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Ethnobotanical study of medicinal plants used to treat human ailments in Aseko District, Southeast Ethiopia

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Aseko district, part of the Hararghe and Arsi Bale massive mountainous region in southeast Ethiopia, is renowned for its religious culture and traditions. The local People believe that plants are sacred to God and hold medicinal potential. This study aims to investigate ethnomedicinal knowledge of plants used to treat human ailments in the district. Ethnobotanical data were collected through semi-structured interviews, key informants' interviews, guided field observations, and focus group discussions. Quantitative methods were employed to calculate the Informant Consensus Factor (ICF), preference ranking, and Fidelity level values. The finding revealed that 96 species (trees 24%; shrubs 28%; herbs 40%) belonging to 89 genera and 66 families are utilized as medicinal plants to treat human ailments by indigenous people and local communities of the district. The plant Families with the highest number of species were Lamiaceae and Solanaceae, followed by Fabaceae. It was found that leaves (44%), roots (19%), and barks (10%) of species of these species are commonly used, raising concerns that such extensive use may significantly reduce their populations. Therefore, there is an urgent need for a proper conservation plan and management strategy for medicinal plants.

Keywords: Ethnomedicine, Indigenous knowledge, Mode of preparation, Route of administration, Traditional medicine

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Ethnobotany investigates the relationship between local communities and their natural environment, encompassing plant classification, management, and utilization[1,2]. Conversely, tradition-related studies delve into cultural practices, skills, and knowledge, rooted in theories and beliefs, often employed for health maintenance and treatment[3,4], relying on locally available resources and indigenous wisdom. The domestication of plants approximately 10,000 years ago marked a significant reliance on them for sustenance, medicine, and utility across diverse cultures[1,2]. Herbal medicine, utilized by about 80% of the Asian and African populations, underscores the global significance of traditional medicinal practices[2]. Estimates suggest that 50,000 to 80,000 plant species serve as traditional medicine sources out of the known 298,000 global plant species[3,4].

Ethiopia, rich in biodiversity and traditional knowledge, utilizes medicinal plants significantly in its healthcare system[5]. Biodiversity loss, driven by factors like agricultural expansion and resource extraction, poses threats, prompting conservation efforts to safeguard genetic resources[5-8]. With approximately 6,027 higher plant species, of which 10% are endemic, Ethiopia's diverse flora is intricately linked to its varied geography[9,10]. Despite ethnobotanical studies documenting medicinal plant importance, gaps remain, particularly in documenting traditional knowledge across Ethiopia's diverse ethnic communities, highlighting the need for comprehensive inventories[8,11-15].

The Aseko district, part of the Harar-Arsi-Bale Mountain massifs, exhibits distinct vegetation and socio-economic characteristics[16]. Local livelihoods heavily rely on subsistence agriculture and forest resources, given the district's limited infrastructure and access to modern education and healthcare[17]. The present study posits that the Aseko community possesses rich ethnobotanical knowledge unique to its vegetation and socio-cultural context, warranting

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Abbreviations
EBI: Ethiopian Biodiversity Institute; IK: Indigenous knowledge MPs: Medicinal Plants; MTU: Mizan Tepi University WGCFNR: Wondogenet College of Forestry & Natural Resources.

documentation of traditional medicinal plants and their usage[16]. The extensive use of these plants, particularly leaves, roots, and barks, raises concerns about potential population declines, necessitating urgent conservation efforts. This study addresses the gap in ethnobotanical knowledge by investigating the types of medicinal plants used, their preparation methods, administration routes , and their significance to local health practices the local community in the Aseko district, in southeastern Ethiopia.

Methodology

Study area

Aseko District is located between 8°15'10"N to 8°41'0"N latitude and 39°55'40"E to 40°16'20"E longitude (Fig. 1). It is approximately 161 km from Ethiopia's capital, Addis Ababa. Aseko borders the Chole to the southwest, the Merti to the northwest, the Gololcha district to the east, and the West Hararghe Zone to the north (Fig. 1).

The district spans 607 km^2, representing 2.9% of Arsi Zone's total area[18]. Its topography comprises mountain ranges extending from the west Hararge Zone to the Gugu Mountains in Arsi, with altitudes ranging from 1177 to 2946 meters above sea level. These mountains are interspersed with rivers and streams and surrounded by undulating low-lying plateaus. Notable hills include Abakoro, Bako, Dao Gulliso, Komicha, Simo, and Woranbus, all exceeding 2100 m above sea level. The district experiences a moderately cool climate ('Woyenadega') for 48% of the area, with temperatures ranging from 15°C to 20°C. The remainder is split between cool ('Dega') at 25% and moderately warm ('Kola') at 27%, with temperatures varying from 10°C to 15°C and 20°C to 25°C, respectively. Rainfall follows a bi-modal pattern, with a short rainy season ('Belg') from March to April and a long rainy season ('Kiremt') from June to September, occasionally extending into October[17].

The vegetation cover of the district has diverse species of natural forest, bushes, shrubs, and dry evergreen montane forest, with important tree species such as, *Juniperus procera* Hochst. ex Endl., *Cordia africana* Lam., *Olea europaea* sub sp. *cuspidata*

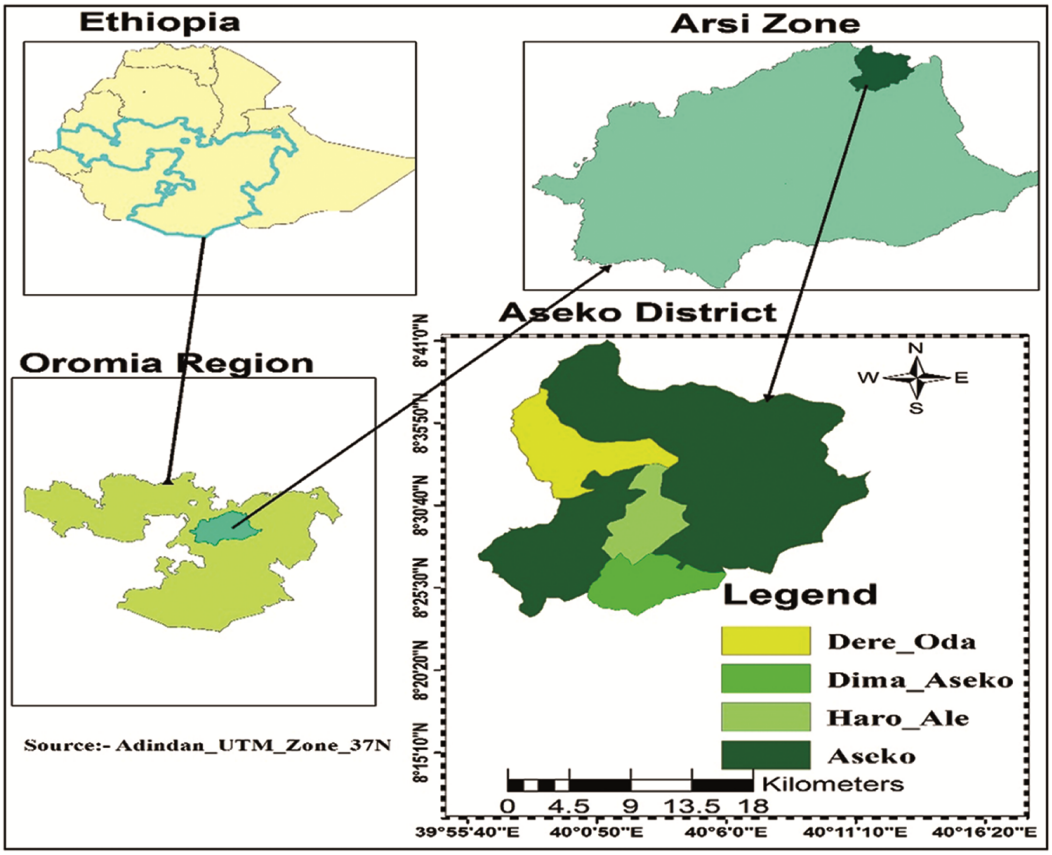

Fig. 1 — Map of study area (Source: Adindan_UTM_Zone_37)

(Wall. ex-DC.) Ciffieri, *Croton macrostachyus* DeL., *Bersama abyssinica* Fersen., and *Allophylus abyssinicus* Hochst[18,19]. Mountainous parts of the district, such as Bofe, Worgona, Weranbus, and Miro, are covered with dry evergreen Afro-montane natural forests of diverse plant species[18]. The indigenous people inhabiting the area belong to the Oromo ethnic group, where the dominant language spoken in the area is 'Afan Oromo'.

According to CSA20, the total population of the district is 113,187, of which 57,077 were men and 56,110 were women; 6,284 or 5.55% of its population were urban dwellers. But, 4.74% of its population were urban dwellers. The majority of the inhabitants said they were Muslims (62.83%), while 36.89% of the population follow Ethiopian Orthodox Christianity. Agriculture is the main economic activity of the district, particularly cereal and livestock production[19]. According to[20] the most prevalent disease in the district is pneumonia (21%) followed, by acute fever illness (AFI) (13%) and upper respiratory tract infection (10.13%).

Materials and Methods

Sampling

A cluster multi-stage sampling method was utilized to select the study sites. Based on the preliminary survey between September 10 and 30, 2017, out of 18 Kebeles (the smallest administrative unit of the government in Ethiopia), three Kebeles namely Dere Oda from 'Kola' (low altitude with a warm climate), Haro Ale 'Woyena Dega' (middle altitude with a moderately warm climate) and Dima Aseko 'Dega' (higher altitude with a cool climate) have been selected purposively based on agroclimatic differences, availability of plant resources and medicinal plant knowledge.

The selection of informants for the household survey was done following the method described by previous workers[21,22]. Individuals who were ≥ 20 years old were included as the informants. This age group was chosen since they could be legally accounted for their actions, but selecting participants below age 20 may require parental approval, which could make the study impractical. The required number of households sampled in each kebele was calculated by the formula[22].

n =NP1-PN-1(dZα/2)2+P1-P … Eq. (1)

Where, n = sample size for each selected area

P = prevalence of traditional medicinal users in Ethiopia (80%)

N = Total household of selected Kebeles

D = margin of error (10% of P) Zα/2= value under normal standard table (1.96)

Accordingly, out of the number of households found in Dere Oda (1802), Haro Ale (1731), and Dima Aseko (1352), a total of 114 samples were calculated. For each kebele, the number of households to be sampled was calculated proportional to the number of households in each kebele. Accordingly, 42, 40, and 32 households were calculated and sampled consecutively. In addition, a total of 24 KIs were selected using the snowball method, which makes the total sample size 138.

Data collection

Ethnobotanical data were collected through semi-structured interviews, focus group discussions, field observations, and guided field walks[21,22]. A pilot survey was conducted to test the questionnaire's clarity and applicability, interviewing the first five individuals encountered in each kebele. Interviews were conducted individually in the local Oromo language[2,22].

Information on the respondents' background, health issues, diagnosis, treatment methods, local names of medicinal plants (MPs), habitat, plant parts used, freshness or dried status of plant parts, remedy formulation methods, dosage, administration routes, and any adverse effects were recorded. Additionally, details on the source and transfer methods of indigenous knowledge, non-medicinal uses of ethnomedicinal plants, marketability, threats, and conservation efforts for medicinal plants were carefully documented.

Observations and guided field walks accompanied by semi-structured interviews, and direct identification and gathering of medicinal plants in their natural habitat[13,14,16]. Additionally, 3-4 focus group discussions per kebeles, with 5 participants, were conducted to enhance understanding of community and to validate data obtained from semi-structured interviews[16].

Medicinal plants were gathered in the field and identified by local names (Oromo language) with the assistance of traditional healers and local field assistants. Specimens were then pressed, dried, labeled, and deposited in the herbarium of the Ethiopian Biodiversity Institute (EBI). Identification

of the collected species was conducted at EBI using taxonomic keys from the Flora Volumes of Ethiopia and Eritrea, and by comparison with authenticated herbarium specimens, with guidance from EBI expert taxonomists.

Data analysis

Favorites of medicinal plant species used to treat the commonly reported human diseases in the district were ordered in rank[1,21]. Informant Consensus Factor (ICF) values were calculated to determine the most important human ailment categories in the district and identify potentially effective medicinal plant species in the respective disease categories[22]. ICF values were obtained by[23].

ICF = nur-ntnur-1 … Eq (2)

Where, ICF= Informants Consensus Factor nur= number of use citations in each category, nt = number of species used. Pair comparison was used for evaluating the degree of preferences or levels of importance of certain selected plants/parts of plants[1]. Furthermore, rank is made based on the reports of the informants. The numbers of pairs were determined by Espinosa M *et al*[22].

N = n (n-1)2 … Eq (3)

Where, N=is the total number of pairs n=number of objects

The fidelity level index was used to quantify the importance of a given species for a particular purpose in a given cultural group[21]. According to [22], an index fidelity level was calculated as follows.

FLI (%) = IpIu*100 … Eq (4)

Where Ip = is the number of informants who autonomously specified the use of a species for treating a specific disease and Iu = is the total number of informants who stated the plant for use.

Ethical clearance

Ethical clearance for the study was obtained from the Ethiopian Institute of Biodiversity and Hawassa University Research Ethics Committee vide Ref. No. REC/001/2021, Date: 12/03/2021. This ensured compliance with Ethiopian regulations on Access and Benefit Sharing for collecting local medicinal knowledge. A support letter was then issued by the Aseko District administration. Verbal consent was obtained from farm household interviewees and healers, and confidentiality of their information was maintained.

Results

Households ccharacteristics

The age of the informants included in the study shows that the highest number was 72, ranging from 41-60 (52.2%), followed by 25 ranging from 21-40 (18.1%) and 60 and above (29.7%). Males accounted for the highest number, which was 109 (79%), and females were 29 (21%). The educational status of the informants showed, that most of them were uneducated, accounting for 109 (79%) followed, by those with elementary education, 23 (13.8%), and others, 6 (4.3%). Regarding the job and marital status of the informants, most were married, followed by widows.

Diversity of medicinal plants used against human ailments

In Aseko District, 96 medicinal plant (MP) species from 90 genera and 66 botanical families were reported for treating human ailments (Supplementary Table S1). The dominant families were Lamiaceae and Solanaceae, each with 5 species, followed by Fabaceae and Euphorbiaceae, each with 4 species. Approximately 24% of families had more than one medicinal plant species, while the remaining 50 families were represented by a single species (Fig. 2).

Sources of indigenous knowledge (IK) transfer in the study area

The result of the study showed that the most prominent sources of IK in the study area were parents/family members (62.3%), followed by herbalists (11.6%).

Habitats and Habits and Habitats of Medicinal Plants in the Study Area “The identified dominant growth forms of medicinal plants indicated that herbs, followed shrubs, whereas epiphytes were the least represented growth form of medicinal plants in the study area. Predominantly, medicinal plant species were collected from the wild (67 species, 70%), while 29 species (30%) were collected from home garden areas.

Plant parts and condition of medicinal plants used for remedy preparation

Despite mentioning different plant parts used for remedy preparation, the majority (44%) of preparations were made from leaf parts alone, followed by roots (19%) and barks (10%) (Table 1).

Freshly harvested plant parts dominated (57.2%) the remedy preparation (Fig. 3)

Disease types and treatment methods

Healers and health experts from Aseko District and Abomsa General Hospital identified 55 types of human diseases. In Aseko District, constipation, diarrhea, gastritis, and taeniasis were the most commonly reported gastrointestinal issues, while topical dermatitis (eczema) was the most frequently reported dermatological condition.

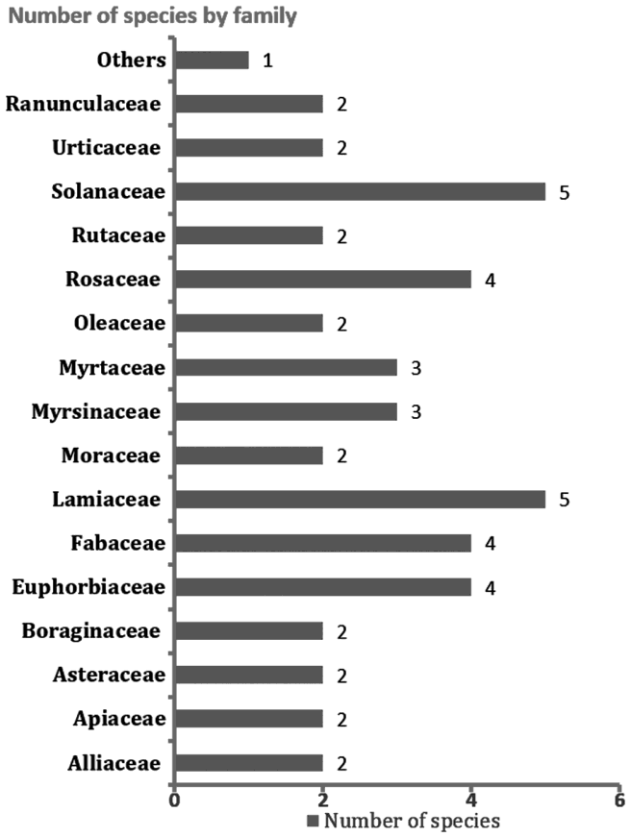

Fig. 2 — Number of species by each family in the study area

Table 1 — Parts of medicinal plants used for remedy preparation in the study area.

Parts Used	Frequency	Percentage
Leaves alone	149	43.82
Root alone	66	19.41
Seed	37	10.88
Bark	13	3.82
Fruit	12	3.53
Bulb	10	2.94
Others	9	2.65
Stem	8	2.35
Latex	6	1.76
Rhizome	6	1.76
Roots & leaves mixed	5	1.47
Entire plant	5	1.47
Sap	5	1.47
Leaves and bark mixed	3	0.88
Flower	2	0.59
Stem oil	2	0.59
Twigs	2	0.59

Modes of remedy preparation

Traditionalists in the district reported various ways of remedy preparation, which depend on the sort of ailment. The major modes of remedy preparation were crushing (20%); pounding and homogenizing plant parts (19%); squeezing (13%); powdering (12%) and other methods such as concoction, chewing, burning, cooking, roasting, and soaking constitute about 36% (Fig. 4).

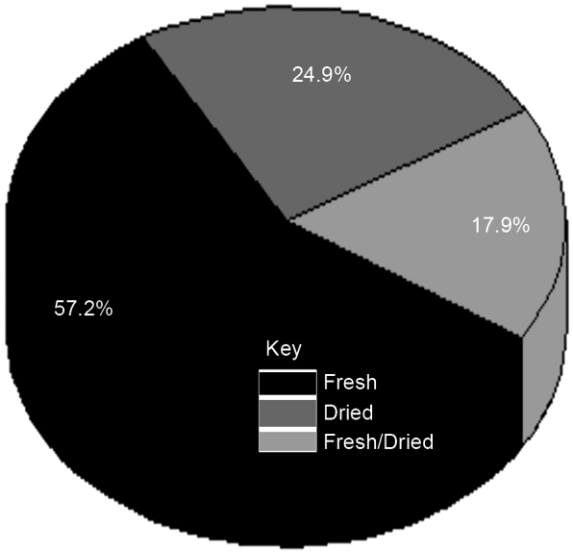

Fig. 3 — Condition of medicinal plant used for remedy preparation in the study area

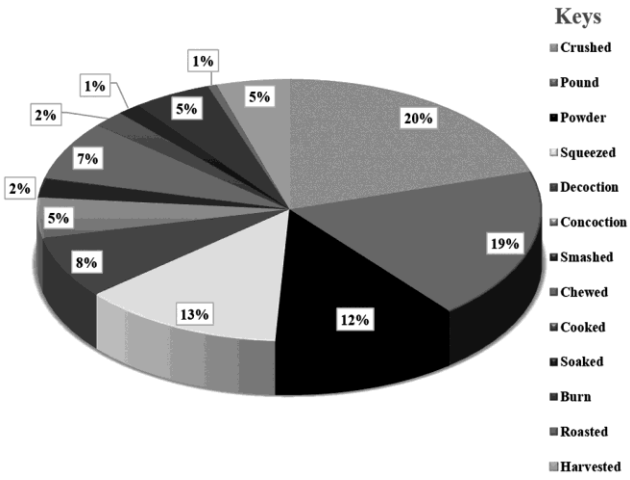

Fig. 4 — Modes of remedy preparation in the study area

Routes of administration and application

The medicinal plants prepared were administered through different routes. Oral application was the dominant and most commonly used route of administration (54.41%), followed by topical or dermal application (29.42 %). Other routes of administration include nasal (7.65%), auricular (2.94%), tooth surface (2.65%), anal (1.18%), and others (1.73%) routes prescribed as per the types of aliments reported by the respective patients (Fig. 5).

Diagnosis, dosages, and antinodes

Traditional healers identified signs through interviews and visually examined patients' eyes, skin color, tongue, throat, sore status, bleeding, infections, and body temperature. Medicinal plants were typically administered without standardized doses, relying on traditional measures. Approximate dosages were determined based on factors such as age, sex, type of disease, and the physical appearance of patients. Some preparations were measured using small cups ('siinii), spoons, handfuls, or finger sizes. Common antidotes for herbal preparations with adverse effects included coffee, milk, honey, yogurt, butter, and the dissolved powder of roasted barley.

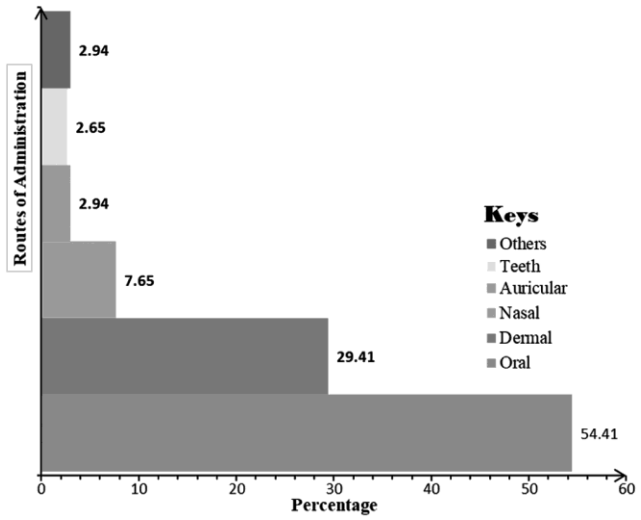

Fig. 5 — Routes of remedy administration in the study area

Efficacy of medicinal plants

About fourteen disease categories were identified from the total of 55 various human ailments reported in the district. Amongst these, the categories with the highest ICF values were gastro-intestinal and parasitic diseases (0.76), which were followed by febrile illness (0.74); and oral, dental, and pharyngeal diseases (0.62). The highest plant use citation (25.36%) was found for gastrointestinal and parasitic diseases, followed by dermatological diseases (20.29%) (Table 2).

Relative healing potential of medicinal plants, fidelity level

Table 3 presents the comparative healing potential, or fidelity levels, of the top 13 medicinal plants against major human health problems. These problems include infectious diseases, febrile illness, asthma, intestinal parasites, diarrhea, urinary system problems, eye diseases, headaches, skin rashes (ringworm), malaria, ear diseases, evil eye, and snake bites. The 13 most cited diseases were derived from ethnomedicinal information provided by informants. *Ocimum gratissimum* L. (100%), *Rubus steudneri* Schw (100%), and *Podocarpus falcatus* (100%) exhibited the highest fidelity levels, while *Croton macrostachyus* had a relatively lower fidelity level (56.2%) (Table 3).

Table 2 — ICF Values of traditional medicinal plants for treating human ailments in Aseko District.

Disease categories	Species	% of all species	Use citation	% of all use citation	ICF
Gastro-intestinal and parasitic	9	9.38	35	25.36	0.76
Febrile illness	8	8.33	28	20.29	0.74
Oral, dental and pharyngeal	6	6.25	14	10.14	0.62
External injuries, bleeding	9	9.38	19	13.77	0.56
Placental retention and urine retention	7	7.29	13	9.42	0.50
Evil spirit and evil eye	11	11.46	20	14.49	0.47
Respiratory	5	5.21	8	5.80	0.43
Dermatological	11	11.46	18	13.04	0.41
Swelling, Blood and lymphatic system	7	7.29	11	7.97	0.40
Organ disease	10	10.42	14	10.14	0.31
Malaria and fever	8	8.33	10	7.25	0.22
Musculoskeletal and nervous system	10	10.42	12	8.70	0.18
Sensorial	6	6.25	7	5.07	0.17
Insect allergy & poison	8	8.33	9	6.52	0.13
Others	15	15.63	19	13.77	0.22

Preference ranking

The finding showed that the preference of a particular MP species against a particular ailment is not necessarily the same; it varies from district to district. Among the five selected medicinal plants used to treat gastritis, *Urtica simensis* Hochst. ex. A. Rich. stood first, followed by *Ensete ventricosum* (Welw.), Both species are endemic to Ethiopia (Table 4).

Pair wise comparison of medicinal plants used to rabies

Pair wise comparison was established to calculate the use of MP species to treat rabies in the study area. Accordingly, *Justicia schimperiana* (Hochst. ex Nees) T. Anderson stood first followed by *Phytolacca dodecandra* L' Herit. and *Clutia abyssinica* Jaub. & Spach. Results of test for consistency and transitivity through paired comparison for top eight medicinal plants against rabies problems was obtained by simple preference ranking as indicated in (Table 5).

Discussions

The results of the current study indicated that the Aseko district is relatively rich in medicinal plant diversity. Various ethnobotanical studies carried out in Ethiopia and elsewhere in the world suggested such as good vegetation cover, acceptance of traditional medicine, efficacy, cost affordability, and limited access to modern healthcare facilities could be among the factors that have made people more reliant on local traditional medicinal plants.

Table 3 — Fidelity Level Index of most common uses of medicinal plants in the study area.

Species	Used to Treat	FL (%)
Ocimum gratissimum L.	Fibril illness	100
Rubus steudneri Schw	Asthma	100.
Podocarpus falcatus (Thunb.) R. Br. ex Mirb.	Intestinal Parasite	100.
Echinops kerebicho Mesfin	Blotting, Diarrhea, Urinating problem	93.3
Ocimum urticifolium L.	Eye disease, Fibril illness, Head ache	88.9
Lagenaria siceraria (Molina) Standl.	Skin rash (ringworm), Malaria, Ear disease, Evil eye, Snake bite	87.5
Lepidium sativum L.	Malaria, Blotting, Diarrhea, Tonsillitis, Cough Fibril illness	86.5
Calpurnia aurea (Ait.) Benth	Snake bite, Arthropod external parasite, Wound	87.5
Allium sativum L.	Malaria, Stomach ache, Blotting,	77.8
Ricinus communis L.	Anthrax, Ulceric lymphagities, Blotting	75.0
Phytolacca dodencandra L.	Liver ache, Gonorrhea, Hemorrhoid, Rabies, Hyena bite	66.7
Cucumis ficifolius A. Rich	Stomachache, Febrile illness, Skin infection, Black leg, Blotting, Hemorrhoid	62.5
Croton macrostachyus D.	Evil eye, Gonorrhea, Febrile illness, Headache, Hemorrhoid, Rabies, Lymphatic swelling	52.6

Table 4 — Preference ranking of medicinal plants reported for treating gastritis.

MPs used	Respondents (R1-R10)										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10		
Urtica simensis Steudel	4	5	4	5	4	4	5	4	5	4	40	1st
Ensete ventricosum W.	5	5	4	3	5	3	4	3	5	5	37	2nd
Linum usitatissimum L.	5	4	5	2	3	4	3	5	4	4	35	3rd
Vernonia amygdalina Del.	5	4	3	5	1	3	5	3	4	3	33	4th
Zingiber officinale R.	3	1	2	4	3	2	3	5	3	4	26	5th

N.B: Scores in the Table 4 indicate ranks given to MPs based on their efficacy. Highest number (5) given for the medicinal plant which informants thought most effective in treating Malaria and the lowest number (1) for the least effective plant.

Table 5 — Pair Wise Comparison results of medicinal plants used to rabies.

MPs used	Respondents (R1-R9)									Total	Mean	Rank
	R1	R2	R3	R4	R5	R6	R7	R8	R9			
Justicia schimperiana (Hochst.ex A. Nees)	5	4	5	3	5	3	4	5	4	38	4.2	1st
Ficus sycomorus L.	3	5	4	5	4	3	5	4	4	37	4.1	2nd
Phytolacca dodecandra L.	4	5	3	4	2	5	3	4	3	33	3.7	3rd
Myrsine africana L.	5	1	3	4	5	3	3	5	2	31	3.4	4th
Clutia abyssinica Jaub. & Spach.	3	4	2	1	4	5	4	3	3	29	3.2	5th
Brucea antidysenterica J. F. Miller	2	3	4	5	3	0	2	4	5	28	3.1	6th
Hypericum revolutum Vahl	3	2	1	5	4	1	2	1	3	22	2.4	7th
Croton macrostachyus Hochst. ex Delile	1	2	3	2	1	5	0	4	3	21	2.3	8th

The dominance of the Solanaceae, Lamiaceae, Fabaceae, and Euphorbiaceae families in the checklist of medicinal plants could be attributed to their wider distribution and abundance in the regional Flora[23-25]. This for instance, ethnobotanical studies in Guji-semi pastoral people (southern Ethiopia)[26], Tigray (northern Ethiopia)[25], around the Himalayas (Nepal)[26], and Mardin (central Turkey)[27].

The dominance of the Solanaceae, Lamiaceae, Fabaceae, and Euphorbiaceae families in the checklist of medicinal plants could be attributed to their wider distribution and abundance in the regional Flora[24-27]. This can be testified by the consistent recordings of ethnomedicinal uses of species from the aforementioned families in different Ethiopian ethnobotanical investigations[19,25,26,28-30].

Most medicinal plants used in the area (39.6%) were found to be herbs. This could relate to the fact that they are more easily accessible in nearby areas than trees and shrubs. Herbaceous medicines can also replace themselves easily, given an acceptable climatic condition. The finding agrees with the general pattern of dominance of herbaceous species seen in most medicinal plant inventories in Ethiopia and other countries[25,]. Furthermore, the forms of growth could also contribute to the high frequency of usage of herbaceous plant species because herbs are the leading plant growth forms in the Ethiopian flora[23,24]. The results were Similar with the findings of[12-15,31].

Ethnobotanical studies carried out in different localities of Ethiopia revealed leaves are the most often used part for the preparation of medicinal plants[31-34]. The collection of leaves could be promoted as a more sustainable method. Moreover, plant leaves are sources of phytochemicals such as phenols, flavonoids, and alkaloids that are important for curing human ailments[35]. The roots of medicinal plant species were reported to be harvested for a significant proportion of the remedy preparations (19%) next to the leaves. Overexploitation of entire root parts for remedial preparations shows the threat posed to the long-term survival of the corresponding medicinal plants. Researchers[32-35] also reported that the utilization of the root part is risky to the survival of medicinal plant species. Rare species, for instance, may be vulnerable to local extinction due to over-exploitation. A typical example is the case of *Echinops kebericho*, whose root was highly marketable in the local markets of the area. Medicinal plant parts used could also assist in marking organs for further medicinal outlining, indorsing, and drug advancement.

The persistent use of freshly harvested medicinal plant materials in the area is reported to be linked with the notion of achieving high efficacy using active ingredients. However, fresh collection could pose a threat to medicinal plants since local people have no habit of preserving the dry form of traditional medicine in most cases. Other ethnomedicinal inventories in Ethiopia[36-38] have also indicated wide use of fresh plant materials for remedy preparations. A comparable result was testified by Jewar *et al*[19] & Teklay A[35] that the newly collected plant material is the most regularly used state of preparation. Traditional healers believe that some medicinal plants lose their healing capacity if not used in fresh form. The inference was that there was inadequate practice of dry storage for forthcoming use. It means that there could be a cumulative occurrence of harvesting, which may threaten the medicinal plant in use or its parts.

The dominant use of medicinal plant parts is through crushing (20%) and pounding (19%) for various ailments. This might be related to their proven effectiveness over many years by healers. The results of the current study are similar to those of other investigations done in different parts of Ethiopia[34-38]. However, they disagree with the results finding[37] which indicated the dominant preparation in the Ankober district to be decoctions for various ailments might be related to their proven effectiveness over many years of trial and error of traditional knowledge accumulated by a particular community.

The reason that most remedies in the study area were applied orally (54.41%) followed by topical or dermal application (29.42%) could be due to the high occurrence of gastrointestinal and dermatological disorders in the study area. Dermal remedial application could also be attributed to the fact that it reduces the chance of drug intoxication more than oral administration. In addition, there is a belief that both oral and dermal routes permit a fast physiological reaction of prepared medicines with the pathogens and enhance their curative power. In connection with this, studies showed that oral and dermal routes of administration of remedies were found to enhance the physiological reactions of remedies with the pathogens that in turn increased the healing power of the medicine[19,25,38]

Misidentification of diseases commonly leads to missed prescriptions, which may result in adverse effects for patients. Even if dosages for different ailments were reported to be determined based on age, pregnancy, physical fitness/appearance, and gender of the patient, there were no standardized measurements or guidelines. There is a chance that the patient will be a victim of the side effects of the medicinal plant in use. That is why, the Food, Medicine, and Health Care Administration and Control Authority (EFMHACA) of Ethiopia, for example, has already established standard treatment guidelines at various levels of health facilities[25] for multistage treatment services. An overdose of remedies was also reported to cause adverse effects in the patient. Lack of precision and standardization has been mentioned as a global drawback of the traditional healthcare system[39].

The highest informant's consensus factor (ICF) values (0.76 and 0.74) reveal the best agreement among informants on the usage of medicinal plant species stated to help treat gastrointestinal, parasitic, and febrile illnesses, respectively. According to Jewar *et al*[19], Alexiades M[40], high ICF values are important to identify plants of particular interest in the search for bioactive compounds. Hence, plants with the highest bioactivity are considered to have the highest ICF values and are better candidates for bioprospecting and further profiling[32]. The fidelity level (FL) of medicinal plants signifies the relative healing ability of medicinal plants against a given illness. In the current study, the relative healing potential or fidelity level (FL) of most cited medicinal plants with relatively higher fidelity level values for treating human ailments were recognized and discussed. The stated highest fidelity level for *Ocimum gratissimum* L. to treat febrile diseases, *Rubus steudneri* Schweinf. treat Asthma and *Podocarpus falcatus* (Thunb.) R.Br. ex Mirb. to treat intestinal parasites (100%FL) respectively, could be taken as a clue for the highest healing potential of these plants against the corresponding diseases. The medicinal plants have comparatively high healing potential, likely against the respective health problems mentioned. On the other hand, plants with high FL values might be target species ranked for conservation, management, and sustainable utilization after their bioactivities were appropriately assessed and confirmed. A substantial number of medicinal plants in the district need further chemical profiling to ensure their validity and efficacy. Systematic evaluation of indigenous therapeutic methods and practices to improve healthcare in marginalized regions became an important element of the agenda of international and national organizations[41]. Additionally, the findings of[39,42]. Summarized that priority for further pharmacological studies must be given to medicinal plants scoring the highest fidelity level.

These high-ranking medicinal plants are subjects for further phytochemical profiling in medical research and advancements. Medicinal plants with comparatively high use values are considered to be the most used ones. They are well-thought-out and under burden due to overexploitation, which may, in the long run, lead to the scarcity of the species. Such medicinal plant species require urgent conservation efforts[42].

Conclusion

In conclusion, the study revealed a rich diversity of medicinal plants used for treating various human ailments in the Aseko District. A total of 96 medicinal plant species from 90 genera and 66 botanical families were documented, with prominent families including Lamiaceae and Solanaceae. However, conservation efforts were found lacking, with oral transmission of IK and insufficient documentation. Indigenous knowledge was predominantly sourced from parents/family members, and the majority of medicinal plants were collected from the wild. Leaf parts were most commonly used in remedy preparation, and oral application was the primary route of administration. Traditional diagnosis methods and approximate dosages based on patient characteristics were reported, with some antidotes used to mitigate adverse effects. The efficacy of medicinal plants varied across different disease categories, with gastrointestinal and parasitic diseases showing the highest plant use citations. Furthermore, certain medicinal plants exhibited high fidelity levels for specific health problems, indicating their relative healing potential. The preference ranking of medicinal plants against particular ailments demonstrated variability across districts, underscoring the importance of local knowledge and context in herbal medicine practices.

However, the heavy reliance on specific plant parts, such as leaves and roots, raises significant conservation concerns regarding the sustainability of these resources. As biodiversity faces increasing threats from agricultural expansion and environmental

degradation, there is an urgent need for effective conservation strategies to protect these invaluable genetic resources. Comprehensive efforts in conservation and documentation are essential to ensure the continued availability of these resources for future generations. Lastly, some herbalists show commitment to cultivating MPs at home, highlighting the need for government support for conservation efforts. Recommendations include establishing a traditional healers' association and providing scientific assistance to strengthen members.

Supplementary Data

Supplementary data associated with this article is available in the electronic form at https://nopr.niscpr.res.in/jinfo/ijtk/IJTK_23(11)(2024)1073-1084_SupplData.pdf

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Conflict of Interest

Authors declare that there is no conflict of interest.

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Author Contributions

JS involved conceived the research, did the data collection, and drafted the manuscript ZG and MM designed the research and wrote the manuscript. All authors read and approved the final manuscript.

Consent for Publication

Collaborators were informed that results would be presented in a scientific article and gave their approval.

Ethics Aapproval and Consent to Participate Ref. No.REC/001/2021, Date: 12/03/2021

The study was conducted following a thorough review of the study protocols by scholars in the ethnobotanical field of study from Wondo Genet College of Forestry and Natural Resources, Hawassa University. Furthermore, an official permission support letter was provided by the Hawassa University administration. The study participants were informed about the benefits of taking part in the present study. During the discussion with participants, it was made clear that the customary benefit they get by providing a remedy to health-seekers will never be affected in the course of providing full information about the medicinal plants to the investigator. Verbal consent was obtained from the study participants before beginning the study. The costs of travel and time spent were compensated with modest payments.

Data Availability

Data that support the findings of the study will be made available upon request.

References

1 Martin, G, Ethno-botany: A method manual, (Chapman and Hall, London), (1995) 265-270.

2 Oyinlola Oyebode, Ngianga-Bakwin Kandala, Peter J Chilton & Richard J Lilford, Use of traditional medicine in middle-income countries: a WHO-SAGE study, *Health Policy Plan*, (2016) p. 984-991.

3 IUCN species survival commission medicinal plant specialist group, "Why conserve and manage medicinal plants?", 2007.

4 Marinelli, J, (ed). Plant: The Ultimate Visual Reference to Plants and Flowers of the World, New York: DK Publishing, Inc, 2005.

5 Ethiopian Biodiversity Institute, Government of the Federal Democratic Republic of Ethiopia, Ethiopia's National Biodiversity Strategy and Action Plan 2015-2020, Addis Ababa Ethiopia, (2015) p. 138.

6 Netsanet Gonfa, Dereje Tulu, Kitessa Hundera1 & Dasalegn Raga, Ethnobotanical study of medicinal plants, their utilization, and conservation by indigenous people of Gera district, Ethiopia, *Cogent Food & Agric*, 6 (1) (2020). https://doi.org/10.1080/23311932.2020.1852716.

7 Kidane L., Gebremedhin G & Beyene T, Ethnobotanical study of medicinal plants in Ganta Afeshum District, Eastern Zone of Tigray, *Northern Ethiopia, J Ethnobiol Ethnomed*,

14 (1) (2018). P.64. https://doi.org/10.1186/s13002-018-0266-z.

8 Jima, T T & Megersa, M, Ethnobotanical study of medicinal plants used to treat human diseases in Berbere District, Bale Zone of Oromia Regional State, South East Ethiopia, *Evid Based Complement Altern Med*, 2018 (Article ID 8602945), 16. https://doi.org/10.1155/2018/86.

9 E Kelbessa & S Demissew Diversity of vascular plant taxa of the flora of Ethiopia and Eritrea, Ethiopian, *J Biol Sci*, (13) (2014) p. 37-45.

10 Demissew S, Friis I & Weber O, Diversity and endemism of the flora of Ethiopia and Eritrea: state of knowledge and future perspectives, *Rend Fis Acc Lincei* (32) (2021) p. 675-697. https://doi.org/10.1007/s12210-021-01027-8.

11 Megersa M, Asfaw Z, Kelbessa E, Beyene A & Woldeab B, An ethnobotanical study of Medicinal plants in Wayu Tuka District, east Welega Zone of Oromia Regional State, west Ethiopia, *J Ethnobiol Ethnomed*, 9 (2013) p. 68.

12 Tahir M, Gebremichael L, Beyene T, *et al.*, Ethnobotanical study of medicinal plants in Adwa District, Central Zone of Tigray Regional State, Northern Ethiopia, *J Ethnobiol Ethnomed*, 17 (2021) p. 71. https://doi.org/10.1186/s13002-021-00498-1.

13 Teka A, Asfaw Z, Demissew S & Van Damme P, Medicinal plant use practice in four ethnic communities (Gurage, Mareqo, Qebena, and Silti), south-central Ethiopia, *J Ethnobiol Ethnomed*, 16 (27) (2020).

14 Maryo M, Nemomissa S & Bekele T, An ethnobotanical study of Medicinal plants of the Kembatta ethnic group in Enset-based agricultural landscape of Kembatta Tembaro (KT) Zone, Southern Ethiopia, *Asian J Plant Sci Res*, 5 (7) (2015) p. 42-61

15 Zewdie K, Zemede A & Sebsebe D, An ethnobotanical study of medicinal plants in Sheka Zone of Southern Nations Nationalities and Peoples Regional State, Ethiopia, *J Ethnobiol Ethnomed*, 16 (7) (2020).

16 Yahya N, Tesfaye B Gardi, O & Blaser J, Forest cover dynamics and its drivers of the Arba Gugu forest in the Eastern highlands of Ethiopia during, 1986-2015, Remote Sensing Applications Society and Environment, 20 (4) (2020) 100378.

17 AWADNRO, Aseko District Agriculture and Natural Resource Development Office annual work report, Aseko District, Aseko, Unpublished, (2020) p. 38.

18 Shambel Abebe, Woody Species Composition, Diversity and Structural Analysis of Angada Forest In Merti District, Arsi Zone of Oromia Region, Addis Ababa University, Ethiopia, (2011) p. 103.

19 Jewar Safeno Jara, Zerihun Girma Girma, Melesse Maryo Selamo, *et al*., Ethnomedicinal study of plants used against human ailments in Aseko District, South East Ethiopia, 27 April 2020, PREPRINT (Version 1) available at Research Square [https://doi.org/10.21203/rs.3.rs-23592/v1]

20 AWHO Aseko Woreda Health Office, Common human diseases in Aseko Woreda. Unpublished report, 2020.

21 Hoft M, Barik, S K & A Lykke, Quantitative Ethno-botany, Application of Multivariate and Statistical Analysis in Ethno-botany people and plants Working paper, Hoft, R.ed, 6 (1999) p. 1-46.

22 Espinosa M M, Bieski I G & Martins D T, Probability sampling design in ethnobotanical surveys of medicinal plants, *Rev Bras de Farmacogn*, 6 (2012) p. 1362-367.

23 Tadesse M, Flora of Ethiopia and Eritrea, Part 2: Asteraceae (Compositae), Addis Ababa, Ethiopia: The National Herbarium, Addis Ababa University, (2004) p. 4.

24 Hedberg I, Kelbessa E, Edwards S, Demissew S & Persson E, Flora of Ethiopia and Eritrea. Gentianaceae to Cyclochelicaceae Uppsala, Sweden, (2005) p. 5.

25 Eshete M A & Molla E L Cultural significance of medicinal plants in healing human ailments among Guji semi-pastoralist people, Suro Barguda District, Ethiopia, *J Ethnobiol Ethnomed*, 17 (61) (2021). https://doi.org/10.1186/s13002-021-00487-4.

26 Mengistu D K, Mohammed J N, Kidane Y G & Fadda, C, Diversity and traditional use knowledge of medicinal plants among communities in the South and South-Eastern Zones of the Tigray Region, Ethiopia, *Diversity*, (14) (2022) p. 306. https://doi.org/10.3390/d14040306.

27 Pandaa S & Thami J K, An ethnomedicinal field survey report on traditionally used plants by the Nepalese of Alubari Jungle Busty in Darjeeling Himalaya as potential immunity booster and fever-related herbal drugs, *Indian J Tradit Know*, 21 (1) (2022) 157-167.

28 Murat Kılıç, a, Kemal Yelda & Fatma Mungan Kılıç, Traditional uses of wild plants in Mardin central district and attached villages (Turkey), *Indian J Tradit Know*, 20 (3) (2021) 784-798.

29 Zewdie Kassa, Zemede Asfaw & Sebsebe Demissew, An ethnobotanical study of medicinal plants in Sheka Zone of Southern Nations Nationalities and Peoples Regional State, Ethiopia, *J Ethnobiol Ethnomed,* 16 (7) (2020).

30 Merouane A, Fellag S, Touaibia M & Beldi A, A Ethnobotanical survey of medicinal plants consumed during the holy month of Ramadan in Chlef region, Algeria, *Ethnob Res Appl*, (23) (2022) p. 1-14.

31 Tefera B N & Kim Y D, Ethnobotanical study of medicinal plants in the Hawassa Zuria District, Sidama zone, Southern Ethiopia, *J Ethnobiol Ethnomed* 15 (25) (2019). https://doi.org/10.1186/s13002-019-0302-7.

32 Tolosa K, Debela E, Spiridoula A S, Tolera A, Ganga G, *et al.*, Ethnomedicinal study of plants used for the treatment of human and livestock ailments by traditional healers in South Omo, southern Ethiopia, *J Ethnobiol Ethnomed*, 9 (32) (2013).

33 Ayyanar M & Ignacimuthu S, Ethnobotanical survey of medicinal plants commonly used by Kanitribals in Tirunelveli hills of Western Ghats, India, *J Ethnopharmacol*, 134 (3) (2011) 851-864.

34 Offiah N V, Makama S, Elisha I L, Makoshi M S, Gotep J G, *et al,* Ethnobotanical survey of medicinal plants used in the treatment of animal diarrhea in Plateau State, Nigeria, BMC Vet Res, 7 (1) (2011).

35 Teklay A, Abera B & Giday M, An ethnobotanical study of medicinal plants used in Kilte Awulaelo District, Tigray Region of Ethiopia, *J Ethnobiol Ethnomed*, 9 (1) (2013) 65.

36 Ammar Altemimi, Naoufal Lakhssassi, Azam Baharlouei, Dennis G Watson & David A, Lightfoot, Phytochemicals: extraction, isolation, and identification of bioactive compounds from plant extracts, Plants, (6) (2017) p. 42.

37 Lulekal E, Asfaw Z, Kelbessa E & Van Damme P, Ethnomedicinal study of plants used for human ailments in

Ankober District, North Shewa Zone, Amhara region, Ethiopia, *J Ethnobiol Ethnomed*, 9 (1) (2013).

38 Belayneh A & Bussa N F, Ethnobotanical plants used to treat human ailments in the prehistoric place of Harla and Dengego valleys, eastern Ethiopia, *J Ethnobiol Ethnomed*, (2014) 10-18.

39 Cotton C M, Ethnobotany principle and application; John Wiley and Sons Manchester, England, 1996.

40 Alexiades M, Collecting ethnobotanical data, An introduction to basic concepts and techniques, In Selected Guideline for Ethnobotanical Research: A Field Manual, Edited by Alexiades M, Sheldon JW. Bronx, New York: The New York Botanical Garden, (1996) p. 53-94.

41 Heinrich M, Edwards S, Moerman D E & Leonti M, Ethnopharmacological field studies: a critical assessment of their conceptual basis and methods, *J Ethnopharmacol*, 124 (1) (2009) p. 1-45.

42 Kaushalya D, Samant S, Sunil Puri & Amit Singh, Diversity, distribution pattern and traditional knowledge of sacred plants in Kanawar Wildlife Sanctuary (KWLS), Himachal Pradesh, Northwestern Himalaya, *Indian J Tradit Know*, 19 (3) (2020) p. 642-651.