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RESEARCH

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Ethnobotanical investigation of medicinal plants utilized by indigenous communities in the Fofa and Toaba sub-districts of the Yem Zone, Central Ethiopian Region

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Abstract

Background Ethnobotany investigates the ways in which communities utilize plant species to tackle a range of health concerns in both humans and animals, highlighting the intricate relationships between plant life and local cultural practices. The degradation of habitats resulting from agricultural development and deforestation poses a considerable risk to the accessibility of these vital plants. This research was conducted in the Fofa and Toba sub-districts of the Yem Zone in Central Ethiopia, aiming primarily to explore and record the medicinal plant species that indigenous communities use for treating various health issues in both people and livestock.

Methods This study was carried out between March 2023 and April 2024, involving a total of 96 informants, with 12 selected from each kebele. A range of quantitative methodologies were employed in the research, such as the informant consensus factor (ICF), fidelity level (FL), plant part value, preference ranking, and direct matrix ranking. Furthermore, various statistical analyses including independent t-tests, one-way ANOVA, correlation, and regression were performed using R to evaluate and compare the ethnobotanical knowledge among different groups of informants.

Results A total of 164 medicinal plant species from 140 genera and 60 families were identified in the study. Of these species, 67.68% were utilized for human ailments, 19.5% for livestock issues, and 12.8% for both. The sources of these medicinal plants included 81 species from wild areas, 35 from home gardens, 23 from agricultural fields, 15 from living fences, and 10 from roadsides. In terms of growth forms, herbs comprised the largest group with 76 species, followed by trees with 42 species, shrubs with 34 species, and climbers with 9 species. The most commonly used plant parts were leaves, followed by roots. Preparations were primarily made by crushing the plants, with other methods including powdering, chewing, smashing, and boiling. The highest informant consensus factor value of 91% indicated a significant healing potential for respiratory diseases, common colds, coughs, and fevers. Notably, *A. sativum* (for malaria) and *H. rueppelii* (for abdominal pain) recorded the highest fidelity level values. Additionally, the average number of medicinal plants reported by participants varied significantly across different demographic factors, including gender, age groups, educational levels, and experience ($P < 0.05$).

Conclusion The study area is home to a wide variety of potential medicinal plants along with valuable indigenous knowledge. To address the growing anthropogenic threats and safeguard these plants and their associated knowledge, it is essential to adopt effective conservation strategies and promote responsible use. Additionally,

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the medicinal properties of these plants should be scientifically validated to harmonize local knowledge with modern medicine effectively.

Keywords Ethnobotany, Indigenous knowledge, Medicinal plants, Yem, Central Ethiopia

Background

Herbal medicine boasts a deep-rooted history and has been a key therapeutic resource for numerous cultures across the globe [1, 2]. Many communities in Asia, Latin America, and Africa, such as those in Ethiopia, depend on traditional medicine, especially herbal remedies, for their healthcare needs due to constraints in accessing modern medical services and the cultural acceptance of these practices [3, 4]. The Food and Agriculture Organization (FAO) highlights Ethiopia's rich ethnic diversity, which plays a significant role in the country's extensive variety of around 6,000 plant species used for health and livelihood purposes [5, 6]. Ethiopia, located in Sub-Saharan Africa, has a population that heavily relies on native plants for their health and livelihoods [7]. The country is home to various ethnic groups with millennia of ethnobotanical knowledge, beliefs, and practices related to local flora. Traditional medicine is a vital component of Ethiopia's healthcare system [3, 8]. However, despite some organized studies on ethnomedicine, the development of therapeutic products remains limited, and traditional knowledge is threatened by urban migration, industrialization, environmental degradation, and changing lifestyles [9]. It is estimated that around one-third of Ethiopia's plant families have applications in traditional medicine, catering to the diverse ethnic groups throughout the nation [9, 10]. Traditional remedies are essential, with about 80% of the population depending on them, and approximately 95% of these remedies based on plants [11]. Preserving the traditional knowledge of medicinal plants is crucial not only for maintaining cultural heritage and biodiversity but also for supporting contemporary healthcare and drug development [12, 13].

Traditional medicinal practices often provide a more affordable alternative to modern healthcare [3, 14, 15]. Indigenous knowledge includes the collective understanding, skills, and practices that local communities have developed over generations regarding the use and management of plants [15, 16]. In Ethiopia, this knowledge has empowered communities to sustainably utilize a wide variety of plants for different purposes [17, 18]. However, habitat destruction, deforestation for commercial purposes, and agricultural expansion have significantly reduced forest areas that are rich in medicinal plants [19, 20]. The concentration of these plants is particularly evident in the southern and western regions of Ethiopia, which are also areas of high biological and cultural diversity [21, 22]. Rural communities and economically disadvantaged urban populations primarily rely on traditional medicine for their healthcare needs. Despite this dependence, documentation of traditional knowledge about medicinal plants remains insufficient [23].

The Yem people, who mainly inhabit the Afromontane vegetation region of Central Ethiopia, possess extensive traditional knowledge regarding the use and management of medicinal plants for treating various human and livestock ailments. This indigenous knowledge, passed down through generations, continues to shape their healthcare practices, often due to the lower cost of herbal remedies compared to modern pharmaceuticals. Although Ethiopia has published ethnobotanical studies on various ethnic groups in recent decades, research conducted in the Yem region reveals methodological, spatial, temporal, and theoretical gaps. Previous studies in the Yem Zone [24] focused on a limited number of sub-districts, while the current study aims to cover eight sub-districts where medicinal plants have not been thoroughly documented. The people of the Yem Zone maintain a traditional rural lifestyle and have a strong connection to plants [24]. It is crucial to conduct a survey to document the indigenous knowledge and medicinal plants in this study area. Despite the region's significant forest cover and vibrant traditional cultures, it suffers from inadequate infrastructure, especially in education and healthcare facilities. Traditional healers in the Yem have noted that the area is remote from hospitals and health centers, increasing the risk of mortality from various health issues and prompting residents to turn to traditional medicine. Additionally, the dense forest environment and the community's close relationship with nature have led to many incidents related to vector-borne diseases, which are mostly treated through traditional remedies provided by local healers rather than modern medical care.

The cultural diversity and rich plant life of the study area suggest the presence of extensive knowledge regarding medicinal plants that warrants further investigation. Nevertheless, this traditional knowledge is often eroded over time, resulting in diminished awareness among younger populations. The loss of habitats due to agricultural expansion and deforestation represents a significant threat to the availability of these plants. Furthermore, increased access to modern education has adversely impacted the utilization of traditional medicine. The

decline of these essential resources not only jeopardizes the availability of traditional remedies but also threatens the cultural integrity of the communities reliant on them. As modernization continues to shape lifestyle choices and healthcare practices, it is imperative to evaluate the status of medicinal plants in the region and comprehend their implications for both biodiversity and cultural heritage. Moreover, juxtaposing the findings of this study with the central Ethiopian ethnobotanical medicinal plant database could yield valuable insights into the regional distribution and application of these plants, thereby enriching our understanding of Ethiopia's extensive tradition of plant-based healthcare. This study aims to: (i) document the medicinal plants utilized by indigenous communities in the Fofa and Toaba subdistricts, detailing their local names, the parts used, and preparation methods; (ii) investigate how socioeconomic factors influence the utilization and transmission of ethnobotanical knowledge within these communities; (iii) assess the contribution of traditional medicinal plants to food security and public health, particularly their roles in local diets and health practices; (iv) analyze the traditional medicinal practices linked to these plants, focusing on the ailments they address and the cultural beliefs regarding their effectiveness; and (v) evaluate the knowledge and perceptions of community members about the availability, sustainability, and conservation of medicinal plants in their environment. Furthermore, comparing our findings with the Ethiopian ethnobotanical medicinal plant database could enrich our understanding of the regional distribution and usage of these plants, enhancing our appreciation of Ethiopia's rich heritage in plant-based healthcare.

Materials and methods

Description of the study area

This study was carried out in eight sub-districts of the Yem Zone, located in the Central Ethiopia Regional State. The zone is named after the Yem people, the indigenous inhabitants of the area, who speak a distinct language called "Yemisa," classified within the Omotic language group. Yem is bordered to the west and north by the Oromia Region and is separated from Gurage on the northeast and Hadiya on the east by the Omo River. Prominent geographical features include Mount Bor Ama, Mount Azulu, and Mount Toba. The administrative center is Saja, which is situated 234 km west of Addis Ababa and 112 km from Jimma Town. The elevation in the region ranges from 1000 to 2500 m above sea level [24]. Geographically, the Yem Zone lies between latitudes 7°36′54"N and 8°27'N, and longitudes 37°36′54"E, with altitudes spanning from 1000 to 2930 m above sea level (Fig. 1). This diverse climate supports a variety of crops across the districts, contributing significantly to local agriculture and the livelihoods of the Yem people. Subsistence agriculture in the zone primarily focuses on cereals and enset (*E. ventricosum*), which is the main food crop and reflects the region's agricultural practices and dietary preferences. The agro-climatic diversity also allows for the cultivation of important cash crops such as teff, wheat, barley, and pulses. Non-agricultural income sources include selling butter and remittances. According to the 2007 Census by the Central Statistical Agency of Ethiopia (CSA), the Yem Zone has a population of 80,687, comprising 40,566 men and 40,121 women. With an area of 647.90 square kilometers, the population density is approximately 124.54 people per square kilometer. Urban inhabitants account for 7952, or 9.86% of the population, while 106, or 0.13%, is pastoralists. There are a total of 17,632 households, yielding an average of 4.58 individuals per household and 17,204 housing units [25]. The three largest ethnic groups in the Yem Zone are the Yem (90.57%), the Oromo (5.41%), and the Hadiya (1.27%), with other ethnicities making up 2.75%. Yemisa is spoken as a first language by 72.67% of the inhabitants, while 22.63% speak Oromo, 2.57% speak Amharic, and 1.16% speaks Hadiya. The remaining 0.97% speaks various other languages. The predominant religions practiced in the area are Ethiopian Orthodox Christianity (63.05%), Islam (27.09%), and Protestantism (9.61%) [25].

Climate of the study area

The Yem Zone features three distinct agro-ecological climatic zones: highland (dega), midland (woynadega), and lowland (kola). The region receives mean annual rainfall varying from 900 to 2,200 mm, primarily occurring between March and September. According to the National Meteorological Service Agency (NMSA), Saja has an average monthly temperature of 20.7 °C, with maximum and minimum temperatures reaching 34.0 °C and 9.9 °C, respectively (Fig. 2). Rainfall patterns show significant precipitation from March to October, with April experiencing the highest rainfall at 275 mm. In contrast, the dry season from November to February sees considerably lower rainfall, with January recording just 25 mm.

Vegetation of the study area

The Yem Zone boasts a rich variety of vegetation, including both woodlands and protected natural forests. Among these protected areas are the Kumuli Forest, Hanebari Forest, Bori Mountain Forest, and Oya Forest, all situated within the Fofa district. The region's agricultural lands exhibit an agroforestry system, where mature indigenous tree species coexist with cultivated crops. Key species include *A. schimperiana, A. dimidiata, C.*

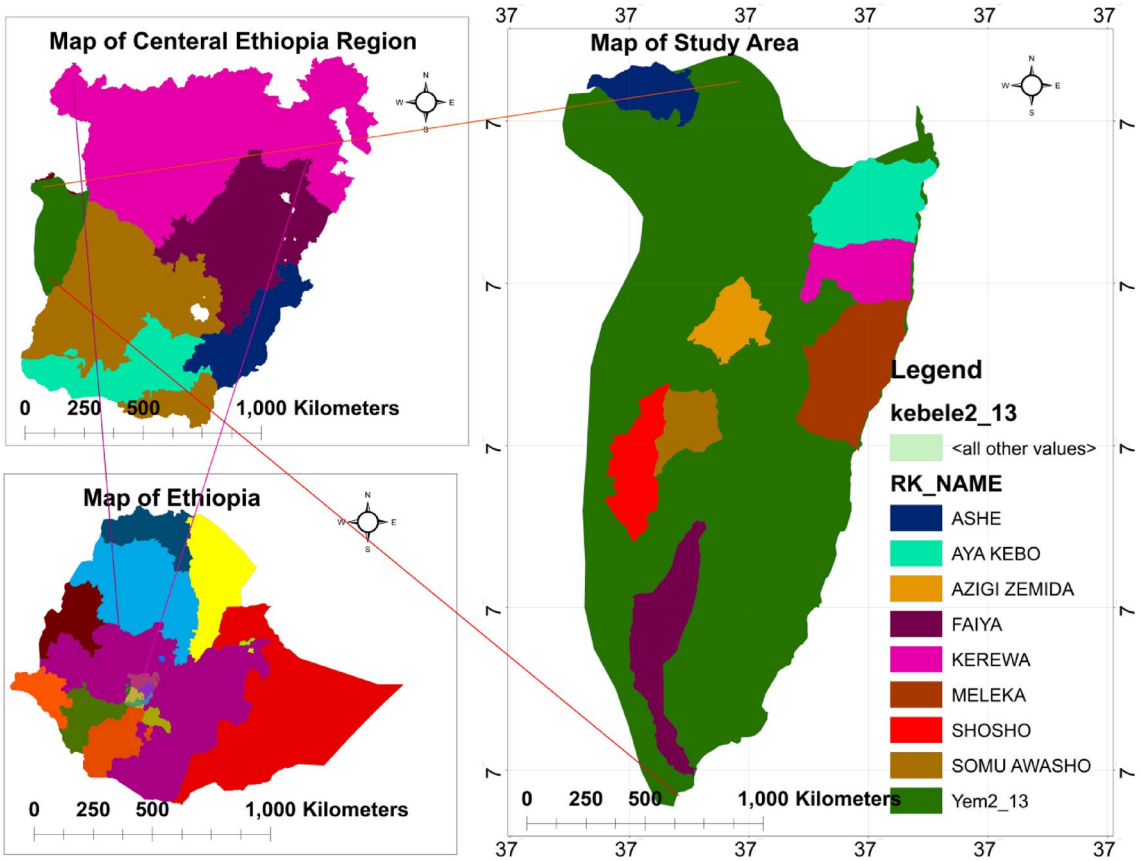

Fig. 1 Map of the study area (generated By ArcGis 10.4.1)

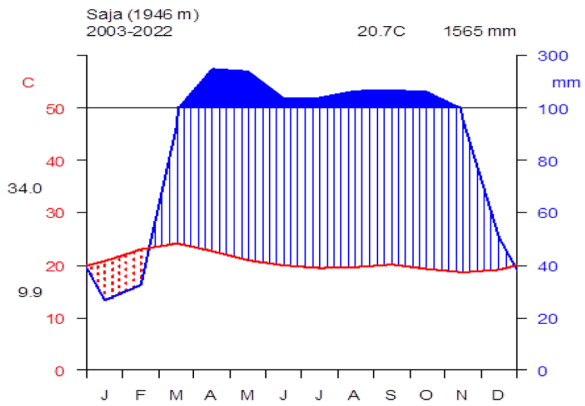

Fig. 2 Climate diagram showing climatic data at Saja station, Yem Zone

macrostachyus, F. sycomorus, J. procera, O. capensis, P. falcatus, P. africana, S. guineense, A. nilotica, E. globulus, and *H. abyssinica.* Vegetation types in the Yem Zone vary with altitude. At higher elevations, particularly on Bori Mountain, which rises to 2939 m above sea level, dry evergreen Afromontane vegetation predominates. In contrast, the lower altitudes, especially along the Gibe River valley, support wooded grasslands characterized by deciduous Combretum-Terminalia types, extending down to about 1400 m above sea level [24]. This diverse vegetation not only sustains local biodiversity but also plays a vital role in maintaining ecological balance and supporting the livelihoods of the communities in the area.

Reconnaissance survey and sampling techniques

A reconnaissance survey of the study area was conducted from November 15 to November 30, 2022, to gather essential information from selected sub-districts and facilitate personal preparations. Within each sub-district, specific villages and their corresponding key informants (healers) were identified based on insights obtained from the Culture and Tourism Offices of both districts, as well as input from local administrators, community members, religious leaders, and elders. Purposive sampling was used to select the kebeles for the study, focusing on the presence of traditional medicinal plants, availability of healers, historical usage of traditional medicine, vegetation cover, and agro-ecological conditions. The selection

Table 1 Overview of selected study locations and socio-demographic profiles of participants

Name of Kebeles	Altitude	GPS Coordinates		Gender		Ethnicity (Ym, Hd, Or,Am)	Age categories			Language (Ym,Hd,Ao,Am)	Occupation (F,M,H,S,T)	Religion (Ot,Mu,Pr)	NH	AE
		Latitude (N,S)	Longitude (E,W)	M	F		28–40	41–50	51–85					
Somu awasho	2440 m	7°47′46"N	37°27′48"E	10	2	Ym, Hd, Or,Am	1	1	9	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	489	Highland
Azigi zemida	2382 m	7°51′20"N	37°29′29"E	10	2	Ym, Hd, Or, Am	2	4	7	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	517	Highland
Shosho	2151 m	7°46′08"N	37°25′53"E	8	4	Ym, Hd, Or, Am	1	3	8	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	687	Highland
Ashe	1829 m	8°00′31"N	37°26′19"E	8	4	Ym, Hd, Or, Am	3	2	6	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	668	Mid-highland
Faiya	1721 m	7°40′41"N	37°27′01"E	11	1	Ym, Hd, Or, Am	2	4	8	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	576	Mid-highland
Meleka	1420 m	7°48′59"N	37°34′13"E	8	4	Ym, Hd, Or, Am	1	3	8	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	656	Mid-highland
Kerewa	1405 m	7°52′33"N	37°35′15"E	9	3	Ym, Hd, Or, Am	3	3	6	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	689	Mid-highland
Aya kebo	1023 m	7°57′13"N	37°36′49"E	10	2	Ym, Hd, Or, Am	2	2	7	Ym,Hd,Ao,Am	F,M,H,S,T	Ot,Mu,Pr	712	Low-land
Total				74	22		15	22	59		F,M,H,S,T		4994	

Ym: Yem, Am: Amhara, Or: Oromo, Hd: Hadiya, Yms: Yemisa, Amc: Amharic, Ao: Affanoromo, Hdy: Hadiyegna, Ot: Orthodox, Mu: Muslim, Pr: Protestant, M: male, F: female, AE: agro-ecology, NH: number of households, F: farmer, M: merchant, H: house wife, S: student, T: teacher

process was informed by prior data collected from local healthcare practitioners, respected elders, community leaders, participants in focus group discussions, and traditional healers. Ultimately, eight kebeles were chosen for the study, representing 25.8% of the total 31 kebeles in the district. The selected kebeles include Ashe, Azigi Zemida, Somu Awasho, Shosho, Faiya, Kerewa, Aya Kebo, and Meleka (Table 1).

A total of 96 informants were selected, with 12 respondents from each kebele, employing both purposive and simple random sampling methods. The sample consisted of 74 males and 22 females, all aged 28 and above. Among the 96 informants, 72 (75%) were chosen as general informants through simple random sampling, with 9 selected from each kebele. The remaining 24 (25%), or 3 from each kebele, were identified as key informants through purposive sampling, following the guidelines of [26, 27]. Key informants were selected based on their indigenous knowledge of medicinal plants, with assistance from local administrators, recommendations from community elders (locally known as *gayma*), religious leaders, and other residents.

Methods of ethnobotanical data collection

Ethnobotanical data were collected during five field trips conducted between March 2023 and April 2024, following the methodologies outlined by [27, 28]. The data collection focused on various aspects, including respondents' backgrounds, diagnostic and treatment methods, local names of medicinal plants, parts of plants used for treating ailments, preparation techniques, availability of medicinal plants in the area, factors threatening these plants, and conservation practices. Information was gathered through semi-structured interviews, questionnaires, group discussions, guided field walks, and field observations with selected respondents and key informants.

Semi-structured interviews

Semi-structured interviews were conducted according to the guidelines established by [27, 28]. This approach allowed the researcher to ask follow-up questions, providing additional insights beyond the prepared checklist. The questionnaire items were originally developed in English and then translated into the local language, Yemsa. Most interviews and discussions were held directly in Yemsa by the investigator, a native speaker, which facilitated informal conversations with villagers and accessible informants, enhancing the richness of the information gathered. Key informants were initially interviewed individually, followed by non-healer informants, who were interviewed both individually and in group settings.

Field observations

Field observations, including market assessments, were carried out in three purposefully selected forest areas: Oya Forest, Kumuli Forest in Zemda kebele, and Semuawasho Forest in Semunama kebele. Local residents with extensive knowledge about the forests' histories and their significance to the community assisted during these observations. Key aspects documented included the past and present status of medicinal plants in each forest, plant communities, indigenous knowledge related to the cultivation of medicinal plants, and conservation and management strategies.

Group discussions

Group discussions were organized in the study areas, involving eight participants seven males and one female. Among the participants, three were healers, while the remaining five were non-healers. All participants actively engaged in the discussions, which the researcher facilitated. Important topics covered included the distribution of medicinal plants, factors threatening their survival, treatment methods, commonly used plant parts for medicinal purposes, and conservation and management strategies. These group discussions were invaluable, allowing participants to share and compare their knowledge freely, ultimately leading to a consensus on the ethnomedicinal data.

Market survey

A market survey was conducted at the Shosho Monday market in the Fofa district to evaluate the trade and marketability of medicinal plants. During the survey, only a limited number of medicinal plants were observed, alongside a few additional varieties available in the market. Data on prices, availability, and the types of diseases treated by these remedies were collected from sellers observed in the market.

Specimen collection and identification

Based on information gathered from informants, medicinal plant species were collected from various sources, including the wild, home gardens, roadsides, and agricultural fields. Throughout the collection process, details such as the local names of the plants, their habitats, the ailments they are used to treat, the parts utilized, and other relevant information were documented. The collected species were categorized into trees, shrubs, herbs, and climbers. Preliminary identifications were conducted in the field, while unidentified specimens were further examined by comparing them with authentic illustrations and taxonomic keys found in the Flora of Ethiopia and Eritrea [29]. The researcher cross-referenced the

actual plants and their characteristics with the descriptions in this reference. Documentation included scientific names, vernacular names, families, habitats, uses of the plant species, and the number of medicinal plant species within each family.

Data analysis

Field data were collected, organized, categorized, and documented using Microsoft Word 2019, encompassing both scientific and local plant names, their respective families, life forms, utilized parts, and habitats. Analytical tools such as tables, bar graphs, and pie charts were employed for frequency analysis. Descriptive statistics, including mean and standard deviation, were calculated using R software version 4.3.3. Before conducting the t-tests, the Shapiro–Wilk test was performed to assess normality. Gender differences in medicinal plant knowledge were analyzed using an independent t-test based on reported plants. Additionally, variations in knowledge across different educational levels and healing experiences were assessed with separate t-tests. Knowledge differences among age groups were analyzed using ANOVA. The relationship between age and reported plants was examined through Pearson correlation and linear regression. Furthermore, quantitative ethnobotanical analysis methods such as informant consensus factor (ICF), fidelity level (FL), direct matrix ranking (DMR), and preference ranking (PR) were applied, following the guidelines of [27].

Informant consensus factor (ICF)

Informant consensus factor (ICF) was calculated to determine the effectiveness of medicinal plants in each ailments categories and to identify the agreement of the informants on the reported use of medicinal plants to cure a group of ailments using the formula adopted from [30]. ICF was calculated as $\mathrm{ICF} = \frac{\mathrm{Nur-nt}}{\mathrm{Nur-1}}$ where ICF is informant consenus factor.

Nur refers to the number of use reports for a particular ailment category.

nt refers to the number of medicinal plant species used for a particular ailment category by all informants. ICF was used to evaluate the reliability and validity of information recorded during the interview; it helps the researcher to rejects irrelevant information that the informants did not agree in common ideas and only accept to ideas that were relevant and agreed by all informants. The calculated values of ICF always lie between 0 and 1, the values closed to 1 mean there was high agreement of informants in the effectiveness of medicinal plants in order to heal the given aliments, and low ICF values indicate that informants disagree over the healing potential of medicinal plants for the given aliments.

Fidelity Level (FL)

Fidelity Level (FL) was utilized to determine the percentage of informants who reported using a specific plant for the same major purpose. FL was calculated for the most frequently reported ailments using the formula from (32,33). $\mathbf{Fl} = \frac{\mathbf{NP}}{\mathbf{N}} \times \mathbf{100}$ where

NP refers to the number of informants that claim the use of a plant species to treat a particular disease; **N** refers the number of informants that use the plants as a medicine to treat given disease; FL was used to evaluate the relative healing potential of each reported medicinal plant used against human diseases.

Direct matrix ranking (DMR)

The direct matrix ranking (DMR) exercise was employed to compare the multiple uses of a given species and relate this to the extent of its utilization, following the methodology outlined in [27]. This approach identifies and ranks the most important medicinal plants in the study area based on various values beyond their medicinal uses. Among the collected medicinal plants, nine tree species were selected for their multiple uses, including medicinal, fodder, food, firewood, construction, charcoal, fencing, furniture, and recreational value. These species were presented to ten selected key informants, who assigned use values and ranked each species. Respondents used a ranking system where: 5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used, and 0 = not used.

Preference ranking (PR)

Preference ranking (PR) was conducted according to the guidelines in [27, 28]. Each medicinal plant was paper-tagged, and informants were asked to assign the highest value to their most preferred species for treating illnesses and the lowest value to the least preferred plant, in accordance with their order of preference for the remaining species. The values for each species were summed, and the rank for each was determined based on the total score, indicating the order of the most effective medicinal plants used by the community to treat diseases in the study area.

Jaccard similarity index (JSI)

Jaccard's similarity index (JSI) was utilized to evaluate the similarity in the composition of medicinal plant species across various studies conducted in different regions of the country. The index is calculated using the formula: JCS = c/ (a + b + c). In this formula, Jaccard's similarity index quantifies the level of similarity between two distinct study areas: study area a (the

current study area) and study area b (other study areas). The variables represent the species present in each area, with "a" denoting the number of species in study area a, "b" for study area b, and "c" for the number of common species shared between the two areas. The values of the JSI range from 0 to 1, where a value of 1 indicates complete similarity and a value of 0 indicates no similarity. To express the JSI as a percentage, it can be multiplied by 100, yielding a percentage representation of the similarity index [31].

Results

Background of respondents of the study area

The data collected from respondents regarding their backgrounds revealed considerable variation in age, sex, educational level, and marital status. Among the 90 respondents interviewed in the study area, 74 (77.1%) were male and 22 (22.9%) were female. Males outnumbered females in both the general and key informant categories. The lower participation of females in the collection and treatment of traditional medicine was primarily attributed to their larger responsibilities for household activities compared to males, who were more likely to engage in outdoor activities and share their indigenous knowledge with peers. The age of the informants ranged from 28 to 85 years, with the majority being over 51 years old. In terms of educational background, 70.8% of respondents were illiterate, 22.9% had completed primary school, and 6.2% had attained secondary education or higher. All informants were married. Regarding religious affiliation, approximately 80.2% identified as Orthodox Christians, followed by 11.4% as Protestants, and 8.3% as Muslims (Table 1).

Ethnobotanical plant species in the study areas

In this study, a total of 164 medicinal plant species used for treating ailments in humans and livestock were collected from the study area. These species belong to 140 genera and 60 families. Among them, 111 species (67.68%) were used exclusively for human ailments, while 32 species (19.51%) were used for livestock ailments. The remaining 21 species (12.8%) were utilized for both human and livestock conditions. In terms of species count, the Asteraceae and Fabaceae families each contained 14 species (8.53%), making them the most numerous. They were followed by the Lamiaceae family with 10 species (6.09%) and the Cucurbitaceae and Poaceae families, each with 8 species (4.87%). Other notable families included Solanaceae and Euphorbiaceae, both having 7 species (4.26%), and Rutaceae, which included 6 species (3.65%) (Table 2).

Human and livestock diseases in the study area

Data collected from informants in the study area identified a total of 83 known ailments affecting both humans and livestock. Of these, 54 (65.06%) were human ailments, 8 (9.63%) were livestock ailments, and 21 (25.30%) were ailments that impacted both humans and livestock.

Medicinal plants used to treat human and livestock diseases

The study findings revealed that out of the 164 plant species collected, 111 species (67.68%) were used exclusively for treating human ailments, while 32 species (19.51%) were designated for livestock ailments. Additionally, 21 species (12.8%) were employed to treat ailments in both humans and livestock.

Habitats of medicinal plants

Analysis of the data indicated that most medicinal plant species were collected from wild habitats, accounting for 81 species (49.39%). This was followed by home gardens with 35 species (21.34%), agricultural fields with 23 species (14.04%), living fences with 15 species (9.14%), and roadsides with 10 species (6.09%).

Growth forms of medicinal plants

The analysis of growth forms revealed that herbs comprised the largest group, with 76 species (46.34%). This was followed by trees with 42 species (25.60%), shrubs with 34 species (20.73%), and climbers with 12 species (7.31%). Among the 76 herb species collected, 56 (34.14%) were used for human ailments, 13 (7.92%) for livestock ailments, and 7 (4.26%) for both. Similarly, of the 42 tree species, 28 (17.07%) were used for human ailments, 9 (5.48%) for livestock ailments, and 5 (3.04%) for both. Among the 34 shrub species, 21 (12.8%) were used for human ailments, 7 (4.26%) for livestock ailments, and 6 (3.65%) for both. Additionally, of the 12 climber species, 6 (3.65%) were used for human ailments, 3 (1.8%) for livestock ailments, and the remaining 3 (1.8%) for both.

Plant parts used for medicinal purposes

The investigation revealed that nine different parts of medicinal plants were utilized to treat both human and livestock ailments in the study area. The most commonly used part was the leaf, accounting for 72 instances (43.90%), followed by the root with 49 instances (29.87%). Both bark and seed were used 20 times (12.19%), while stem and bulbs were utilized 7 times (4.26%). Additionally, fruits were used 12 times (6.55%), and both flowers

Table 2 Lists of medicinal plants used to treat human and livestock ailments in the study area

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Vachellia abyssinica (Hochst. ex Benth.) Kyal. & Boatwr	Fabaceae	Ezu	T	F	L	O	Hu	Back pain	Fresh leaves are ground and subsequently combined with water, with the resulting mixture consumed in a cup each morning for a duration of one week	FL01
				F	L	De	Hu	Goiter	The leaf of *A. abyssinica* is crushed, and the resulting sap is administered to the goiter over a period of three days using a needle	
Vachellia negrii (Pic.Serm.) Kyal. & Boatwr	Fabaceae	Foro Ezu	T	F	L	O	Hu	Allergic	The leaf was crushed, and the painted section was secured with a tie	FL02
Acalypha fruticosa Forssk	Euphorbiceae	Doqonu	Sh	F	R	O	Hu	Stabbing Pain	Fresh roots are ground and subsequently combined with water to prepare a coffee beverage, which is consumed in a single cup each day for a duration of three days	FL03
Acanthus polystachyus Delile	Acantaceae	Kogna	H	F	L	De HU		Wound	The crushed leaf was applied to the impacted area of the skin	FL04
Achyranthes aspera L.	Amaranthaceae	Zarno	H	F	L	Na	Hu	Nose Bleeding	Crushed fresh leaves are applied to the wound, and this action induces sneezing, which aids in the cessation of bleeding	FL05
Achyrospermum schimperi (Hochst. ex Briq.) Perkins	Lamiaceae	Zufiya	H	F	L	O	Hu	Rheumatic Arthritis	To prepare the mixture, crush the leaf and combine it with water. Consume one cup every two days for a duration of ten days	FL06
*Acokanthera schimperi (*A.DC.) Schweinf	Apocynaceae	Qaraaru(O)	H	F	L	De	Hu	Leprosy	The leaves of the plant are crushed in conjunction with the leaves of *B. antidysenterica* and combined with a bitter substance, after which the mixture is applied to the skin and secured in place	FL07
Adiantum capillus-veneris L.	Pteridaceae	KorichaS ididu(O)	H	F	R	O	Hu	Spider poison	The substance should be crushed and combined with water, after which half a glass should be consumed three times a day, with a one-day interval, over the course of one week	FL08
Acmella caulirhiza Delile	Asteraceae	Shishmo (Gutichaa)	H	F	R/F	O	Hu	Tonsillitis	Fresh roots are crushed to extract a small amount of juice, which is then administered to the patient to facilitate its passage through the esophagus. Alternatively, the patient may chew the flowers of the plant and swallow them along with their saliva	FL09

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Ajuga integrifolia Buch.-Ham. ex D.Don	Lamiaceae	Tanachu	H	D	L	O	Hu	Swelling	Fresh leaves are crushed and subsequently combined with water, or alternatively, the powdered form is applied directly to the affected area	FL10
			H	F/D	L	O	Hu	Arthritis	The substance is crushed and combined with a small quantity of water to create a solution or filtrate. One cup of this solution is consumed on an empty stomach, or alternatively, the paste can be incorporated into one cup of local alcohol known as "Hereqe" or coffee, and this regimen is followed for a duration of one week	
Allium sativum L.	Amaryllidaceae	Foro Sunto	H	D	Bu	O	Hu	Common cold,	The bulb, whether dry or fresh, is crushed and combined with honey and ginger, after which it is consumed orally using a heaping teaspoon for a duration of approximately three to four days	FL11
				D	Bu	O	Hu	Malaria	The bulb was peeled, then immersed in clarified butter before being consumed	
				D	Bu	O	Hu	Stomach ache	The bulb of *A. sativum* and the seeds of *L. sativum* are ground together and consumed alongside injera	
				D	Bu	O	Hu	Evil eye	Blub is combined with a single rhizome of *Z. officinale* and *L. sativum*, which has been blended with honey, and a dosage of two teaspoons is administered	
Allium cepa L.	Amaryllidaceae	Shingurt a	H	F	Bu	O	Hu	Blood pressure	To prepare the mixture, crush the bulbs and combine them with water, then consume a full cup of this solution each morning prior to commencing your diet	FL12
Aloe macrocarpa Tod	Asphodelaceae	Hargeess aa(O)	H	F	L	O	L S	Bloat	Fresh leaves are crushed in combination with *R. chalepensis, A. sativum*, and *F. vulgare*, then mixed with water and administered to cattle using a large container. The sap is applied to the affected area every other day until the wound heals	FL13
Aloe trigonantha L.C.Leach	Asphodelaceae	Riet(Am	Sh	F	L	De	H	Wound	To address the infected area, excise the leaves and apply a jelly-like juice directly onto the affected site	FL14

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Amaranthus caudatus L.	Amaranthaceae	Zanno	H	F	L	O	LS	Diarrhea	The leaves of the plant are crushed and boiled in combination with *A. sativum* and *A. cepa*, after which approximately one jug of the mixture is administered to cattle each morning until the diarrhea subsides	FL15
Amaranthus spinosus L.	Amaranthaceae	Gu?ea	H	F	Fl	O	Hu	Uterine prolapse	A glass of a smashed and water-based solution is consumed, after which the healer performs a uterine repositioning technique, utilizing their hands to make contact with the organ	FL16
Aloe trichosantha A.Berger	Asphodelaceae	Arka Geni heta	H	F	L	O	LS	Bloat	Fresh leaves are crushed in combination with *R. chalepensis* and *A. sativum*, then mixed with water and administered to cattle, sheep, or goats using a large container	FL17
				F	L	O	Hu	Fire burn	The process involves excising a fresh leaf from the plant and applying the extracted sap to the affected area until the injury is healed	
Albizia schimperiana Oliv	Fabaceae	Siso	T	F	L	O	Hu	Eye diseases	The leaf was crushed and subsequently combined with water, resulting in discomfort in the eye	FL18
Aloe pulcherrima M.G.Gilbert & Sebsebe	Asphodelaceae	Mashika Geni Heta	H	F	L	O	Hu	Burn	Leaf latex applied as a poultice directly to the site of the burn	FL19
Annona senegalensis Pers	Annonaceae	Gishita	T	F	Se	De	Hu	Lice	Thick extract, applied to various areas of the body, is pounded to achieve a uniform consistency	FL20
Arisaema schimperianum Schott	Araceae	Zawinia wa	H	F	Ba	O	Hu	Chronic patient	Crushed small fragments of Acacia negrii and Albizia schimperiana bark, when homogenized with water, can be consumed in a quantity of one cup twice weekly	FL21
Anthospermum herbaceum L.f	Rubiaceae	Durbo	H	F	L	O	Hu	Bone cancer	A homogenate made from smashed ingredients, consumed twice weekly for a duration of one month, along with one cup of water	FL22
Arundinaria alpina K.Schum	Poaceae	Wosha	T	F	St	O	Hu	Tooth diseases	Applying the fresh stem of the plant directly to the affected tooth can release its juices onto the painful area	FL23

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Artemisia afra Jacq. ex Willd	Asteraceae	Akafko	H	F	L	O	Hu	Stomachache	Chewing the fresh leaf and allowing it to mix with saliva before swallowing	FL24
Asparagus setaceus (Kunth) Jessop	Asparagaceae	,Keshelz ona	Sh	F/ D	R	O	Hu	Tape worm and ascariasis	To prepare the infusion, one should boil either the dried or fresh root in water, and the resulting liquid should be ingested in a single glass all at once	FL25
Aspilia africana (Pers.) C.D.Adams	Asteraceae	Ha?mu	H	F	L	De	Hu	Tineaversicolr	The mixture is crushed using hands, followed by the application of paint, and allowed to sit for one week to extract the juice	FL26
Bersama abyssinica Fresen	Francoaceae	Boia	T	F	R	O	LS	Dermal	The powdered root of *B. abyssinica* is applied directly to wounds on the skin of cattle, and the powder is also sprinkled onto their fodder, permitting the animals to consume it	FL27
Beta vulgaris L.	Amaranthaceae	Kosta	H	F	L	O	Hu	Dehydration	Fresh leaves are sautéed in oil and seasoned with salt before consumption	FL28
Bidens biternata (Lour.) Merr. & Sherff	Asteraceae	Kara zaino	H	F	L	Na	Hu	Sudden Illness (dingetegna)	The leaf of *B. biternata* is crushed and inhaled, subsequently leading to a spontaneous sneeze	FL29
Bidens pilosa L.	Asteraceae	Foro zaino	H	F	L	De	Hu	Wound	The leaf of *B. pilosa* is subjected to fire and heat, after which the heated leaf is applied or rubbed onto the affected wound	FL30
Brassica carinata A.Braun	Brassicaceae	Gesha	H	D	Se	O	Hu	Malaria	The dry seeds of *B. carinata* are initially roasted, subsequently pounded, and combined with crushed garlic. This mixture is then added to boiled water, and the resulting juice is consumed in a full cup daily for a duration of one week	FL31

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Brucea antidysenterica J.F.Mill	Simaroubaceae	Tollo	Sh	F/ D	R	De	B	Wound	The dried or fresh root is ground and combined with the fresh leaves of *D. angustifolia*, after which the mixture is applied to the wound and secured in place daily for a duration of approximately three days	FL32
				F	L	O	LS	Cate diarrhea	Decoction of young shoot tips and roots is consumed in a single bottle daily until improvement is observed	
				F	Ba	O	Hu	Diarrhea	Bark and shoot should be decocted, and one glass of the resulting infusion should be consumed, with repetition as necessary	
Capsicum annuum L.	Solanaceae	Ziga(dab usi)	H	D	Fr/ S	O	L S	Bloat	Crush the fruit or seed and combine it with water, then administer the mixture orally to the individual who is intoxicated	FL33
Capparis tomentosa Lam	Capparaceae	Arangam a(Gama ma)	Sh	F/D	R	De	LS	Swelling	Freshly harvested root is crushed and blended with butter before being applied to the affected area	FL34
				F	L	O	Hu	Toothache	Fresh leaves are crushed and combined with lemon juice, after which the mixture is applied to the affected tooth and secured for a duration of three to four hours	
				D	L	De	Hu	Evil eye (asun afa)	The leaf is pulverized and introduced to the flames, subsequently permitting the individual to inhale the resulting smoke	
Calpurnia aurea (Aiton) Benth	Fabaceae	Zimza	Sh	F	L	De	LS	Lice	The fresh leaves of *C. aurea* are crushed and combined with water, after which the mixture is used to wash the skin of cattle until the lice are eliminated	FL35

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Carica papaya L.	Caricaceae	Papaye	T	F	S	O	Hu	Jaundice	The seed is ground and combined with water, and it is recommended to consume one glass of this mixture each morning for a duration of approximately four days	FL36
								Intestinal parasite	The fresh seeds are ground and combined with sugar, after which approximately four teaspoons should be consumed each morning for a duration of one week	
Catha edulis (Vahl) Endle	Celastraceae	Jima	Sh	F	L	O	Hu	Cough	The leaves of *C. edulis* are infused in boiling water, and the resulting juice is consumed in half-glass portions after cooling	FL37
							Bs	Urine – Retention	The fresh leaf, in conjunction with *R. chalepensis*, is combined with *F. vulgare*, pounded, and mixed with water. This mixture is then supplemented with local areke (*Katkala*) and administered orally	FL38
Carduus schimperi Sch.Bip	Asteraceae	Asewa	H	F	R	De	Hu	Hemorrhoids	Fresh root is ground and incorporated into boiled water, which is then allowed to cool before being applied to the affected area	FL39
Carissa spinarum L.	Apocynaceae	Alalu	Cl	F	R	O	Hu	Evil eye	The root of *C. spinarum* is crushed and subsequently dried. The resulting dry smoke is employed as a remedy for the evil eye	FL40
					L	O	Hu	Headache	The leaves of *C. spinarum* are crushed and subsequently dried. The resulting dry material is utilized in the form of smoke as a remedy for headaches	FL41
					L	O	Hu	Stomach Ache	The crushed leaves of *C. spinarum* are combined with honey. A dosage of two to three tablespoons is consumed in the morning	
Chenopodium ambrosioides L.	Chenopodiaceae	Mika	H	F	L	De	Hu	Wound	Leaves are crushed and combined with butter, then applied to the injured area until healing occurs	FL44
Cicer arietinum L.	Fabaceae	Shunbur a	H	D	Se	O	Hu	Malaria	Initiate the germination process and subsequently consume the mixture	FL43

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Citrus × *limon* (L.) Osbeck	Rutaceae	Lomiya	Sh	F	F r	O	Hu	Toothache	To alleviate discomfort from an affected tooth, one may consider cutting a lemon into small pieces, sprinkling salt over the pieces, and then placing them in the vicinity of the affected tooth for approximately two hours. It is advisable to avoid swallowing saliva during this period	FL44
				F	Fr	O	Hu	Stomach ache	Fruit juice can be mixed with water and consumed, or one may choose to drink the juice on its own	
				F	Fr	De	Hu	Skin rashes	Apply the juice of the lemon to the surface, along with the pericarp	
				F	Fr	De	Hu	Athletes Foot	Applying lemon juice to the affected area	
Citrus medica L.	Rutaceae	Tirngo	Sh	F	Fr	O	Hu	Abdominal pain	Juice was prepared from the fruit, and half a glass was consumed daily for two days	FL45
Citrus × *sinensis* (L.) OsbeckOsbeck	Rutaceae	Birtukani	Sh	F	Fr	O	Hu	Common cold	Combine orange juice with tea and consume the mixture	FL46
Cirsium vulgare (Savi) Ten	Asteraceae	Tuzgu	Sh	D	R	O	Hu	Intestinal parasite	Transform the mixture into a powdered form and consume it with honey. After a brief interval, partake in the local beverage known as *Tella*	FL47
Cissampelos pareira L.	Menspermaceae	Meshka Temteko	H	F	R	O	Hu	Amoebiasis	The crushed root should be combined with water, then filtered, and consumed in a full teacup each morning for a duration of three days	FL48
				F	R	O	Hu	Diarrhea	The crushed root should be combined with water, then filtered, and consumed in a full tea cup twice daily	
Clausena anisata (Willd.) Hook.f. ex Benth	Rutaceae	Kamekes a	Sh	F	L	De	Hu	Skin rash	The leaves of *C. anisata*, Solanecio gigas, and *J. schimperiana* are combined through a pounding process and subsequently applied as a cream to the skin	FL49
Clematis simensis Fresen	Ranunculaceae	Segu	Cl	F	L	De	Hu	Tonsillitis	The leaf of *C. simensis* is crushed and subsequently pressed, then wrapped in a clean cloth and secured around the neck	FL50

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Clutia abyssinica Jaub. & Spach	Peraceae	Nagiga	Sh	F	L	De	LS	Bloat of cattle	Striking the abdomen of the cattle with the stem while incorporating sections of plant leaves	FL51
Coccinia abyssinica (Lam.) Cogn	Cucurbitaceae	Aju	Cl	F	R	O	Hu	Bone break	Prepared with vegetables, seasoned, enriched with butter, and consumed over the course of a week, thereafter as required	FL52
Coffea arabica L.	Rubiaceae	Buna	T	D	Se	De	Bs	Wound	The dry seed is initially roasted, after which it is ground into a powder that is subsequently applied to the wound	FL53
				D	Se	O	Bs	Diarrhea	The seeds were roasted, subsequently ground, and combined with honey, after which two full spoons of the mixture were consumed	
Convolvulus kilimandschari Engl	Convolvulaceae	Ku?reni Eta	He	F	R	O	Hu	Sore nose	A decoction of one cup should be consumed, while fresh shoots should be finely crushed and a concentrated solution applied to the affected area, remaining in place for a duration of three days	FL54
Cordia africana Lam	Boraginaceae	Waza	T	F	L	De	Hu	Spider Poison	The leaves of *C. africana* are incinerated, and the resulting ash is combined with butter, which is then applied to the affected area	FL55
				F/ D	Ba	O	Hu	Abnormal menstrual / continues bleeding	Bark is crushed, combined with water, and consumed in a coffee cup over a period of three consecutive days	
				F/ D	Ba	De	Bs	Wound	The leaves are crushed into a fine powder, which is then combined with butter and applied to the affected area	
				F	Ba	O	Hu	Rheumatic pain	Bark is ground, simmered in combination with honey, and consumed as a beverage	
Coriandrum sativum L.	Apiaceae	Demisa	H	F	L/S e	O	Hu	Abdominal pain	The leaf or seed was masticated and ingested	FL56
				F	L	O	Hu	Stomach ache	The simultaneous mastication and ingestion of *C. sativum* leaves and garlic	
Crinum abyssinicum Hochst. ex A.Rich	Amaryllidaceae	Majan sunto	H	F	R	O	Hu	Dyspepsia	Root should be crushed and then dissolved in water, with the resulting extract consumed in quantities of 2 cups for adults and ½ cup for children	FL57

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Croton macrostachyus Hochst. ex Delile	Euphorbiaceae	Woshikala	T	F	L	De	Bs	Bleeding	Fresh leaves are crushed and squeezed to extract their juice, which is then applied to the bleeding wound	FL58
				F	L	De	Hu	Ring worm	The leaves of *C. macrostachyus* are crushed and the resulting extract is applied as a cream to the affected area	
				F	L	Na	Hu	Headache	The leaves of *C. macrostachyus* and *O. urticifolium* are crushed and inhaled	
Cucumis ficifolius A.Rich	Cucurbitaceae	Sikiya (Dani edi)	H	F	R	O	Hu	Febrile Illness	The leaves of *C. ficifolius*, *O. gratissimum*, and *C. aurea* are combined through a process of pounding, followed by the addition of cold water. This mixture is then served to individuals in the form of a beverage, akin to a cup of coffee	FL59
				F	Fr	O	LS	Cattle Infection	The roots of *C. ficifolius* are combined with the leaves of *T. nobilis*, then crushed and blended with cold water. This mixture is administered to cattle in the form of two cups of *Tella*	
Cucurbita pepo L.	Cucurbitaceae	Dabu	Cl	F	Se	O	Hu	Hooke worm	The fruit is prepared by cooking it along with its seed. After the cooking process, the fruit is allowed to cool, at which point the seed is removed	FL60
Cupressus lusitanica Mill	Cupressaceae	Ferenjini arkewa	T	F	L	O	Hu	Amoebiasis	The leaves surrounding the bud are gathered, crushed, and then pressed with water. The mixture is subsequently filtered, and the resulting liquid is consumed at a rate of one cup per day for a duration of three days	FL61
Cupressus sempervirens L.	Cupressaceae	Foro arkewa	T	F	L	O	Hu	Amoebiasis	The leaf buds are crushed and combined with water, subsequently boiled and allowed to cool. This mixture is consumed in a full glass each morning for a duration of five days	FL62
				F	L	O	Hu	Hepatitis	A preparation involving one glass of a mixture, which includes pounded leaves of *J. procera*, is to be consumed daily for a duration of one week	FL63
				F	L	O	Hu	Typhoid fever	A single glass of palmful infusion is consumed on an empty stomach	

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Cyathula cylindrica Moq	Amaranthaceae	Umo	H	F	R	Na	Hu	Epistaxis	The substance is pulverized, mixed with a small amount of water, and the resulting concentrated extract is inhaled through the nasal passages	FL64
Cymbopogon martini (Roxb.) Will.Watson	Poaceae	Sha,a	H	F	L	O	Hu	Malaria	The pseudostem and leaves of *V. amygdalina*, along with a few bulbs of *A. sativum,* are prepared and consumed in a glass on an empty stomach twice weekly	FL65
Cynodon dactylon (L.) Pers	Poaceae	Dalmeta	H	F	St	De	Hu	Snake poison	The aerial portions of *C. dactylon* are applied to the affected skin through a rubbing technique, accompanied by butter, over a duration of seven days	FL66
Cynoglossum amplifolium Hochst. ex A.DC	Boraginaceae	Kera zano	H	F	L	O	Hu	Mich	Fresh leaves, in conjunction with *O. lamiifolium*, are crushed and consumed alongside coffee, or alternatively, the leaves may be used to massage the body	FL67
Datura stramonium L.	Solanaceae	Asangra	H	D	Fr	O	Hu	Malaria	The powdered fruit of *D. stramonium* is combined with honey, and a quantity of three to four spoons is consumed alongside crushed *A. sativum*	FL68
				F	R	Na	Hu	Headache	The roots of *D. stramonium* are crushed and combined with the leaves of Ocimum gratissimum, which are then inhaled through the nose	
				F	L	De	Hu	Eye diseases	The leaf is crushed, and the extracted juice is then applied to the eye	
Daucus carota L.	Apiaceae	Caroti	H	F	R	O	Hu	Night blindness	Clean the fresh root thoroughly and consume it either raw or after cooking	FL69
Discopodium penninervium Hochst	Solanaceae	Buzo	Sh	F	L	De	Hu	Wound	The fresh leaf is mashed and applied to the affected regions	FL70
Dicliptera laxata C.B.Clarke	Acanthaceae	Focho	H	F	L	O	Hu	Mich	The leaf was crushed, combined with coffee, and consumed	FL71
Dioscorea alata L.	Dioscoreaceae	Boye	CL	F	L	O	Hu	Skin fungi	Leaves applied with considerable friction to the skin for the treatment of fungal ailments	FL72

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Dodonaea viscosa subsp. *angustifolia* (L.f.) J.G.West	Sapindaceae	Titira		D	L	De	LS	Wound	Dried leaves of *D. angustifolia* are ground into a powder and applied to the wounds of animals	FL73
				F/ D	Se	O	LS	Intestinal parasites	Grind the oats into a fine flour, combine with other ingredients, bake the mixture, and then provide it to the animal	FL74
Dracaena steudneri Engl	Asparagaceae	Teso	T	F	R	O	LS	Blackleg	The roots of the red variety of *R. communis* are combined with the leaves of *S. didymobotrya*, crushed and homogenized with water, after which the resulting filtrate is consumed	FL74
Drynaria volkensii Hieron	Polypodiaceae	Biska	H	F	R	O	Hu	Toothache	Chewing on rhizomes can provide relief from discomfort	FL75
Erythrina abyssinica Lam	Fabaceae	Kocho(Wolensu (o)	T	F	L	O	L S	Eye diseases	Fresh leaves are crushed and pressed to extract their juice, which is then applied to the eye	FL76
Ehretia cymosa Thonn	Boraginaceae	Karewaz a	T	F/D	R/L	O	Bs	Stomach Ache	The leaves and/or roots, along with the dried roots of *Z. scabra* and *Z. pentandra*, are crushed and mixed with katicala before being administered to cattle	FL77
Ekebergia capensis Sparrm	Meliaceae	Oroma	T	F/ D	Ba	O	LS	Leech	Bark is crushed and combined with a minimal quantity of water, then administered through the nostrils over a period of three consecutive days	FL78
Ensete ventricosum (Welw.) Cheesman	Musaceae	Hewa	H	F	R	O	Hu	Stomachache	The root is prepared through cooking and subsequently consumed	FL79
Embelia schimperi Vatke	Primulaceae	Tomoko	Sh	F	R	O	Hu	Hepatitis	The leaves of Embelia and Niger are to be crushed together and consumed in a full cup daily for a duration of approximately two days	FL80
				F/D	Se	O	Hu	Taeniasis	Seeds are crushed, combined with water, and allowed to steep overnight before consumption	
				F/D	Se	O	Hu	Tapeworm	The seed can be ground into a powder and consumed alongside porridge or combined with water to create a drink	

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Eragrostis tef (Zuccagni) Trotter	Poaceae	Key teff(saye)	H	D	Se	O	Hu	Rabies	Bread is prepared by incorporating a mixture of crushed roots from *M. foetida* and *S. abyssinica*, which is then consumed	FL81
				D	Se	O	Hu	Anemia	The seeds are ground, after which a soup is prepared and consumed	
				D	Se	O	Hu	Abdominal pain	The seeds are ground and combined with boiled water, with a recommended intake of two glasses daily for a duration exceeding one week	
Eucalyptus camaldulensis Dehnh	Myrtaceae	Foro barizafi	T	D/F	L	Na	Hu	Common cold	Fresh or dried leaves are immersed in boiling water, and the resulting steam is inhaled while wrapped in sealed clothing before bedtime	FL82
				F	L	O	Hu	Cough	A young leaf infusion is prepared and consumed at a rate of one cup daily for a duration of approximately three to four days	FL83
Euphorbia abyssinica J.F.Gmel	Euphorbiaceae	Akma	T	F	L	O	Hu	Gonorrhea	A minimal quantity of milky latex is combined with red tef flour, baked, and consumed over a period of three consecutive days	FL84
				F/ D	Ba	O	Hu	Ascaris	The finely ground powder derived from the bark of *C. macrostachyus* is combined with food and consumed during meal times	
Euphorbia schimperiana Scheele	Euphorbiaceae	Binebish	Sh	F	L	De	Hu	Tine versicolor	The surface was marked by means of scratching to create a painted effect	FL85
Euphorbia tirucalli L.	Euphorbiaceae	Taja	Sh	F	Lx	De	Hu	Warts	The latex was utilized at the specified site	FL86
Foeniculum vulgare Mill	Apiaceae	Osonsila (Inchilal)	Sh	F	L	O	Bs	Urine retention	Fresh leaves, along with those of *J. schimperiana*, are crushed, combined with water, and administered	FL87
				F	L	O	Bs	Stomachache	Fresh leaves, along with garlic and pepper, are ground together, combined with water and *Katicala*, and then administered orally	
Ficus sycomorus L.	Moraceae	Kaasha	T	F	L	O	LS	Foot Infection	A one-liter leaf infusion administered over a period of three days	FL88

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Ficus sur Forssk	Moraceae	Teha	T	F/ D	Ba	De	Bs	Wound	The finely ground bark is combined with butter and then applied to the wound, where it is allowed to remain for several minutes under the sun	FL89
Guizotia schimperi Sch.Bip	Asteraceae	Tufo	Sh	F/ D	L	De	Bs	Wound	The components of the plant are ground into a fine powder, which is then blended with butter and subsequently applied to the affected area	FL90
Hagenia abyssinica (Bruce) J.F.Gmel	Rosaceae	Kosso (ofa)	T	F/ D	Fr	O	Hu	Tapeworm	Flowers are macerated and immersed in water for a duration of one day before being consumed alongside local beer known as *Borde*	FL91
Haplocarpha rueppellii (Sch.Bip.) Beauverd	Asteraceae	Taseta	H	F/ D	R	O	Hu	Abdominal pain	The root can be chewed and swallowed, or alternatively, it can be crushed, mixed with water, and consumed in a quantity of approximately one full cup	FL92
				D/F	R	O	LS	Galacto gogue	The root is pulverized and combined with water, resulting in the consumption of approximately one bottle of the mixture	
Hordeum vulgare L.	Poaceae	Agewa	H	D	Se	O	LS	Bloat	The seeds, along with the dried leaves of *M. azedarach*, are ground and then distributed over the feed	FL93
				F	Se	O	Hu	Tonalities	Fresh malt was chewed, retained in the mouth, and subsequently swallowed	
Hypericum quartinianum A.Rich	Hypericaceae	Arinshes ho	Sh	F W	p	O	Hu	Epilepsy	One cup of crushed material is consumed after being extracted with water	FL94
Hypoestes forskaolii (Vahl) R.Br	Acanthaceae	Darguu(O)	H	F	L	De	LS	Bleeding	A fresh leaf is applied to the injured area and gently rubbed until the bleeding ceases	FL95
Indigofera hochstetteri Baker	Fabaceae	Festupo	H	F	R	De	Hu	Tetanus	Freshly crushed root is combined with butter and applied to the affected area	FL96
				F	R	De	LS	Anthrax	A single bottle of crushed and water-extracted substance is consumed	
Inula confertiflora A.Rich	Asteraceae	Oyazu	Sh	F	L	O	Hu	Mich	One cup of infusion is consumed while steam is inhaled	FL97

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Jasminum abyssinicum Hochst. ex DC	Oleaceae	Gemdu	H	F	L	O	Bs	Snake bite	Apply fresh leaf directly to the affected area or consume a glass of the fine powder blended with milk	FL98
Juniperus procera Hochst. ex Endl	Cupressaceae	Arkewa	T	D	Ba	O	Hu	Toothache	A mixture of powdered substance combined with the finely ground powder of *R. nepalensis*, along with food oil, is applied to the teeth	FL99
Justicia schimperiana (Hochst. ex Nees) T.Anderson	Acanthaceae	Atebiyo	Sh	D	L	De	Bs	Lice	A decoction of the leaves from this plant is combined with *C. aurea* and used to cleanse the body	FL100
Kalanchoe marmorata Baker	Crassulaceae	Bosoqee	H	D	L	Na	LS	Anthrax	The fresh leaves and roots of *P. dodecandra* are crushed and consumed, and this preparation is also administered to individuals who have ingested the flesh of animals infected with anthrax	FL101
Lagenaria abyssinica (Hook.f.) C.Jeffrey	Cucurbitaceae	Gengana (	Cl/H	F	Se	De	Hu	Evil eye	Seeds are crushed and combined with honey for consumption as a beverage	FL102
Laggera tomentosa (A.Rich.) Sch.Bip. ex Oliv. & Hiern	Asteraceae	Gufufa	H	F	L	De	Bs	Wound	Pounded leaves are secured to the source of the odor	FL103
Lagenaria siceraria (Molina) Standl	Cucurbitaceae	Bocha	H	D/ F	Se	O	Hu	Snake bite	Fresh leaves are crushed and consumed with a minimal quantity of water	FL104
Landolphia buchananii (Hallier f.) Stapf	Apocynaceae	Agega	Cl	F	L	O	LS	Induced mating	Fresh leaves are crushed and combined with salt and water, with approximately one liter consumed three times a week	FL105
Lantana trifolia L.	Verbenaceae	Borabom a	Sh	F	L	O	Hu	Amoebiasis	Fresh leaves of *H. abyssinica* and *B. antidysentrica* are combined, crushed, and mixed with water, after which approximately one full cup of the mixture is consumed two to three times per week	FL106
Lens culinaris Medikus	Fabaceae	Fiya(mis ir)	H	D	Se	O	Hu	Shortage of protein	Cooking lentils (*L. culinaris*) with wheat (*T. aestivum*) and various spices over the course of a week	FL107
Leonotis ocymifolia (Burm.f.) Iwarsson	Lamiaceae	Mika	Sh	F	L	O	Hu	Mich	A freshly picked leaf from Eucalyptus globulus was consumed in its entirety, filling a cup completely	FL108

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Lepidium sativum L.	Brassicaceae	Shima	H	D	Se	O	Hu	Amoebiasis	The seed is soak in water for one night at the morning the soaked seed is mixed with sugar drunk full one water glass for about 4 time in week	FL109
				D	Se	O	LS	Internal parasite	The seeds are ground and combined with water, and the resulting mixture is administered at a rate of approximately half a liter per day	
Leucas martinicensis (Jacq.) R.Br	Lamiaceae	Mari	Sh	F	L	De	Hu	Ringworm	Fresh leaves are crushed, and lemon juice is incorporated before being applied to the affected area	FL110
				F	R	O	Hu	Sudden illness	The fresh root is ground and combined with water, after which the resulting juice is filtered and administered through the nasal passages	
Linum usitatissimum L.	Linaceae	Mororo	H	D	Se	O	Hu	Amoebaisis	The powdered seed is consumed on an empty stomach	FL111
				D	Se	O	Bs	Constipation	Seeds are immersed in water overnight, and the resulting solution is consumed	
Lippia abyssinica (Otto & A.Dietr.) Cufod	Verbenaceae	Kosoroti	H	F	L	O	Hu	Typhoid	A decoction made from the root of *O. lamiifolium*, combined with butter, is consumed once a week for a duration of one month, using a full glass for each serving	FL112
Lippia adoensis Hochst. ex Walp	Verbenaceae	Shasha	H	D	R	O	Hu	Intestinal parasite	Dried root, in conjunction with the dried bark of *C. macrostachyus*, is ground and consumed following breakfast	FL113
				D	L	O	Hu	Cough	Dried leaves are crushed and boiled, with a teaspoon of the resulting mixture added to a cup of coffee, which is consumed daily for a duration of three days	

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Maesa lanceolata Forssk	Primulaceae	Tegewa	T	D	R	O	Bs	Placenta retention	The root is subjected to boiling alongside the seeds of *L. usitatissimum* and subsequently consumed as a beverage	FL114
				F	Fr	O	Hu	Intestinal worms	A beverage is prepared by roasting and grinding specific ingredients, which is then consumed as coffee. Alternatively, fresh fruits can be finely crushed and mixed with water, creating a solution that is ingested from a container referred to locally as "*Gubaya*," typically consumed in a single sitting	
Maytenus arbutifolia (Hochst. ex A.Rich.) R.Wilczek	Celastraceae	Sona	T	D	Ba	O	LS	Diarrhea	Fresh bark, along with the flowers of *H. abyssinica*, is crushed and combined with water and local beer before being administered orally	FL115
Melia azedarach L.	Meliaceae	Mimi(Ni mi(O)	T	F	St	O	LS	Anthrax	The powdered form of desiccated bark is incorporated into a glass of water and administered orally on a single occasion	FL116
Melissa officinalis L.	Lamiaceae	Tanachu	H	F/D	St	O	Hu	Stomach ache	The act of masticating and ingesting the stems	FL117
Millettia ferruginea (Hochst.) Hochst. ex Baker	Fabaceae	Tollo	T	F	Ba	O	Hu	Pneumonia	The bark is to be crushed and dissolved in water, with adults consuming one glass of the extract over a period of five days, while children should take one cup for three days	FL118
Momordica foetida Schumach	Cucurbitaceae	Wojimiya	Cl	F	L	De	Bs	Snake biter	The leaf is pressed to extract its juice, which is then administered twice daily either through the left ear or applied directly to the site of the bite	FL119
Moringa oleifera Lam	Moringaceae	Shiferaw	T	F	L	O	Hu	Blood pressure	Fresh leaves are crushed and consumed in a full cup twice daily, once in the morning and once at night	FL120
Musa acuminata Colla	Musaceae	Muzi	H	F	La x	De	Bs	Wound	Latex from the fruit stalk is utilized for wound application	FL121
Nigella sativa L.	Ranunculaceae	Kara azimacha	H	D	Se	O	Hu	Stomach ache	The seed is masticated and ingested	FL122

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Nicotiana tabacum L.	Solanaceae	Tumako	H	F	L	O	LS	Mich	The fresh leaf is pulverized and combined with water, then allowed to steep overnight. The resulting mixture is consumed as a full glass in the morning for a duration of 2 to 3 days	FL123
				F	L/ R	O	LS	Bloating	The leaves and roots of *N. tabacum* are dried and ground into a powder, which is then combined with salt to create a bread-like substance. This mixture is provided to cattle in slices over a period of three days	
				F	L	O	LS	Trypanosomiasis(Gandii)	The crushed and processed leaves of Nicotiana tabacum are provided as feed for cattle	
				D	L	De	Hu	Evil eye	The leaves of *C. macrostachyus* are crushed and homogenized in water, after which the resulting solution is used to wash the patient's body	
Ocimum gratissimum L.	Lamicaeae	Damakes e	Sh	F	L	O	Hu	Mich	The newly harvested leaf is pulverized and combined with coffee before consumption	FL124
				F	L	Na	Hu	Common cold	The fresh leaf is crushed and subsequently filtered before being inhaled through the nasal passages	
				F	L	O	Hu	Amoebiasis	A complete cup of leaf infusion should be consumed over the course of 2 to 3 mornings	
Ocimum urticifolium Benth	Lamiaceae	Coopi(O)	Sh	F	L	O	Hu	Mich	To obtain the advantageous properties, one may submerge the leaf in boiling water and inhale the resulting steam, or alternatively, chew the stem and consume it	FL125
Olea capensis L.	Oleaceae	Zigja	T	F	Ba	O	Hu	Dyspepsia	The stem bark is pulverized, mixed with water, and the resulting extract is consumed in a quantity equivalent to one glass	FL126
Olea europaea L.	Oleaceae	Woira	T	F	L	O	Hu	Gonorrhea	The leaves are subjected to boiling and subsequently consumed as a beverage	FL127

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Olinia rochetiana A.Juss	Penaeaceae	Fegegu	T	F	L	De	Hu	Tuberculosis	The apex of the stem is severed and secured to the enlarged section	FL128
Oreosyce africana Hook.f	Cucurbitaceae	Sikilu	Cl	F	R/ L	O	LS	Sudden illness	The glass, filled with water, is consumed after being crushed and decocted	FL129
Pentas lanceolata (Forssk.) Deflers	Rubiaceae	Watabiy o	H	F	R	A U	Hu	Ear pain	The crushed root is combined with water, filtered, and then the resulting liquid is administered into the ear	FL130
Pennisetum sphacelatum (Nees) T.Durand & Schinz	Poaceae	Fasha	H	F	W	O	Hu	Impotence	A thick extract, prepared by pounding and dissolving in a small amount of water, should be consumed in a quantity of one glass each morning for a duration of two weeks	FL131
Persea americana Mill	Lauraceae	Abukado	T	F	Fr	De	Hu	Gastritis	The fruit was consumed during the occurrence of the condition	FL132
Pisum sativum L.	Fabaceae	Attu	H	F	Se	O	Hu	Fracture	Roasted seed flour, when prepared with ample butter and consumed alongside fresh milk once daily for a duration of approximately two weeks, offers a nourishing dietary practice	FL133
Plantago lanceolata L.	Plantaginaceae	Buriyo	H	F	R	De	Hu	Mich	Fresh leaves are crushed, extracted, and consumed as a beverage	FL134
Plectranthus edulis (Vatke) Agnew	Labiatae	Yema duna	H	F	R	O	Hu	Loss of appetite	The root was prepared and consumed	FL135
Premna schimperi Engl	Lamiaceae	Sarewa	T	F	Ba	O	Hu	Toothache	To prepare the root, first strip away the bark, then chew the remaining portion and retain it in the mouth	FL136
Physalis peruviana L.	Solanaceae	Kasi Timami	H	F	R	O	Hu	Sudden illness	A small quantity of root pieces may be chewed together with salt and subsequently swallowed, or alternatively, they can be crushed, dissolved in water, and consumed as a single glass	FL137
Phaseolus vulgaris L.	Fabaceae	Topma	Cl	F	L	O	LS	Leech	The leaves of *P. vulgaris* and *N. tabacum* are to be crushed together, subsequently boiled in water with the addition of salt. The resulting mixture can then be consumed, including both the leaves and the extracted juices	FL138

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Plumbago zeylanica L.	Plumbaginaceae	Deya	T	F	Fr	O	LS	East coast fever	A homogenate of pulverized material mixed with one glass of water should be consumed over a period of two to three days	FL139
				D	L	O	LS	Cough	A mixture of leaves is consumed in liquid form each morning for a duration of three days	
				F	Ba	O	Hu	Toothache	The partially desiccated bark of the root is alternately chewed with *M. azadarach* and retained between the teeth	
Phytolacca dodecandra L'Hér	Phytolaccaceae	Endode	H		R	O	BS	Rabies	The roots of *A. abyssinica* and *J. schimperiana* are crushed and combined with water. For human consumption, a half-cup of this solution is administered on the 7th, 15th, and 21st days. In the case of animals, the procedure remains the same; however, the dosage should be adjusted to 10 units	FL140
				F	R	O	Hu	Gonorrhea	The roots of *P. dodecandra* and *C. macrostachyus* are ground into a fine powder, and a dosage of 1 to 2 cups of coffee is administered to individuals alongside the coffee	
				F	L		Hu	Eye diseases	Fresh leaves are crushed, and two drops of the resulting extract are applied to the eye	
				F	R	O	Hu	Helminthes	The fresh root is ground, mixed with water, and subsequently filtered, after which one full cup of the resulting solution is consumed	
Plectranthus marrubatus J.K.Morton	Lamiaceae	Zero	Sh	F	L	O	Hu	Mich	The leaf was crushed, incorporated into the coffee, and consumed	FL141
Podocarpus gracilior Pilg	Podocarpaceae	Gedewa	T	F	Ba	O	Bs	Intestinal parasite	A mixture consisting of a decoction made from finely powdered bark, crushed garlic, and honey is prepared into a paste. Approximately two teaspoons of this paste are consumed at bedtime for a duration of 3 to 5 days	FL142

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Premna schimperi Engl	Lamiaceae	Wagnara	T	F	R	O	Hu	Toothache	To prepare the root, first strip away the bark, then masticate the remaining portion and retain it in the mouth	FL143
				F	L	O	LS	Anthrax	The leaves of *P. schimperi* and *I. hochstetteri* are combined, crushed, and dissolved in water, after which the resulting mixture is administered to an individual who is intoxicated, approximately filling one entire bottle	
Prunus africana (Hook.f.) Kalkman	Rosaceae	Ona	T	F	Ba	O	Hu	Amoebiasis	The bark is ground and subsequently boiled, after which a complete glass of tea is consumed	FL144
				F	L	De	LS	Wound	The fresh leaf is macerated, and the extracted juice is applied to the wound	
Prunus persica (L.) Batsch	Rosaceae	Kuko	T	F	L	O	Hu	Amoebiasis	The leaves located at the terminal sections of the shoot are subjected to boiling in water, then allowed to cool, and consumed in a full cup for a duration of three days	FL145
Psidium guajava L.	Myrtaceae	Zayituni	T	F	Ba	De	Bs	Wound	The crushed bark is applied to the wound	FL146
Rhamnus prinoides L'Hér	Rhamnaceae	Geshe	Sh	F	L	O	LS	Leech	Fresh leaves, in conjunction with *N. tabacum*, are crushed and combined with water and milk before being administered nasally	FL147
				F	L	O	Hu	Tonsillitis	Consume the leaf by chewing it and then swallow it two times daily for a duration of three days	

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Ricinus communis L.	Euphorbiaceae	Sheia kobo	Sh	F	L	De	Bs	Tuberculosis	The leaf is heated gently and applied to the inflamed area	FL148
				D	Se	O	LS	Anthrax	The dried seeds of *R. communis* are ground into a fine powder and subsequently combined with water. A single cup of this mixture is administered to cattle	
				F	R	O	LS	Sudden illness	The roots of *R. communis* and *J. schimperiana* are crushed and combined with cold water. Subsequently, 1 to 2 cups of the resulting tea are administered to cattle	
				F	R	O	LS	Bloat	*R. communis* roots are crushed in conjunction with table salt and subsequently combined with cold water. A half-cup of this mixture is administered to livestock	
Rumex abyssinicus Jacq	Polygonaceae	Ferfeku	H	D	R	O	Bs	Stomach ache	The root, along with the dried leaves of *R. chalepensis* and *A. sativum*, is crushed, combined with honey, and administered orally	FL149
				F	R	De	Bs	Wound	The powdered form of the root is combined with butter to create a paste, which is then applied to the wound	
Ruta chalepensis Wall	Rutaceae	Chirata	H	F	L	O	Hu	Stomach ache	Fresh leaves are masticated and ingested	FL150
				F	L	O	Hu	Headache	The fresh leaves of *O. gratissimum* are crushed and combined with coffee before consumption	
				F	L	O	Hu	Fever	Fresh leaves are crushed in combination with *Z. officinale*, incorporated into coffee, and consumed each morning for three consecutive days	
Schinus molle L.	Anacardiaceae	Kondo berbere	H	F	L/F r		LS	Eye Diseases	The leaves and fruits of *S. molle* are masticated and then expectorated onto the eyes of cattle, equines, goats, and sheep	FL151
Snowdenia polystachya (Fresen.) Pilg	Poaceae	Bogno	H	F	L	O	Hu	Teniapedis	The aerial portions of *S. polystachya* are applied to the affected skin through rubbing for a duration of five days	FL152

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Solanum incanum L.	Solanaceae	Amaba	Sh	F	R	O	Hu	Abdominal pain	Small fragments of the root of Soanum are masticated and ingested	FL153
Stereospermum kunthianum Cham	Bignoniaceae	Botoro	T	F	L	O	Hu	Snake bite	The roots and leaves of *A. africanus* are crushed and then homogenized with water, resulting in a mixture of which one liter is consumed	FL154
Syzygium guineense (Willd.) DC	Myrtaceae	Shahu	T	F	Ba	O	Hu	Tonsillitis	The bark was ground and added to boiling water, after which the resulting decoction was consumed in its entirety from a cup	FL155
Teclea nobilis Delile	Rutaceae	Meku	Cl	F	L	O	LS	Trips	The leaf is crushed, combined with water, and administered to the animal	FL156
				F	L	O	LS	Cough	The latex and leaves of *T. nobilis* are crushed, and the resulting decoction is administered to cattle	
Tagetes minuta L.	Asteraceae	Shonu	H	F	L	Na	Hu	Headache	Crushed the leaf and breathed in through the nostrils	FL157
Thymus vulgaris L.	Lamiaceae	Zifia	H	F/ D	L	O	Hu	Blood pressure	Infusion and consumption of one cup over a period of five days	FL158
Trigonella foenum-graecum L.	Fabaceae	Abishi	H	D	Se	De	Hu	Swelling	To prepare the mixture, first crush both Abish and Bean, then combine the crushed substances with water and secure the mixture to the swollen area	FL159
				D	Se	O	Hu	Abdominal pain	Crushed seeds combined with water and honey should be consumed as a beverage	
				D	Se	O	Hu	Eye diseases	The leaf is crushed in conjunction with roasted seeds of *C. arabica*, combined with butter, and applied externally around the eye area	
Verbascum sinaiticum Benth	Scrophulariaceae	Agnani odo	H	F	R	O	Hu	Abdominal pain	Fresh root should be crushed and prepared as a decoction, with one full cup consumed	FL160

Table 2 (continued)

Botanical name	Family name	Local name	GF	CP	PU	RA	UT	DT	Methods of preparing medicinal plants	VN
Verbena officinalis L.	Verbenaceae	Gala	H	F	R	O	Hu	Tonsillitis	The root is subjected to fumigation for the patient, or alternatively, fresh leaves are crushed, combined with water, and consumed	FL161
				D	R	O	Hu	Mich	The roots of *V. officinalis*, *C. spinarum*, and *R. chalepensis* are subjected to fumigation for the patient	
Vernonia amygdalina Delile	Asteraceae	Sukaru	T	F	L	O	Hu	Ascariasis	Crushed leaves were dissolved in one glass of water and consumed	FL162
				F	L	O	Hu	Giardiasis	Crushed leaves are dissolved in a glass of water, which is then consumed	
				F	L	O	LS	Intestinal parasites	Freshly chopped leaves will be incorporated into local beer and salt, and subsequently provided to the animal	
				F	L	O	Hu	Diarrhea	The leaf is crushed in conjunction with coffee seeds, combined with butter, and consumed	
Vernonia hymenolepis A.Rich	Asteraceae	Soyoma	Sh	F	L	O	Hu	Gonorrhea	The leaves of *V. hymenolepis* and the bark of *C. macrostachyus* are crushed and combined with ground honey. A dosage of 3 to 4 tablespoons is administered in the morning for a duration of four consecutive days	FL163
Vernonia myriantha Hook.f	Asteraceae	Buzo	T	F	L	De	Hu	Wound	The fresh leaves of *V. myriantha* are crushed, and the resulting fluid is applied to the wound	FL164

GF: growth form, CP: condition of preparation, PU: part used, RA: route of administration, UT: used to treat, DT: diseases to treat, VN: voucher number T: tree, H: herb, Sh: shrub, Cl: climber, Hu: human, Ls: livestock, Bs: both, F: fresh, D: dry, F/D: fresh and dry, O: oral, Na: nasal, De: dermal, Au: auditory L: Leaf, R: root, St: stem, Ba: bark, Fl: flower, Fr: fruit, S: seed, Bu: bulb, La: latex, Wp: whole plant

and whole plants were the least utilized parts, with 2 instances each (1.21%).

Preparation method of medicinal plants

The study revealed that local people in the area employed various methods for preparing herbal medicine, which depended on the types of medicinal plants collected and the ailments being treated in both humans and livestock. Among the different preparation methods used by herbalists, crushing was the most common, 49 (29.87%), followed by pounding with 39 (23.78%). Other methods included powdering (9.75%), chewing (7.31%), cooking (6.7%), smashing (4.87%), boiling and brushing (4.26%), and both decoying and juicing (3.04%). The least used methods were squeezing and smoking, each with 2 (1.21%), and soaking, which was noted once (0.6%).

Condition of medicinal plants preparation

Results from the study indicated that most medicinal plants were prepared in their fresh form. Specifically, 118 species (71.80%) were prepared fresh, while 25 species (15.24%) were prepared in both fresh and dry forms. The remaining 21 species (12.80%) were prepared in dry form.

Route of administration of medicinal plants

Data collected from the study area showed that various routes of administration were used by healers, depending on the type of disease and the methods of herbal preparation. The most common route of administration in the study area was oral, followed by dermal, nasal, and auditory (Fig. 3).

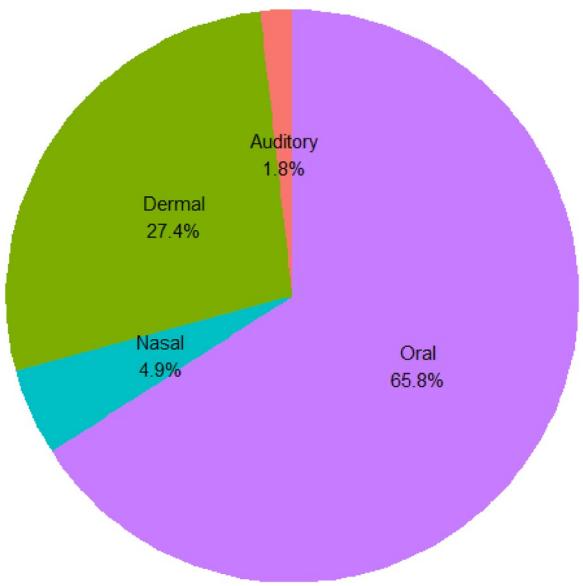

Fig. 3 Most cited rout of administration of medicinal plants

Dosage of administration, additives, and diagnostic features for medicinal plants

The dosage of herbal medicine varied according to the type of disease and the practitioners treating them. Factors such as the age and condition of the patients also influenced dosage variations. Informants noted that doses were typically estimated using various measuring tools, including liters, spoons, tea cups, coffee cups, water glasses, and even the palm of the hand, depending on the patient's age, the nature of the disease, and their overall condition. Data from informants revealed that practitioners relied on specific diagnostic features to determine diagnoses and prescribe appropriate doses, considering both the type and duration of the ailments. Healers in the area commonly diagnosed health issues through patient interviews and visual inspections. They typically asked patients or their attendants about observed symptoms and the duration of health problems, while also visually examining changes in the eyes, urine, and skin color, as well as the tongue and throat. This included monitoring body temperature, swelling, edema, coughing, bleeding, diarrhea, vomiting, the presence of parasites, and the condition of sores in both humans and livestock. In the current study area, herbal remedies were utilized both with and without additives. Notably, most medicinal plants were used without any additional ingredients. However, certain herbal medicines did incorporate additives, such as water, milk, coffee, honey, meat, bulla locally made from *E. ventricosum*, and "*Tella*" (a local beer). Informants in the current study indicated that additives were considered essential for enhancing the healing efficacy of remedies. According to the traditional healers, antidotes are used to counteract any negative effects of medicinal preparations like *P. dodecondra* and *C. macrostachyus*, which are used to treat rabies and malaria. Water is the most frequently used solvent in the preparation of herbal medicine.

Informant consensus factor (ICF)

The calculated values of the informant consensus factor (ICF) for the study area indicated that diseases most frequently encountered had higher ICF values. This suggests that medicinal plants recognized by community members as highly effective for treating these diseases also received elevated ICF scores. Notably, plants used to treat respiratory diseases, such as the common cold, cough, and fever, had the highest ICF value at 91%. This was closely followed by plants used for managing diabetes and blood pressure at 90%, and those addressing issues related to evil spirits and the evil eye at 89% (Table 3).

Table 3 Informant consensus factor (ICF)

Diseases categories	Nt	Nur	ICF	%	Rank
Respiratory system diseases, common cold, cough, fever	7	75	0.91	91	1st
Diabetes, blood pressure	3	21	0.90	90	2nd
Evil eye and evil sprit	5	40	0.89	89	3rd
Organ diseases; eye diseases, ear diseases, toothache, headache	12	68	0.83	83	4th
Tonsillitis, goiter	7	33	0.81	81	5th
Abdominal pain, intestinal pain, diarrhea, vomiting	15	76	0.81	81	5th
Mich, dehydration, sudden illness	14	69	0.80	80	6th
Joint pain, hiccup, fracture	5	18	0.76	76	7th
Skin problems, wound, fire burn	16	59	0.74	74	8th
Animal diseases,leeches,anthrax, animal bit, bloat, swelling	21	77	0.73	73	9th
Intestinal parasite, tape worm, ascariasis,Malaria, rabies viruses	20	71	0.72	72	10th

Table 4 Fidelity level index of some medicinal plants

Species name	Primary use/s	N	Np	FL %	Rank
A. sativum	Malaria	8	8	100	1
H. rueppedir	Abdominal pain	16	16	100	1
R. chalepensis	Stomach ache	14	12	91	2
O. grattisimum	Mich	20	18	90	3
E. camaldulenis	Common cold	19	17	89	4
L. sativum	Internal parasites	15	13	86	5
C. macrostachyus	Ring worm	12	10	83	6
V. anygdalina	Ascariasis	15	11	73	7
P. dodecandra	Rabies	9	6	66	8
J. procera	Amoebia	14	9	64	9

Fidelity level (FL)

The fidelity level (FL) was calculated for the most cited medicinal plant species, with eight or more informants reporting each species. The results showed that all species had FL values exceeding 60%, reflecting strong consensus among informants regarding their healing potential. Among the cited plants, *A. sativum* (used against malaria) and *H. rueppelli* (for abdominal pain) achieved a perfect FL of 100%, ranking first. They were followed by *R. chalepensis* (for stomach ache) with an FL of 92, securing the second rank, and *O. gratissimum* (used for various ailments) with an FL of 90, placing third. *E. camaldulensis* (for common cold) received an FL of 89, ranking fourth, along with other species (Table 4).

Direct matrix ranking of medicinal plants

The results from the direct matrix ranking in the study area indicated that many medicinal plant species are under threat due to their diverse uses beyond medicinal applications. These plants serve multiple purposes, including food, firewood, charcoal, construction materials, farming, furniture, and forage. In this study, direct matrix ranking (DMR) was conducted with ten key informants to assess nine multipurpose medicinal plant species at risk from various utilitarian factors. Informants ranked the plants across eight categories of use, from highly threatened to least threatened. The ranking system was defined as follows: 5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used, and 0 = not used. According to the rankings, *C. africana*, *E. ventricosum*, and *J. procera* emerged as the first, second, and third most threatened indigenous medicinal plant species, respectively. They were followed by *A. abyssinica*, *E. globulus*, *P. falcatus*, *C. macrostachyus*, and *E. abyssinica*, which were deemed the least threatened by activities such as firewood collection, charcoal production, construction, and furniture making (Table 5).

Preference ranking of medicinal plants

In the study area, seven medicinal plants were identified as effective in treating wound infections. Ten key informants were selected to compare and rank these plants according to their efficiency and healing potential. The informants assigned higher ranks to plants with greater healing abilities and lower ranks to those with less effectiveness. The scores given by the informants were summed and organized in order of effectiveness. *C. macrostachyus* received the highest score, earning the top rank, followed by *V. myriantha* and *C. arabica*, indicating that these species are regarded as the most effective and preferred for treating wound infections. The remaining plant species, G. *schimperi*, *R. communis*, *C. limon*, and *E. globulus*, were ranked fourth to seventh, respectively, based on their treatment potential for this ailment (Table 6).

Table 5 Average direct matrix rank of nine multi-uses of medicinal plants in the study area

Name of species	Use categories								Total	Rank
	Fur	Far	Fod	Fo	Fiw	Cha	Con	Med		
A. abyssinica	10	13	13	0	15	15	0	13	79	4
C. africana	15	12	11	0	15	14	15	13	95	1
C. macrostachyus	0	12	11	0	15	14	4	13	69	7
E. ventricesum	12	14	14	15	12	0	13	14	94	2
E. globulus	12	0	5	0	15	14	14	13	73	5
E. abyssinica	11	11	0	0	13	0	12	13	60	9
J. procera	9	8	8	11	11	13	12	14	88	3
P. falcatus	14	0	5	0	14	13	14	12	72	6
V. amygdalina	0	0	15	0	15	13	9	14	66	8
Total	88	70	82	26	125	96	93	119		
Rank	5th	6^{7}th	6th	8th	1st	3rd	4th	2nd		

Furniture: Fur, farming: Far, fodder: Fod, food: Fo, fire wood: Fiw, charcoal: Cha, construction: Con, medicine: Med

Table 6 Preference ranking of eight medicinal plants species used to treat wound

Medicinal plants	Respondents										T	R
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
C. limon	4	2	5	1	1	4	2	1	3	4	27	6th
C. arabica	5	4	2	3	6	5	6	6	1	5	43	3rd
C. macrostachus	7	6	6	5	7	7	4	7	5	7	61	1st
E. globules	1	3	1	4	4	1	3	4	2	1	24	7th
G. schimperi	3	1	4	7	3	3	7	3	7	3	41	4th
R. communis	2	5	3	6	2	2	1	2	6	2	31	5th
V. myrantha	6	7	7	2	5	6	5	5	4	6	53	2nd

T: total, R: rank

Jaccard's similarity index (JSI) analysis

The Jaccard's similarity index (JSI) was employed to assess cultural similarities among different ethnic communities based on shared plant species and their medicinal uses. This comparative analysis highlights both the similarities and differences between the current findings and previous studies. The traditional medicinal uses of plants, as detailed in Table 2, were compared with 29 published ethnomedicinal sources at both regional and national levels (Table 7).

Market observation of medicinal plants

A local market observation conducted in the study area revealed that there was minimal trading of medicinal plants. During the survey, only a few species, such as *H. rueppelli* (locally called *Taseta*), *N. tabacum* (locally known as *Bao tumako*), *R. chalepensis* (locally referred to as *Chirata*), and *E. kebericho* (locally called *Kebercho*), were observed being sold for their medicinal value. Informants interviewed at the market indicated that selling medicinal plants in legal markets was uncommon in the community. Instead, healers typically prepared and sold these plants from their homes. This practice reflects the local preference for gathering these plants themselves or seeking treatment directly from local healers rather than purchasing them. Additionally, cultural beliefs within the community suggested that selling medicinal plants could diminish their healing potential and lead to a loss of indigenous knowledge. Both medicinal practitioners and community members felt that activities related to traditional medicine should remain private and confidential. The market observation further noted that the plants available for sale were primarily intended for food, spices, stimulants, aromatics, and beverages, rather than for medicinal purposes.

T-test analysis of medicinal plant knowledge between key and general informants

R software was utilized to conduct a t-test to examine the differences in TMPK between key informants and

Table 7 Jaccard similarity index comparing the current study with earlier research conducted in Ethiopia

Study area	Species number (a or b)	Common species(c)	Jaccard index	Similarity (%)	References
Yem	164	–	–	–	Present study
Ameya	78	34	0.123	12.3	[32]
Gurage	244	52	0.113	11.3	[33]
Gera	63	28	0.109	10.9	[34]
Dawuro	274	53	0.108	10.8	[17]
Goro	84	29	0.104	10.4	[35]
Tulo	104	31	0.103	10.3	[36]
Gamo	188	40	0.102	10.2	[21]
Hamar	145	34	0.099	9.9	[37]
Dalle	71	25	0.096	9.6	[2]
Yeki	98	28	0.096	9.6	[23]
Ale	72	25	0.095	9.5	[38]
Gechi	70	24	0.093	9.3	[39]
Guraferda	81	25	0.092	9.2	[30]
Borecha	81	25	0.092	9.2	[40]
Sheka	266	42	0.089	8.9	[41]
Kelala	82	23	0.085	8.5	[42]
Asagirt	103	25	0.085	8.5	[43]
Zuway	73	22	0.084	8.4	[44]
Fadis	40	18	0.081	8.1	[45]
Habru	134	26	0.080	8.0	[46]
Ensaro	101	23	0.079	7.9	[47]
Quarit	112	23	0.076	7.6	[48]
Nensebo	127	24	0.076	7.6	[49]
Mojana	56	18	0.075	7.5	[50]
Sekela	121	23	0.074	7.4	[51]
Ganta	173	27	0.074	7.4	[52]
Quara	128	23	0.073	7.3	[31]
Armachiho	78	19	0.02	7.2	[53]
Dibatie	170	26	0.072	7.2	[54]

Table 8 Medicinal plants knowledge among informant groups (t-test)

Characters	Informant groups	*N*	*Mean ± SD*	*t –value*	*p – value*
Gender	Male	74	4.1 ± 1.8	5.7	*P < 0.05*
	Female	22	2.1 ± 1.2		
Literacy level	Illiterate	68	4.1 ± 1.9	5.9	*P < 0.05*
	Literate	28	2.1 ± 1.3		
Experience of informant	Key informant	24	5.5 ± 1.3	9.3	*P < 0.05*
	General informant	72	2.5 ± 1.4		

general informants. The results indicated a statistically significant difference in MPK between the two groups ($t = 9.3$, $P < 0.05$). Key informants had a significantly higher average MPK score ($M = 5.5$, SD = 1.3) compared to general informants ($M = 2.5$, SD = 1.4) (Table 8).

T-test analysis of medicinal plant knowledge between gender

A t-test was performed using R software to analyze the differences in MPK between male and female informants. The results revealed a statistically significant disparity in MPK scores across genders ($t = 5.7$, $P < 0.05$),

as shown in Table 8. Specifically, male informants had a higher mean MPK score ($M = 4.1$, SD = 1.8) compared to their female counterparts ($M = 2.1$, SD = 1.2).

T-test analysis of medicinal plant knowledge by educational background

A t-test was conducted using R software to explore the differences in medicinal plant knowledge (MPK) among informants based on their educational backgrounds. The results indicated a statistically significant difference between the two groups ($t = 5.9$, $P < 0.05$). Additionally, as shown in Table 8, the mean MPK score for illiterate informants was significantly higher ($M = 4.1$, SD = 1.9) compared to that of literate informants ($M = 2.1$, SD = 1.3).

ANOVA analysis of medicinal plants knowledge by age group

The analysis of variance (ANOVA) conducted in *R* indicated that age groups—young, middle-aged, and elderly—significantly influenced TMPK scores ($F = 19.33$, $P < 0.05$). The results demonstrated substantial age-related differences in MPK, as reflected by the greater variance between age groups (SS = 143.6, MS = 71.78) compared to the variance within groups (SS = 345.4, MS = 3.71) (Table 9). Further analysis using Tukey's HSD post-hoc tests revealed that the elderly group had significantly higher mean scores ($M = 4.3$, SD = 2.1, $P < 0.05$) than both the middle-aged group ($M = 2.5$, SD = 1.3, $P < 0.05$) and the young group ($M = 1.5$, SD = 1.1, $P < 0.05$).

The relationship between age groups and MPk shows a strong positive correlation, as demonstrated by a correlation coefficient of 0.8 (see Fig. 4). Additionally, regression analysis indicated that at a significance level of $P < 0.05$, the estimates for β0 and β1 were -2.3 and 0.12, respectively. The positive correlation highlighted by the β1 estimate suggests that with each increase in age category, the expected value of MPk increases by 0.12 (refer to Fig. 5).

Table 9 Age categories with informant knowledge (One way ANOVA)

Source of variation	Df	SS	MS = SS/Df	F ratio	*P-value*
Between groups	k – 1 3–1 = 2	143.6	71.78	19.33	*P < 0.05*
Residual (within)	n-k 96–3 = 93	345.4	3.71		
Total	n – 1 96–1 = 95	489	75.49		

K: number of level, n: number of observation, Df: degree of freedom, SS: sum of squares, MS: mean of square, significant codes: 0.05

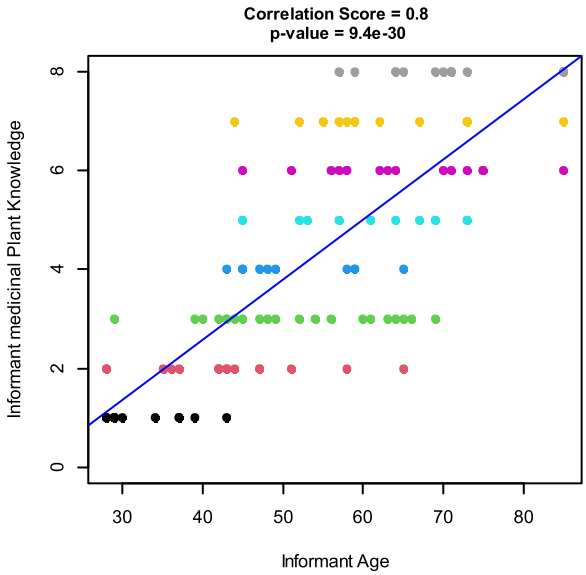

Fig. 4 Correlation model of informant age groups

Transmission of traditional medicinal knowledge

Traditional medicinal knowledge is handed down through generations using various methods. Fathers often teach their oldest sons while collecting medicinal plants and observing them in their natural habitats. Knowledge is also shared among close relatives during collaborative activities and extended journeys, as well as between friends within a tight social network. In the

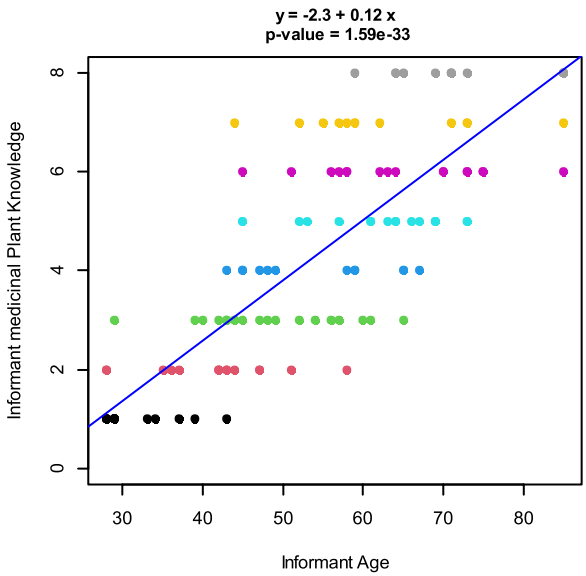

Fig. 5 Regression model of informant age groups

Table 10 Transmission of medicinal plant knowledge

Medicinal plant knowledge transfer	No of respondents	%
Trusted oldest son	40	41.6
All members of the family	22	22.9
Nearest relatives	17	17.7
Nearest friends	6	6.2
Samo Eta anniversary	11	11.4
Total	96	100

study area, an annual event known as "*Samo Eta*," celebrated on October 17, brings community members together to collectively gather medicinal plants from surrounding areas. This event promotes the sharing of experiences and the transfer of indigenous knowledge across generations. According to data collected from respondents, the most common methods of knowledge transfer include direct transmission to the oldest son (40%) and sharing with relatives (26%) (Table 10).

Threats of medicinal plants

Data collected from informants revealed various threats to medicinal plants in the study area. The most frequently mentioned factors included agriculture, firewood collection, construction, charcoal production, house and fence building, overgrazing, and urbanization. To evaluate the extent of damage caused by these threats, respondents ranked each factor based on its damaging potential. Ten informants were asked to rank seven threat factors, assigning the highest ranks to the most damaging and the lowest to the least damaging. The results indicated that agriculture, construction, and firewood collection were the top three threats, ranked first, second, and third, respectively. They were followed by house and fence construction, and charcoal production, which ranked fourth and fifth. Overgrazing and urbanization were identified as the least significant threats to medicinal plants in the area (Table 11).

Identification of most threatened medicinal plants

To determine which medicinal plants are most threatened in the study area, eight species were selected for evaluation, and eight informants ranked the degree of threat to each plant. The results revealed that *L. abyssinica*, *H. abyssinica*, and *C. africana* were the most threatened, ranking first, second, and third, respectively. They were followed by *E. kebericho*, *C. edulis*, and *P. dodecandra*, which ranked fourth, fifth, and sixth. In contrast, *E.*

Table 11 Treating factors of medicinal plants in the study area

Threatening factors	Respondents										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Agriculture	7	6	6	5	7	7	4	7	5	7	61	1st
Charcoal production	2	5	3	6	2	2	1	2	6	2	31	5th
Construction	6	7	7	2	5	6	5	5	4	6	53	2nd
Fire wood	5	4	2	3	6	5	6	6	1	5	43	3rd
House construction	3	1	4	7	3	3	7	3	7	3	41	4th
Overgrazing	4	2	5	1	1	1	2	1	3	4	27	6th
Urbanization	1	3	2	4	4	1	3	4	2	1	25	7th

Table 12 Rank of threatened medicinal plants

Threatened medicinal plants	Respondents								Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8		
L. abyssinica	8	7	6	6	8	8	5	6	54	1st
H. abyssinica	7	8	5	4	7	7	6	7	51	2nd
C. africana	5	6	8	7	3	4	7	8	48	3rd
E. kebericho	6	5	4	6	5	6	8	5	45	4th
Carissa edulis	2	4	7	3	6	5	4	2	33	5th
P. dodecandra	4	2	3	1	4	3	2	3	22	6th
E. abyssinica	3	3	1	2	1	1	3	1	15	7th
C. macrostachyus	1	1	2	2	2	2	1	2	13	8th

abyssinica and *C. macrostachyus* were not seen as highly threatened, ranking seventh and eighth, respectively (Table 12).

Management and conservation of medicinal plant

Informants from the study area reported that traditional practitioners actively conserve and manage local plants to fulfill various needs, including food, construction materials, firewood, fodder, commercial uses, cultural and spiritual significance, and medicinal applications. Indigenous communities possess a wealth of knowledge regarding plant habitats, distribution, harvesting techniques, optimal times for harvesting, and the conservation status of local flora. Traditional practitioners are recognized as more effective custodians and managers of medicinal plants than other community members. These plants are primarily conserved through cultivation in home gardens and sacred areas, where they receive better management compared to their wild counterparts. The spiritual, ritualistic, and material values associated with medicinal plants promote their conservation in the region. Field observations with key informants in Semunama Kebele revealed that spiritual and ritual sites are particularly well protected, with restrictions on cutting and harvesting in these areas. Notable species such as *P.falcatus, C. macrostachyus, J. procera, R. communis*, and *O. europaea* were found to be well preserved around the Mekoyu Mikael Church. Further observations in the Kumul Forest in Zemda Kebele, which also serves ritual purposes, highlighted a diverse array of well-conserved plant species, many of which are utilized for medicinal purposes.

Discussion

Ethnobotanical plant species in the study areas

A total of 164 medicinal plant species belonging to 60 families and 140 genera were collected and documented for their use in treating 83 ailments in humans and livestock. The number of medicinal plant species identified in this study is notably higher compared to similar research conducted in various regions of Ethiopia. For instance, a study by [30] reported 81 medicinal plant species in the Guraferda District of the Benchi-Sheko zone, Southwest Ethiopia, while [31] documented 128 species in the Quara district of northwestern Ethiopia. Other studies, such as those by [55] and [56], identified 48 and 49 species, respectively, in the Madda Walabu District of Bale Zone and Ghimbi District in Southwest Ethiopia. In contrast, studies from other parts of the world have reported only 42 to 55 medicinal plant species, as noted by [57, 58]. However, reports by [41, 59] identified 266 and 189 species, respectively, which surpasses the findings of the current study. The relatively high diversity of traditional medicinal plant species in this area may be attributed to the varied landforms, favorable climatic conditions, and the rich indigenous knowledge within the community that aids in the protection of plant biodiversity. It has been observed that communities with valuable indigenous knowledge tend to conserve their medicinal plants effectively, as highlighted by [60], who noted that local populations possess accumulated knowledge for classifying, utilizing, managing, and conserving natural resources. In this study, the majority of medicinal plants belonged to the families Asteraceae, Fabaceae, Lamiaceae, Cucurbitaceae, Poaceae, Solanaceae, and Euphorbiaceae, with respective species counts of 14, 14, 10, 8, 8, 7, and 7. Other families had fewer species represented. This finding aligns with previous literature that also indicates a high abundance of Asteraceae, Fabaceae, Lamiaceae, and Cucurbitaceae families [23, 24, 41, 35, 52]. Among the 164 medicinal plants identified, 111 (67.68%) were used to treat human ailments, 32 (19.51%) were utilized for livestock ailments, and the remaining 21 (12.80%) were effective for both. This indicates a greater focus on treating human diseases compared to livestock. Various ethnobotanical studies conducted by different researchers over the years have similarly shown that most medicinal plants are primarily used for human ailments [24, 30, 40–61].

Habitats and growth forms of medicinal plant

In this study, a significant number of medicinal plant species were collected from various habitats in the study area. The majority (49.39%) were sourced from wild areas, followed by home gardens (21.34%), agricultural fields (14.04%), life fences (9.14%), and roadsides (6.09%). Field observations revealed that wild areas harbored a rich diversity of medicinal plants, highlighting their importance as a primary source of plant biodiversity for medicinal purposes. Conversely, fewer medicinal plants were found along roadsides and in life fences. The roadside plants faced greater exposure to various threats, while those in life fences were limited in number, as they were primarily planted by farmers for fencing and other purposes. Although the number of medicinal plants in home gardens was smaller than in wild areas, these plants were well-conserved and protected by traditional practitioners of medicine, who cultivated and managed them effectively. Informants noted that wild areas were increasingly threatened by factors such as rapid population growth, house construction, overgrazing, and unmanaged collection of charcoal and firewood. Previous studies ([30, 55, 53, 62]) have similarly reported that most medicinal plants are found in wild settings, which are often exposed to various threats. The study identified different growth forms of plants, each utilized

to varying degrees. Herbs constituted the largest proportion at 46.34%, followed by trees (25.60%), shrubs (20.73%), and climbers (5.48%). Among the herbs collected, 34.14% were used to treat human ailments, 7.92% for livestock ailments, and 4.26% for both. This indicates that herbs are the most commonly used medicinal plants in the area, followed by trees. The predominance of herbs can be attributed to their adaptability; they thrive in the shade of larger trees and grow rapidly, allowing for quick reproduction. Herbs were collected from wild areas, home gardens, agricultural fields, life fences, and roadsides, demonstrating their adaptability to various habitats. While previous studies in Ethiopia [23, 31, 42–64] have reported a high prevalence of herbs and shrubs for medicinal uses, this study found that trees ranked as the second most dominant group after herbs, which may reflect the unique plant biodiversity of the current study area compared to others. In contrast, many studies have highlighted the use of shrubs and trees at both local [31, 53, 37] and global scales [65–68]. This trend may be due to their consistent annual availability and resilience to drought conditions and invasive species, making them suitable for widespread use in traditional medicine.

Plants parts used for medicine and mode of preparation

Healers in the study area utilize various parts of plants for their medicinal properties. In this research, leaves were the most frequently cited plant part used for medicine preparation, accounting for 72 instances (43.9%), followed by roots at 49 instances (29.87%), bark and seeds at 20 instances (12.19%), stems and bulbs at 7 instances (4.26%), fruits at 12 instances (6.55%), and flowers at 2 instances (1.21%). This indicates that healers in the area predominantly collect leaves for medicinal purposes over other plant parts. Traditional medicinal practitioners in the region prefer leaves due to their high healing potential, freshness, nutrient content, and ease of collection. However, since leaves are vital for the plant's food production, excessive harvesting can lead to the destruction of the entire plant, a concern that traditional practitioners do not seem to acknowledge. Similar findings have been reported by other studies [23, 47–70] and in various countries [68, 71–74], which suggest that leaf harvesting poses a threat to the sustainability of medicinal plants. The removal of leaves can hinder vegetative growth and reproductive development, such as flower production and seed set, ultimately limiting the natural regeneration of these plants. According to [30], herbal preparations involving roots, rhizomes, bulbs, barks, stems, or whole plant parts can negatively impact the survival of the parent plants. Roots were the second most commonly used plant part for medicinal purposes. Being underground, roots have better access to water and minerals, keeping them fresh and less susceptible to drying out compared to other parts of the plant. They also possess significant healing potential similar to that of leaves. However, harvesting roots requires digging them out of the soil and separating them from other plant parts, which can disrupt water transportation within the plant. Consequently, plants with harvested roots face a higher risk of damage and loss within their communities. Literature from various authors supports these findings, indicating that leaves and roots are the primary plant parts used for medicinal purposes [41, 44, 75]. Herbalists in the study area employ different preparation methods based on the plant parts used, the type of ailment being treated, the specific site of the ailment, and the intended form of application. The most common methods included crushing (49 instances or 29.87%), pounding (39 instances or 23.78%), chewing (16 instances or 9.75%), cooking (11 instances or 6.70%), smashing (8 instances or 4.87%), and boiling (7 instances or 4.26%). Other methods such as brushing, squeezing, smoking, and soaking were used less frequently. Leaves, roots, and barks were primarily prepared through crushing, pounding, and smashing, while harder parts like roots, barks, and stems were often cooked before further processing. Traditional practitioners also mix various additives—such as water, oil, sugar, salt, milk, honey, and coffee into their preparations to soften the medicine for patient consumption, enhance flavor, and mitigate adverse effects like vomiting and diarrhea. This aligns with [30], which states that many traditional remedies are prepared by combining multiple components to enhance their healing effectiveness while minimizing side effects for patients. The results of this study echo findings reported by [24, 46, 76].

Condition of preparation and rout of administration of medicinal plants

Traditional practitioners prepared medicinal plants in fresh, dry, and a combination of both conditions. According to informants in the study area, the majority of medicinal plants were prepared fresh, with respective numbers of 118 (71.95%), followed by 25 (15.24%) for dry and 21 (12.80%) for both dry and fresh. The preference for using fresh plant parts is attributed to their higher nutritional content and greater healing efficacy compared to dried ones. Plant parts that cannot be preserved for long periods are typically prepared fresh. In contrast, harder plant parts and some leaves are dried, crushed, and stored for extended use. The collection and storage of medicinal plants for long durations are crucial, especially when climatic conditions change and limit access to these resources in the field. In the study area, the practice of storing medicinal plants for extended periods is a unique cultural tradition known as *Samo Eta*.

On October 17th each year, community members aged 10 and above participate in collecting medicinal plants, primarily from the mountainous regions, particularly Bori Mountain. This date is considered sacred by the Yem people, as it is associated with Orthodox Christianity and commemorates "Martyr St. Stephen." Stored medicines must be prepared carefully, covered with dry materials, and kept in a dry place. Traditional practitioners in the study area employ various routes of administration to treat patients, depending on the type of medicine used, the nature of the disease, and the patient's condition. The most common routes of administration identified were oral (65.8%), dermal (27.4%), nasal (4.8%), and auditory (1.8%). Respondents indicated that patients typically take traditional medicines orally for internal ailments and parasitic infections. Most oral medications are prepared in liquid form for easy consumption and distribution throughout the body. Other routes of administration are selected based on the specific conditions affecting the patient. These findings are consistent with similar research conducted by various scholars [76–77].

Dosage of administration and diagnostics features

In the study area, herbalists did not provide consistent or precise dosage prescriptions. Dosage varied based on the type of disease, the patient's condition, and their age. Informants indicated that doses were often estimated using various measuring tools such as liters, spoons, tea cups, coffee cups, water glasses, and even the palm of a hand. These estimations were tailored to the patient's age, the nature of the disease, and their overall condition. For children and patients who are more sensitive to the effects of medicines, smaller doses were typically prescribed. However, this reliance on estimations can lead to overdosing, which may result in serious complications, including death, while underdosing can prevent effective treatment. Local people have gained experience in recognizing appropriate quantities based on the physical condition of patients. The lack of consistent precision and standardization is a significant challenge within traditional medicine. This aligns with findings from previous studies ([30]), which highlighted the absence of precision and standardization as obstacles to the recognition of traditional healthcare systems. Similarly, [41] noted that imprecision in dosage is a major limitation of traditional remedies, corroborating the results of this study. According to informants, medicinal practitioners employed specific diagnostic features to determine prescribed doses according to the type of ailment. Healers typically diagnosed patients through interviews and visual inspections. They would ask patients or their attendants about observed symptoms and the duration of the health issue. Practitioners visually examined various indicators such as changes in eye color, urine, skin color, tongue and throat appearance, body temperature, swelling, edema, coughing, bleeding, diarrhea, vomiting, discharge of parasites, and the condition of sores for both humans and livestock.

Comparative analysis of medicinal plant species in present study and other regions of Ethiopia

Ethiopia is well known for its diverse ecosystems and a rich heritage of herbal medicine. Numerous studies have highlighted the ethnobotanical knowledge held by local communities regarding the medicinal use of plants. For instance, research conducted in the Yeki district of southwestern Ethiopia identified 98 species of medicinal plants [23], while another study documented 266 species in the Sheka Zone of the same region [41]. In the Quarit and Yilmana Densa districts of the West Gojam zone in northwestern Ethiopia, locals were found to utilize 112 medicinal plant species to treat ailments such as malaria, intestinal parasites, rabies, snake bites, evil spirits, and wounds, underscoring the significance of traditional knowledge [48]. Comparative studies have also demonstrated how this local knowledge contributes to biodiversity conservation [30]. Moreover, advanced pharmacological investigations have explored the antibacterial properties, antioxidant potential, and phytochemical profiles of selected medicinal plants in the Dibatie district of the Metekel zone and in Habru District, North Wollo Zone, Amhara Region, Ethiopia [78]. Our research identified 164 medicinal plant species used by the community in Yem, aligning with previous studies that reported 244, 81, and 78 species, respectively [30, 32, 33]. The traditional uses of various medicinal plants in Yem reflect trends observed in other regions. For example, *B. pilosa* is utilized for treating wounds, consistent with findings from [30], while *D. stramonium* is employed for ringworm, similar to its application in the Sheka zone of southwestern Ethiopia as noted by [41]. A recent study in the Yeki district highlighted the unique use of *P. abyssinica* Fresen, locally known as *Yearo*, which is used for typhoid by applying the leaves on the body while also consuming them orally [23]. Another study in the Guraferda district documented the use of *C. mucronata* for stomachaches, where the root is chewed, the juice consumed, and the abdomen gently smeared [30]. This ethnobotanical research has revealed previously unreported phytomedicines used in Yem and surrounding areas. Additionally, a separate study conducted in the Sheka zone of southwestern Ethiopia identified more novel species utilized by local communities [41], contributing to the expanding literature on Ethiopian ethnomedicine. These studies not only catalog the plants used but also explore their preparation and administration methods, offering valuable insights into traditional healthcare

practices. Research into the pharmacological properties of traditionally used plants is on the rise. For instance, a study examining the antibacterial activity, antioxidant potential, and phytochemical profiles of selected medicinal plants in the Dibatie district of the Metekel zone and the Habru District in the North Wollo Zone of the Amhara Region, Ethiopia, revealed that certain plants believed to treat human ailments contain bioactive compounds with confirmed efficacy [78, 79]. These findings not only validate traditional claims but also encourage further exploration of their therapeutic potential.

The highest Jaccard's similarity index (JSI) recorded was 12.3% from a study conducted in Ameya [32], followed by 11.3% in Gurage, central Ethiopia [33], 10.9% in the Gera district [34], and 10.8% in Dawuro [17]. The JSI results indicate a gradual decline from the south-central, southwestern, and southeastern regions to the western, northern, northwestern, and northeastern parts of the country [23]. This trend is consistent with findings from Quara district in northwestern Ethiopia [31]. The high JSI between the current study and the Ameya district [32] can be attributed to their geographical proximity. The similarities observed among various regions in southwestern, south-central, and southeastern Ethiopia can be explained by several factors, including geographical features, cultural traditions, and types of vegetation. The similarities in ethnobotanical practices between the study area and certain other regions can be attributed to a combination of factors, including shared plant ecology, common linguistic ties, and overlapping customs. Ecologically, specific plant species may thrive in similar environmental conditions, leading to comparable uses and cultural significance across different communities. For instance, regions with similar climates and soil types typically support a similar range of flora, influencing local dietary practices and medicinal applications. Additionally, language plays a crucial role in the transmission of ethnobotanical knowledge; communities that share linguistic backgrounds often inherit similar customs and practices regarding plant use. This linguistic connection can facilitate the exchange of ideas and practices, further reinforcing the similarities in how plants are perceived and utilized. Ultimately, it is the interplay of these ecological and cultural factors that shapes the ethnobotanical landscape, highlighting the importance of both environmental conditions and cultural heritage in understanding the observed similarities across various regions [30, 31, 61]. The gradual decrease in JSI from southern to northern regions likely reflects the impact of distance and geographical barriers that hinder the exchange of information regarding the use of ethnomedicinal plants [31]. These findings indicate that traditional medicinal plant practices tend to be more consistent in areas that are geographically close and culturally similar, while diversity increases with greater distances and obstacles. This underscores the importance of considering regional and cultural factors when examining traditional plant-based healthcare practices. The shared use of certain species points to a common cultural heritage associated with traditional medicine in Ethiopia, whereas the unique practices observed in Yem highlight localized knowledge that warrants further exploration. This chapter illustrates that, while there is a robust foundation of shared knowledge about medicinal plants throughout Ethiopia, regional variations reflect adaptations to local environmental conditions and cultural traditions. Despite the rich heritage of traditional medicine, various threats jeopardize the sustainability of medicinal plant resources in Ethiopia, including the study area. Deforestation, land degradation, and climate change present significant challenges to biodiversity and the availability of medicinal plants. Research has shown that habitat loss due to agricultural expansion and urbanization has led to the decline of many plant species traditionally used for medicinal purposes [4, 30, 43]. The insights gained from this comparative analysis suggest several potential avenues for future research, including biodiversity conservation, understanding how local practices contribute to the preservation of medicinal plant species, conducting phytochemical studies to explore the bioactive compounds in uniquely utilized species from Yem, and documenting cultural heritage to safeguard local knowledge systems related to ethnomedicine.

Implications of utilizing medicinal plants in the study area

The findings of this study on the traditionally used medicinal plants in the Yem district of Central Ethiopia have significant implications for environmental sustainability, food security, and public health. The region's rich biodiversity in medicinal plants highlights the importance of traditional knowledge systems in maintaining ecological balance and promoting sustainable practices. However, challenges such as habitat loss, overharvesting, and climate change pose serious threats to local flora and the livelihoods that depend on them. Regarding food security, the study emphasizes the vital role of traditional knowledge in utilizing plants for health and nutrition. A decline or loss of this knowledge could jeopardize food security, as many medicinal plants also serve as food supplements. Additionally, most of the medicinal plants used by the community are harvested or cultivated locally. A decrease in their availability could negatively impact local economies that rely on the harvesting and sale of these plants, exacerbating poverty and further threatening food security as households may struggle to afford adequate food and healthcare. Traditional knowledge surrounding

the preparation and consumption of these plants can play a crucial role in addressing malnutrition and promoting dietary diversity. Examples of medicinal plants that also serve as food include *M. esculenta, S. americanum*, and *C. abyssinica.* Economically, the sale of medicinal plants such as *C. arabica, H. rueppelli, R. chalepensis, C. edulis, A. abyssinica,* and *E. kebericho* provides income opportunities for local communities, helping families facing food insecurity access essential goods. Promoting sustainable harvesting and cultivation of these plants can enhance resilient livelihoods and reduce dependence on external food sources [23].

The decline of these medicinal plants could lead to reduced dietary diversity and exacerbate malnutrition, particularly among vulnerable populations. The variety of medicinal plants present in the Yem district underscores the region's ecological richness. The local community's reliance on these native species is crucial for biodiversity conservation. Traditional knowledge promotes sustainable harvesting practices, which help prevent overexploitation. Furthermore, many medicinal plants play a significant role in habitat restoration, aiding in soil stabilization and providing shelter for various wildlifes, thereby enhancing overall ecosystem health. Medicinal plants also offer essential ecosystem services to the community, such as attracting pollinators that are vital for the productivity of both wild and cultivated crops and improving soil health through processes like nitrogen fixation and the enhancement of organic matter. From a public health perspective, this study emphasizes the importance of integrating traditional medicine into formal healthcare systems. Many communities rely on these phytomedicines to address various health issues, with their effectiveness often rooted in centuries of empirical knowledge. However, threats to these resources could increase dependence on synthetic pharmaceuticals, which may be less accessible or culturally accepted in these communities. Protecting and promoting the sustainable use of traditional medicines can enhance public health outcomes by providing affordable and culturally appropriate healthcare options. This study thus highlights the interconnectedness of environmental integrity, food security, and public health in the Yem district. Addressing the threats to traditionally used medicinal plants is vital for fostering a sustainable future that honors local traditions while safeguarding both ecological and human health. These findings align with reports by [31, 41, 43].

Quantitative analysis of ethnobotanical data (ICF, FL, DMR, and PR)

Various quantitative tools were utilized to assess the biodiversity of medicinal plant species in the study area and the high level of community acceptance regarding their medicinal value. Informant consensus factors, fidelity levels, direct matrix ranking, and preference ranking were employed to illustrate the agreement among community members on the presence of diverse medicinal plants used for treating different ailments. The informant consensus factor (ICF) highlighted the most prevalent diseases in the area and the community's shared understanding of remedies used for these ailments. The results indicated that medicinal plants recognized by community members as effective for specific diseases tend to have higher ICF values. This finding aligns with previous reports by [41, 75], which noted that plants believed to be effective for certain diseases also exhibit elevated ICF values. In this study, respiratory system-related diseases had the highest ICF value at 0.91, followed closely by conditions associated with the evil eye and evil spirits at 0.89, organ diseases at 0.83, abdominal pain and intestinal pain at 0.81, and sudden illnesses at 0.80. In contrast, other disease categories such as joint pain, skin-related diseases, livestock ailments like leeches and anthrax, and intestinal parasites showed lower ICF values of 0.76, 0.74, 0.73, and 0.72, respectively. Diseases related to the respiratory system exhibited a high informant consensus factor (ICF) value of 0.91, indicating strong agreement among healers regarding their prevalence. The high incidence of these diseases in the study area can be attributed to factors such as changing weather conditions, inadequate personal sanitation, and the practice of living in close quarters with domestic livestock. Similar findings have been reported by [41], highlighting that cohabitation with domestic animals, consumption of raw or undercooked meat, poor sanitation practices, improper food management, local climatic conditions that favor disease vectors like flies, lack of a balanced diet, insufficient awareness, and poverty contribute to the increased transmission of diseases within communities.

The fidelity level (FL) was utilized to gauge respondents' consensus on the healing properties of specific medicinal plant species for treating particular diseases in the study area. A high FL value indicates strong agreement among respondents regarding the effectiveness of certain medicinal plants for specific ailments. In this study, *A. sativum* (garlic) and *H. ruebepediri* (both used against malaria and abdominal pain, respectively) achieved a 100% FL, while *R. chalepensis* (for stomach aches) had a FL value of 92%. *O. gratissimum* (used for malaria) received a 90% FL, *E. camaldulensis* (for the common cold) had an 89% FL, and other species such as *L. sativum, C. macrostachyus, V. angolensis,* and *P. kotschyi* had FL values of 86%, 83%, 76%, and 66%, respectively. *A. sativum* and *H. ruebepediri* are well-known medicinal plant species for treating malaria and abdominal pain, boasting high Fidelity Level (FL) values. *A. sativum*, commonly found

in home gardens, is widely available in most households and can also be purchased in local markets. This observation aligns with findings from previous studies [30, 80–83]. According to [30], plants with the highest FL values are recognized for their significant healing potential and are considered model species for further phytochemical research.

In addition to their medicinal uses, many plant species in the study area serve various purposes. The multipurpose nature of these medicinal plants was assessed using direct matrix ranking (DMR). The results indicated that these plants are utilized for food, firewood, charcoal, construction, farming, furniture, forage, and fodder. It is important to highlight that species including *C. africana, E. ventricosum, J. procera, A. abyssinica, E. globulus, P. falcatus, C. macrostachyus,* and *E. abyssinica* were prioritized from first to ninth according to their comprehensive benefits to the community, extending beyond their medicinal properties. Information gathered from informants indicated that these versatile medicinal plants encounter more significant threats compared to other plant species. In particular, *C. africana* is heavily utilized by the community for timber, firewood, charcoal, construction, and furniture, leading to significant deforestation in the area. *E. ventricosum* is culturally significant and used for food, firewood, construction, agriculture, and furniture. As a result of its cultural importance, all communities in the study area cultivate it around their homes and engage in annual reforestation efforts. However, despite ongoing cultivation by farmers, *E. ventricosum* is currently threatened by diseases that can rapidly spread from one enset plant to another, diminishing its population in a short time. Previous studies [30, 77, 84] have reported that plants commonly used by communities across different parts of Ethiopia are more vulnerable than other species. A preference ranking was conducted to identify the most favored medicinal plant for treating specific ailments. Informants were asked to assign the highest value to their preferred species for a particular illness and the lowest value to the least preferred one while ranking the others accordingly. In this study, *C. macrostachyus* was selected as the most preferred among seven different medicinal plants used to treat wounds. *C. macrostachyus* is recognized for its wound-healing properties due to the important fluids present in its leaves and stems. It is readily available in various regions and can be easily prepared for use.

Market survey in the study area

Market observation was one of the methods used for data collection in this study. The findings revealed a significant decline in the trading of medicinal plants in the local market. Only a few species, including *H. pueppeli, N. tobaccum, R. chalepensis*, and *E. kebericho*, were sold directly for medicinal purposes by healers. Most of the same medicinal plants available in the market were not primarily intended for medicinal use; instead, they were sought after for their value as food, spices, stimulants, aromatics, and beverages. Medicinal plants such as *A. cororima, C. annum, Z. officinale, B. carinata, B. nigra, A. sativum, A. cepa, G. abyssinica, C. edulis, C. arabica, R. chalepensis,* and *R. paranoid* were predominantly sold for their culinary and aromatic properties rather than for their medicinal benefits. This trend of marketing medicinal plants for non-medicinal purposes has also been observed in various studies conducted in Debark district (North Gonder), Halaba, Guraferda district, Sheka zone, Quarit district, and Tach Gayint district[30, 41, 85–87]. People purchased these plants for their medicinal properties, although they were not specifically marketed as such. In the study area, individuals often obtained medicinal plants directly from the homes of traditional healers. These healers cultivated medicinal plants in their gardens or collected them from the wild, preparing them at home to sell to patients. According to the healers and the cultural norms of the local communities, practices related to traditional medicine are meant to be kept hidden and secretive. They believe that selling medicinal plants in the market could diminish their healing potential and lead to a loss of indigenous knowledge.

Some respondents indicated that selling medicinal plants in the market is frowned upon, as it could expose traditional knowledge to exploitation. In terms of pricing, traditional medicine is generally much cheaper than modern pharmaceuticals; however, costs vary from one healer to another. Many healers maintain that culturally and spiritually, it is inappropriate to charge high prices for traditional medicine. Historically, their primary goal was not to collect and sell medicinal plants for profit but rather to alleviate illness and address issues within their communities. They see themselves as chosen by a higher power to heal and help others, believing that their compensation comes from divine sources rather than monetary transactions. This belief contributes to the lower cost of traditional medicine.

Relationship of informant socio-demographic variables and medicinal plant knowledge

The results from the t-tests conducted in this study reveal significant differences in medicinal plant knowledge across different groups of informants, indicating the influence of socio-demographic factors on such knowledge. The substantial difference in average medicinal plant knowledge scores between key informants and general informants ($t = 9.3$, $P < 0.05$) suggests that key informants possess specialized knowledge, likely due to

their roles in their communities or their experiences with herbal medicine. This finding implies that key informants, who are typically more engaged in traditional medicinal practices, may have more opportunities for experiential learning or direct exposure to medicinal plants. These findings are consistent with those reported in previous studies [30, 43, 88]. This indicates that key informants are perceived to have a greater reliance on traditional knowledge compared to general informants, likely due to cultural influences and their extensive, hands-on experience with plant resources. The notable knowledge gap between key informants and general informants carries several important implications. In the context of medicinal plant knowledge, this disparity highlights the critical need to recognize and utilize the expertise of key informants. These individuals are essential for preserving traditional knowledge and practices related to medicinal plants, as well as for promoting sustainable harvesting and cultivation techniques. Additionally, the significant knowledge divide underscores the necessity for targeted educational and capacity-building initiatives aimed at enhancing the understanding of medicinal plants among general informants.

The gender-based differences in knowledge, where male informants scored higher than female informants (($t=5.7$, $P<0.05$), raise questions about the factors influencing this disparity. The analysis revealed a statistically significant difference in knowledge of medicinal plant scores between the genders, which is consistent with findings from previous studies [43, 75, 89]. However, some research [90] has suggested that women may have greater knowledge of medicinal plants than men, while other studies have indicated that both genders possess similar levels of knowledge of medicinal plant [52, 91]. For instance, a study on ethnic tribes in Mizoram, India, found no significant difference in knowledge between male and female informants ($P>0.05$) [92]. The results indicated that males were more active and knowledgeable in the collection and application of traditional medicine compared to females. This may be attributed to the fact that males are often guided by their fathers or elders and engage in outdoor activities such as agriculture, livestock management, wood collection, and hunting—activities that enhance their familiarity with local medicinal plants. In contrast, many females in the study area primarily focus on domestic responsibilities and have limited involvement in herbal medicinal practices, resulting in fewer female healers. Similar trends of male dominance in the practice of medicinal plant knowledge have been reported by other researchers [93–95]. These disparities may arise from historical, social, or cultural factors that shape knowledge of medicinal plant across genders. Additionally, men may have more opportunities to interact with natural environments like fields and forests, which are rich in wild medicinal plants. Some studies [30, 53] have also noted that medical knowledge is often passed down to sons rather than daughters, although this is not a universal truth. Women have historically been equally capable of exploring remote areas and gathering plant species; in many cultures, they have played vital roles in hunting and gathering activities. It is crucial to challenge the stereotype that only men can contribute to the collection of plant species and to recognize the contributions of both genders. To address the underlying factors contributing to this inequality, further research is needed to inform the development of programs and policies that empower female informants and promote gender-inclusive strategies in resource management and traditional medicine.

The analysis revealed a statistically significant difference in knowledge of medicinal plant between the two groups ($t=5.9$, $P<0.05$). The analysis indicates that illiterate informants had a higher average medicinal plant knowledge score compared to literate informants suggests that extensive formal education does not necessarily equate to practical knowledge of medicinal plants. These findings align with previous studies conducted nationwide [88, 91]. Moreover, individuals with advanced degrees may possess less knowledge about medicinal plants, potentially due to limited exposure to traditional practices within formal educational settings, especially at higher education institutions. Cultural factors also play a significant role in shaping awareness of medicinal plants across different educational levels, as traditional knowledge is often passed down within specific communities. Higher-educated individuals might become disconnected from traditional medical practices due to a curriculum that prioritizes Western medicine. Consequently, the study's findings carry important implications for public health and education policies, highlighting the need for targeted interventions to bridge the knowledge gap regarding medicinal plants among individuals with varying educational backgrounds. To foster a more integrated approach to healthcare, it is essential to incorporate traditional medical knowledge into formal education and healthcare systems.

The analysis of variance (ANOVA) indicated that age groups—young, middle-aged, and elderly—significantly influenced knowledge of medicinal plant scores ($P<0.05$). These results imply a potential decline in the perceived value of traditional knowledge across generations. Supporting evidence from international studies, including those conducted in Ethiopia [30, 55, 96], shows that older individuals are more likely to utilize medicinal plants compared to their younger counterparts, a finding that this research reinforces. The observed disparity may

be attributed to the extensive experience that older adults have with local medicinal plants for treating various ailments through traditional methods. In contrast, younger generations seem to be increasingly distanced from these practices, influenced by modernization and globalization. Many young individuals in local communities are now pursuing contemporary educational opportunities, leading to a waning interest in traditional ethnomedicinal knowledge. This shift has prompted migration in search of diverse employment prospects, raising concerns about the erosion of local ethnobotanical and indigenous knowledge. The relationship between age groups and knowledge of medicinal plant demonstrates a positive correlation, indicating that as individual's age, their understanding of knowledge of medicinal plant tends to increase. This finding aligns with previous research [23, 88, 45]. The strong positive correlation (0.8) between age categories and knowledge of medicinal plant, as suggested by the β1 estimate, indicates that with each advancement in age category, the expected knowledge of medicinal plant value increases by 0.12. These results underscore the importance of prioritizing and supporting older generations as vital sources of knowledge of medicinal plant to ensure its transmission and preservation.

Threats of medicinal plants

The findings of this study revealed that medicinal plants in the area were affected by several factors. The most significant factors impacting these plants included agriculture, firewood collection, construction, charcoal production, house and fence building, overgrazing, and urbanization. These threat factors were ranked based on their contribution to the decline of medicinal plants in the environment. Agriculture, construction, and firewood collection were identified as the top three threats, taking the 1st, 2nd, and 3rd ranks, respectively. They were followed by house and fence construction, charcoal production, overgrazing, and urbanization, which ranked 4th to 7th. The prominence of agriculture, construction, and firewood collection as major threats can be attributed to the daily activities of local communities that rely heavily on these factors. Agricultural practices have expanded significantly due to the rapid population growth in the study area. Currently, deforestation is prevalent among both individual farmers and groups engaged in investment activities. Collecting firewood for sale has become a common practice among women and youth; they often do not limit themselves to gathering shrubs and branches but also cut down large trees for their trunks, exacerbating the threat to local medicinal plants. Urbanization has been steadily increasing, leading to more road and house construction, which contributes to the decline of medicinal plant populations. In urban areas, there is a high demand for charcoal, resulting in greater deforestation of medicinal plants near these regions compared to other threats. Informants in the study area reported that species such *as P. falcatus, C. africana, J. procera, A. abyssinica, E. capensis,* and *O. europaea* have been particularly affected by charcoal production. Additionally, overgrazing was not considered a significant threat in this context, as the local communities do not primarily depend on animal husbandry. This aligns with previous studies that identified agriculture, firewood collection, construction, and charcoal production as the most common threats to medicinal plant loss [5, 35, 75, 33, 87].

Management and conservation of medicinal plants

According to the responses from informants in the study area, traditional practitioners actively conserve and manage local plants to fulfill their needs for food, construction materials, firewood, fodder, commercial purposes, cultural and spiritual values, as well as medicinal uses. This finding aligns with reports from previous studies [32, 33, 89, 97]. The indigenous people in the area possess knowledge that enables them to understand plant habitats, distribution, harvesting techniques, optimal harvest times, and the conservation status of local flora. Traditional practitioners are more effective in conserving and managing medicinal plants compared to other community members. They primarily achieve this by cultivating these plants in home gardens and spiritual sites, which tend to be better conserved and managed than those found in the wild [98, 99, 100, 101].

The spiritual, ritual, and material significance of medicinal plants to the local people plays a crucial role in their conservation efforts. Field observations and discussions with key informants in Semunama Kebele revealed that spiritual and ritual areas are more effectively protected and managed than other locations, as cutting and harvesting are prohibited in these specific zones. Additionally, medicinal plants in the mountainous regions of the study area are generally better conserved and managed than those in flatter lands. Informants indicated that these mountain areas are culturally protected by the community due to their use for spiritual and other cultural activities. Activities associated with traditional beliefs and reverence occur in these locations, leading to a strong communal commitment to avoid cutting or depleting plants unless permitted by cultural leaders. Most medicinal plants in the study area are harvested from mountainous regions. Traditional practitioners and community members believe that plants from these areas possess superior healing properties compared to those from other locations, with many asserting that these plants are divinely chosen for their medicinal efficacy. Mountain Bori, one of the largest mountains in the Yem

Zone, is naturally conserved and hosts a diverse array of medicinal plant species, serving as a primary source for healers. Field observations identified plant species such *as P. falcatus, C. macrostachyus, J. procera, R. comunis,* and *O. europaea* in spiritual areas like Mekoyu Mikael Church in Semunama Kebele and Kumul Forest in Zemda Kebele. These locations demonstrate effective natural protection for medicinal plants used for ritual purposes. However, informants noted that despite the benefits of indigenous knowledge for conserving medicinal plants, modernization and changing attitudes among younger generations toward herbal medicine are leading to a decline in the culture of conservation and management of these vital resources.

Limitation of the Study

During the ethnobotanical study of medicinal plants utilized by indigenous communities in the Fofa and Toaba Sub-districts of the Yem Zone in Central Ethiopia, several limitations emerged that may impacted the study's outcomes and interpretations. Cultural biases influenced both data collection and analysis, especially since the researcher was not a member of the indigenous community, which may have led to misinterpretations of local practices and beliefs regarding medicinal plants. Language barriers also presented challenges, resulting in misunderstandings about plant names, uses, and preparation methods. Moreover, the seasonal variability in the availability and use of these plants restricted the findings, as the study was conducted at a specific time and did not encompass the full range of plants used throughout the year. A limited sample size that did not accurately represent the entire community further affect results, compounded by ethical considerations related to informed consent that affected participation rates and the willingness to share traditional knowledge.

Additionally, the reliance on oral transmission of traditional knowledge posed documentation challenges, making it difficult to capture this information accurately. Rapid changes in traditional practices, driven by socioeconomic shifts, urbanization, and globalization, diminished the relevance of the study's findings. Environmental factors, including land use changes and climate change, also influenced the availability of medicinal plants, restricting the scope of current practices documented in the research. Although the study documented traditional plant uses, it lacked scientific validation regarding their efficacy or safety, which limited the applicability of its findings in broader contexts. Despite these challenges affecting the research process, the study successfully achieved its objectives by employing alternative strategies, such as encouraging informants to participate, utilizing translators, and overcoming transportation difficulties by walking or renting horses and motorcycles. By recognizing these limitations, researchers were able to better contextualize their findings and identify areas for further investigation, including phytochemical analyses and antibacterial testing, as well as methodological improvements for future studies.

Conclusion and recommendation

Conclusion

This ethnobotanical study revealed that communities in the area rely more on medicinal plants for healthcare than on modern pharmaceuticals. Herbalists treat both human and livestock ailments using locally available medicinal plants. Initially, community members attempt to address any health issues themselves with these plants, and if the condition does not improve, they seek assistance from local herbalists for more effective treatment. The limited availability of modern healthcare services and their high costs compel these communities to depend on herbal medicine. Most medicinal plants in the area are not sold in markets and are typically available at low prices. However, the community believes that selling these plants commercially could diminish their healing properties and contribute to the loss of indigenous knowledge. An annual medicinal plant collection event fosters a culture among herbalists and community members to gather various medicinal plants in a single day and store them for use throughout the year. While this practice strengthens the community's connection to their local flora, it also poses challenges for the conservation of these plants. Currently, several activities threaten medicinal plant populations in the area, including agricultural expansion, overgrazing, construction, firewood collection, and charcoal production. As a result, many indigenous plant species are experiencing significant declines due to these pressures. Therefore, areas rich in medicinal plant biodiversity require heightened protection and measures to mitigate these threats. Additionally, the methods of dose prescription and diagnosis employed by traditional practitioners can negatively impact patients. Dosing is often based on assumptions and varies among herbalists, leading to inconsistencies in treatment outcomes. There were no standardized measuring tools for determining the appropriate dosage of medicine, leading to variations based on the healer's experience and the patient's characteristics, such as age and sex. This inconsistency sometimes resulted in overdoses or underdoses, which could lead to fatalities or ineffective treatments. Therefore, it is crucial for traditional practitioners to be mindful of the dosages they prescribe. Healers diagnose patients through interviews and visual examinations. They assess changes in eye color, urine and skin color, tongue and throat appearance, body temperature,

swelling, edema, coughing, bleeding, diarrhea, vomiting, the presence of parasites, and the condition of sores in both humans and livestock. However, this oral and physical diagnostic approach has its drawbacks. Different diseases can exhibit similar symptoms, which may confuse herbalists and lead to the inappropriate use of medicinal plants for various ailments. Consequently, some patients may lose confidence in traditional medicine. According to this study, traditional medicinal knowledge is passed down vertically from elders to younger generations, often within families or among close friends and relatives, particularly during *Amo Eta* anniversaries. The *Amo Eta* culture is unique to the study area and warrants further investigation and protection for the benefit of the community. Medicinal plant families such as Asteraceae, Fabaceae, and Lamiaceae contain the highest number of species used for treating human and livestock ailments, indicating that these families require additional conservation efforts due to their medicinal significance.

Medicinal plants are sourced from wild areas, home gardens, agricultural fields, living fences, and roadside locations. Most are found in wild areas, which face various threats leading to their decline. The values of informant consensus (IC), fidelity level (FL), disease mention rate (DMR), and preference ranking (PR) suggest that the communities in the study area rely more on traditional medicine than modern pharmaceuticals and highly regard the medicinal properties of local plants. The study identified ailments with high agreement among informants regarding their frequency and noted that plant species with strong consensus on their healing potential had high ICF values. Similarly, the highest FL values reflected a strong agreement among informants about the healing properties of specific medicinal plants. The DMR indicated that activities related to fodder collection; firewood gathering, charcoal production, construction, agriculture, furniture making, and forage significantly threaten the medicinal plants in the area. Traditional practitioners emerged as more effective conservators and managers of medicinal plants compared to other community members. They primarily conserve these plants by cultivating them in home gardens and spiritual areas, which tend to be better managed than those found in the wild. In summary, the communities in the study area rely on traditional medicinal plants for treating human and livestock ailments more than they do on modern medications.

Recommendations

The conservation and promotion of medicinal plants and traditional knowledge are critical issues that require immediate attention. Most medicinal plants in the study area are found in the wild, making them highly vulnerable to various threats. To mitigate this, it is essential to encourage healers and community members to cultivate medicinal plants around their homes, farmlands, and living fences. Governmental and non-governmental organizations, alongside educational institutions, should create awareness and provide support for the development of a culture of growing medicinal plants in home gardens. Additionally, there is an ongoing loss of indigenous knowledge related to traditional medicine due to modernization and globalization. To combat this decline, community awareness initiatives should be implemented to encourage young people to integrate modern practices with indigenous knowledge. Collaborative efforts among higher educational institutions, civic organizations, and government bodies are necessary to educate youth and shift negative attitudes toward herbal medicine. Furthermore, traditional healers must receive recognition and support from both government and local communities for their professional contributions, which is vital for the development of their profession and the preservation of indigenous knowledge. Unique cultural practices, such as '*Samo Eta*' among the Yem nation where communities collect and store traditional medicine annually on October 17, play a significant role in transferring indigenous knowledge and facilitating experience sharing, warranting protection and promotion. Certain highly valued medicinal plants like *C. africana*, *E. ventricosum*, *J. procera*, *A. abyssinica*, *E. globules*, *P. falcatus*, and *C. macrostachyus* are particularly threatened due to their multipurpose uses. Therefore, it is imperative to prioritize the rehabilitation and protection of these species, with government bodies formulating guidelines for their conservation. Lastly, traditional practitioners often engage in collection practices that damage either single parts or entire plants. To address this issue, training should be provided by professionals in plant science and related fields to equip traditional practitioners with techniques that minimize damage during the collection of medicinal plants. By addressing these points, we can foster a more sustainable approach to the conservation of medicinal plants and the preservation of traditional knowledge within communities.

Abbreviations

ANOVA	Analysis of variance
CSA	Central Statistical Agency of Ethiopia
FL	Fidelity level
ICF	Informant consensus factor
TMPK	Traditional medicinal plants knowledge
TMPs	Traditional medicinal plants
FGD	Focus group discussion
JSI	Jaccard similarity index
PR	Preference ranking
DMR	Direct matrix ranking
NMSA	National Meteorological Service Agency

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Author contributions
All authors contributed significantly to this original research. FL was responsible for drafting the manuscript and methodology, as well as managing data collection. SA concentrated on language editing, verifying the botanical names of plants, and conducting a comprehensive review. ZK also focused on language editing and the verification of botanical names. AA verified the data analysis, created the climatogram for the study area, and prepared the map of the study area. Each author has reviewed and approved the final manuscript.

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Declarations

Ethics approval and consent to participate
Prior to the start of data collection, authorization letters were secured from the Yem Zone Administration Offices. Informants gave verbal consent before participating in interviews and group discussions, and their information was recorded with their approval. Furthermore, consent was obtained from the informants for the publication of the individual data collected from them.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no conflicts of interest.

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