education, religious shifts, and broader sociocultural modernization, appears to limit intergenerational knowledge transmission. Additionally, younger generations are reluctant to learn traditional medicinal practices, which could result in the loss of knowledge as elderly individuals age.

This study demonstrated that key informants possess higher knowledge compared to general informants, which likely reflects their active and prolonged engagement with traditional medicinal practices and experiential learning. This highlights their role as critical custodians of indigenous knowledge of medicinal plants, which can inform conservation, sustainable use, and knowledge preservation efforts [5, 48, 28]. Higher knowledge scores among the elderly suggest that ethnomedicinal knowledge develops through long-term interaction with medicinal plants and practical experience. This pattern is consistent with other studies reporting that elderly individuals hold significantly more ethnobotanical knowledge than other age groups do [26, 50, 25]. The relatively high level of knowledge among younger adults may reflect their active involvement in daily household healthcare, agricultural, and foraging activities, as well as their exposure to ethnomedicinal practices through family and community interactions. However, periods of high external responsibility may limit engagement and reduce knowledge acquisition. The study also revealed that gender did not significantly influence knowledge, as indicated by comparable mean scores between males and females (8.23 vs. 7.97; Table 13). This finding aligns with previous ethnobotanical studies, which report similar ethnobotanical knowledge levels across genders [29, 47], suggesting that men and women acquire medicinal plant knowledge through overlapping social roles and responsibilities, such as cultivation, collection, and household

healthcare. In contrast, other studies have shown a significant difference in indigenous medicinal plant knowledge between men and women, where men possess more knowledge than women [55, 43, 58].

According to the present study, medicinal plant knowledge appears to be shared across the community regardless of formal education, as indicated by similar mean scores between nonliterate and literate informants (8.01 vs. 8.57; Table 14). This corresponds with [46], who also reported comparable knowledge levels among informants of different educational backgrounds. This could be attributed to the fact that medicinal plant knowledge is transmitted largely through informal, experiential, and socially embedded processes rather than through formal schooling. Individuals acquire this knowledge through daily interactions with family members, neighbors, and elders; participation in agricultural, grazing, and foraging activities; and engagement in cultural practices or rituals where medicinal plants are used. In addition, knowing how to identify, collect, and prepare medicinal plants often relies on observation, imitation, and repeated practice rather than written instructions, making formal education less influential.

Informants identified both human and environmental factors as threats to medicinal plants. Overgrazing emerged as the most severe threat, reflecting intense livestock pressure on wild medicinal plant populations; overharvesting was similarly ranked as a high-priority threat, driven by increasing demand for medicinal plants in local markets; household use; and the construction of shelters, fences, and animal enclosures. *Cissampelos mucronata* and *Myrtus communis* were noted as particularly vulnerable, indicating that the use of multiple functions increases exploitation pressure. This aligns with previous studies, which reported that overexploitation for multiple uses contributes to the depletion of medicinal plants [3, 34, 48]. Agricultural expansion has emerged as another significant threat. Informants linked this issue to the growing pressure on land, as cultivation increases to meet food demands, which is consistent with reports by [5] and [49], who documented similar patterns of habitat loss due to agricultural development in various districts across Ethiopia. Climate variability poses additional long-term risks, emphasizing the need for integrated mitigation strategies. Low-ranking threats, including soil erosion, funding shortages, and low awareness, were perceived as indirect but compounding factors. Key informants emphasized that limited financial support restricts community-led conservation initiatives, and low awareness, particularly among youth and farmers, contributes to practices that endanger medicinal plants. These include the removal of medicinal species during land clearing and their misidentification as invasive or undesirable plants due to limited knowledge of their value. Fewer concerns, such as landslides, lodging, and plant diseases, have been noted but may become more serious under changing environmental conditions. These ecological pressures are compounded by threats to the continuity of indigenous knowledge. Weak intergenerational transmission, secrecy among traditional healers, low interest among youth, and modernization limit the continuity of ethnomedicinal knowledge. Similar trends have been observed in other Ethiopian communities, where younger generations show limited engagement with traditional medicinal practices, and elderly individuals often withhold knowledge to protect their value [45, 61]. Together, these factors suggest that erosion of indigenous knowledge arises from a combination of social, cultural, and generational dynamics rather than a single cause.

Conservation practices for medicinal plant resources and their associated indigenous knowledge were generally limited in the study area, reflecting broader patterns observed across Ethiopia [23, 7, 65, 48]. One likely reason may be that most medicinal plants in Ethiopia are harvested from wild natural vegetation rather than being cultivated or managed systematically [51, 4]. Despite these constraints, some traditional healers and local community members have made efforts to preserve these resources through practices such as sustainable collection methods, controlled harvesting, replanting, and patrolling key harvesting sites in the study area. These local initiatives, although often small-scale and informal, represent important steps toward the in situ conservation of valuable traditional medicinal plant species and the retention of associated indigenous knowledge, highlighting the potential for community-led conservation efforts to complement broader ecological and cultural protection measures.

CONCLUSIONS AND RECOMMENDATIONS

This ethnobotanical study documented medicinal plants used for treating human ailments in Bekelecha Biftuu, Ifa Haqaa, and Tokuma Jaalalaa, along with the associated indigenous knowledge. Shrubs and herbs were the most commonly utilized growth forms, and leaves were the dominant plant parts used in remedy preparation. Indigenous medicinal knowledge in the study area is transmitted mainly orally, often within families, with the eldest sons typically serving as custodians. However, secrecy among traditional healers, modernization, and religious changes have contributed to a decline in knowledge transfer, especially among youth. It has been reported that there are no standardized dosage measurements, and remedies are usually given with additives such as butter and honey to improve their effectiveness and acceptability. The quantitative indices (ICF, FL, and RFC) demonstrated strong agreement among the informants regarding the importance of certain medicinal species, suggesting their central role in local healthcare systems. Direct matrix ranking revealed that the five species assessed for multipurpose uses also serve nonmedicinal functions, increasing pressure on these species. These threats are compounded by major threats such as overharvesting, overgrazing, agricultural expansion, and climate variability, whereas conservation efforts remain largely informal and limited. Statistical analyses revealed that age significantly influenced ethnomedicinal knowledge, with elderly individuals possessing greater expertise, whereas gender had no significant influence. The results of this study indicated that the sustainability of both plant resources and associated indigenous knowledge is at risk, underscoring the urgent need for documentation, implementation of conservation strategies, and promotion of intergenerational transmission. Integrating indigenous wisdom into formal education and healthcare systems can play a vital role in safeguarding this valuable biocultural heritage. Effective conservation requires coordinated action from local communities, government institutions, and development partners, and continued research and monitoring.

Declarations

Ethics approval and consent to participate

This study was conducted with the approval of the Biodiversity and Ecosystem Management Department, Haramaya University. Research in the study area was carried out after obtaining official permission from the Doba District Administrative Office. Participation of local informants in interviews and plant data collection was entirely voluntary, and informed consent was obtained. The information collected was used solely for academic purposes, including publication.

Consent for publication

Not applicable.

Availability of data and materials

The authors declare that all other data supporting the findings of this study are available within the article and its supplementary information files..

Competing interests

The authors declare no competing interests.

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Authors' contributions

A.T conducted the research, including data collection, analysis, and manuscript writing. Co-authors reviewed and provided guidance on the manuscript.

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Figures

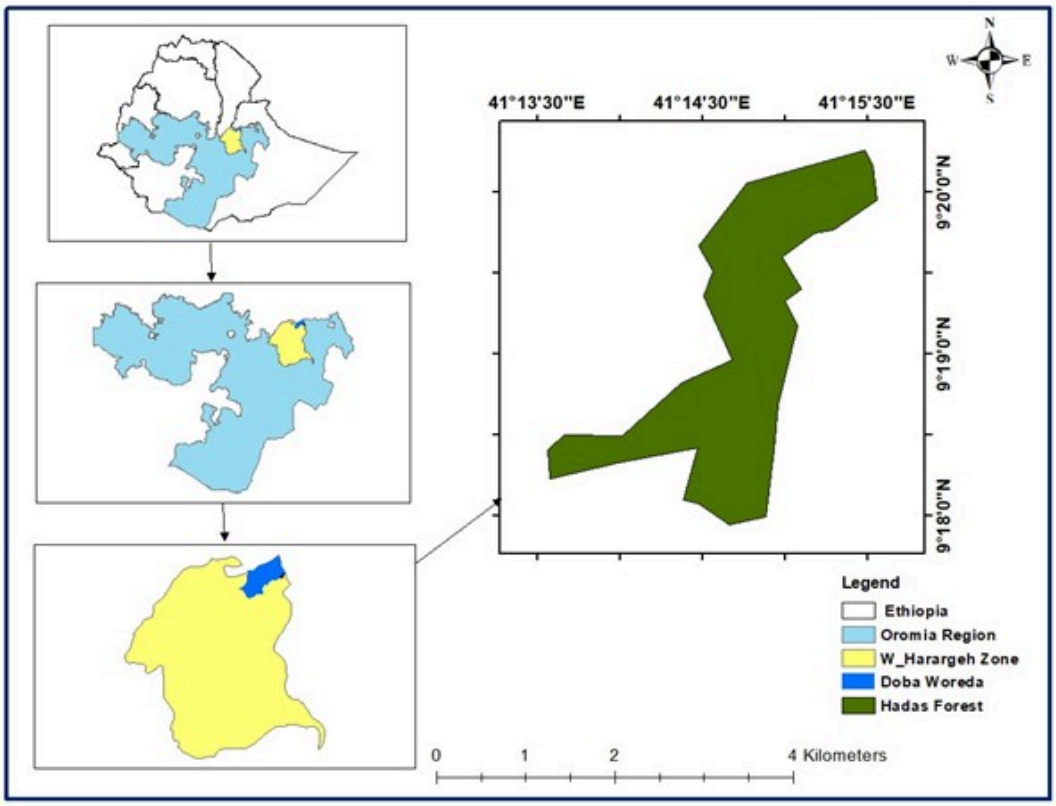

Figure 1

Location map of Hades and surrounding communities in Doba District, Ethiopia

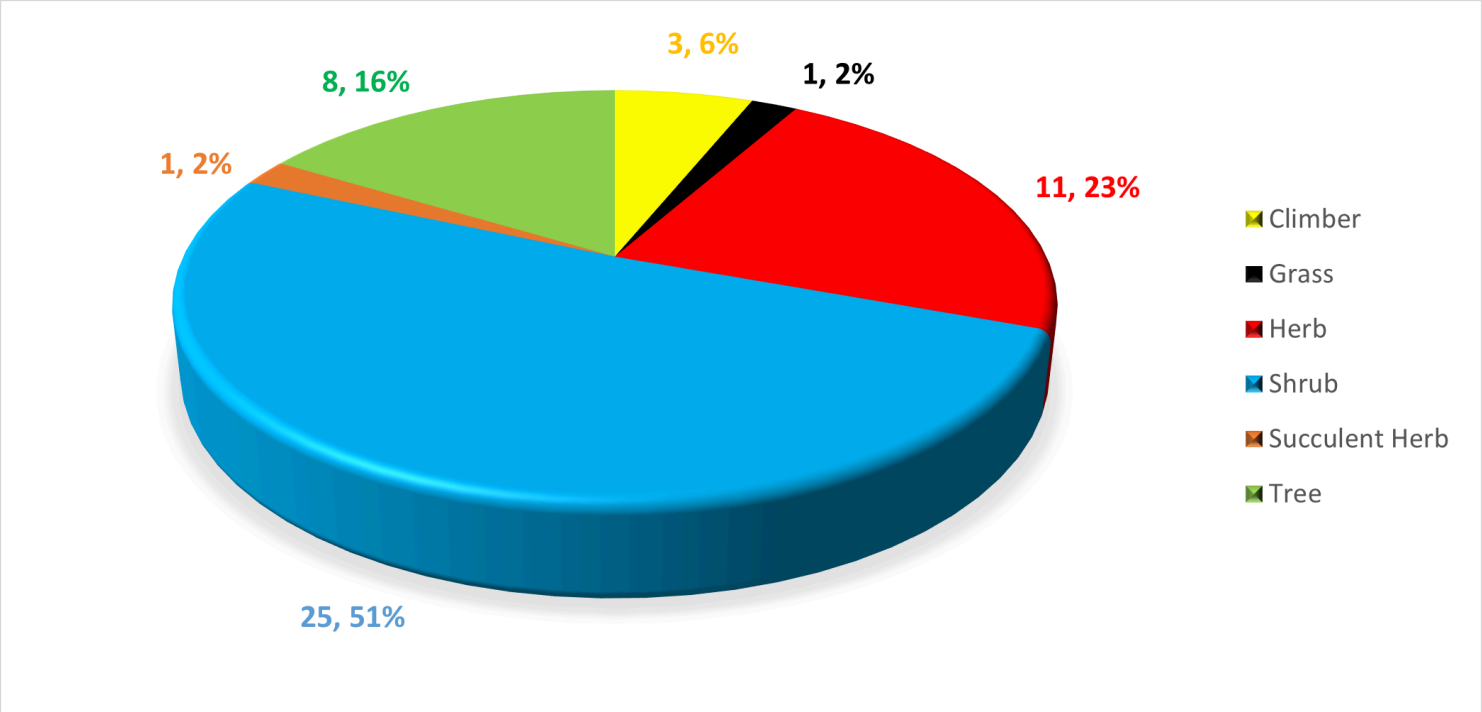

Figure 2

Habits of medicinal plants in the study area

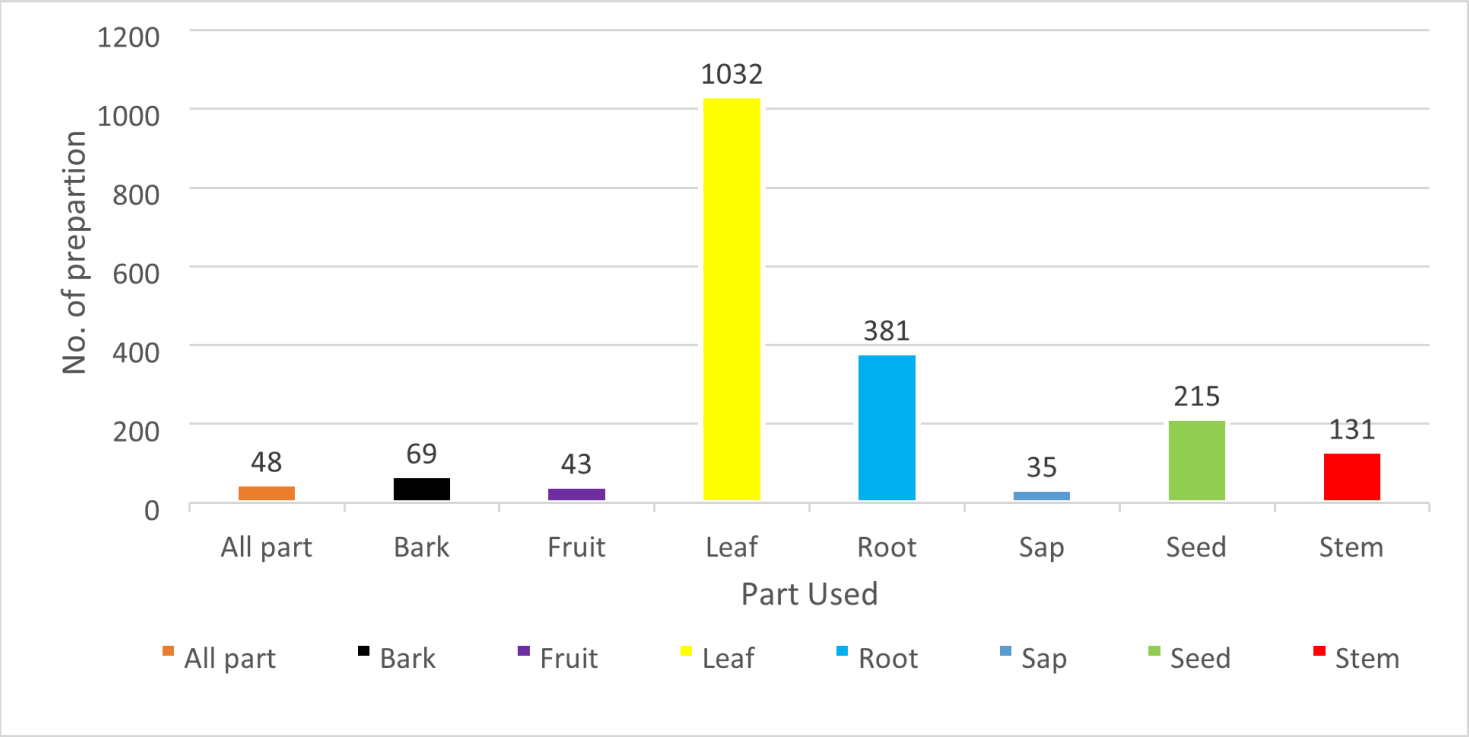

Figure 3

Plant parts used for treating human ailments in the study area

Supplementary Files

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- Additionalfile1.xlsx
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