Ethnobotanical survey of medicinal plants in Yilmana Densa and Quarit Districts, West Gojjam, Western Ethiopia

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Research

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Abstract

Background: Traditional herbal preparations for addressing human diseases and ailments have been applied in Yilmana Densa and Quarit Districts, Ethiopia, for generations. However, the medicinal knowledge of the community and the plants are subjected to loss without being scientifically documented due to anthropogenic factors. Hence, this study aims at providing a comprehensive documentation on medicinal plant knowledge of the people to conserve the knowledge and medicinal plants of the areas.

Methods: Semi-structured interviews, focus group discussions, participant observation, field observation and market survey were used to collect ethnobotanical data. All semi-structured interviews were followed by independent walk in the woods exercises. Field observations were performed with the help of local guides. The data analysis methods were informant consensus factor and fidelity level, frequency and cultural significance indices, preference and direct matrix ranking exercises.

Results: A total of 112 medicinal plants were reported. Fabaceae was represented with highest species. Leaves were the primary source of remedy. Most remedy was prepared by pounding and administered orally. Miscellaneous, central nervous and digestive system diseases were recorded with highest informant agreements while *Dodonia angustifolia, Dovyalis abyssinica, Hagenia abyssinica, Nigella sativa and Urtica simensis* were recorded with highest healing potential for malaria, tapeworm, cough, stomach ulcer respectively. *Phytolacca dodecandra, Trigonella foenum-graecum, and Carissa spinarum* and *Croton macrostachyus* were recorded with highest frequency, use, and cultural values respectively. *Verbascum sinaiticum* was the most preferred to treat blood pressure

Conclusion: The study indicated that indigenous knowledge on medicinal plant use is still rich and active in the Districts. Species with recorded highest consensus for curative role are a useful pool for further phytochemical and pharmacological validation for better utilization. Declining medicinal flora of the area calls for implementation of a coordinated complementary in situ and ex situ conservation strategy.

Background

Medicinal plants are defined as plants used in official and various traditional systems of medicines throughout the world and provide people with medicines for prevention of disease and maintain health [1]. According to [2], any plant can be a medicinal herb. Medicinal plants have an essential role for the traditional treatment of various human and animal diseases in Ethiopia [3, 4]. According to [5], c. 1000 medicinal plants are used for the traditional treatment of several human and domestic animal diseases in different parts of Ethiopia.

According to [6], approximately 80% of the populations of Ethiopia depend on traditional medicinal plants as their primary health care needs. In connection to this, an estimated 95% of the traditional medicine of the country has been prepared from plants [7]. This is due to the presence of a rich indigenous knowledge on medicinal plant use [5]. Particularly, a privileged concentration of medicinal plants knowledge is found in South and Southwestern parts of Ethiopia due to high cultural diversity of the population of the areas [5, 8].

It is estimated that about 56,000 tons of medicinal plants of Ethiopia was harvested only in a year and most of these were harvested largely from non-cultivated medicinal plant species [9]. This harvested amount of traditional medicinal plants was estimated to become a source of 2 billion Ethiopian birr [10]. Many herbal substances that are used in Ethiopian traditional medicine are also used as ingredients and spices in Ethiopian food [11]. Consumption of these herbs and spices as part of a normal diet is not likely to cause adverse herb drug interactions as consumed in relatively small quantities but when utilized for medicinal purposes there may be an increased likelihood of adverse interactions with modern medicines [12].

Moreover, medicinal plants have cultural significance for indigenous communities of the country particularly in preparing and avoiding harmful spiritual (magical) works [13], and in providing traditional knowledge systems such as knowledge of collection, preparation and quantifying the doses of medicinal plants [14]. These essential resources are currently exposed to loss due to anthropogenic factors without being scientifically documented. Thus, the purpose of the current study was to document and analyze medicinal plants and the associated indigenous knowledge of the local community in Yilmana Densa and Quarit districts.

Methods

Study Area Description

Yilmana Densa District (Woreda) is located at 11º 30′0″ N and 37º 20′0″ E in West Gojjam Zone (Fig. 1). It is bordered by Kuarit on the south, by Sekela on the southwest, by Mecha on the West, by Bahir Dar Zuria on the North, on the East by Abay River which separates it from the south Gondar Zone and by Gonji Kolela on the Southeast. The major town of this District is Adet. Yilmana Densa District has two agroclimatic Zones namely Weyna Dega and Dega Zones. Weyna Dega ranges from 1500 m to 2300 m above sea level and Dega ranges from 2300 m to 3200 m above sea level. Moist Dega ranges in its annual rainfall amount from 900 mm to 1400 mm and the amount of annual rainfall in Wet Dega is above 1400 mm [15].

Approximately, 24.27% of the District is Weyna Dega and 75.75% is Dega agroclimatic Zone [15, 16]. Total annual rainfall is comparatively very high with a long term mean of 1366 mm per annum. The rainy season is relatively long and lasts from May to October (Fig. 1). The District has plains, mountains, valleys and undulating areas that consist of 16, 20, 8 and 56 percent of the area respectively. The soils are moderately fertile [16] and they are traditionally classified into black soil, red soil and brown soil that consist of 20, 65 and 15 percent of the soil of the District respectively [16]. According to [17], Yilmana Densa District has a total population of 214,852, of whom 107,010 are males and 107,842 females; 19,169 or 8.92% are urban inhabitants. The majority (98.19%) of the inhabitants practiced Ethiopian Orthodox Christianity while 1.76% was Muslim. According to the 1994 national census report this District has 48,521

households, of whom 122,135 were men and 122,668 were women; 12,178 or 4.97% of its population were urban dwellers. The largest ethnic group reported in the District was Amhara (99.94%). Amharic was spoken as a first language by 99.96% [18].

Quarit District is located at 11º 10′0″ N and 37º 15′0″ E and it is one of the Districts in West Gojjam Zone. It is bordered on the southwest by Jabi Tehnan, on the west by Sekela, on the north by Yilmana Densa, on the east by East Gojjam Zone, and on the southeast by Dega Damot Districts respectively. The major town is Gebeze Mariam (Fig. 1). According to [16], this District has two agroclimatic zones namely Dega and Weyna Dega that comprise 36 and 64 percent of the District climatic zone respectively. The main rainy seasons are May to October (Fig. 2). The temperature of the District ranges from 16-25º whereas the average amount of rainfall is 1400 mm. The District has a total area of 61473 ha among of which 44.77, 25.59 and 29.68 percent of undulating, mountains and plains respectively.

Quarit District has a total population of 114,771. This shows an increase by 16.49% over the 1994 census. Among the total population, 56,767 are males and 58,004 are females respectively. The majority of the population resides in rural area whereas the least number, 4,750 or 4.14% are urban inhabitants. A population density of Quarit is 190.34 with a total area of 602.99 square kilometers. This density shows a great variation compared to the zone average density of 158.25 persons per square kilometer. The District has also 25,402 households those result an average of 4.52 persons to a household, and 24,927 housing units. The District is inhabited by 99.9% of Amhara people, and 99.96% of the residents are practicing Ethiopian Orthodox Christianity [17].

Ethical consideration

The study engaged the local community and the administrators to get ideas and views on medicinal plants, threats and conservation and other related issues. To perform semi-structured interview based survey all necessary measures were taken to ensure that the ethical aspects of the local community and the Districts' administrators were guaranteed. However, before the interviews and group discussions the study objectives and possible outcomes were described to the respondents. The values or religions of the local community were respected.

Site selection and sampling method

The sites were selected during reconnaissance survey by discussing with the Districts' administrators, different individuals who had different background about many Kebeles, the residence of the Kebeles, agricultural professionals, rural teachers, and by observation. Following the discussion twelve rural Kebeles from Yilmana Densa District and seven rural Kebeles from Quarit District were selected (Fig. 1). The sample Kebeles of each District and the key informants were selected purposively whereas the general informants were selected using systematic random sampling method. The 19 rural Kebeles were selected based on the presence of relatively dominant vegetation covers. For the determination of the sample size of the two Districts, the following formula was applied:

$$n = \frac{N}{1+N(e)^2}$$

Where n is the sample size, N is the population size (total number of households of the two Districts), and e (e=0.05) is the level of precision. This formula is a simplified way used to calculate the sample sizes at 95% confidence level and P = 0 [19]. The calculation gave 395 required representative general informants for this study. After determining the amount of informants for the study, representative general and key informants of the Districts were selected using systematic random and purposive sampling (based on their relative better knowledge) approaches respectively as described by [20] and [21].

Therefore, the total number of general informants involved in ethnobotanical survey of medicinal plants of the Districts having two agroclimatic Zones (Weyna Dega and Dega) was 268 males and 127 females, separately 102 men and 45 women from Quarit District, and 165 men and 83 women informants from Yilmana Densa District respectively. Peer recommendations from community members, elderly people and knowledgeable inhabitants helped in nominating 95 key informants (68 men and 27 women). Separately 35 (25 men and 10 women) were from Quarit District and 60 (43 men and 17 women) were from Yilmana Densa District. The age of the general informants ranged from 20-81 years (139 were from 20-40 whereas 256 were > 40 years old). Informed consent was obtained from each informant who participated in this study after explaining the purpose of the study and assuring him/her of the most responsible legal use of information before the start of interviews.

Data Collection

Ethnobotanical data were collected during 4 different field visits conducted between 15 September 2016 and 30 June 2018. Data were collected in different seasons over different years with the objective of including different Kebeles found in the two agroclimatic Zones of the Districts, and collecting plant specimens during the respective flowering seasons. Market surveys were conducted between 10 December 2017 and 7 May 2018. Semistructured interviews, focus group discussions, participant observation, field observation and market survey were used to collect ethnobotanical data in the manner recommended by [20].

A semistructured interview and FGD were by using a checklist of questions prepared before hand in English, and presented by translating in to Amharic which is the common language of the local community. Informants were interviewed individually in the local Amharic language. Semistructured interviews addressed questions regarding name, age, gender, level of education, occupation, religion, nationality, District, Kebele and peasant association of each informant. All semistructured interviews were followed by independent walk in the woods exercises to pave a way for a detailed discussion with the informant and the practical identification of traditionally used medicinal plants in the natural environment.

Field observations were performed with the help of local guides, as well as some respondents of the local community. In addition, one focus group discussion (consisting of 7 participants) per Kebele was undertaken to gain detailed information on medicinal, wild edible and other useful plant knowledge at the community level and to supplement the information collected through semistructured interviews. The informants were asked about local names, habitats, parts used, collecting households, condition of plant part used (fresh/dried), ingredients used, mode of preparation, the threats and traditional conservation practices (if any) of medicinal plants [22, 23].The informants were also asked about over all use values, diseases treated, methods of remedy preparation, dosage, prescriptions and routes of remedy administration, other ingredients or additives, beliefs related to collection and use of plants [24].

Data analysis

Informant consensus factor and fidelity level were used to analyze different disease categories. Informant consensus factor (ICF) was computed to measure the level of homogeneity of the information collected and the degree of overall agreement on the treatment of specific health disorders category and to identify potentially effective medicinal plants used for the traditional treatment of disease categories in the two Districts by using the method of [23]. During information gathering the informants were contacted three times for the same ideas to ascertain the reliability of information recorded during the first interview and the information that was repeated in the same manner by the informants at three contact times was recorded as stated by [22].

As described by [23], ICF was computed as follows: ICF = Nur – Nt / (Nur – 1), where, Nur = number of use reports from informants for a particular plant use category; Nt = number of taxa or species that are used for that plant use category for all informants. ICF values range between 0 and 1, where '1' indicates the highest level of informant consent. The relative healing potential of each reported medicinal plant used against diseases was also evaluated using an index of fidelity level (FL) and it was calculated as follows: FL (%) = (Ip/Iu) X 100, where Ip is the number of informants who independently cited the importance of a species for treating a particular disease and Iu the total number of informants who reported the plant for any given disease [22].

Frequency Index Of Medicinal Plant Species

Frequency index was calculated to determine the percentage frequency of single medicinal plant species mentioned by informants. The following formula was used to calculate frequency index: FI = FC / N × 100 where FC is the number of informants who mentioned the use of the species, and N is a total number of informants [25]. The frequency index is high when there are many informants who mention a particular plant and low when there are few reports.

Cultural Significance Index

The cultural significance index (CSI) was used to record the role of a species that plays in a culture by using the method of [25]. This index was altered by [24] in the following way: CSI = $\sum$ (i. e. c). CF, where CSI = cultural significance index, i = management of the species, e = preference of use, c = frequency of use, CF = correction factor. The values of the variables "i," "e," and "c" are either 2 or 1 and are determined by each citation of use. i = species management (non-managed (1) or managed (2)); Species management considers the plant's impact on the community's daily life [26].

The value of 2 is given for species that are cultivated, managed, or manipulated in any way, even if in an initial manner; the value of 1 is given for species found in the area yet free from any kind of management or conservation practices. e = Use preference (not preferred (1) or preferred (2)); this represents the preference given to the use of one species in relation to another for any given purpose. The numerical value of 2 is suggested for a species preferentially used for a given purpose, and value 1 is suggested for other available species not chosen preferentially for that purpose. c = Use frequency (rarely used (1) or used frequently (2)); this considers plants effectively used. In accordance with the values designated by [27], a value of 2 is attributed to plants effectively known and used, and 1 is attributed to plants rarely cited. CF = Correction factor (number of citations for a given species divided by the number of citations for the most mentioned species).

Preference Ranking And Direct Matrix Ranking

Three preference ranking were exercised for three disease types (blood pressure, asthma and common cold). Sixteen key informants were selected for the preference ranking of 7 medicinal plants (*Croton macrostachyus*, *Dovyalis abyssinica*, *Lupinus albus*, *Phragmanthera regularis*, *Rosa abyssinica*, *Thymus schimperi* and *Verbascum sinaiticum*) that used to treat blood pressure. The same number of key informants was also asked to rank 4 medicinal plants (*Verbascum sinaiticum*, *Rubia cordifolia*, *Dovyalis abyssinica* and *Catha edulis*) that used to treat asthma. Moreover, 6 medicinal plants (*Echinops kebericho*, *Eucalyptus globulus*, *Olea europaea* subsp. *cuspidata*, *Otostegia integrifolia*, *Ocimum urticifolium* and *Rumex nervosus*) used to treat common cold were also ranked by the same number of key informants.

Descriptive Statistics

The method of descriptive statistics was applied to identify the number and percentage of species, genera and families of medicinal plants used, their growth forms, proportions of parts harvested, modes of remedy preparation and routes of administration [22].

Market Surveys

Market surveys were conducted at three market places namely Adet, Dabi and Bir Gebeya whose market date is going on Saturday and Wednesday for the first two and Friday for the later respectively. The purpose of market survey was to record, document and analyze the availability, price and unit of measurement, extent of use and income - generating potential of medicinal plants found in these markets.

Results

Traditional medicinal plants

A total of 112 traditional medicinal plants were recorded to be grouped under 101 genera and 62 families of angiosperms that were reported to be used for traditional treatment of human diseases (Table 1). Out of the reported species, 8 species were endemic while 19 species were exotic. Fabaceae was represented with high species number (8 species, 7.5%) followed by Lamiaceae and Cucurbitaceae (6 species, 5.4% each), Asteraceae, Euphorbiaceae and Solanaceae (5 species, 4.5% each). Polygonaceae and Rosaceae (4 species, 3.6% each), Rubiaceae and Rutaceae (3 species, 2.7% each) were recorded with more than 3 species representation while 11 families namely Acanthaceae, Alliaceae, Amaranthaceae, Apocynaceae, Brassicaceae, Loranthaceae, Malvaceae, Myrtaceae, Oleaceae, Poaceae and Ranunculaceae were recorded with 2 species (1.8% each) representation. Each of the remaining 41 families (66.1% of the total families) had single species representation. This shows that 33.9% of families were represented by more than one medicinal plant species.

Table 1
List of medicinal plants, disease treated and parts used

Scientific name	Disease treated	Part used
Acacia negrii Pic. Sermi. (Fabaceae)	Wound	Resin
Achyranthes aspera L. (Amaranthaceae)	Throat (Oesophagus) disease	Leaf
Acokanthera schimperi (DC.) Oliv. (Apocynaceae)	Syphilis, wound	Leaf, stem
Allium cepa L. (Alliaceae)	Headache	Bulb
Allium sativum L. (Alliaceae)	Evil eye, cough, abdominal pain (vomiting), swelling, malaria	Bulb
Amaranthus caudatus L. (Amaranthaceae)	Frequent miscarriage/Neo-natal death	Root, stem
Argemone mexicana L. (Papaveraceae)	Wound	Fruit
Asparagus africanus Lam. (Asparagaceae)	Migraine	Root
Astragalus atropilosulus (Hochst.) Bunge (Fabaceae)	Snake bite	Root
Brassica carinata A. Br. (Brassicaceae)	Abdominal pain	Seed
Brucea antidysenterica J. F. Mill. (Simaroubaceae)	Madness/ Mental disease	Leaf, fruit
Buddleja polystachya Fresen. (Loganiaceae)	Headache	Leaf, root
Carica papaya L. (Caricaceae)	Diabetes	Leaf
Carissa spinarum L. (Apocynaceae)	Snake bite, mental illness, toothache	Leaf, root
Calpurnia aurea (Ait.) Benth. (Fabaceae)	Snake bite	Root, leaf, bark
Catha edulis (Vahl) Forssk. ex Endl. (Celastraceae)	Malaria, cough, asthma	Leaf
Citrus aurantiifolia (Christm.) Swingle. (Rutaceae)	Gonorrhoea	Fruit
Clausena anisata (Willd.) Benth. (Rutaceae)	Madness/mental illness	Leaf, fruit
Clerodendrum myricoides (Hochs-t.) Vatke (Lamiaceae)	Migraine	Leaf
Clutia lanceolata Jaub. & Spach. (Euphorbiaceae)	Frequent miscarriage/Neo-natal death	Root, stem
Coccinia abyssinica (Lam.) Cogn (Cucurbitaceae)	Malaria, evil eye	Root
Coffea arabica L. (Rubiaceae)	Headache	Stem
Crotalaria spinosa Hochst. ex Benth. (Fabaceae)	Rabies	Root
Croton macrostachyus Del. (Euphorbiaceae)	Tinea nigra, Tinea corporis, blood pressure, snake bite, eye disease, epistaxis (nose bleeding), malaria	Latex, leaf, bud
Cucumis ficifolius A. Rich. (Cucurbitaceae)	Evil eye, abdominal pain (bloating, vomiting), febrile illness, rabies, ear pest	Root, leaf
Cucurbita pepo L. (Cucurbitaceae)	Rheumatic pain	Seed
Cynoglossum coeruleum Hochst. ex A.DC. (Boraginaceae)	Febrile illness, spider bite, toothache	Leaf, root
Cyperus rigidifolius Steud. (Cyperaceae)	Snake bite	Root/ Stolon
Cyphostemma cyphopetalum (Fresen.) Descoings ex Wild & Drummond (Vitaceae)	Poisonous	Fruit
Datura stramonium L. (Solanaceae)	Dandruff, rheumatic pain	Leaf, seed
Dodonea angustifolia L.f. (Sapindaceae)	Malaria	Root, leaf
Dovyalis abyssinica (A. Rich.) Warb. (Flacourtiaceae)	Blood pressure, asthma	Leaf

Scientific name	Disease treated	Part used
Echinops kebericho Mesfin (Asteraceae)	Evil spirit, evil eye, mental illness, febrile illness, common cold	Root
Embelia schimperi Vatke (Myrsinaceae)	Ascaris, abdominal disease (bloating), Taenia saginata infection or beef tapeworm	Fruit
Eucalyptus globulus Labill. (Myrtaceae)	Common cold	Leaf
Euclea racemosa Murr. subsp. *schimperi* (A. DC.) White (Ebenaceae)	Eczema	Leaf
Euphorbia abyssinica Gmel. (Euphorbiaceae)	Rabies	Latex
Euphorbia platyphyllos L. (Euphorbiaceae)	Poisonous	latex
Ferula communis L. (Apiaceae)	Night blindness	Leaf
Ficus palmata Forssk. (Moraceae)	Breast swelling, swelling	Latex, leaf
Gardenia ternifolia Schumach. & Thonn. (Rubiaceae)	Evil sprit	Stem
Gladiolus abyssinicus (Brongn. ex Lemaire) Goldblatt & de Vos (Iridaceae)	Haemorrhoids	Root
Guizotia abyssinica (L. f.) Cass. (Asteraceae)	Tinea capitis (boldness)	Seed
Guizotia schimperi Sch. Bip. ex Walp. (Asteraceae)	Ascaris, Taenia saginata infection or beef tapeworm	Root, leaf
Hagenia abyssinica (Bruce) J. F. Gmelin (Rosaceae)	Ascaris, Taenia saginata infection or beef tapeworm	Fruit
Helianthus annuus L. (Asteraceae)	Rabies	Seed
Hordeum vulgare L. (Poaceae)	Impotency	Seed
Hygrophila schulli (Hamilt.) M.R. & S.M. (Acanthaceae)	Eczema	All parts
Impatiens ethiopica Grey-Wilson**(Balsaminaceae)	Cough	Root
Jasminum abyssinicum Hochst. ex DC. (Oleaceae)	Ascaris, Taenia saginata infection or beef tapeworm	Leaf, root
Justicia schimperiana (Hochst. ex Nees) T. Anders. (Acanthaceae)	Abdominal pain (bloating), swelling, rabies	Root, leaf
Kalanchoe petitiana A. Rich. (Crassulaceae)	Tonsillitis	Root
Kanahia laniflora (Forssk.) R. Br. (Asclepiadaceae)	Gland removal, evil eye, scabies (itching)	Latex, root
Laggera crispata (Vahl) Hepper & Wood (Asteraceae)	Abdominal burning (gastritiss) and knocking	Root
Laggera siceraria (Molina) Standley (Cucurbitaceae)	Abdominal bloating, stoma-chache	Fruit
Leonotis ocymifolia (Burml. f.) Iwarsson var. *raineriana* (Visiani) Iwarsson (Lamiaceae)	Cancer, wound	Root, flower
Lepidium sativum L. (Brassicaceae)	Febrile illness, evil eye, gonorrhoea	Seed
Linum usitatissimum L. (Linaceae)	Constipation, eye disease	Seed
Lobelia rhynchopetalum Hemsl. (Lobeliaceae)	Impotency	Root
Lupinus albus L. (Fabaceae)	Blood pressure	Seed
Melia azedarach L. (Meliaceae)	Malaria	Leaf
Millettia ferruginea (Hochst.) Bak. (Fabaceae)	Tinea nigra, Tinea corporis, eczema, skin peeling	Seed
Momordica foetida Schumach. (Cucurbitaccae)	Wound	Leaf
Myrica salicifolia A. Rich. (Myricaceae)	Migraine	Bark
Myrtus communis L. (Myrtaceae)	Wound, scabies (itching)	Leaf
Nigella sativa L. (Ranunculaceae)	Cough	Bulb, seed

Scientific name	Disease treated	Part used
Ocimum americanum L. (Lamiaceae)	Lung disease, liver disease/jaundice, intestinal diseases	Leaf, flower
Ocimum urticifolium Roth (Lamiaceae)	Febrile illness, abdominal pain, common cold	Leaf, fruit
Olea europaea L. subsp. *cuspidata* (Wall. ex G.Don) Cif. (Oleaceae)	Common cold, night blindness	Leaf, stem
Olinia rochetiana A. Juss. (Oliniaceae)	Swelling	Stem
Osyris quadripartita Decn. (Santalaceae)	Trachoma	Root
Otostegia integrifolia Benth. (Lamiaceae)	Common cold, evil sprit	Leaf
Pennisetum thunbergii Kunth (Poaceae)	Febrile illness	Root, leaf
Persea americana Mill. (Lauraceae)	Diabetes	Leaf
Phoenix reclinata Jacq. (Arecaceae)	Deafness	Fruit
Phragmanthera regularis (Sprague) M. Gilbert (Loranthaceae)	Blood pressure	Leaf
Phragmanthera macrosolen (A. Rich.) M. Gilbert (Loranthaceae)	Blood pressure	Leaf
Phytolacca dodecandra L'Her. (Phytolaccaceae)	Abdominal pain (swelling, vomiting), rabies, scabies (itching)	Leaf, fruit, root
Piper nigrum L. (Piperaceae)	Haemorrhoids	Fruit
Plantago lanceolata L. (Plantaginaceae)	Wound	Leaf
Plumbago zeylanica L. (Plumbaginaceae)	Abdominal pain, swelling	Leaf
Pterolobium stellatum (Forssk.) Brenan (Fabaceae)	Evil eye	Root
Punica granatum L. (Punicaceae)	Abdominal pain	Bark
Ricinus communis L. (Euphorbiaceae)	Abdominal impelling, poisoning, abdominal pain	Root, seed
Rubia cordifolia L. (Rubiaceae)	Asthma	Root, leaf
Rosa abyssinica Lindley(Rosaceae)	Blood pressure	Fruit
Rosa x *richardii* Rehd. (Rosaceae)	TB (head wound)	Flower
Rubus apetalus Poir. (Rosaceae)	Blood pressure	Stem
Rumex abyssinicus Jacq. (Polygonaceae)	Diabetes	Root
Rumex nepalensis Spreng. (Po1ygonaceae)	Abdominal impelling, abdominal pain, abdominal swelling, diarrhoea, evil eye, tonsillitis	Root
Rumex nervosus Vahl(Polygonaceae)	Warts, common cold, wound	Stem, leaf, bulb
Ruta chalepensis L. (Rutaceae)	Evil eye, abdominal pain, swelling, vomiting	Flower, stem
Scadoxus multiflorus (Martyn) Raf. (Amaryllidaceae)	TB (Wound), abdominal and penis swelling	Root
Schefflera abyssinica (Hochst. ex A. Rich.) Harms(Araliaceae)	Snake bite	Root, leaf
Securidaca longepedunculata Fresen. (Polygalaceae)	Headache	Bark
Sesamum orientale L. (Pedaliaceae)	Haemorrhoids	Root, fruit
Sida rhombifolia L. (Malvaceae)	Vomiting, wound	Leaf
Sida schimperiana Hochst. ex A. Rich. (Malvaceae)	Gonorrhoea, urinary retention	Stem, leaf
Solanum anguivi Lam. (Solanaceae)	Wound	Fruit

Scientific name	Disease treated	Part used
Solanum incanum L.(Solanaceae)	Scabies (itching), wound	Fruit
Solanum nigrum L. (Solanaceae)	Scabies (itching), burned wound	Fruit, leaf
Stephania abyssinica (Dillon & A. Rich.) Walp. (Menispermaceae)	Abdominal impelling, febrile illness	Root, leaf
Thalictrum rhynchocarpum Dill. & A. Rich. (Ranunculaceae)	Nightmare	Root
Thymus schimperi Ron. (Lamiaceae)	Blood pressure	Leaf
Trigonella foenum-graecum L. (Fabaceae)	Abdominal pain, swelling, abdominal bloating, wound, cough	Stem
Urtica simensis Steudel(Urticaceae)	Rheumatism/ rheumatism, stomach ulcer	Leaf
Verbascum sinaiticum Benth. (Scrophulariaceae)	Swelling, abdominal pain, eczema, oesophagus swelling, backache, asthma, nose bleeding (epistaxis), blood pressure, loss of weight, rheumatism	Root, leaf, bark
Verbena officinalis L.(Verbenaceae)	Poisoning, diarrhoea, snake bite, tongue disease, acute febrile illness (elevated T^{o}.), stabbing pain	Root, Leaf, Stem
Withania somnifera (L.) Dunal(Solanaceae)	Diarrhoea, haemorrhoids	Leaf
Ximenia americana L. (Olacaceae)	Wound	Root, leaf
Zehneria scabra (Linn. f.) Sond.(Cucurbitaceae)	Febrile illness (fever), trachoma, TB (wound)	Stem, leaf
Zingiber officinale Roscoe (Zingiberaceae)	Cough, common cold	Rhizome

Growth forms and sites of collection

Most of the recorded medicinal plants were herbs (51 species, 45.5%) followed by shrubs (40 species, 35.7% each), trees (13 species, 11.6%), climbers (including woody and herbaceous climbers) (6 species, 5.4%) and parasitic epiphytes (2 species, 1.8%). Moreover, they were reported to be collected from various habitats. The major reported sites of collection of medicinal plants were farmlands, forests, homegardens, irrigation lands, pasture lands and roadsides. Most of the species (73 species, 40.8%) were collected from forests (Fig. 3).

Plant parts used, modes of remedy preparation and application

The major reported parts of medicinal plants were bark, bud, bulb, fruit, latex, leaf, resin, rhizome, root, seed, stem and flower. Most of the remedy (33.8%) was prepared from leaf followed by root (22.8%), fruit (11.7%) (Fig. 4), seed (11.7), stem (4.1%), bud (4.1%), bark (3.4%), latex (2.8%), flower (2.1%), bulb (1.4%), rhizome (1.4%) and resin (0.7%). Most of the remedy (87.6%) was prepared from these harvested fresh parts whereas the remaining less amount of remedy was prepared from dried parts including ingredients of the remedy.

Most of the remedy was prepared by pounding including splicing (30.2%) followed by crushing (29.3%) and boiling (distillation) (20.7%). The remaining remedy was prepared by squeezing (8.6%), smoking (5.2%), cooking (3.4%), heating (0.9%), melting (0.9%), and roasting (0.9%). In connection to this, the dried parts were reported to be prepared by pounding while the fresh ones were reported to be prepared by crushing (Fig. 5). The remedy that was prepared via various methods were applied to patients by painting (18.7%), dropping (4.7%), tying (1.9%), washing (0.9%), rubbing (0.9%), inserting (2.8%). In addition, it was also taken by patients by drinking (44.9%), inhaling (9.3%), chewing (5.6%), eating (9.3%) and rinsing (0.9%) (Fig. 6).

Diagnosis and treatment methods

Sixty one disease types were reported in the districts. Blood pressure and asthma were the most commonly reported human health problems. Most of the disease types were diagonized through visual inspection and interviews. Traditional healers interview patients for symptoms, followed by visual inspection of eyes, skin color, tongue, throat, status of sores, bleeding and infections. They also sense the body temperature of their patients with their bare hands whereas patients with swellings on the body were treated by rubbing and pasting herbal preparations. Patients with visible wounds were treated by dropping the squeezed liquid on the wound whereas patients with tonsillitis or throat wound were ordered to chew the parts of medicinal plants.

Routes of administration, dosages and antidotes

Most of the prepared remedy (59.6%) was administered through oral routes followed by dermal (24.8%) and nasal (10.1%). The remaining remedy was administered through auricular and optical routes (2.8% each) depending on the type of diseases. The remedy was also given to patients by using traditional standards such as amount in a cup (if it is in liquid form) that equals at the depth of a joint of a finger, a spoonful, a glass of tea, a cup and a glass depending on age, sex, pregnancy status and physical appearance of patients. Butter, sulfur, eye cosmetics, salt, honey, tella (local alcohol), malt, water, milk, buttermilk, stew, myrrh and Katicala (local beer) were also the commonly reported antidotes for herbal preparations with adverse side effects.

Consensus and relative healing potential of medicinal plants

Among eleven types of disease categories miscellaneous, central nervous system and digestive system diseases were recorded with highest informant consensus values (0.9 each) followed by dermatological and infective diseases (0.8) (Table 2). Out of the total 14 most cited medicinal plants selected for FL calculation, 5 species namely *Dodonea angustifolia*, *Dovyalis abyssinica, Hagenia abyssinica*, *Nigella sativa* and *Urtica simensis* were recorded with highest healing potential value for malaria, asthma, tapeworm, cough and stomach ulcer respectively (FL = 100). *Millettia ferruginea* was also recorded with least relative healing potential (FL = 2.2) for Tinea corporis (Table 3).

Table 2
Consensus of informants for different use categories

Disease categories	Nur	Nt	ICF
1. Central nervous system diseases (Migraine, headache, madness/ mental disease, evil eye, nightmare, impotency)	298	19	0.9
2. Digestive system diseases (Tongue disease, throat (esophagus) disease,	65	41	0.9
tonsillitis, abdominal illness (vomiting, abdominal impelling/pump),			
tapeworm, constipation, toothache, ascaris, intestinal diseases, liver disease /jaundice, hemorrhoids, diarrhea, abdominal burning /gastritis, poisonings)			
3. Miscellaneous diseases (Snake bite, febrile illness, spider bites, swelling)	97	19	0.9
4. Dermatological system diseases (Wound, eczema, Tinea capitis, T. corporis, T. nigra, scabies / rashes, dandruff, skin peeling, TB (wound), swelling, warts, gland removal)	25	41	0.8
5. Infective diseases (Malaria, rabies)	33	6	0.8
6. Musculo-skeletal system diseases (Rheumatism, backache, stabbing pain)	19	6	0.7
7. Sensorial diseases (Eye disease, night blindness, deafness, trachoma, ear pest, tongue disease, epistaxis, earache)	48	14	0.7
8. Circulatory system diseases (Blood pressure)	9	6	0.4
9. Metabolism diseases (Diabetes)	4	3	0.3
10. Respiratory system diseases (Coughs, asthma, common cold, lung disease)	19	15	0.2
11. Reproductive system diseases (Syphilis, gonorrhea, Neo-natal death, breast swelling, penis swelling, urinary retention)	8	7	0.1

Table 3
Fidelity levels (FL) of 14 most cited traditional medicinal plants

Plant species	Family	Therapeutic uses	Ip	Iu	(FL) (%)
Dodonea angustifolia L.	Sapindaceae	Malaria	3	3	100
Dovyalis abyssinica (A. Rich.) Warb.	Flacourtiaceae	Asthma	4	4	100
Hagenia abyssinica (Bruce) J.F. Gmelin	Rosaceae	Tapeworm	53	53	100
Nigella sativa L.	Ranunculaceae	Cough	3	3	100
Urtica simensis Steudel	Urticaceae	Stomach ulcer	2	2	100
Rumex abyssinicus Jacq.	Polygonaceae	Diabetes	3	4	75
Croton macrostachyus Del.	Euphorbiaceae	Blood pressure	6	9	66.7
Rumex nervosus Vahl	Polygonaceae	Common cold	4	8	50
Calpurnia aurea (Ait.) Benth.	Fabaceae	Snake bite	4	13	30.8
Euphorbia abyssinica Gmel.	Euphorbiaceae	Rabies	3	30	30
Kanahia laniflora (Forssk.) R. Br.	Asclepiadaceae	Scabies	5	27	18.5
Osyris quadripartita Decn.	Santalaceae	Trachoma	2	21	9.5
Verbena officinalis L.	Verbenaceae	Diarrhea	2	26	7.7
Millettia ferruginea (Hochst.) Bak.	Fabaceae	Tinea corporis	2	91	2.2

Use preference and use diversities of medicinal plants

Among 7 traditional medicinal plants selected for preference ranking, *Verbascum sinaiticum* was recorded with highest total score (TS = 74) for traditional treatment of blood pressure while *Thymus schimperi* was the second with total score of 70 for blood pressure (Table 3). *Verbascum sinaiticum* was further recorded as the most preferred species for treatment of asthma (TS = 45) followed by *Catha edulis* (TS = 44) from the preference ranking exercise of 4

medicinal plants (Table 4). The output of direct matrix ranking (DMR) exercise showed that *Olea europaea* subsp. *cuspidata* was ranked first (most threatened) followed by *Eucalyptus globulus* and *Carissa spinarum* (Table 6).

Table 4
Preference ranking of 7 medicinal plants by 16 key informants

Medicinal plants for blood pressure	Informants labeled A to P																	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	TS	R
Croton macrostachyus Del.	6	7		4	5	6	1	1	4	6	2	4	7	2	2	3	60	5th
Dovyalis abyssinica (A. Rich.) Warb.	1	1	5	6	3	1	5	5	3	1	4	6	6	4	1	4	56	6th
Lupinus albus L.	5	5	6	1	7	5	6	3	5	5	3	1	1	7	5	1	66	3rd
Phragmanthera regularis (Sprague) M. Gilbert.	3	3	2	5	4	4	2	2	6	3	6	5	5	6	3	5		4th
Rosa abyssinica Lindley.	2	2	7	3	2	7	3	4	2	2	1	2	3	1	4	2	47	7th
Thymus schimperi Ron.	4	4		2	6	3	4	7	7	4	5	3	2	5	7	7	70	2nd
Verbascum sinaiticum Benth.	7	6		4	1	2	7	6	1	7	7	7	4	3	6	6	74	1st

Note: Scores in the table indicate ranks (R) given to medicinal plants based on their efficacy. Highest number (7) given for the medicinal plant which informants thought most effective in treating blood pressure and the lowest number (1) for the least effective plant.

Table 5
Preference ranking of 4 medicinal plants reported to treat asthma

Medicinal plants for asthma	Informants labeled A to P																	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total score	Rank
Verbascum sinaiticum Benth.	4	4	1	4	2	3	1	1	4	3	3	4	4	2	2	3	45	1
Rubia cordifolia L.	1	1	4	2	1	1	3	4	1	1	4	3	2	3	1	4	36	3
Dovyalis abyssinica (A. Rich.) Warb.	2	2	3	1	4	2	4	3	2	2	2	1	1	1	4	1	35	4
Catha edulis (Vahl) Forssk. ex Endl.	3	3	2	3	3	4	2	2	3	4	1	2	3	4	3	2	44	2

Note: Scores in the table indicate ranks given to medicinal plants based on their efficacy. Highest number (4) given for the medicinal plant which informants thought most effective in treating asthma and the lowest number (1) for the least effective plant.

Table 6
Average DMR score of six key informants for six species with additional uses

UD	Medicinal plants																										
Eucalyptus globulus						*Croton macrostachyus*						*Dovyalis abyssinica*						*Olea europaea*. subsp. *cuspidata*						*Carissa spinaru*		
Informants (I)(1–6)						I						I						I						I		
AT	2	1	2	1	0	3	4	5	5	4	4	5	2	1	0	0	1	0	1	5	2	2	1	3	3	2
FW	3	2	1	3	4	5	3	1	4	1	3	1	3	4	3	5	2	1	5	4	5	4	5	5	4	5
F	5	4	3	5	5	2	0	0	0	0	0	0	4	3	2	2	4	2	0	0	0	0	0	0	2	1
M	5	5	5	5	4	4	3	3	2	1	4	5	1	2	3	3	4	1	3	2	4	5	5	4	5	4
CO	1	1	0	1	1	1	1	1	2	3	4	3	2	1	3	2	1	2	4	2	5	4	5	5	5	4
IT	16	13	11	15	14	15	11	10	13	9	15	14	12	11	11	12	12	6	13	13	16	15	16	17	19	16
GT	84						72						64						90						73	
R	1st						6th						3rd												2	

Abbreviations: UD = Use diversity; AT = Agricultural tools; FW = Firewood; F = Food; M = Medicine; CO = Construction; IT = Informant total; GT = Grand total; R = R

Medicinal use values

Use value (UV) calculation was applied for 24 most cited traditional medicinal plant species. Among the species *Trigonella foenum-graecum* was recorded with highest use value (UV = 6.8) followed by *Carissa spinarum* (UV = 4.7) while *Zehneria scabra* was the least with total UV of 2.6 (Table 7).

Table 7
Use values of most cited medicinal plants

Medicinal plants	Number of Uses (Ui) listed by key informants (I1-I16)																∑Ui	n	UV
	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16			
Allium sativum L.	5	2	6	3	4	1	4	6	5	4	3	5	2	1	3	6	60	16	3.8
Carissa spinarum L.	3	7	8	5	4	2	5	3	3	4	4	3	8	2	7	7	75	16	4.7
Catha edulis (Vahl) Forssk. ex Endl.	3	4	3	4	1	4	4	2	1	3	2	4	3	4	4	4	50	16	3.1
Croton macrostachyus Del.	7	2	5	3	3	7	3	3	4	4	7	3	4	7	5	3	70	16	4.4
Cucumis ficifolius A. Rich.	5	3	4	1	4	4	3	4	5	3	4	3	5	3	5	5	61	16	3.8
Cynoglossum coeruleum Hochst. ex A. DC.	3	4	3	3	4	3	4	3	4	1	4	4	4	2	4	3	53	16	3.3
Echinops kebericho Mesfin	5	6	2	5	3	3	6	2	5	3	6	6	3	6	3	5	69	16	4.3
Embelia schimperi Vatke	4	5	4	2	5	3	5	4	2	5	3	5	4	2	5	2	60	16	3.8
Justicia schimperiana (Hochst. ex Nees) T. Anders.	3	4	4	4	2	1	4	3	2	4	3	2	4	4	3	4	51	16	3.2
Kanahia laniflora (Forssk.) R. Br.	3	3	4	4	4	2	1	4	3	2	4	3	2	4	4	3	50	16	3.1
Lepidium sativum L.	3	4	4	4	2	2	3	3	4	2	4	3	4	4	2	4	52	16	3.3
Millettia ferruginea (Hochst.) Bak.	4	5	2	6	3	4	1	4	6	5	4	3	5	2	1	3	58	16	3.6
Ocimum americanum L.	3	4	4	4	2	3	3	4	4	2	5	3	3	4	2	3	53	16	3.3
Ocimum urticifolium Roth	3	4	4	4	2	3	3	4	4	2	5	3	3	4	2	3	53	16	3.3
Phytolacca dodecandra L'Her.	4	5	5	1	2	2	2	2	5	5	5	3	4	4	3	3	55	16	3.4
Ricinus communis L.	3	4	2	3	3	4	4	2	2	3	3	4	4	2	3	4	50	16	3.1
Rumex nepalensis Spreng.	6	4	5	2	6	3	4	1	4	6	5	4	3	6	5	4	68	16	4.3
Rumex nervosus Vahl	3	4	4	4	2	3	3	4	4	2	4	3	3	4	2	3	52	16	3.3
Ruta chalepensis L	4	5	5	1	2	2	2	4	5	5	5	3	4	4	3	3	57	16	3.6
Scadoxus multiflorus (Martyn) Raf.	3	2	1	2	1	2	2	2		3	3	2	3	4	4	3	37	16	2.3
Trigonella foenum-graecum L.	10	6	4	10	4	2	10	6	4	10	3	10	5	10	4	10	108	16	6.8
Verbascum sinaiticum Benth.	5	4	5	4	2	5	3	5	4	2	5	3	3	2	3	4	59	16	3.7
Verbena officinalis L.	6	5	4	5	4	2	5	3	5	4	6	5	3	3	4	6	70	16	4.4
Zehneria scabra (Linn. f.) Sond.	3	3	2	1	2	2	2	3	3	3	2	3	4	4	3	1	41	16	2.6

Cultural Role

Out of the total 6 traditional medicinal plants selected for the calculation of their cultural values, *Carissa spinarum* and *Croton macrostachyus* were recorded with highest cultural value (each species had CSI value of 17.1) followed by *Rosa abyssinica* (CSI = 14). *Dodonea angustifolia* was recorded with least cultural significance value (CSI = 6.3) (Table 8).

Table 8
Cultural significance index of 6 traditional medicinal plants

Species	IC		M	FW	Fc	AT	∑ (i. e. c)	CF	CSI
Carissa spinarum L.	6	Management (i)	2	2	2	2			
		Preference (e)	2	1	2	1			
		Frequency (c)	2	1	2	1			
		(i*e*c)	8	2	8	2	20	0.86	17.1
Calpurnia aurea (Ait.) Benth.	4	Management (i)	2	2	2	2			
		Preference (e)	1	1	2	2			
		Frequency (c)	1	1	2	2			
		(i*e*c)	2	2	8	8	20	0.57	11.4
Croton macrostachyus Del.	6	Management (i)	2	2	2	2			
		Preference (e)	2	2	1	1			
		Frequency (c)	2	2	1	1			
		(i*e*c)	8	8	2	2	20	0.86	17.1
Dodonea angustifolia L.	4	Management (i)	2	2	2	2			
		Preference (e)	2	1	1	1			
		Frequency (c)	2	1	1	1			
		(i*e*c)	8	1	1	1	11	0.57	6.3
Millettia ferruginea (Hochst.) Bak.	5	Management (i)	2	2	2	2			
		Preference (e)	1	2	1	1			
		Frequency (c)	1	1	1	1			
		(i*e*c)	2	4	2	2	10	0.7	7
Rosa abyssinica Lindley.	7	Management (i)	2	2	2	2			
		Preference (e)	1	1	2	1			
		Frequency (c)	1	1	2	1			
		(i*e*c)	2	2	8	2	14	1	14

Marketability of medicinal plants

Out of the total 112 species, 23 species, which were grouped under 18 families, were sold in the local markets of the districts. Asteraceae was represented by three species namely *Helianthus annuus*, *Guizotia abyssinica* and *Echinops kebericho*. Fabaceae was represented by *Lupinus albus and Trigonella foenum-graecum*. Similarly, Alliaceae was represented by *Allium cepa* and *A. sativum*. *Rutaceae* was represented by *Citrus aurantiifolia* and *Ruta chalepensis*. The other 14 families were represented by single species. The species were *Amaranthus caudatus*, *Brassica carinata*, *Carica papaya*, *Catha edulis*, *Coffia arabica*, *Hordeum vulgare*, *Laggera siceraria*, *Linum usitatissimum*, *Myrtus communis*, *Nigella sativa*, *Olea europaea* subsp. *cuspidata*, *Otostegia integrifolia*, *Securidaca longepedunculata* and *Zingiber officinale*.

However, only *Echinops kebericho*, *Myrtus communis*, *Olea europaea* subsp. *cuspidata, Otostegia integrifolia* and *Securidaca longepedunculata* were reported and observed to be sold and purchased entirely for the purpose of their medicinal applications. Approximately 7 cm root of *Echinops kebericho* was sold by six Birr (Ethiopian Birr); a handful leaves of *Myrtus communis* was sold by 3 Birr. Similarly, a bunch of *Olea europaea* subsp. *cuspidata* and *Otostegia integrifolia* was sold by 3 birr while a small piece of *Securidaca longepedunculata* dried stem was sold by 6 Birr. The remaining medicinal plants were mainly sold in bulk for their non-medicinal uses but are occasionally also applied as medicine when the need arises.

Threats and conservation efforts of plants

The major reported threats of plants in the study areas were agricultural expansion, plantation of monoculture *Eucalyptus* species, firewood, overgrazing and overharvesting. *Olea europaea* subsp.*cuspidata* was reported to be highly harvested for its branches and stems for the purpose of fumigation and agricultural tools respectively. *Echinops kebericho* was also harvested for its roots for fumigation purposes to avoid evil spirits, especially during childbirth. The roots of this plant were also sold in local markets of the study areas. *Cucumis ficifolius* was also the other highly overharvested medicinal plant for its roots for traditional treatment of human and animal diseases. The other reported indirect causes to the vegetation dwindling of the study areas were lack of sufficient awareness creation, and lack of regular guards to the patches. The reported conservation practices taken by the local peoples of the study areas were also

cultivating plants in homegardens and covering bare lands with seedlings, seasonal protection of forest patches. It was reported that plants were cultivated for their indirect uses including aesthetic, fence, food, shade, spice, firewood, charcoal, source of income and cultural uses.

Discussion

Medicinal plants of the districts

The results showed that all the reported medicinal plants were belonged to angiosperms. This was in agreement with [28] who documented and described as almost all traditional medicinal plants are flowering plants. This might be due to the success of flowering plants in invading large areas of the globe, and thus it might be also due to their cosmopolitan distribution globally and nationally. Out of c. 213 families of flowering medicinal plants of Ethiopia, 92 families have medicinal properties. Among 92 families having medicinal value, only two families are non-flowering plants; one family is a gymnosperm and the other is a fern [29]. Therefore, it agrees with the current findings.

Fabaceae was recorded as a dominant family of the districts. In agreement to the current study, Fabaceae was recorded as the dominant family in other findings [30, 31, 32]. The dominance of Fabaceae as medicinal plant might be due to their content of active flavonoid compared with other families [33, 34]. The results also showed that most of medicinal plants were herbs followed by shrubs. In agreement with the current study, other research findings recorded herbs as the primary source of remedy in other parts of Ethiopia [35, 36). The use of herbaceous species as the primary source of traditional medicine in the study districts might be related to their availability compared to trees and shrubs [31, 37]. It might also be associated to their abundance with relatively high amount of rainfall in the areas; or it might be due to possessing strong phytochemicals like alkaloids and flavanoids that have strong antibacterial and antifungal properties [37].

The results further showed that 60 disease types were treated by traditional medicinal plants of the districts. Out of these, blood pressure and asthma were the prevalent human health problems under circulatory and respiratory system disease categories respectively. Miscellaneous, central nervous system and gastrointestinal disease categories had also highest informant agreements. According to [38], the treatment of asthma in modern medicine could not restrain all of its symptoms. Thus, treating this disease by traditional medicinal plants was highly efficacious, with low cost, easily managed and with few adverse effects. Similarly, common cold was predominantly self-diagnosed and self-medicated with herbal products [39, 40, 41].

The results showed that leaves were the primary source of remedy. According to [42], the extracts from the barks, flowers, fruits, leaves and roots of medicinal plants have alkaloids, naphtoquinones, saponin, flavonoids, terpenoids, sesquiterpenoid, quassinoids, xanthones and ferruginol that have ethnopharmacological use. However, the use of leaves as primary sources of remedy might be related to conservation and sustainable utilization, ease of preparation and collection, and availability of medicinal plants in near by surrounding areas. In agreement with the current study, similar results were reported in other parts of Ethiopia where leaves were the most commonly used medicinal plant parts [43, 44].

The results also showed less number of species were sold and purchased entirely for the purposes of their medicinal applications in Adet and Dabi towns while the majority was sold in bulk for their non-medicinal purposes. This low availability and marketability of medicinal plants in local markets might indicate the presence of low market consumption of the species. Thus, medicinal plant trade might not be a major threat for the species of the study areas.The results showed that miscellaneous, central nervous system and digestive system diseases were recorded with highest informant consensus values (0.9 each). Dermatological system and infective diseases had also the second highest informant agreements (0.8 each).

According to [21], ICF values are always greater when single or few plants are documented to be used by large number of respondents to cure a specific disease, while low ICF values give an indication that informants do not agree over which plant to use. Moreover, highest informant agreements indicated the prevalence of the disease in the areas. Thus, the study showed that diseases with highest ICF were prevalent in the areas. The highest occurrence of digestive system diseases in the districts might be due to poor hygiene, water and air pollution.

The results also showed that out of the total 14 medicinal plants, *Dodonea angustifolia*, *Dovyalis abyssinica*, *Hagenia abyssinica*, *Nigella sativa* and *Urtica simensis* had highest fidelity level. According to [45], medicinal plants with highest fidelity level are widely used by the local people than those that are with less fidelity level. Thus, it indicated that these species were the most widely used species in the study areas. According to [21], highest fidelity level demonstrates the knowledge distribution of the species in the local people. Thus, these species were the most well known medicinal plant species of the areas.

The results further showed that out of the total 24 most cited traditional medicinal plants, *Trigonella foenum-graecum* had highest use value. According to Phillips and Gentry (1993), the relative importance of plants reflects the number of uses assigned to it. The results using this technique are commonly interpreted as the pressure on a given resource resulting from use, considering the logic that most well-known resources are also the most used. However, [21] considered that there are no studies that have established a direct relationship between use value and the real pressure on a given resource resulting from use.

The results showed that *Carissa spinarum*, *Croton macrostachyus*, *Calpurnia aurea*, *Millettia ferruginea*, *Rosa abyssinica* and *Dodonea angustifolia* had highestculturalvalues. According to [26], cultural significance index is important in indicating the importance of traditional medicinal plants for the local communities. Thus, these species with highest cultural values had highest cultural role for the local people. The index further showed that these species with highest cultural values were highly preferred by the community. The results showed that *Phytolacca dodecandra*, *Embelia schimperi*, *Otostegia integrifolia*, *Zehneria scabra*, *Cucumis ficifolius*, *Alliumsativum* and *Stephania abyssinica* were recorded with highest frequency values. Thus, these species were the most frequently mentioned species in study areas. In addition, it showed that medicinal plants with highest FI values were mentioned by many informants. It also indicated that such types of medicinal plants were under pressure and might be exposed for various threats.

Use Diversity And Preference

The results showed that the majority of the species (86.5%) were cited for one or more uses other than their medicinal role. The highest total score of multipurpose species was an indication to identify plant species that were the most widely used by local communities. It also showed multipurpose plants that were most under pressure in the areas and the respective factors that threaten them. Thus, based on their rank these species were found to be threatened in the areas due to their diverse uses for the local community. As [46] stated that such types of ranking exercise is important for demonstrating taxonomic groups that could be targets for greater extractives pressure.

Threats And Conservation Efforts

The results of the current study revealed that agricultural land expansion was the primary threat to the medicinal plants of districts. In agreement with the findings of the current study, the reported and observed threats particularly agricultural expansion was also recorded to be the main threat for medicinal plants in other parts of the country [47, 48]. The primary reason for agricultural expansion to be the most threat for medicinal plants might be due to not only it damages the species of the forest patches but it also destroys all species that existed at any habitats since land expansion takes place at any direction and place.

The preference of a species and its parts might be a threat for that particular species [46] since preference of use might result in overharvesting of the species. *Cucumis ficifolius* and *Echinops kebericho* were rare in the areas because of overharvesting of the species. This might be due to the fact that overharvesting might kill the roots of some medicinal plants that might result in a severe threat for the survival of rare and slowly reproducing medicinal plants [31]. In agreement with the current study, such types of activities done on non-cultivated medicinal species were recorded as the most critical threats for such species [31, 49]. Moreover, medicinal species with highest use diversity might be under pressure. The results also showed that multipurpose species such as *Calpurnia aurea*, *Croton macrostachyus* and *Phytolacca dodecandra* were the most threatened species. This was due to the fact that multipurpose species were the most threatened [50]. The results showed that some conservation activities were practiced in the districts. The participation of the local community in conserving plant resources was also stated as the best approach of conservation [51, 52; 53]. Many medicinal plants were also conserved by indirect activities in agreement with other findings done in other parts of Ethiopia [54, 49, 55, 56].

Conclusions

The study districts were the rich sources of medicinal plants as they were the major sources of medicines in the districts. Thus, the local people of the districts have a reserved indigenous knowledge on medicinal plants. Nowadays low attentions have given to medicinal plants in using and conserving plants. Moreover, most of the species are non-managed and non-marketable. Therefore, extensive awareness creation is needed regarding their conservation and their habitats. Besides, pharmacological tests should be conducted on medicinal plants. Healer association should be established and there should be coordination with the districts health offices for successful provision of traditional medicines. Priority of conservation should be also given for medicinal plants.

Declarations

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Ethics approval and consent to participate

Prior to data collection, participants gave oral consent to participate in the study.

Consent for publication

The respondents were informed that their opinions were to be published in a scientific paper and gave their approval.

Author's contributions

I have read and approved the final manuscript.

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Availability of data and materials

The datasets supporting the conclusions of this article are included in Appendix 1.

Competing interests

The author declares that he has not any competing interests.

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Figures

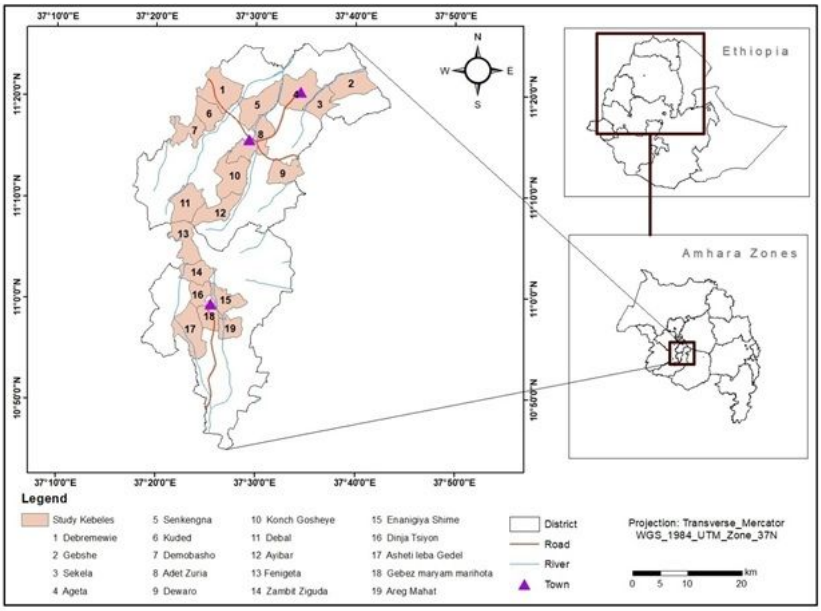

Figure 1

Map of the study Districts and Kebeles of West Gojjam Zone of Amhara Region, Ethiopia (Drawn by using Arc GIS ver. 10.5)

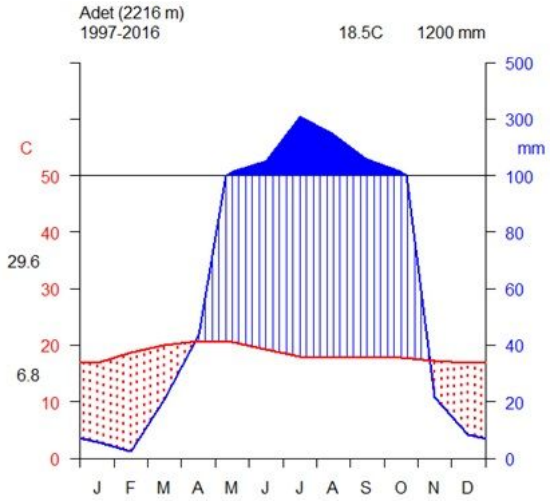

Figure 2

Climate diagram of Adet

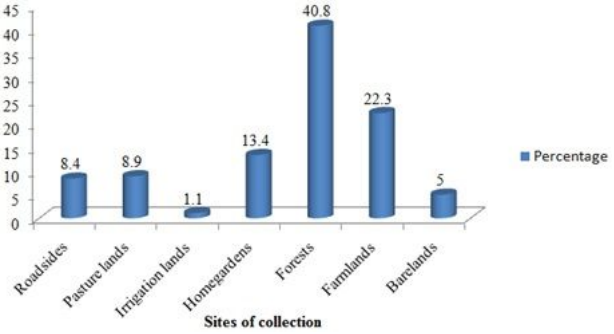

Figure 3

Sites of collection of medicinal plants

Figure 4

Photos of some medicinal plants of the Districts (A-B). A. Embelia schimperi collected from homegardens in Konch Goshiye Kebele. B. Euphorbia abyssinica on roadsides from Sekela Kebele (The researcher' photo)

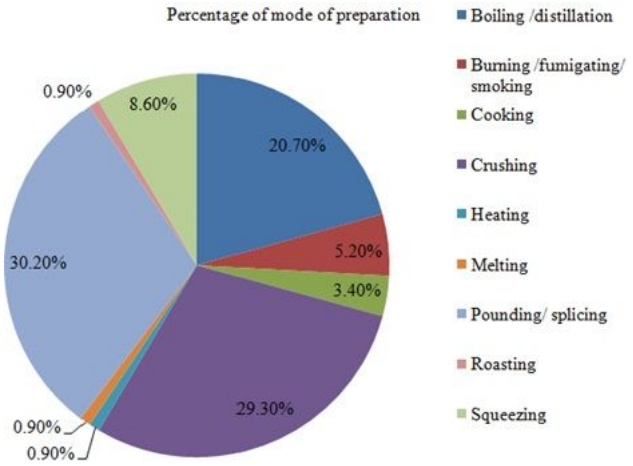

Figure 5

Percent of mode of prepararions

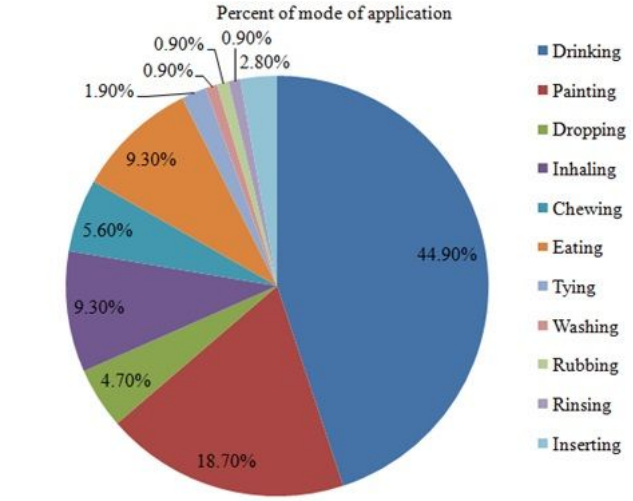

Figure 6

Percent of mode of applications

Supplementary Files

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