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Ethnobotanical Study of Traditional Medicinal Plants in Debark District, North Gondar, Ethiopia

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***Abstract*:** An Ethnobotanical study on the medicinal plant was carried out from October to May 2017 in Debark District, North Gondar, Ethiopia. The objective of the study was to compile and document medicinally important plants in the study area. A total of 62 informants (45 males and 17 females) between the ages of 22 and 70 were selected from ten sampled Kebeles with purposive (key informants) and random sampling (general informants) techniques. Data were collected using semi-structured interviews, field observations and group discussions. The collected data were analyzed with descriptive statistics and detailed ethnobotanical analytical tools including informant consensus factor (ICF), Fidelity level (FL) and Jaccard's Coefficient of Similarity (JCS). A total of 93 plant species were collected and identified, 60 species from the wild vegetation, 27 species from home-gardens and 6 from both (wild vegetation and homegardens) that distributed in 86 genera and 51 families. From these, 50 species were recorded for the treatment of human health problems, 3 species for livestock and 40 species for the treatment of both human and livestock diseases. Herbs were found the highest plant life forms. The most frequently used plant parts were leaves (33.33%) followed by roots (15.48%). The most widely used method of preparation was crushing (20%) followed by pounding and mixing (18.40 %). Oral use was the commonest (56.67%) administration route followed by dermal use (29.63%). The most commonly used application of medicinal plant was drinking (37.57%) followed by creaming (16.76 %). Agricultural expansion, firewood collection, construction, timber, forage and charcoal preparation were reported as major threats to plants of the study area. In order to protect medicinal plants destruction and loss of indigenous knowledge, local communities could be involved in conservation and management of plant resources and their indigenous knowledge is paramount.

Keywords: Debark District, Indigenous Knowledge, Medicinal Plants, Traditional Healers

I. INTRODUCTION

1.1. Background and justification of the study

Ethnobotany is the study of the relationships between plants and people with particular emphasis on traditional cultures [1]. Ethnobotany is also defined as local people's interaction with their natural environment: how they classify, manage and use plants available around them [2]. The traditional use of medicinal plants dates back to the beginning of human civilization and they are integral part of culture of many indigenous communities in Asian and African countries [3, 4]. In Ethiopia, utilization of medicinal plant remedies plays a significant role in preventing or curing various ailments in most parts of the country [5, 6, 7]. Particularly, traditional herbal healing systems are widely practiced throughout the rural population as their primary healthcare system [8, 9]. The existence of diverse languages, cultures, beliefs and significant geographical diversity favored the formation of indeginous knowledge on medicinal plants [10]. Hence, there is enormous indigenous knowledge and associated medicinal plant species in Ethiopia [11]. It has been estimated that traditional remedies are the most important and sometimes the only source of therapeutics for nearly 80% of the worldwide population, of which 95% of traditional medicinal preparations are of plant origin [12]. Much of the knowledge on traditional medicine is available in rural communities and perpetuated by word of mouth within family or small community. However, since cultural systems are highly dynamic, these skills are likely to be lost when the communities migrate to towns or regions, or if the local ecology is significantly changed [13].

However, the high population pressure and its related consequences like increased need for agricultural land, settlement, fuel wood, house construction and income generation have led to an extreme reduction of medicinal plant in all over their ranges [14]. According to [15] the current loss of medicinal plants in the country due to natural and anthropogenic factors links with the missing of valuable indigenous knowledge associated with the plants. This strong link suggests a need to conduct ethnobotanical research to document the medicinal plants and the associated indigenous knowledge and to identify threatened plants to take appropriate conservation

measures. Therefore, the present research was conducted to document the wealth of indigenous knowledge on utilization, management and conservation of medicinal plants as well as threats to the plants in Debark District, Northern Ethiopia.

Debark has a suffered plant habitat due to agricultural expansion, firewood collection, overgrazing, construction, timber, forage, charcoal, over usage of medicinal plants and expansion of other infrastructures in the area. This causes the disappearance of medicinal plants and associated indigenous knowledge in the area. Hence, this study on medicinal plants and associated knowledge is fundamental because of no much scientific information about medicinal plants in Debark District. Therefore, this study was conducted to study the diversity and conservation status of traditional medicinal plants in Debark District to recommend appropriate conservation measures.

1.2. Objective of the study

The general objective of the study was to document medicinal plants and associated indigenous knowledge as well as their management and conservation status in Debark District, Northern Ethiopia.

The study has the following specific objectives:

- ♣ To collect and document useful plants as traditional medicine and associated indigenous knowledge in the District.
- ♣ To distinguish the plant parts used in the study area.
- ♣ To distinguish the methods of preparations of medicinal plants in the study area.
- ♣ To distinguish the conservation methods of traditional medicinal plants in the study area.
- ♣ To identify the major threats to medicinal plants.

II. RELATED WORK

In Ethiopia, there is a great geographical diversity which creates tropical, subtropical and temperate climatic condition resulted in great diversity in flora and fauna in country. This conciliation also favored the evolution of diverse disease and their causative agents. In response to this disease, Ethiopians have developed remedies that restore and enhance good health. The knowledge is based on oral traditional or information codified in early medico-religious manuscripts [16. Traditional medicinal plants, used for medicinal purposes, may have one of the following habits: herbaceous, shrubby or shrub trees, climber or any other. The traditional medicinal constituents or ingredients may be found in their leaves, seeds, flower, fruit, root, rhizomes, stems, bark, and seed-coat and so on. To get maximum benefit or medicine, there is specific season and time of the day in which active principle of plant materials would be attainable [17].

III. MATERIALS AND METHODS

Description of the study area: The study was carried out in Northern Ethiopia, Amhara Region, North Gondar Zone in Debark District. The District is situated at 13° 08' N to 13° 13' N and 37° 53' E to 37° 90' E at an elevation of 1000-4200 m a. s. l. The total area of the District is 282, 105 hectares (282.105 km^2) and comprises 33 Kebeles, 30 rural Kebeles and 3 urban Kebeles (in Debark town). The District is bordered on the South by Dabat, on the West by Tegede, on the Northwest by Tigray Region, on the North by Addi Arkay and on the East by Jan Amora. The district is crossed by the Limalimo Mountains, which form the western end of the Semien Mountains National Park. Topographically the district is 20% valley, 60% flat and 20% mountain. Agroecologically, Debark district is classified into 15% lowland (Kolla), 43% middle land (Weina Dega), 34 % highland (Dega) and 8% moist highland (Wurch).

Study sites and informants selection: Out of the total 33 Kebeles (small administrative area), in Debark District, ten were selected purposefully for ethnobotanical data collection based on the altitudinal variation, vegetation distribution and availability of traditional medical practitioners. Information about the sampled Kebeles was gathered from Kebele administration leaders, elders, religious leaders, students, and other local inhabitants. The names of sampled study Kebeles are Arba Tensa, Debark town (01, 02, and 03 Kebeles), Debir, Dib Bahir, Kino 1, Kirarena Wogemba, Miqara and Zebena (Figure.1). A total of 62 informants (About 5-7 from each Kebele) both males (45) and females (17) the age between 22-74 were selected during data collection with purposive and random samplings methods. A total of 22 key informants (20 males and 2 females) were selected with purposive sampling method based on comments and recommendations from different societal groups listed above. In addition, identified traditional practitioners were also invited to suggest other traditional practitioners. On the other hand, general informants were selected randomly using lottery methods to check indigenous knowledge sharing system within the community.

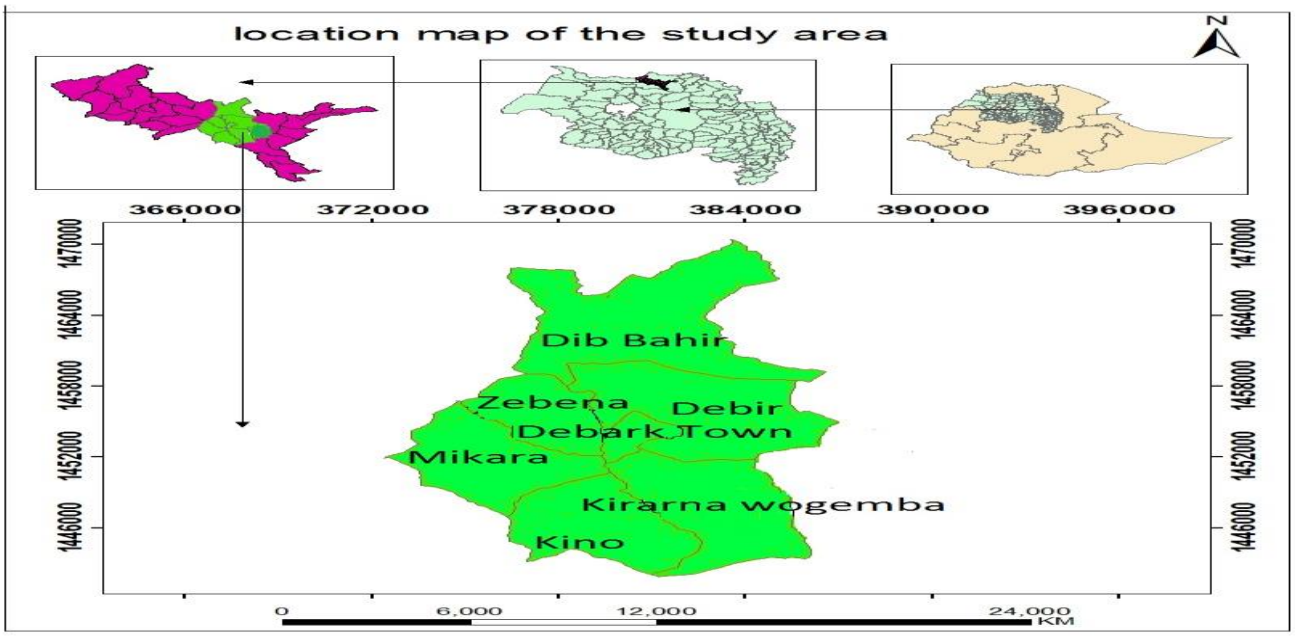

Figure 1: Map of the study area

Ethnobotanical data collections techniques and procedures: Ethnobotanical data were collected from November 2 – February 10, 2017 following the method of Martin [2, 18]. Accordingly, data were collected with guided field walks, individual and group discussions and market surveys through semi-structure interviews. All of the interviews were held based on the check list of questionnaires prepared beforehand in English language and translated into Amharic by the help of asperities. Following this, interviews and discussions were carried out with informants and key informants. Informant consensus was considered and both quantitative and qualitative data were collected following the prepared questions. The place and time for discussion were settled on the interest of the informants.

Plant specimens' collections were performed with help of guided field walks and the plant specimens were pressed and dried for voucher specimens. Identification of the plant specimens was done both in the field and later at the University of Gondar using taxonomic keys, Flora of Ethiopia and Eritrea and confirmed with taxonomists. Finally, the identified medicinal plant specimens were mounted, labeled and stored in University of Gondar as voucher specimens.

Data Analysis: A descriptive statistical methods such as percentage and frequency was employed to analyze and summarize the data on medicinal plants, use, and associated knowledge. The most useful information gathered on medicinal plants reported by local people: application, methods of preparation, route of application, disease treated, and parts used and the habit was analyzed through descriptive statistics. Facilities in MS Excel spreadsheet were utilized to make simple calculations and draw different graphs. In addition, some ethnobotanical analytical tools including fidelity level index (FL), Jaccard`s Coefficient of Similarity (JCS) and informant consensus factor (ICF) were used for data analysis.

IV. RESULTS AND DISCUSSIONS

Medicinal plants diversity and habitats: A total of 93 medicinal plants which are belonging to 86 genera and 51 families were documented from the study area. Out of these, 50 species (53.76%) were noted to treat only human ailments while 3 species (2.23%) were used to treat livestock ailments and 40 species (43.01%) were used to treat both human and livestock ailments. In terms of species composition, family Asteraceae was represented by a highest number of medicinal plants species (7 species) followed by Solanaceae (6 species), Lamiaceae and Euphorbiaceae (5 species each), and Fabaceae (4 species). Brassicaceae, Cucurbitaceae, Myrtaceae, Rosaceae and Polygonaceae (3 species each). Cupressaceae, Malvaceae, Alliaceae, Boraginaceae, Oleaceae, Myrsinaceae, Ranunculaceae, Rhamnaceae, Rutaceae and Urticaceae (2 species each). Each 31 Families were represented by only one species.

From the total of 93 medicinal plant species documented in the district, 60 species (64.52%) were collected from the wild/natural vegetation and this indicates that there is a significant harvesting pressure on the wild plant source of the study area. The remaining percent, constitute 6 species (6.45%) were collected both from cultivated and wild vegetation, whereas 27 species (29.03 %) were collected from cultivated fields (Figure 2). This is consistent with the findings of [19] that traditional medicinal plants were harvested mostly from wild vegetation followed by homegardens.

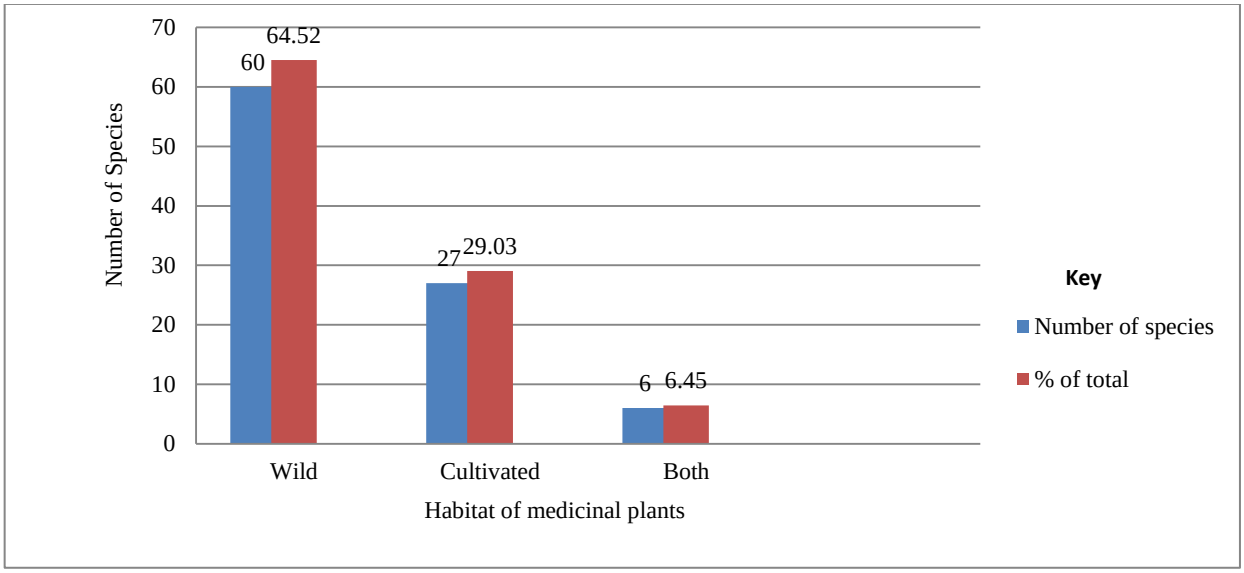

Figure 2: Habitats of medicinal plant species

Habits and parts used of medicinal plants: Out of the total 93 medicinal plants collected from the study area, 34 (36.56%) were herbs species followed by 31 (33.33%) shrubs species (Figure 3). This may be due to a high level of abundance of these habits in the study area compared to tree and climber species. Relatively high number of herbs for medicinal purpose has also been reported previously by [20-24]. The study result is in contrast with the findings of [19, 25, 26] revealed that shrubs were the most used ones.

The study showed that the widely used plant part for the preparation of the remedies in the study area were leaves 28 cases (40%) followed by roots 13 (18.57%) and seeds 9 (12.86%). Plant parts such as stem, bark, fruit, and bulb were also reported for the remedy preparations (Table 1). The findings of the study showed that the plant parts which are mostly used for the preparation of the remedies in the study area were leaves and harvesting of leaves has less impact due to some leaves are leftover on the mother plant. Fortunately, the remedy preparation that involves roots, rhizomes, bulbs, barks, stems has effects on the survival of mother plants compared to leaves. This finding is similar to the results of other ethnomedicinal studies [20, 27, 28] who had reported that leaves were the most cited plant parts used in remedy preparations. Nonetheless the study is contradicted to study conducted by [29] in Konso Special Woreda revealed that roots were the most used plant parts.

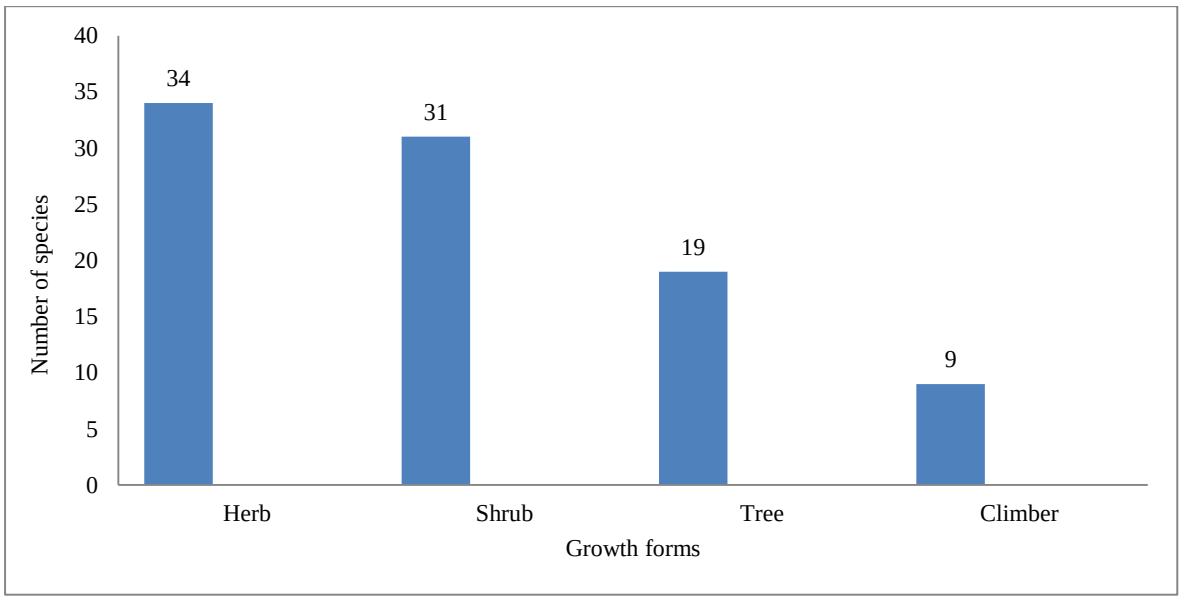

Figure 3: Growth forms of medicinal plants

Table 1: Plant parts used in the preparation of the remedies

Plant parts used	The frequency of each uses	Total frequency of uses in Percentages (%)
Leaf	28	40
Root	13	18.57
Seed	9	12.86
Root and leaf	7	10
Stem	6	8.57
Bark and fruit	4	5.71
Above ground, bulb, tuber, fruit, and seed	2	2.86
Flower, rhizome, latex, root bark and shoot	1	1.43
Total	**70**	**100**

Mode of preparation and route of administration: Concerning the preparation of traditional medicine, the local people of the study area employed various methods of preparation of traditional medicines to treat different types of ailments. The principal method of traditional medicine preparation reported was in the form of crushing 25 (20%) followed by pounded and mixed 23 (18.4%) (Table 2). This is due to the effective extraction of the plant gives immediate response for health problems when crushed or pounded to increase its curative potential. The result of the present study is in consistent with the findings of [25] in which crushing is highly reported method of remedy preparation. But it is disagrees with the report of [30] which revealed that squeezing is the most used preparation method of different medicine preparations.

The most widely used route of administration was oral accounted for 153 (56.67%) followed by dermal 80 (29.63%) (Table 2).This is the reason that oral and dermal routes permit rapid physiological reaction of the prepared medicines with the pathogens and increase its curative power. This finding agrees with some previous reports in Ethiopia like work of [25, 25, 31].

Table 2: Mode of preparation and route of administration

Forms of preparation	Total preparation	% of total	Route of administration	Remedy counts	Percent (%)
Crushing	25	20	Oral	153	56.67
Pounding and mixing	25	18.4	Dermal	80	29.63
Pounding and powdering	23	17.6	Nasal	19	7.04
Squeezing	21	16	Optical	6	2.22
Chewing	18	14.4	Auricular	5	1.85
Pounding and squeezing	6	4	Nasal and oral	4	1.48
Decoction	5	4	Neck	3	1.11
Cooking	2	1.6			
Total	**125**	**100**		**270**	**100**

Ways of applications and dosage of plant remedies: The prepared traditional medicines were applied in a number of methods, among which drinking (37.57%), creaming (16.76%), and eating (10.40%) were mentioned (Figure 4). This finding is consistent with the finding of [27, 31] in which drinking accounted the largest percentage of remedy taking methods.

The dosage of medicine to be administered is given by estimating age, the physical condition of the patient and the severity of the diseases. Amounts to be administered is also estimated by the use of measurements such as length of a finger (for bark, root and stem length), pinch (for powdered plant material) different measuring materials (e.g. spoon, coffee cup, tea cup and glass cups) and number count (for sap/extract drops, leaves, seeds, fruits, bulbs, rhizomes and flowers). But these measurements are not accurate enough to determine the precise amount to be given for patients. Some of the medicinal preparations are reported to have adverse effects on the patients. Informants reported that *Hagenia abyssinica, Phytolacca dodecandra* and some others are found to have adverse side effects like stomach pain, vomiting and diarrhea. The informants recommended additives for some of these adverse side effects, such as drinking of milk and barley soup immediately after intake of medicines that are prepared from aforementioned medicinal plants.

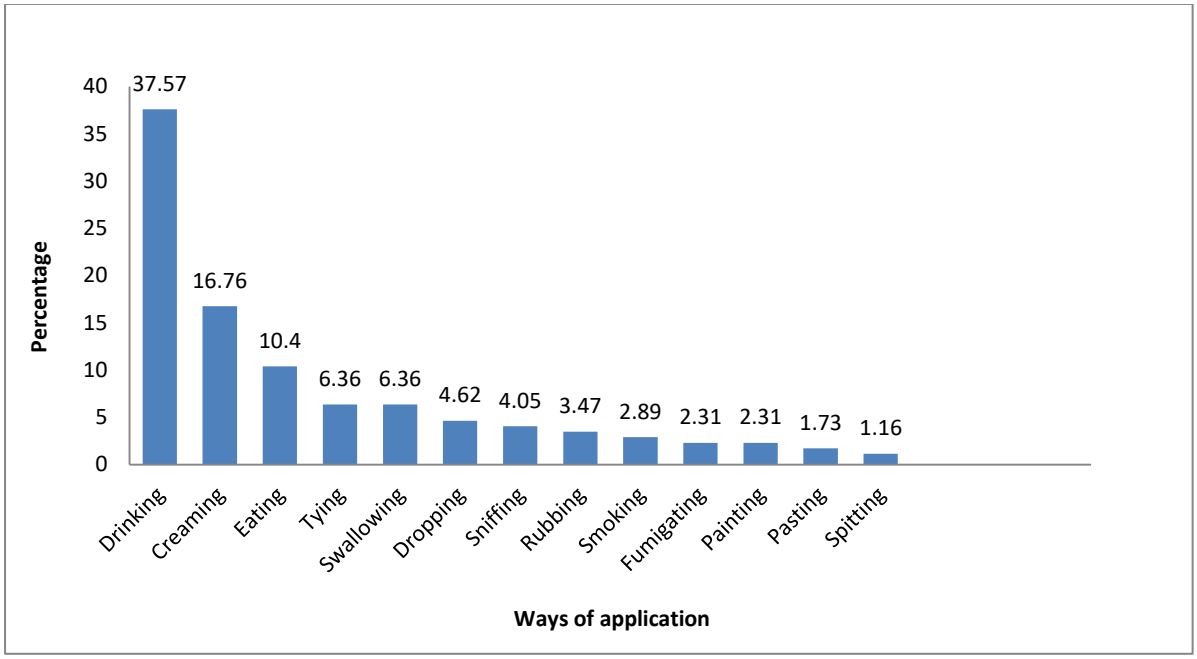

Figure 4: Application ways of remedies for human and livestock ailment treatment

Informant consensus factor (ICF): The results of the study showed that diseases that are frequent in the study area have higher informant consensus factor. It is further shown that medicinal plants that are effective in treating certain diseases and well known by community members also have higher ICF values. Accordingly, plants against fibril illness have high ICF scoring 85% followed by plants against tapeworm scoring 78% (Table 3).

Table 3: The top Informant Consensus Factor (ICF) for some diseases

Aliment treated	nt	nur	%	ICF	% ICF
Fibril illness	7	41	66.13	0.85	85
Tapeworm	5	19	30.65	0.78	78
Leech	6	19	30.65	0.72	72
Evil eye	10	27	43.55	0.65	65
Malaria	14	37	59.68	0.64	64
Tonsillitis	9	22	35.48	0.62	62

Jaccard`s Coefficient of Similarity (JCS): The results of the comparison by using Jaccard coefficient of similarity indicated that the highest degree of similarity was observed with the study conducted by [19, 24, 24, 32]**.** The least similarity was linked with the study conducted by [30] (Table 4). According to [31] the highest degree of similarity observed between two or more study areas is due to socio-cultural factors that could contribute to the medicinal plant knowledge base of people or the nearness to each other of the study area. In contrast, the lowest degree of similarity might be due to vegetation difference of the two study areas and cultural difference of the two groups of people.

Table 4: The Jaccard coefficient of similarity of Debark District with five other areas with respect to medicinal plant composition.

Sample area	a	b	c	JCS%	Sources
Debark District	93	-	-	-	
Jigjiga District	50	26	24	20	[28]
Jima Rare District	82	46	36	28	[26]
Melka Belo District	66	32	34	27	[22]
Minjar-Shenkora District	118	66	52	33	[17]
Seru District	121	65	56	35	[30]

Fidelity level index (FL): Fidelity level values were calculated for some commonly used medicinal plants against some commonly reported ailments. The top known plants species are: *Zehneria scabra*, *Allium sativum*, *Ruta chalepensis*, *Phytolacca dodecandra*, *Hagenia abyssinica*, *Achyranthes*, *Justicia schimperiana* and *Echinops kebericho* (Table 5). The medicinal plants that are widely used by the local people to treat one ailment have higher FL values than those treated more than one ailment [33]. For example, *Zehneria scabra* was reported by many informants to treat fibril illness and hence, it had 95% FL. High FL could also be an indication of the efficiency of the reported plant to cure the specific ailment.

Table 5: Fidelity Level Index some medicinal plants

Plant species	primary use for	Ip	Iu	FL	FL%
Zehneria scabra	Fibril illness	58	61	0.95	95
Allium sativum	Malaria	46	50	0.92	92
Ruta	Stomach-ache	42	45	0.93	93

chalepensis					
Phytolacca dodecandra	To stop pregnancy	31	35	0.89	89
Hagenia abyssinica	To expel tape worm	28	31	0.90	90
Achyranthes aspera	Body swelling	23	29	0.79	79
Echinops kebericho	Evil eye	18	22	0.82	82
Justicia schimperiana	Cocoidiosis	15	18	0.83	83

Threats to medicinal plants: The cause of threats to medicinal plants in the study area can be grouped into natural and anthropogenic factors. Mostly, anthropogenic factors affect the medicinal plants in the area are: agricultural expansion, firewood, charcoal preparation, timber, construction woods, medicinal plants trade for different uses and others are contributing factors to the loss of plant species in general and medicinal plants in particular. Similar findings were also reported in Ethiopia by [25, 27, 31] that showed that, the need for agricultural land and for other uses severely threatened plant species in general and medicinal plants in particular. Likewise, natural causes include prolonged drought and wildfire is also well-known causes in the study area. According to the traditional healers, nowadays searching for medicinal plants require a long time and moving long distance even going to a neighboring country (e.g. up to Eritrea and Sudan) to collect desert and lowland grown medicinal plants.

Conservation of medicinal plants and associated knowledge: Local people of the area know the importance of conserving the plants in both ex-situ and in-situ conservation methods. For instance, some people have started conserving the plants in fenced/protected pasture land; in different worship areas (churches, mosques) in their farms' field/farm margins and around their home gardens and live fences of the famers. Getnet Chekole and Nigussie Amsalu have also reported that different worship areas are conservation sites for remnant vegetation in general and medicinal plants in particular [23, 35].

For instance, medicinal plants like *Juniperus procera*, *Olea europaea* subsp.*cuspidata* and *Euphorbia abyssinica* are found in church forest and also plants like *Hagenia abyssinica*, *Ocimum urticifolium* and *Ruta chalepensis* are found in the majority of homegardens in the study area, as they need these plants in their daily life as spices, medicine or for other values. Plants such as *Acacia abyssinica* and *Cordia africana* are also left as remnants of forest in the agricultural field due to their uses as timber source, for construction and fuel wood.

V. CONCLUSION AND FUTURE SCOPE

The ethnobotanical study of medicinal plants in Debark District showed that medicinal plants are used by a large number of the population and it is the most important means of treating some common human and livestock ailments**.** All of the medicinal plants of the study area were collected and identified by their taxonomic features. Whereas herbs and shrubs are most growth forms of medicinal plants of the study area and even all plant parts were used for preparation of different remedies. However, the use of medicinal plants for multiple purposes is leading to depletion in an alarming rate. This is worthy because of some of the uses (Agricultural expansion, firewood, construction, forage, charcoal.) are the major destructive. The results of this study also showed that cultivation of plant species in and around home gardens for different purposes have great contribution to the conservation of medicinal plants and the associated knowledge.

Based on the results of the study, the following future scopes are forwarded.

- Integrated conservation and management program on medicinal plants focused on awareness development and active involement of local community, governmental and non gevrmental bodies shall be practiced in the District.
- Avoid uprooting of the plant species for medicinal purpose particularly before its flowering, fruiting and/seeding. If possible, it is better to use other parts of the medicinal plants such as leaves instead of root to protect them from the risk of extinction and endangering the species by collecting the roots or barks of the plants.
- Establishing traditional healers associations by providing supports like giving cultivation land, providing funds and assistances for cultivations of medicinal plants in the District would help to conserve medicinal plants.
- Further phytochemical investigation should be carried out on top important medicinal plants of the study area.

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