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Ethnobotanical study of medicinal plants used by local communities of Damot Woyde District, Wolaita Zone, Southern Ethiopia

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Abstract. *Megersa M, Woldetsadik S. 2022. Ethnobotanical study of medicinal plants used by local communities of Damot Woyde District, Wolaita Zone, Southern Ethiopia. Nusantara Bioscience 14: 10-24.* Humans have used traditional medicines, mainly of plant origins, to treat diseases. Early humans faced a tremendous challenge when searching for natural products used as medicines. This study reports on an ethnobotanical study that focused on the traditional medicinal plants used by local communities to treat human and livestock diseases. An ethnobotanical study on medicinal plants was conducted from February 2020 to October 2020. That involved semi-structured interviews, field observations, market surveys, and group discussions with informants to document information on the use and management of medicinal plants by the people of Damot Woyde District. Fifty-seven medicinal plant species belonging to 31 families have been collected in the study area inhabitants use that to treat various diseases in humans and livestock. The leading family was Asteraceae which was represented by 7 species (12.3%), followed by Rutaceae (6 species, 10.5%) and Solanaceae (5 species, 9%). Of the 57 medicinal plants collected, 36 (63.2%) were used to treat human ailments only, while 6 (10.5%) plant species were used to treat livestock ailments only, and 15 (26.31%) were used to treat both human and livestock ailments. Herbs constituted the largest number of 22 species (38.6%), followed by shrubs 18 species (31.6%), trees 15 species (26.3%), and climbers 2 species (3.51%). Leaves (31.3%) were the study area's most commonly used plant parts for preparing traditional remedies. Oral administration was the predominant mode of administration, accounting for 71%. Preference ranking analysis revealed *Allium sativum* L. was the most preferred plant species for treating the common cold. When the direct matrix ranking was analyzed, *Croton macrostachyus* Hochst. Ex. Del. was the most commonly used medicinal plant for various purposes. Our finding revealed that plant species' use plays a vital role in treating human and animal diseases in Damot Woyde District. Phytochemical and pharmacological tests are recommended mainly on frequently used medicinal plants.

Keywords: Conservation, Damot Woyde, medicinal plants, traditional medicine, Wolaita

Abbreviations: ICF**:** Informants Consensus Factor**;** JCS: Jaccard's coefficient of similarity; URTI: Upper Respiratory Tract Infection; UTI: Urinary Tract Infection

INTRODUCTION

People have used traditional medicines to treat diseases, mainly of herbal origin. Early humans faced an enormous challenge of finding natural products to use as medicines (Yuan et al. 2016). It is very likely that early humans often consumed poisonous plants in search of food but could still develop knowledge about natural medicines (Yuan et al. 2016). In several countries, considerable indigenous knowledge from the earliest times is associated with using traditional medicine (Farnsworth 2007). Many widely used products, such as herbal medicines for livestock and human health, have been developed using traditional indigenous knowledge.

Indigenous knowledge of medicinal plants has made, and can still make, a significant contribution to resolving local problems such as human and livestock diseases. Furthermore, indigenous knowledge contributes to science in many fields related to plant-based use for developing modern medicine. However, due to rapid changes in the way of life, low awareness of the importance of indigenous knowledge, lack of written documentation, the disappearance of indigenous practices, and loss of biological species, indigenous knowledge is threatened (Langton and Rhea 2005; Megersa et al. 2013).

Like everywhere in the world, local communities in Ethiopia have developed indigenous knowledge of using plants to treat diseases in humans and animals. Various studies have been conducted in different parts of Ethiopia, and many medicinal plants have been collected to treat human and livestock diseases. For example, in Kasaa et al. (2020), 266 plant species were recorded medicinal value and used by local communities in Sheka, Southern Ethiopia. Eighty-two medicinal plants were used by local communities in Kelala, Northeastern Ethiopia (Assen et al. 2021). In a similar study by Tefera and Kim (2019) and Teka et al. (2029), 105 and 244 medicinal plants were recorded to treat human and livestock diseases, respectively. The number of reported medicinal plants and their use by the indigenous people of Ethiopia suggests that the indigenous knowledge of medicinal plants and their uses is extensive. However, there is limited ethnobotanical documentation and relatively few phytochemical analyses of documented medicinal plants.

Consistent with the concentration of biological and cultural diversity, many medicinal plants are found in the south and southwest of the country (Edwards 2001; Megersa et al. 2019). That suggests a high traditional knowledge of medicinal plants in the southern part of Ethiopia, but indigenous knowledge in the region has not been systematically documented (Tefera and Kim 2019). In particular, there is no ethnobotanical study in the current study area of Damot Woyde District.

In addition, many plant species and associated indigenous knowledge are disappearing because there are no written documents on medicinal plants due to the death of knowledgeable elders without passing on traditional skills to other family members. Since knowledge of traditional medicine is passed orally from generation to generation, basic information about the use of plants and the parts used, methods of preparation, diseases treated, and other things may be lost in the process of knowledge transmission. The effects of deforestation, urbanization, and modernization are also causing rural people to abandon their natural habitat, and their knowledge, especially about herbal medicines, is slowly disappearing. Therefore, the first objective of this study was to document the medicinal plants used by the local communities of Damot Woyde District. Secondly, the study aimed to assess the threats to conservation practices and medicinal plants in the study area. The study results will benefit the development of modern medicines from plant species to treat human and livestock diseases.

MATERIALS AND METHODS

Description of the study area

Damot Woyde District is located 384 km south of Addis Ababa, 90 km from Hawassa, and 27 km from the zonal capital (Sodo). Damot Gale District borders it to the north, Humbo District to the south, Duguna Fango District to the east, and Soddo Zuria District to the west. The administrative town of the district is Beddesa. The study area lies at a longitude and latitude of 370 53'0" to 370 59'0" E and 60 55'0" to 60 57'0" N, respectively (DWDHO 2017). According to the Central Statistical Agency (CSA 2007), the population of Damot Woyde District is 91,602, with males numbering 44,861 and females 46,741. The largest ethnic group reported in Damot Woyde was the Welayta (98.6%); all other ethnic groups made up 1.4% of the population. Welaytic was the dominant first language, spoken by 99% of the inhabitants; the remaining 1% spoke all other primary languages.

The district covers an area of about 210 km^2 and has 23 kebeles. In each kebele, at least two health extension workers are responsible for providing health services to the people from house to house. The district has four health centers: Bedessa, Sake, Koyo, and Girrara. There are also twenty-nine primary and four secondary schools teaching in the district.

The ten most common diseases in the district are pneumonia, typhoid, malaria, gastritis, Urinary Tract Infections (UTI), acute febrile illness, Upper Respiratory Tract Infections (URTI), skin infections, intestinal parasites, helminths and eye diseases (DWDHO 2017). Similarly, the district has four animal health centers in Bedessa, Sake, Koyo, and Girrara. The major livestock diseases reported are anthrax, blackleg, trypanosomiasis (Gandi), flatulence, glandular swelling, cough, foot and mouth disease affecting large ruminants, including horses, and avian cholera affecting poultry.

Agriculture in the district is predominantly smallholder, mixed subsistence farming. The cropping system is mainly based on continuous cropping without fallow periods (DWDARDO 2017). In Damot Woyde District, mixed farming with livestock is widely practiced. Maize, sorghum, wheat, and barley are mainly grown in the area. Teff is also grown as an additional crop. Cultivation of Enset (*Ensete ventricosum* (Welw.) Cheesman.) is central to the cropping system on which the entire agricultural system is based, and the crop is the main source of food security and livelihoods (Olango et al. 2014). Sometimes *E. ventricosum* is grown as a mixed crop with *Coffea arabica* L. and *Persea americana* Mill. by farmers in the district. Livestock production, which includes beekeeping, poultry, small ruminants, and livestock, is another important industry in the area. The most common soil types in the study area are Eutric Nitisols associated with Humic Nitisols, which are dark reddish-brown and have deep profiles (Tesfaye 2003).

According to DWDARDO (2017), the district is divided into three major agronomic zones: (Kola 34.5%), (Woyna Dega 60.3%) and (Dega 5.2%). The rainfall distribution is bimodal, with the highest rainfall in the wet season (April to September) and the lowest rainfall in the last half of the dry season (February to March). The highest average monthly rainfall was recorded in May (179.9 mm) and the lowest in December (28.2 mm). The highest average temperature was recorded in March and April (20.5^0C) and the lowest in December (17.9^0C). In general, the mean annual temperature of the district is (19.2^0C), and total precipitation is (1271.2 mm).

Selection of the study sites

A reconnaissance survey of the study area was carried out from 10 to 25 January 2020 to obtain information on the area's agroecology, vegetation condition, and indigenous knowledge on using plants for various purposes. The study was conducted in four kebeles of Damot Woyde District, Wolaita Zone, Southern Ethiopia. The kebeles selected for the study were Dawe sake, Galcha sake, Mundeja sake, and Koyo sake (Figure 1). The four kebeles were purposively selected because of their relatively high plant diversity in the region, the practice of traditional medicine, and the recommendations of the district elders and local authorities. In addition, the three agro-climatic zones were also considered in the selection of the study sites.

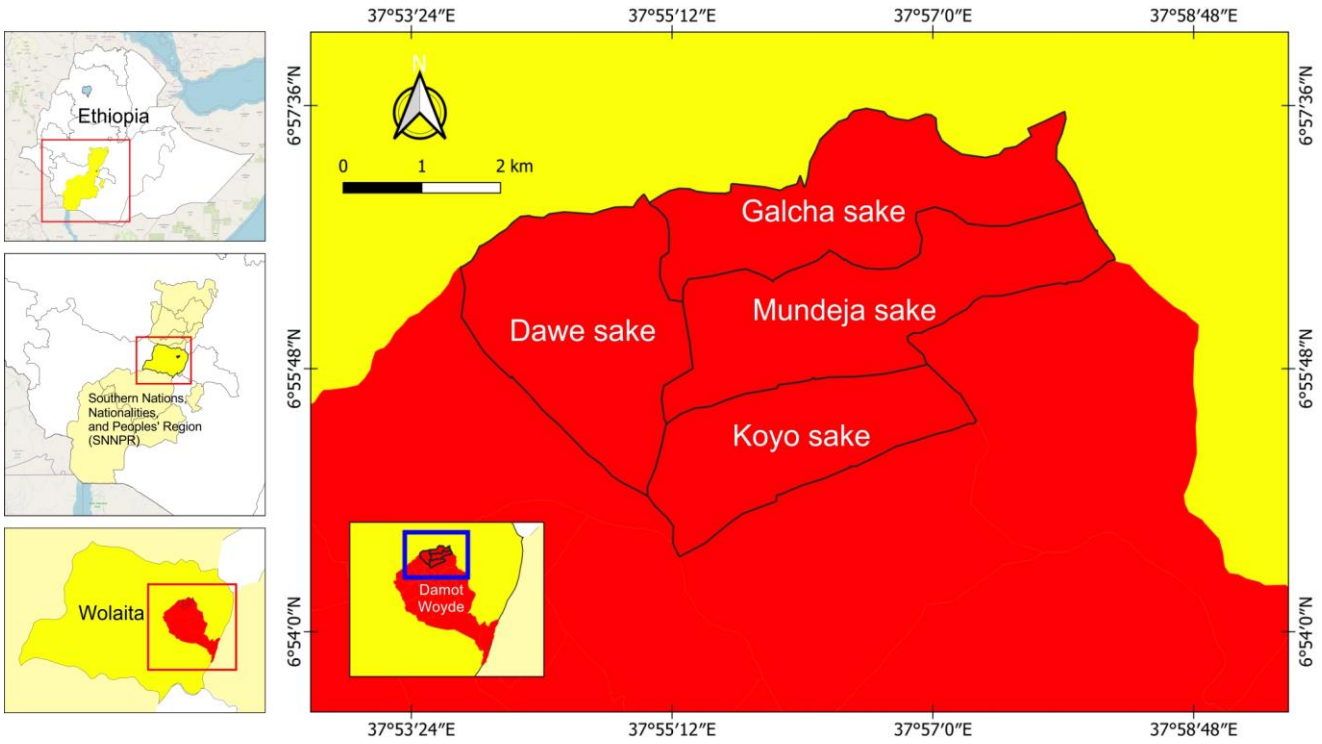

Figure 1. Map of Damot Woyde District, Ethiopia

Informant selection and sample size determination

A cross-sectional study was conducted to obtain information about the current state of the problem. With the help of random and purposive sampling, 60 (36 male and 24 female) informants aged between 34 and 73 years were selected from the four kebeles for this study. Out of the total number of informants, 36 (9 from each kebele) were randomly selected to collect valuable ethnobotanical data from the study areas, while 24 key informants (16 males and 8 females) were selected, 6 individuals from each kebele were purposively selected with the help of kebele administrative bodies and local elders. The 36 individual participants in the study were ordinary informants without formal recognition of their traditional treatment methods. On the other hand, the informants were ordinary people who had lived in the study region long and applied their knowledge of indigenous medicinal plants to their families. The quality of explanations given by particular informants during an interview was used to determine key informants. Traditional professionals who preserve indigenous knowledge of medicinal plants, such as local healers, immediately qualify as key informants.

Ethnobotanical data collection techniques

Ethnobotanical data were collected following the standard procedures of Martin (1995) and Cotton (1996) from February to October 2020. Semi-structured interviews, field observations, a market survey (two open marketplaces), and a group discussion with informants were conducted (Figure 2). The semi-structured interviews with closed and open-ended questions were conducted in English and then translated into the local language (Wolaytic). The questions in the semi-structured interview included the local names of the medicinal plants used to cure human and livestock problems, the parts of the plants used, the process of preparing the traditional medicine, and the method of administration. Field observations on the habits and habitats of the medicinal plants were carried out with the help of local guides. A market survey was conducted to assess the medicinal plants available in the market and the parts of the plants used as medicines. The informants discussed the current threats to the medicinal plants in the study area, the measures the locals took for their conservation, and the selection of multipurpose plant species.

Plant specimen collection and identification

The specimens of medicinal plants were collected from the study sites with the help of key informants (traditional healers) and coded, pressed, and dried for proper identification. Identification of the plants was done in the field at Wolayta Sodo Agricultural University and Wolayta Sodo University with the help of experts. Furthermore, additional identification of all specimens was done using authentic specimens and taxonomic keys from the flora of Ethiopia and Eritrea (Edwards et al. 1995; Edwards et al. 1997; Edwards et al. 2000). Finally, the voucher specimens were kept in the mini herbarium of Madda Walabu University.

Figure 2. The photo was taken during a group discussion on a threat to medicinal plants

Data analysis

Descriptive statistics

Descriptive statistics were used to determine the number and percentage of species, families of medicinal plants used, their growth forms, proportions of parts used, mode of preparation of the remedies, dosage, and routes of administration. The result is presented in tables, figures, and diagrams.

Informant consensus

Informants were interviewed twice on the same ideas to confirm the reliability of the information. Accordingly, the informant's information inconsistent with the previous one was rejected as irrelevant information.

Informants consensus factor (ICF)

The informant consensus factor (ICF) was considered for each group of complaints to determine the informants' agreement with the reported remedies for the group of complaints of the plant. The informant consensus factor was calculated as follows: the number of use citations in each group (*nur*) minus the number of species used (*nt*), divided by the number of use citations in each group minus one (Heinrich et al. 1998). ICF values were calculated: *ICF= nur-nt/ nur*-1. ICF values range from 0 to 1. A higher ICF value of a medicinal plant species indicates efficacy in treating a group of diseases (Trotter and Logan 1986).

Preference ranking

This method was carried out following the protocol of Martin (1995) for the six most important medicinal plants for the treatment of the common cold. Six key informants were randomly selected and participated in this exercise to identify the preferred medicinal plants for the common cold treatment. This disease was chosen because it has similar symptoms to pneumonia, most commonly reported in the region. Therefore, the researchers assume that the local population reports a common cold with similar symptoms to this disease. For each informant, six medicinal plant species were given names on paper to rank them with numbers (1-5) based on their preference or efficacy by assigning the highest value (5) to the plant species most (best) preferred to cure this disease and the lowest value (1) to the least preferred plant. Finally, the individual plant species values were summed and ranked. The plant species with the highest summed value was the most preferred.

Direct matrix ranking

Direct matrix ranking was done following Martin (1995) to compare the multipurpose use of a particular plant species based on the information collected from informants. Multipurpose plants are plants that provide various uses to local communities. The use categories include food, tools, house construction, fencing, firewood, and charcoal. Six plant species were selected from all the identified medicinal plants, and the various uses of these plants were listed. For direct matrix ranking, two focus group discussion (FGD) was conducted to determine the plants' preferences based on multipurpose criteria. Six randomly selected key informants were asked to assign a use-value to each species (5= best, 4= very good, 3= good, 2= less used, 1= least used, and 0= not used). By lottery, 6 key informants were selected from the 24 individuals. Informants were given two numbers (0 and 1), where 1 indicated that they could do the activity and 0 indicated that they could not. The average scores of each species were added together and ranked. The higher the average values of the plant species, the higher the multipurpose use.

Jaccard's coefficient of similarity (JCS)

The JCS was calculated to evaluate the composition of medicinal plant species and the degree of similarity between different areas. The similarity values were calculated between the current study area (Damot Woyde District) and ethnobotanical studies conducted in other

areas in different parts of Ethiopia. JCS is expressed as follows: JCS = c/(a + b + c), where a is the number of species in sample a, b is the number of species in sample b, and c is the number of species common to a and b (Kent and Coker 1992).

RESULTS AND DISCUSSION

Demographic characteristics

The informants (36 male and 24 female) were native to the study area. The ages of the interviewees ranged from 34 to 73 years old. However, most of the respondents (47%) were between 47-59 years of age.

Most study area informants were illiterate (55%), and 48% were farmers (Table 1).

Medicinal plants of the study area

The study area's local people collected fifty-seven species of medicinal plants to treat various diseases in humans and livestock. The families that contributed more medicinal plant species included Asteraceae with 7 species (12.3%), Rutaceae with 6 (10.5%) species and 5 species (9%) from the Solanaceae family, and other 23 families that contributed 23 (40%) species and represented by 1 species (Table 2).

Of the 57 medicinal plant species collected from the study area, 47% were from the wild, 44% were from cultivated areas, and only 9% were from both cultivated and wild habitats. Of the plant species identified, herbs accounted for the largest number, with 22 species (38.6%), followed by shrubs with 18 species (31.6%), trees with 15 species (26%), and 2 species (3.5%) were climbers (Figure 3).

Out of the 57 medicinal plant species, 36 (63.2%) were reported to treat human health problems (Table 3), 6 (10.5%) were reported to treat livestock diseases (Table 4), and 15 (26.3%) were reported for both human and livestock diseases (Table 5). The major types of human health problems identified in the study area were classified into 33 major disease categories, while 12 livestock diseases were treated locally with medicinal plants in the study area.

Medicinal plant parts used and condition of preparation

The local communities used different plant parts (leaves, fruits, seeds, shoots, roots, barks, flowers, bulbs, sap, stem, leaf and flower, leaf and seed, and rhizome) to prepare traditional medicine. However, leaves were the dominant plant parts used for the preparation of traditional medicines accounting for 21 (31.3%), followed by fruits accounting for 14 (21%) species (Figure 4).

The locals use fresh, dried, and fresh-dried medicinal plants to prepare traditional herbal medicines in the study area. As a result, most of the medicinal plants (60.6%) were used in fresh form, followed by fresh or dried form (30.3%) and dried form (9.1%), respectively.

Table 1. Demographic characteristics of informants

Demographic character	No. of informants	Percentage
Sex		
Male	36	60
Female	24	40
Age group		
34-46	21	35
47-59	28	47
Above 59	11	18
Educational background		
No formal education	33	55
Elementary	15	25
High school	6	10
College diploma	4	7
Degree	2	3
Occupation		
Farmer	29	48
Housewife	19	32
Merchant	8	13
Teacher	4	7

Table 2. Taxonomic diversity of medicinal plants

Family	Number of species	%
Asteraceae	7	12.3
Rutaceae	6	10.5
Solanaceae	5	9
Poaceae	4	7
Euphorbiaceae	3	5.3
Lamiaceae	3	5.3
Cucurbitaceae	2	3.5
Linaceae	2	3.5
Musaceae	2	3.5
Other 23 families	23	40
Total	57	100

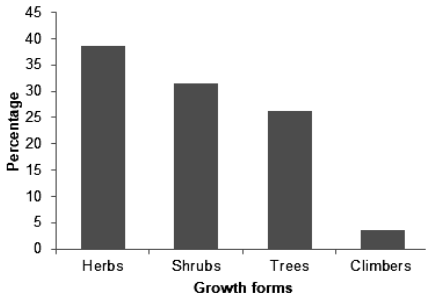

Figure 3. Growth forms of medicinal plants in the study area

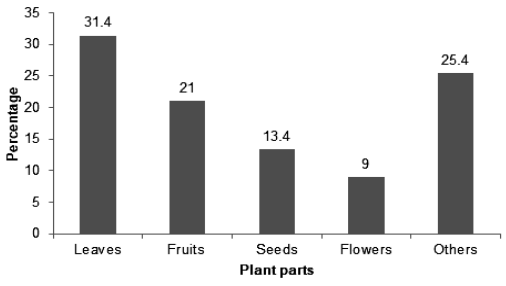

Figure 4. Plant parts used for the preparation of traditional medicine in Damot Woyde District, Ethiopia

Table 3. List of medicinal plants used for treating only human disease

Scientific name (Voucher number)	LN (No. of informants)	Family	GF	SO	PU	CO	DT	RA	Modes of preparation, application & dosage
Acmella caulirhiza Delile. (SW 15)	Idaamiya (37)	Asteraceae	H	W	Fl	F	Tonsillitis Toothache	O O	Chew & swallow a small amount of flower twice a day until recovery. Smash the flower & hold on to the infected part during pain time.
Artemisia abyssinica Sch. Bip.ex.A.Rich. (SW 16)	Ciqugniya (6)	Asteraceae	H	CU	L	F	Eye disease	Op	The leaf is smashed and rubbed or painted on the affected eye twice daily for 3 days.
Aloe debrana Christian (SW 40)	Godare uta (2)	Asphodelaceae	Sh	W	Sa	F	Allergic reaction on the skin	De	The sap of this plant is applied to the affected part once or twice a day for a week.
Catha edulis (Vahl) Endl. (SW 14)	Jimaa (4)	Celastraceae	Sh	CU&W	L	F	Common cold Abdominal pain	O	The leaf of this plant is crushed and boiled, and 2-3 coffee cups of the decoction are taken during pain time.
Capsicum annuum L. (SW 20)	Qariya (11)	Solanaceae	H	CU	Fr	F	Loss of appetite	O	The fruit of this plant is eaten daily with other food as an appetizer.
Capsicum frutescens L. (SW 21)	Mixaamixuwa (19)	Solanaceae	H	CU	Fr	F/D	Respiratory tract infection Cold Loss of appetite	O	The fruit of this plant, the bulb of *A. sativum*, is crushed together, and 2-3 spoons of the concoction per day are eaten with other food for 3 days.
Cymbopogon citratus (Dc.) Stapf (SW 39)	Gucachaa (10)	Poaceae	H	CU	L	F	Abdominal cramp	O	The leaf of this plant is crushed and boiled, and one coffee cup of the decoction is taken during pain time.
Carica papaya L. (SW 02)	Papayaa (10)	Caricaceae	T	CU	Fr	F	Gastric pain Tiredness	 O	Eat the fruit or drink the juice continuously until recovery.
Citrus x aurantium L. (SW 23)	Qomxaaxe (9)	Rutaceae	T	Cu	Fr	F	Abdominal pain	O	Eat the fruit, extract the juice, and drink one coffee cup during pain.
Citrus limon (L.) Osbeck (SW 22)	Lomiya (24)	Rutaceae	T	CU	Fr	F	Abdominal cramp Skin rash or allergic	O De	Drink one coffee cup of the juice of this plant during pain time. Crush the fruit and rub/paint on the affected skin twice daily for 3-7 days.
Citrus sinensis (L.) Osbeck (SW 24)	Birtukaaniya (2)	Rutaceae	T	CU	Fr	F	Coughing	O	Eat the fruit or drink the juice twice a day for a week.
Cucurbita pepo L. (SW 38)	Lalahiya (6)	Cucurbitaceae	Cl	CU&W	Se	F/D	Liver problem	O	The seed of this plant is crushed and boiled, and 1-2 coffee cups of decoction per day are given for one week.
Cordia africana Lam. (SW 01)	Moqota (10)	Boraginaceae	T	W	Fr	F	Abdominal pain	O	Eat the fruit 2-3 times daily during pain time.
Dovyalis abyssinica (A.Rich.) Warb. (SW 37)	Koshimiya (8)	Salicaceae	Sh	W	Fr	F	Abdominal pain/ discomfort	O	Eat a small amount of the fruit during pain time.
Echinops kebericho Mesfin (SW 25)	Boriisaa (32)	Asteraceae	H	CU&W	R	F/D	Evil eye	Na	Crush and burn a small amount of the root, then inhale its smoke during pain.
Embelia schimperi Vatke (SW 36)	Honqoquwaa (12)	Primulaceae	T	W	Se	F/D	Taeniasis Askariasis	O	Grind the seed, mix with water, and one coffee cup is given to the child (age 6-10), and two coffee cups for age >10 in morning before breakfast.
Foeniculum vulgare Mill. (SW 26)	Tatikala (5)	Apiaceae	H	CU	L	F	Kidney problem	O	The leaf of this plant is crushed and boiled, and 1-2 coffee cups of the decoction are taken when it's cooled for 3 days.

Guizotia abyssinica (L.f.) Cass. (SW 42)	Nugiyaa (6)	Asteraceae	H	CU	Se	D	Coughing	O	The roasted seed of this plant is ground, mixed with water, and boiled, and 2-3 tea cups of the filtrate are taken daily for 3 days.
Hagenia abyssinica (Bruce x Steud) J. F. Gmel. (SW 13)	Koso mitaa (12)	Rosaceae	T	W	Fl	F/D	Taeniasi or Ascariasis	O	Grind the flower, mix it with water, and one coffee cup is given to a human (age 6-10) and two coffee cups to age >10 in morning before breakfast.
Justicia schimperiana (Hochst. ex Nees) T. Anderson (SW 35)	Olomuwa (11)	Acanthaceae	Sh	W	L	F	Fibril illness	O	Grind a small amount of leaf and take one coffee cup daily for 3 days with coffee.
Linum usitatissimum L. (SW 44)	Telbaa (7)	Linaceae	H	CU	Se	D	Gastric pain	O	Boil the seed and drink the decoction 1-2 water glasses when cool during pain time.
Moringa stenopetala (Baker f.) Cufod. (SW 12)	Haalakuwaa (10)	Moringaceae	T	CU	L	F/D	Coughing	O	Crush, boil and drink the decoction (1-2 water glasses per day for 3 days.
					B	F/D	Abdominal pain	O	Grind the bark, and 1-2 spoons of the powder are mixed with one teacup of water and drink during pain.
					R	F/D	Bladder problem	O	Grind the root, then 2 spoons of the powder are mixed with one coffee cup of water and taken once a day for 3-5 days.
Musa x paradisiaca L. (SW 08)	Muziya (8)	Musaceae	Sh	CU	Fr	F	Gastritis	O	Eat the fruit during pain time.
					Sa	F	Minor bleeding	De	Cut the stem and paint/rub the sap on the cut end (bleeding skin) to assist blood clotting.
Ocimum basilicum L. (SW 28)	Kepuwa (13)	Lamiaceae	H	CU	Ag	F/D	Coughing Common cold	O	Crush the shoot of this plant, a shoot of *A. absinthium*, *A. afra*, a leaf of *E. globulus*, bulb of *A. sativum*; mix with water, and salt, boil and drink the concoction 3-6 cups of coffee daily for 3 days.
Ocimum lamiifolium Hochst. ex Benth. (SW 30)	Damaakasiya (35)	Lamiaceae	Sh	CU&W	L	F/D	Fibril illness	O	The leaf of this plant is boiled, and 2-3 tea cups of the decoction are given to humans daily for 3 days.
							Fever Eye disease	De	Smash the leaf and rub it on the skin or affected eye at bedtime.
Olea europaea subsp. *cuspidata* (Wall. ex G. Don) Cif. (SW 11)	Wagaraa (10)	Oleaceae	T	CU&W	Fr	F	Tonsillitis	O	Extract the oil and paint, or hold on to the affected part during pain.
					St	F	Toothache	O	Cut a piece of the stem of this plant, slightly heated, and hold on to the affected part of the teeth repeatedly for a few seconds during pain.
Persea americana Mill. (SW 09)	Avokaatuwa (11)	Lauraceae	T	CU	Fr	F	Dandruff	De	The fruit of this plant is peeled and painted on all parts of the affected skin or hair and waited for 8-10 hours, then washed with clean water and soap, which is repeated weekly for a month.
Phytolacca dodecandra L' Her. (SW 29)	Haanciciyaa (10)	Phytolaccaceae	Sh	W	L	F	Malaria	O	A small amount of the leaf of this plant with a bulb of *A. sativum* is crushed and mixed with water, and one cup of the concoction is taken daily for 3-5 days.
Podocarpus falcatus (Thunb.) Endl. (SW 10)	Ziga/ Zigba (8)	Podocarpaceae	T	CU&W	R/St	F/D	Evil eye	Na	Burn and inhale its smoke (dry bath) during pain time.
Rhamnus prinoides L' Her. (SW 46)	Geshuwa (10)	Rhamnaceae	Sh	CU	L	F	Tonsillitis	O	The tip of the leaf of this plant is collected, smashed, and painted on the tonsil once or twice a day for 3 days.
Ricinus communis L. (SW 47)	Qobuwa/Gulo (9)	Euphorbiaceae	Sh	CU&W	L	F	Tonsillitis	O	The leaf tip is collected, smashed, and painted on the tonsil once or twice a day for 3 days.
					Fr	F/D	Hemorrhoids	Su	Crush and paint the cream on the affected part once or twice a day until recovery.

Sida schimperiana Hochst. ex A. Rich. (SW 49)	Kindichuw (4)	Malvaceae	H	W	L	F	Skin allergic reaction	De	The leaf of this plant is crushed and applied to the affected skin daily for a week.
Solanum incanum L. (SW 48)	Buluwa (10)	Solanaceae	Sh	W	L	F	Nasal bleeding	Na	Crush the leaf and sniff the filtrate 2-3 times during bleeding.
Thymus schimperi Ronniger (SW 32)	Zinbaanuwa (3)	Lamiaceae	H	CU&W	L	F/D	Common cold	O	The leaf of this plant is boiled with water, and 2-3 tea cups of filtrate are taken daily for 3 days.
Toddalia asiatica (L.) Lam. (SW 53)	Gumaaree (9)	Rutaceae	T	W	Fl	F	Liver problem	O	The flower is boiled, and 1-2 coffee cups are taken daily for 3 days.
Vicia faba L. (SW 50)	Baa'eelaa (11)	Fabaceae	H	CU	Se	D	Swelling of the body	De	The raw seed is slightly powdered and tied to the affected part.

Note: Human (Hu), local name (LN), Growth form (GF), Sources (SO), parts used (PU), condition (CO), disease treated (DT), Rout of administration (RA), methods of preparations, application and dosage used, Wild (W), Cultivated (CU), Herb (H), Shrub (Sh), Tree (T), Climber (Cl), Bark (B), Root (R), Leaf (L), Fruit (Fr), Flower (Fl), Seed (Se), Steam (St), Sap (Sa), Bulb (Bu), Above ground (Ag), Whole Plant (Wp), Oral (O), Nasal (Na), Dermal (De), Optical (Op), Suppository (Su)

Table 4. List of medicinal plants used for treating Livestock ailments

Scientific name	LN	Family	GF	SO	PU	CO	DT	RA	Modes of preparation, Application & dosage
Ensete ventricosum (Welw.) Cheesman (SW 07)	Utaa/enset	Musaceae	Sh	CU	St	F	Retained placenta	O	The stem of this plant with a leaf of *C. arabica* is crushed and boiled, 2-3 liters of the concoction is given to a cow, and one liter to sheep and goat to expel the placenta.
Juniperus procera Hochst. Ex Endl. (SW 56)	Abeshaa xidaa	Cupressaceae	T	CU&W	L	F	Bloating	O	The leaf of *J. procera* and bulb of *A. sativum* are crushed and mixed with water half a liter of the concoction for sheep and goat, and one liter for cow and ox is given during pain time.
Leucas abyssinica (Benth.) Briq. (SW 27)	Kirkisa	Lamiaceae	Sh	W	L	F	Sudden illness Loss of appetite Diarrhea	O	The leaf is crushed and mixed with water, and half a liter is given during pain.
							Eye disease	Op	The leaf of this plant is crushed and mixed with water, and 2-3 drops of the filtrate are added to the affected eye daily for 3 days.
Lagenaria siceraria (Molina) Standl. (SW 55)	Gosiya/ kil	Cucurbitaceae	Cl	CU&W	Fr	F	Rabies	O	The fruit of this plant, the leaf of *P. dodecandra*, is crushed and mixed with salt and water, and half a liter of the concoction is given to livestock daily for a week.
Nicotiana tabacum L. (SW 45)	Tanbuwa/ Tibahu	Solanaceae	H	CU	Ag	F	Leech	Na	This plant's leaf is crushed and mixed with water, and one half coffee cup of the filtrate is nasally given to expel the leech.
							Coughing	O	The leaf of this plant is crushed and mixed with water, and one water glass is given to a cow, ox, donkey, and horse and half a water glass for sheep and goat per day for 3 days.
Withania somnifera (L.) Dunal (SW 54)	Etriwaanjiya	Solanaceae	Sh	W	L	F	Evil eye	De	The leaf of this plant, the leaf of *R. chalepensis*, is ground together and rubbed on the affected cow breast daily for a week.

Note: Livestock (Ls), local name (LN), Growth form (GF), Sources (SO), parts used (PU), condition (CO), Treatment for (TF), disease treated (DT), Rout of administration (RA), methods of preparations, application and dosage used, Herb(H), Shrub(Sh), Tree(T), Climber (Cl), Bark (B), Root (R), Leaf (L), Fruit (Fr), Flower (Fl), Seed (Se), Steam (St), Sap (Sa), Bulb (Bu), Above ground (Ag), Whole Plant (Wp), Oral (O), Nasal (Na), Dermal (De), Optical (Op)

Table 5. List of medicinal plants used for treating both Human and Livestock disease in the study area

Scientific name	LN (NI)	Family	GF	SO	PU	CO	TF	DT	RA	Mode of preparation, application & dosage
Allium sativum L. (SW 04)	Tumuwa (42)	Alliaceae	H	CU	Bu	F/D	Hu	Malaria	O	The bulb of *A. sativum* is eaten with other food once or twice a day for 3-5 days.
								Common cold	O	Crush, boil and drink the decoction (one tea cup) twice a day for 3 days.
								Coughing Asthma	O	Eat the bulb with enjera or Crush, boil and drink the decoction (1 or 2 tea cups) twice a day for 3 days.
								Respiratory tract infection	O	The bulb of *A. sativum*, the fruit of *C. frutescens* or *C. annum* are crushed together, and per day 2-3 spoons of the concoction are Eaten with other food for 3 days.
							LS	Loss of appetite (sudden illness)	O	The bulb of *A. sativum and* shoot of *A. afra* are crushed together and mixed with water, and half a water glass for sheep and goat and one water glass for cow and ox are given during pain time.
Artemisia absinthium L. (SW 18)	Naatraa (38)	Asteraceae	H	CU	Ag	F	Hu	Retained placenta	O	The leaf and stem of this plant are crushed and mixed with water one coffee cup is given to humans to expel the placenta.
								Abdominal cramp	O	Crush, mix with water, and one coffee cup is given during pain time.
							Ls	Bloating	O	The shoot of this plant and leaf of *E. globulus* is crushed together, and half a liter for sheep and goat, one liter for cow and ox, is given during pain.
Artemisia afra Jacq. ex Willd (SW 17)	Agupiya (13)	Asteraceae	H	CU	Ag	F/D	Hu	Coughing Common Cold Abdominal pain	O	The leaf of this plant, leaf of *R. chalepensis*, leaf of *C. arabica*, and bulb of *A. sativum* are crushed together, mixed with water, butter, and salt, boiled, and 3-5 coffee cups are taken per day for 3 days.
							Ls	Bloating Sudden illness	O	The leaf of this plant and a small amount of A. sativum are crushed and mixed with water, and half a liter for sheep and goats and one liter for cow and ox are given during pain time.
Coffea arabica L. (SW 03)	Tukiya (20)	Rubiaceae	Sh	CU	L	F/D	Hu	Common cold Respiratory tract infection	O	The leaf of *C. arabica*, bulb of *A. sativum*, and shoot of *A. absinthium* is crushed together, mixed with water, boiled, added salt and butter, then 3-5 coffee cup is taken daily for 3 days.
					Se	D	Hu	Wound	De	The roasted seed is ground and tied on the affected skin daily for 7 days.
					L	F	Ls	Retained placenta	O	The stem of *E. ventricosum* with a leaf of *C. arabica* is crushed, boiled, and 2-3 liter is given to cow and one liter to sheep and goat to expel the placenta.
Croton macrostachyus Hochst. Ex. Del. (SW 05)	Ankaa (46)	Euphorbiaceae	T	W	Sa	F	Hu	Wound Skin infection	De	Extract the sap or smash the leaf and apply it to the affected skin once/twice a day until recovery.
							Ls	Swelled leg	De	The leaf of this plant is slightly heated for a few seconds and covered on the affected part daily until recovery.
Cynodon dactylon (L.) Pers. (SW 41)	Suraa	Poaceae	H	W	Ag	F	Hu& Ls	Snakebite	De	The shoot of this plant, bulb of *A. sativum*, and salt are crushed together and tied on the affected part and repeated until recovery.
Eucalyptus globulus Labill. (SW 06)	Tumuwa (29)	Myrtaceae	T	CU&W	L	F/D	Hu	Common cold Coughing Fibril illness	Na	Boil the leaf, then inhale its steam (steam bath) before bed with a closed door for 3 days.
						F	Ls	Sudden illness	O	Crush the leaf with the bulb of *A. sativum*, mix it with water and give half to one liter to cow, ox, sheep, and goat during pain time.

Euphorbia tirucalli L. (SW 57)	Maxuwa/ Kinchib	Euphorbiaceae	Sh	W	Sa	F	Hu	Allergic reaction on the skin	De	The sap of this plant is applied on the affected skin once/twice a day for a week.
					Ag	F	Ls	Bloating	O	The shoot of this plant, the bulb of *A. sativum*, is crushed and mixed with water, and half a liter is given during pain time.
Hordeum vulgare L. (SW 43)	Baangaa/ Gebis	Poaceae	H	CU	Se	D	Hu	Bone break	O	The roasted seed of this plant is powdered, mixed with milk, and boiled, and 2-3 water glass is given daily until recovery.
							Ls	Bone break	O	This plant's boiled or raw seed is given to livestock (2-5) kilogram daily until recovery.
Lepidium sativum L. (SW 34)	Sifika/feto (35)	Brassicaceae	H	CU	Se/Se&L	F/D	Hu	Sudden abdominal pain	O	The seed is ground and mixed with water; one coffee cup is taken during pain. Or the seed and leaf are ground with a bulb of A. sativum and eaten 1-2 spoons with other food during pain.
								Tonsillitis Arthritis	O	The seed is ground with the bulb of *A. sativum* and eaten 1-2 spoons with other food daily for 3 days.
							Ls	Sudden illness	O	The seed is powdered and mixed with water, and half a liter is given during pain time.
Pentas schimperi (A. Rich) Vatke. (SW 19)	Daanbursaa (43)	Rubiaceae	Sh	W	L	F/D	Hu	Skeletal problem (bone break)	O	Boil the part and drink 1-2 glasses of the decoction when cool daily until recovery.
							Ls	Skeletal problem (bone break)	O	Grind the leaf, mix with cold water and give 1-2 liters daily until recovery.
Ruta chalepensis L. (SW 33)	Xalotiya/ Tenadam (40)	Rutaceae	Sh	CU	L/L& Fr	F	Hu	Evil eye	O	Crush, mix with tea/coffee, and drink 1-2 tea/coffee cups during pain time.
								Abdominal pain	O	A small amount of leaf or fruit is chewed and swallowed during pain.
							Ls	Evil eye	O	Crush, mix with water, and give one water glass to livestock during pain.
Triticum polonicum L. (SW 51)	Qanbaraa/ Aja (14)	Poaceae	H	CU	Se	D	Hu	Bone break	O	Boil the powder with milk and take 2-3 water glasses daily until recovery.
							Ls	Bone break	O	The powder is mixed with water and boiled, and 2-3 liter is given daily until recovery.
Vernonia amygdalina Del. (SW 52)	Garaa (28)	Asteraceae	Sh	CU&W	L	F	Hu	Skin rash	De	Grind the leaf and paint/rub it on the affected skin or use it as soap twice a day until recovery.
								Wound	De	Crush and paint the solution on the wound 2-3 times daily until recovery.
							Ls	Bloating Diarrhea	O	This plant's leaf is crushed and mixed with water, and one water glass is given to the cow and ox during pain.
Zingiber officinale Roscoe (SW 31)	Yenjeluwaa (27)	Zingiberaceae	H	CU	Rh	D/F	Hu	Tonsillitis	O	Chewing a small amount once/twice a day for 3 days.
								Common cold Coughing Respiratory tract infection	O	The rhizome of this plant is crushed and mixed with boiled water, and 1-2 tea cup is given for 3 days.
							Ls	Eye diseases	Op	Crushed, mixed with water, and 1-2 drops (daily) of the filtrate are added to the affected eye during pain.

Note: Human (Hu), Livestock (LS), Local name (LN), Growth form (GF), Sources (SO), Parts used (PU), Condition (CO), treatment for (TF), disease treated (DT), Rout of administration (RA), methods of preparations, application and dosage used, Herb (H), Shrub (Sh), Tree (T), Climber (Cl), Bark (B), Root (R), Leaf (L), Fruit (Fr), Flower (Fl), Seed (Se), Steam (St), Sap (Sa), Bulb (Bu), Above Ground (Ag), Whole Plant (Wp), oral(O), Nasal (Na), Dermal (De), Optical (Op), NI (Number of informants)

Preparation methods and route of administration of traditional medicine

According to the study results, people in the study area indicated they used a single plant, two, three, and more species to prepare traditional herbal medicine. In this study, there were a total of 86 herbal medicine preparations. Of these, 76.7% of the preparations were from a single plant species, 19.7% were from two species, and 3.5% of the traditional medicine preparations were from three or more species. In the study area, crushing (36%) and powdering (20%) were the most common preparation methods of traditional medicine (Table 6). Concoction: mixing/combining different ingredients to make a dish; Decoction: boiling the materials and extracting essences or active ingredients.

Local people of the study area administer traditional herbal medicines through oral, dermal, nasal, optical, and suppositories. The largest number (71%) of traditional medicine reported being administered orally (Figure 5).

Ranking of medicinal plants

In the study area, some medicinal plants were better known by informants than others. Therefore, many informants independently mentioned certain medicinal plant species for their medicinal use against diseases in humans and livestock. For example, *Croton macrostachyus* Hochst. Ex. Del., *Pentas schimperi* (A. Rich) Vatke. and *Allium sativum* L. were mentioned by 46, 43, and 42 informants, respectively (Table 3).

Importance of medicinal plants in the study area

The preference ranking of the six medicinal plant species used for treating the common cold in the study area revealed that *A. sativum* is the most effective medicinal plant for treating the common cold, followed by *Zingiber officinale* Roscoe (Table 7).

Direct matrix ranking for multipurpose medicinal plants

Seven uses and six multipurpose plant species that are not used for medicinal purposes were selected. Six randomly selected key informants were asked to assign a use-value to each species. The direct matrix ranking analysis showed that *C. macrostachyus* is the most preferred medicinal plant used by local communities of Damot Woyde District for multiple purposes, followed by *Cordia africana* Lam (Table 8).

Table 6. Method of traditional medicines preparation in the study area

Forms of preparations	Number of preparations	%
Crushing	31	36
Grinding/Powdering	17	19.7
Concoction	13	15
Decoction	11	12.8
Other forms	14	16.3
Total	86	100

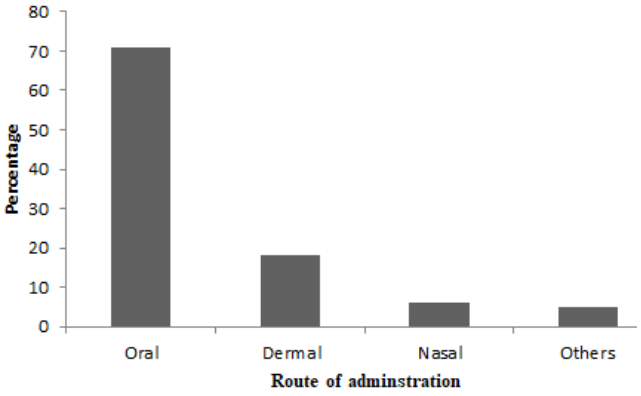

Figure 5. Route of administration of traditional medicine

Table 7. Preference ranking of six medicinal plants used to treat the common cold in the study

Types of medicinal plant species used	Informants labeled by (I_1-I_6)						Total	Rank
	I_1	I_2	I_3	I_4	I_5	I_6		
Allium sativum	5	5	5	5	5	5	30	1st
Artemisia afra	3	3	2	4	2	3	17	5th
Coffea arabica	3	1	2	3	3	2	14	6th
Eucalyptus globulus	5	4	4	5	3	4	25	3rd
Ocimum basilicum	3	2	3	4	3	4	19	4th
Zingiber officinale	5	3	5	5	5	5	28	2nd

Table 8. Direct matrix ranking of six multipurpose medicinal plants

Plant species	Use categories							Total	Rank
	Medicinal	Food	Tool	Construction	Fence	Firewood	Charcoal		
Cordia africana	3	0	5	5	4	4	4	25	2nd
Croton macrostachyus	4	0	4	4	5	4	5	26	1st
Eucalyptus globulus	4	0	3	3	3	2	3	18	5th
Olea europaea	4	0	4	5	4	3	3	23	4th
Persea americana	3	5	2	0	3	2	3	18	5th
Podocarpus falcatus	3	0	5	5	4	4	4	25	2nd

Informant consensus factor (ICF)

The frequent diseases in the study area and medicinal plants that are well-known by community members and effective in treating certain diseases have higher ICF values. For instance, the highest and lowest ICF values belong to a category of diseases (Bone problems and Snakebite, 0.95) and (Kidney problems, Liver problems, and Bladder/Urine problems, 0.4) (Table 9).

Jaccard's similarity index

The highest Jaccard coefficient of similarity in medicinal plants' composition was found between the study area (Damot Woyde District) and Berbere and Hawassa Zuria Districts (13%). In contrast, the degree of similarity was lower in the Babile district (1%) (Table 10).

Marketability of medicinal plants

Most medicinal plants were being sold in the two open markets visited. The medicinal plants encountered in the marketplaces were sold or bought for medicinal and non-medicinal uses. The other uses include; spices, food, household tools, farming tools, fencing, firewood, and constructions. In the markets, flowers of *Hagenia abyssinica* (Bruce x Steud) J. F. Gmel., fruits of *Embelia schimperi* Vatke, and the leaf of *P. schimperi* and *Nicotiana tabacum* L. (Figure 6) are more available for a low price. Usually, small plastic cups or cans are used to measure the quantity.

The threats to the medicinal plants and conservation practices in the study area

A brief group discussion was made with four traditional healers on threats to medicinal plants and the main sources of threats to medicinal plants reported by informants in the study area. Some include urbanization, agricultural expansion, over-harvesting, charcoal collection, destructive harvesting, honey cut, and habitat loss.

Even though there are many threats to medicinal plants, local people in the study area know the importance of conserving the plants. They plant in home gardens, live fences of the gardens, different worship areas, and in their plantation fields. Also, during the field observation, most informants reported that various local beliefs and cultural traditions contribute to the conservation of medicinal plants and associated knowledge in the study area includes: During the collection of parts of medicinal plants, special attention is made to save the life of the mother plant, and they took only small amount from the lateral branches without harming the main parts of the plant. Most plant remedies are only collected in the early morning before the sun rises at night or after sunset, which is believed to maintain the efficacy of the medicines. The collection of traditional medicinal plants is done only by elderly persons of the family, but the children are not allowed to collect them. This action may reduce the damage to plants by children.

Figure 6. Leaf of *N. tabacum* sold in Dawe sake market

Table 9. Informant consensus factor (ICF) of groups of ailments

Diseases categories	Number of sp	Number of use citations	ICF	Rank
Abdominal pain, Intestinal worms, diarrhea, and Gastritis	21	58	0.65	10th
Coughing and Common cold	14	67	0.8	8th
Livestock diseases (sudden illness, bloating, diarrhea, leech, rabies, and retained placenta)	12	28	0.59	11th
Respiratory tract infection, tonsillitis, and Asthma	10	85	0.89	4th
Wound, Hemorrhoids, and Body swelling	10	68	0.87	6th
Skin rash, Skin allergic, and Dandruff	8	51	0.86	7th
Eye and tooth diseases	6	83	0.94	2nd
Malaria, Fever, Tiredness, and Loss of appetite	6	44	0.88	5th
Arthritis and Fibril illness	5	66	0.94	2nd
Bone problem (injury), Snakebite	4	63	0.95	1st
Kidney problems, Liver problems, and Bladder/Urine problems	4	6	0.4	12th
Nasal bleeding, Minor bleeding, and Retained placenta	3	9	0.75	9th

Table 10. Comparison of species in the study area with those in other study areas of Ethiopia

Study areas (districts)	Species no. (a or b)	Common species (c)	Jaccard index	Similarity (%)	References
Damot Woyde	57	-	-	-	The study area
Gera district	63	12	0.09	9	(Gonfa et al. 2020)
Sheka zone	266	26	0.07	7	(Kassa et al. 2020)
Gurage	244	30	0.09	9	(Teka et al. 2019)
Yilmana Densa and Quarit	112	20	0.1	10	(Alemneh 2021)
Bench	35	4	0.04	4	(Giday et al. 2009a)
Babile	51	1	0.009	1	(Belayneh et al. 2012)
Gura Damole	30	6	0.06	6	(Assefa et al. 2021)
Hawassa Zuria	105	24	0.12	12	(Tefera and Kim 2019)
Berbere	70	19	0.13	13	(Jima and Megersa 2018)
South Omo	91	6	0.03	3	(Tolossa et al. 2013)
Meinit	51	10	0.08	8	(Giday et al. 2009b)
Ada'a	131	25	0.11	11	(Kefalew et al. 2015)

Discussion

Medicinal plants of Damot Woyde District

Of the 57 medicinal plants collected in the study area, 36 species were indicated for the treatment of human diseases, while 6 species were used for the treatment of livestock diseases and 15 species for the treatment of both human and livestock diseases. Similar results were obtained from the study of (Kassa et al. 2020; Assen et al. 2021) conducted in other parts of Ethiopia where the locals use more medicinal plants to treat human diseases than livestock diseases. That could be because people prefer human health problems over livestock health problems, as Kassa et al. (2020) justified.

Compared to previous studies conducted in Ethiopia, the present study found a low and high number of medicinal plant species. For example, Kassa et al. (2020) collected 266 plant species used by Sheka zone communities to treat human and livestock diseases. On the other hand, Teka et al. (2019) reported using 244 medicinal plants by Gurage communities. In a similar study, Alemneh (2021) collected 112 medicinal plant species in the Yilmana Densa and Quarit districts of the Amhara region. Therefore, the three authors reported more medicinal plants than the present study. Whereas, Giday et al. (2009a,b), Belayneh et al. (2012), and Assefa et al. (2021) reported 35, 51, and 30 species of medicinal plants, respectively. The difference in the number of medicinal plants could be due to the vegetation of the district, the number of informants involved in the study, the timing and duration of data collection, and the culture.

Jaccard's similarity index result on the composition of medicinal plants shows some similarities between the study area, Berbere (Jima and Megersa 2018), and Hawassa Zuria (Tefera and Kim 2019) districts. Still, less similarity was found with Babile (Belayneh et al. 2012) and South Omo (Tolossa et al. 2013) Districts. According to Megersa et al. (2013), the similarities and differences between the current study and other study areas could be due to cultural and agro-climatic conditions.

The present study revealed that the Asteraceae were represented by 7 plant species, followed by the Rutaceae. Other similar studies in Ethiopia (Teka et al. 2019; Assefa et al. 2021) and elsewhere in the world (Chaachouay et al. 2021; Khajuriaa et al. 2021) have also found that Asteraceae are the major suppliers of medicinal plants. In addition, Fabaceae (Osman et al. 2020; Alemneh 2021), Euphorbiaceae (Jima and Megersa 2018), Lamiaceae (Tuasha et al. 2018; Tamene et al. 2020), and Solanaceae (Abebe and Teferi 2021; Assen et al. 2021; Wendimu et al. 2021) were found to be dominant in the study conducted in South Wollo Zone of Amhara Region, Hulet Eju Enese District and Diguna Fango District of Wolaita Zone.

Growth form and plant parts used for traditional medicine preparation

This study shows that the most represented growth forms of medicinal plants in the study area were 22 species (38.59%). Similar studies conducted in Ethiopia reported the dominance of herbs or shrubs in the use of medicinal plants. For example, Kassa et al. (2020) reported that most medicinal plants collected in the Sheka zone belonged to herbaceous species. According to Tefera and Kim (2019), the local communities of Hawassa Zuria District collected herbaceous plants for making traditional medicine. The findings of Jima and Megersa (2018) and Demie et al. (2018) differ from the present study, as the authors reported that shrubs dominated other growths in the production of traditional medicines. The high use of herbs could be due to their relative abundance and accessibility (Kassa et al. 2020).

The current study results indicate that the local people of Damot Woyde District prepare remedies from different parts of medicinal plants. The most commonly used plant part were leaves for treating human and livestock diseases in the study area. Different research groups reported that roots or leaves are the most important plant parts for preparing traditional medicines in Ethiopia and elsewhere in the world. Among the researchers who reported leaves as the most important part in Ethiopia (Tefera and Kim 2019; Alemneh 2021; Assen et al. 2021; Assefa et al. 2021) and other countries (Tugume and Nyakoojo 2019; Hachlafi et al. 2020; Chaachouay et al. 2021), other research groups

(Tolossa et al. 2013; Kefalew et al. 2015; Jima and Megersa 2018) reported that roots were widely used plant parts for the preparation of traditional medicine. The preference for leaves over other plant parts is due to their easy availability and simplicity of drug preparation. Moreover, the storage of secondary metabolites affects the biological properties of the medicinal plant (Chaachouay et al. 2021).

The present study found that most medicinal plants (60.6%) were used in fresh form. Similarly, Tefera and Kim (2019), Kassa et al. (2020), Assen et al. (2021), and Abebe and Teferi (2021) reported the predominant use of freshly harvested plant parts for the preparation of traditional medicine. People's dependence on fresh plant parts is often due to the efficacy of fresh plant species in therapy, as the constituents are not lost before use compared to dried plant forms (Chaachouay et al. 2021). On the other hand, using fresh plant parts may endanger the plants due to frequent collection, even in dry seasons, as locals make little effort to store dried plant material for later use (Megersa et al. 2013; Tefera and Kim 2019).

Preparation methods of traditional medicine

The local people of Damot Woyde District use various methods of preparation of medicines. The preparation methods used to treat diseases in humans and livestock included crushing, pulverizing, chewing, boiling, and soaking. Crushing was the most common preparation method (36%), followed by powdering (19.7%). Similar results on the most commonly used method of preparing traditional medicine were found elsewhere in Ethiopia (Megersa et al. 2013; Jima and Megersa 2018; Demie et al. 2018; Eshete and Molla 2021). However, the results of Tefera and Kim (2019) showed that grinding was the most commonly used method by the locals in Hawassa Zuria District and elsewhere in the world (Hong et al. 2015).

Most important medicinal plants

Croton macrostachyus and *P. schimperi* were the most commonly cited medicinal plants used to treat human and livestock diseases. According to the results of the preference ranking, the most preferred medicinal plants for treating common colds in humans were *A. sativum* and *Z. officinale*. Ethnobotanical studies in Ethiopia reported different results on preferred medicinal plants to treat human and livestock diseases. Tefera and Kim (2019) showed that *Eucalyptus globulus* Labill. were the preferred medicinal plant to treat stomach pain among people in the Hawassa-Zuria district. *Stephania abyssinica* (Dillon & A. Rich.) Walp. was indicated as the preferred medicinal plant to treat stomach pain by the local communities of the Berbere district. According to Abebe and Teferi (2021), the preferred medicinal plant to treat rabies is *Phytolacca dodecandra* L' Her in the Hulet Eju Enese district. The various reports from the different research groups indicate that the local communities know effective medicinal plants to treat diseases.

According to the direct matrix ranking analysis, *C. macrostachyus* ranked first as the medicinal plant preferred by the local community for various purposes. *Cordia africana* and *Podocarpus falcatus* (Thunb.) Endl ranked second and third as the preferred medicinal plant. In similar studies in Ethiopia, *E. ventricosum* (Tefera and Kim 2019), *C. africana* (Abebe and Teferi 2021), and *Warburgia ugandensis* Sprague (Eshete and Molla 2021) were ranked first as the most used medicinal plant for various purposes by the local people in Hawassa Zuria, Hulet Eju Enese, and Suro Barguda Districts, respectively.

In conclusion, using plant species is important in treating human and animal diseases in Damot Woyde District. In the present study, 57 species of medicinal plants were recorded, and leaves were reported as the most commonly used plant parts for treating diseases. The number of medicinal plants recorded for treating human and livestock diseases indicates indigenous knowledge of traditional herbal medicine. Although medicinal plants are important in treating diseases, they are under threat. Among threats, urbanization, agricultural expansion, and over-harvesting are the major threats to the medicinal plants in the study area. Although the locals in Damot Woyde District have been using medicinal plants to treat diseases for a long time, it is useful to conduct toxicological tests in addition to pharmacological tests. The main focus should be on commonly used medicinal plants such as *C. macrostachyus* and *P. schimperi*.

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