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ORIGINAL RESEARCH ARTICLE

Ethnobotanical Study of Traditional Medicinal Trees and Shrubs Used to Treat Human and Livestock Aliments in Metema District, Amhara Regional State, Ethiopia

Getinet Masresha[a*], Yirgalem Melkamu[b], Getnet Chekole[c]

Department of Biology, University of Gondar, Ethiopia, P.O. Box. 196, [a]danieloct9@gmail.com; [b]melkamuy12@gmail.com; [c]gchekole1@gmail.com

* Corresponding author [a]danieloct9@gmail.com
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Abstract

In Ethiopia, the use of traditional plant medicines has been practiced since ancient times and the bulk of the medicinal plants were collected from natural vegetations. However, the natural vegetation of the country are on the verge of disappearance due to environment degradation and overuses. To save the endangered indigenous medicinal plants, a study was carried out in Metema District with the objective of identifying and documenting trees and shrubs that have traditional medicinal values to the local people with the associated indigenous knowledge. Eight sample Kebeles were selected purposively based on vegetation and availability and access to to key informants. Forty eight key informants and 80 general informants were selected purposively and randomly respectively. Ethnobotanical data were collected using semi structured interview questionnaires, guided field walks, market survey, direct observation and focus group discussion. Data were verified and analyzed using informant consensus, informant consensus factor, simple preference ranking, and fidelity level. Descriptive statistics was also used. A total of 40 traditional medicinal plants which are used to treat 52 human and livestock aliments were recorded. These plants are grouped under 31 general and 23 families. Out of these families, Fabaceae is the dominant family (17.5%) followed by Combretaceae (15%). Leaves were the main plant parts used for medicinal values, and their fresh forms are the most remedy preparation conditions. Crushing and dermal route were the major remedy preparation methods and administration ways respectively. In general, Metema District is rich with trees and shrubs that are used for many health care values to the local community. So, prior conservational practices should be conducted in the area, and there must be a great consensus between the traditional knowledge and the scientific world.

Keywords: Indigenous knowledge, Metema District, Traditional medicinal plants, Trees and Shrubs

INTRODUCTION

In Ethiopia, the use of traditional plant medicines had been practiced since ancient times (Tesfaye*et al*., 2009).Its great geomorphologic and topographic features (Bekele, 2007), make the country to be endowed with highest medicinal plants diversity (Bekele, 2007; Mekuanent *et al*., 2015). This availability of lants diversity situation, led Ethiopians to attempt to come up with remedies or to practices to restore or enhance good health care against to diseases (Tigist *et al*., 2006). The majority of the rural population traditionally use many plants as sources of medicine for humans and livestock disease (Tesfayeand Sebsbe, 2009). About 80% of Ethiopian people and 90% of their livestock treatment depend on traditional medicine for their health care. Furthermore, more than 95% of traditional medicine preparations are made from plant origin (WHO, 2002; Muluken *et al*., 2018).

In Ethiopia, the majority of the medicinal plants are collected from natural vegetations (Bekele, 2015). However, nowadays, natural vegetations are decreasing in type and variety due to environment degradation and overuses (Alemayehu, 2002). Therefore, it is necessary to made scientific documention of medicinal plant species for conservation and sustainable consumption as Martin (1995) and Cotton (1996) stated. In addition to identifying medicinal plants, documenting their uses and assessing the threats could also create a base for local decision making. These can be done by applying appropriate management, conduct detail pharmacological analysis and increasing the capacity of pharmaceutical industries (Bekele, 2015; Mekuanent *et al*., 2015).

Metema district was selected for the study because it is one of the districts in the country where there is no ethnobotanical study on traditional medicinal plantsis conducted. In addition to this, the general vegetation of the district and the associated traditional medicinal plant practice is being reduced from time to time due to different factors. So, an urgent ethnobotanical study in the district is very necessary to fill the gap between local peoples' traditional knowledge and that of the scientific world on the use of trees and shrubs for their medicinal values. Thus, this study was initiated with the objectives to (i) identify locally grown trees and shrubs used for traditional medicine (ii) document medicinal plant parts used, way of preparation and routs of administration (iii) identify the factors that threaten medicinal plants.

Material and Methods

Description of Study Area

Metema District is located in 180 km west of Gondar town, West Gondar Zone of Amhara Regional state about 900 Km Northwest of Addis Ababa. According to the Metema District Office of Agriculture (MDOA, 2005), the total area of the District is about 440,0000 hectare. The District is predominantly rural encompassing 1 town and 17 rural kebeles (Fig.1). The District shares more than 60 Km international boundary with Sudan.

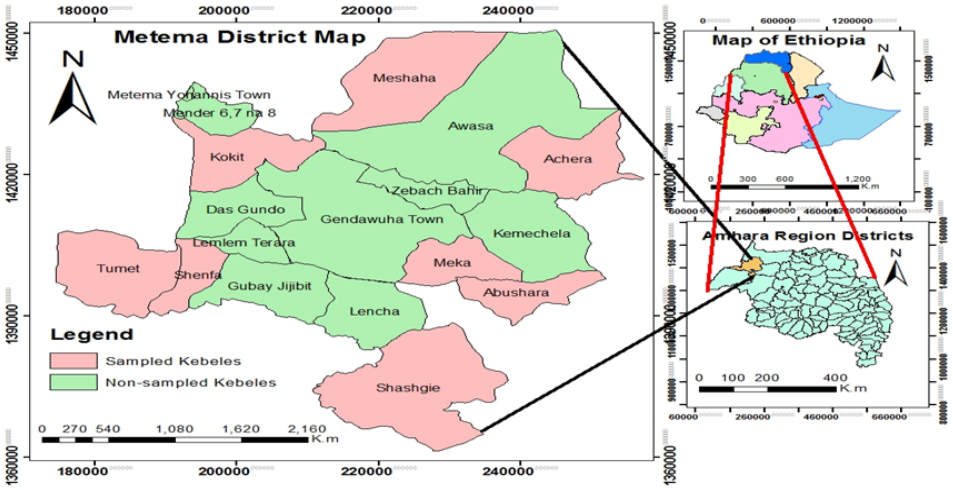

Figure1. Map of Metema District (Woreda)

According to the Central Statistical Agency (CSA, 2007) of Ethiopia, Metema District has a population of 110, 231. It is the home of many ethnic groups including: Amhara, Agaw, Kimnat, Tigrie and Oromo migrated from the different angles of the country for different reasons and the Gumuz people. Thes hetrogenous populations interact in their daily routins displaying a diversity of cultures and indigenous beliefs (IPMSP Team, 2005). Most of the groups are now indigenous to the area since they live in the area for many years as Martin (1995) described.

The altitude of Metema District ranges from 550 to 1608 m above sea level (Dereje, 2014). Nearly all of the land in the District is in the lowlands with hot climatic condition which is traditionally classified as *Kolla* with hot climate (Dereje, 2014).Meteorological data from the National Meteorological Agency Bahir Dar Branch recorded from the period 1999 to 2018 (Fig. 2) showed that the mean annual temperature of the study area is about 26.2^0C, ranging from amean minimum of 15.7^0C to mean maximum of 41.0^0C. The mean annual rainfall of the area is 1008 mm with unimodal rainfall pattern.

The soils in the area are predominantly black and some are soils with vertic properties (IPMSP, 2005). Seasonal rain fall, especially during the heavy rainfall months is so high. The soil in this area is fertile and highly productive when rain fall is minimal. The natural vegetation of the district predominantly composed of *Combretum-Terminalia* broad-leaved deciduous woodland type with different *Acacia* species and a lot of *Hyparrhenia* grass underneath (IPMSP Team, 2005). Metema is one of the Districts where gum and incense is collected. The main species for incense production is *Boswellia papyrifera* whereas *Acacia siberiana* and *Acacia seyal* are used for gum production (IPMSP Team, 2005: Fasil, *et al*., 2018). Farmers in the District extensively cultivate sesame, cotton and sorghum and raise mainly goats and cattle.

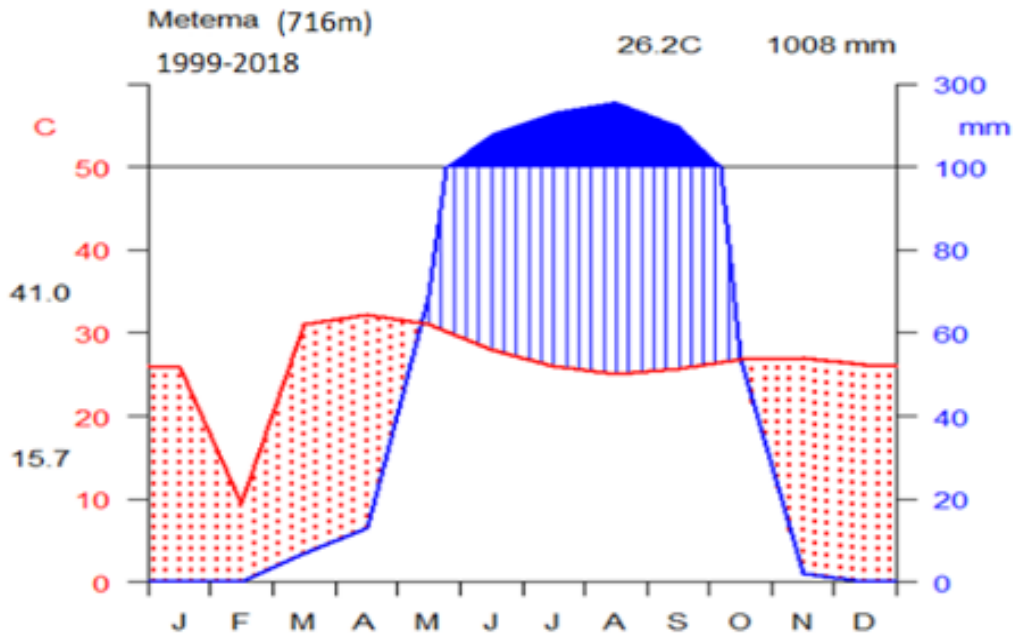

Figure2. Clima diagram of Metema District from 1999-2018 (Data source: National Meteorological Agency from 1999-2018)

Sampling Techniques

Reconnaissance survey was done in July, 2018 in Metema District to identify study sites and to collect general information about the study area. During the survey, information about the study area was gathered from Metema District administration officials, Agricultural officials, and health center officials, inhabitants, and key informants. According to the information received from reconnaissance survey, eight Kebeles were selected for sample sites purposively based on vegetation availability and access to residents and key informants. Following Martin (1995), a total of 80 general informant (10 informants per Kebele) who lived in the Districts for more than 20 years were selected using systematic random sampling to understand knowledge of the local people who are not herbalists. The sampling was taken from 12th household intervals targeting one individual with a better traditional medicinal practice. Forty eight key informants (6 informants per Kebele) who are known by their traditional medicinal knowledge in the community were also selected using purposive sampling techniques. During sampling, all ethnic groups were considered even though knowledge difference among the groups was not undermined. In addition, one field assistant from agricultural office who is resident to the area and knew the total environment of the district was also selected in order to facilitate the field visit in addition to the key informants.

Ethnobotanical Data Collection Methods

The overall data collection was carried out from August to November, 2018. To confirm the validity and reliability of information, a second round contact with key informants was performed in December, 2018 after reaching an agreement. As a result, only the responses of an informant which were equal with the former ones were taken. As described by Martin (1995) and Coton (1996), individual interviews, guided field walk, market survey, direct observation and focus group discussion using semi-structured questions with key informants were used.

The interviews focused on local names of valuable trees and shrubs, habitats, medicinal roles, plant parts used, collection, preparation, rules of administration of the remedy and marketability. Source of knowledge and ways of knowledge transfer were also the major parts of the interview points which were targeted. (Martin, 1995; Balik and Cox, 1996; Cotton, 1996). Threats against the existing traditional medicinal trees and shrubs were also under consideration.

Focus group discussions were also done with key informants to get additional information, and to check the reliability of data taken from each informant. Genrally, in order to get secreted and sensitive information like medicinal plant preparations, individual interview was also used since the informants need to keep this as secret. Availability of the plants in the area, habit and habitat of the plants were checked with guided field walks. Furthermore, sample specimens for identification were collected in open. Market survey which were conducted in each sample Kebele towns in order to cheek the presence of open market system for traditional medicinal plants. In each movement of data collection, hand notes have been taken. All trees and shrubs which are available only in the study area, and which have traditional medicinal values were recorded with their vernacular and botanical names.

Ethnobotanical Data Analysis

The ethnobotanical data were analyzed using Microsoft Office Excel Spreadsheet (2007). Descriptive analysis was used to calculate sum, percentages, tabulate, rank and draw graphs. Ethnobotanical data ranking and scoring methods (Analytical tools) like pair-wise comparison, preference ranking, informant consensus factor, fiedelityvalueand informant consensus were used like the previous authors (Martin, 1995; Balik and Cox, 1996; Cotton, 1996) to check consistency and priority. Pair-wise comparison was applied on six most commonly used trees and shrubs which are acclaimed to treat wound which is a common aliment in the area and believed to be treated by many number of plant species (Appendix 1). All possible pairs developed by using the formula; **n(n-1)/2** where n is the number of medicinal plant species being compared. we used, preference ranking was also used on seven trees and shrubs known for their value to treat febrile illness which is the most frequently reported problem during data collection. Informant consensus factor for ten disease categories was applied to understand knowledge homogeneity among informants for each disease category. This was done by using the formula ICF = Nur – Nt / (Nur – 1) where, nur is the number of uses reported in each category and Nt is the number of species reported in

each category. Fiedelity value was used for more than thirty times reported spcies to check their curaility to treat a specific aliment following Friedman *et al*. (1986). Informant consensus was also used to check the most ten commonly used trees and shrubs by the local community. Individuals for the analysis were selected from the total 48 key informants and analysis was performed.

Results and Discussion

Trees and shrubs with traditional medicinal values in the District

A total of 40 traditional medicinal plants belonging to 31general and 23 families were recorded in the study area (Appendix 1). Many numbers of species were documented from different areas of the country than in the current study area (Tigist *et al*., 2007; Zewdie, 2009; Mekuanint *et al*., 2015; Tilahun, 2017). A few number of plants (23) were also reported by Assegid and Tesfaye (2014). This might be because of the difference in the number of plant species used for traditional medicines across the local communities. Trees accounted for much proportion (29, 72.5%). But, the above cited researchers identified much number of shrubs than trees which might be due to differences in plant habit distribution in which trees are the most distributed plant habits in Metma District unlike the areas studied by the above authors.

Fabaceae has high proportion of medicinal plant species (7 species) followed by Combretaceae and Moraceae (6 and 4 species) respectively. Meliaceae, Euphorbiaceae and Rhamnaceae were represented by two species each, and the remaining 17 families have one species each (Appendix 1). Dominance of Fabaceae was also observed in previous similar studies in Ethiopia (Tesfaye *et al*., 2009; Mekuanent *et al*., 2015; Tilahun, 2017; Assegid and Tesfaye, 2014), and it was the second dominant family in Getnet *et al*. (2015) along with other families. This might be due to high adaptation ability of the species within this family (Alemayehu, 2017). From the total identified species, 12, 19 and 3 species were recorded in the findings of Tigist *et al*. (2007), Mekuanent *et al.* (2015) and Assegid and Tesfaye (2017), respectively. As indicated above, consistency on medicinal plant species is observed in the study conducted by Mekuanent *et al. (*2015) and the current study than with others studies even if all are conducted in arid and semi-arid regions. This might be due to the proximity and environmental conditions of the two districts (Metema and Chilga) that contributed to have common plant species and sharing of indigenous knowledge.

Ethnobotanical Data Ranking and Scoring

Informant consensus of ten most frequently listed plant species showed that *Withtania somnifera* is the most widely used medicinal plant with 78.91% informant agreement while *Acacia polyacantha* and *Ziziphus spina-christ* ranked last with 17.19% informant agreement (Table 1). First ranking of *Withtania somnifera* indicated that this species is very crucial and efficacious for its medicinal values. In contrary, its recent distribution in the area is very rare according to the primary data taken from the informants. As Tesfaye and Sebsebe (2009) reported, the more use values of a plant has, the more frequently it is used and this leads to its depletion in the area.

Table 1. Informant consensus on ten most frequently used medicinal trees and shrubs

Scientific name	Ailment acclaimed to be treated	No. of Reports	Per-centage	Rank
Withtania somnifera	Febrile illness, abdominal dryness common cold, diarrhea, evil eye, evil spirit, sun strike and typhoid	101	78.91	1st
Moringa stenopetala	Common cold, abdominal pain, hypertension, diabetes mellitus, cough, headache, and Cancer	76	59.36	2nd
Tamarindus indica	Abdominal pain, intestinal parasite, typhoid and dyspepsia	41	32.03	3rd
Grewia ferruginea	Dandruff, delaying placenta and intestinal parasite	31	24.22	4th
Stereospermum kunthianum	Bleeding and wound	29	22.66	5th
Terminalia brownie	Hepatitis, abdominal bloating and ecto- parasite	27	21.09	6th
Ximenia americana	Abdominal pain, febrile illness , wart, wound, scorpion bite, snake bite, and calf warm	25	19.53	7th
Balanites aegyptiaca	Abdominal pain, febrile illness amoebic dysentery, mumps, skin infection and anthrax	23	17.97	8th
Acacia polyacantha	Wound and evil eye	22	17.19	9th
Zizipus spina-christ	Eye disease, LFIE, wound and abdominal pain	22	17.19	9th

In addition, ICF analysis was done for ten different disease catagories. Diseases were grouped based on their similarity as indicated by health experts. The highest percentage (96%) of ICF was linked to problems associated with hypertension, diabetes and bleeding. Even if the value is higher, relatively the least (75%) ICF was associated with bone fracture and rheumatism (Table 2). The study result of Abiyu *et al*. (2014) showed similar ICF rank for emergency disease. According to Heinrich (2000) and Gazzaneo *et al*. (2005), when information is exchanged between informants or there is a well-defined selection criterion in the community, ICF approaches to one. So, this result analysis indicated the presence of higher information exchange between (among) the communities in the Districts about medicinal plants. As well, the diseases could also common in most members of the community and the indigenous knowledge shared to cure the aliments.

Table 2. ICF value for eleven ailment categories

Ailment category	Nt	% of total MPT	Nur	% of total citations	ICF value
Hypertension, diabetes and bleeding	4	4.82	83	11.66	0.96
Emergency diseases (febrile illness , asthma, sun strike, fever, cough, headache, tonsillitis)	10	12.05	140	23.31	0.94
Gastrointestinal diseases (abdominal pain, abdominal dryness, abdominal bloating, amoeba, intestinal parasite and dyspepsia, typhoid, diarrhea)	12	14.46	137	11.66	0.92
Spiritual diseases (evil eye, evil spirit somnambulism and epilepsy)	8	9.64	60	8.43	0.88
Livestock diseases (calf warm, anthrax, ecto-parasite, delaying placenta and poultry disease)	6	7.23	39	5.48	0.87
Organ diseases (eye disease, toothache mumps, hepatitis)	10	12.05	57	7.72	0.84
Dermatological diseases (wound, dandruff, wart, LIFIE, LIKFT, QUA-QUCHA, eczema, allergy, scabies, impetigo and skin infection)	15	18.07	83	11.66	0.83
Cancer, tumor and under weight	5	6.02	22	3.09	0.81
Spider, snake and scorpion bites and poisons, malaria	10	12.05	64	5.06	0.86
Bone fracture and rheumatism	3	3.61	9	1.26	0.75
Total	**83**	100	**694**	100	

Fidelity value result for more than 30 times reported diseases revealed that *Acacia seyal* for evil eye, *Flueggeavirosa* and *Combretumsp* for hepatitis and *Stereospermum kunthianum* for bleeding had 100% fidelity level. From this, it is possible to understand that these plant species are used only for the treatment of a single disease. *Polygala persicariifolia* had the second highest fidelity value (81.25%) for the treatment of febrile illness while *Withtania somnifera* and *Ximenia americana* had the lowest (4% each) fidelity value for the treatment of evil eye and abdominal pain respectively (Table3). This means, the latter two species (*somnifera* and *Ximenia Americana*) are used for the better treatment of other disease types than they do for evil eye and abdominal pain treatments respectively. However, this does not mean that they are not efficacious.

Table3. Fidelity value of traditional medicinal trees and shrubs for more than 30 times reported ailment

Ailment treated	Medicinal plants	Np	N	FL (%)
Febrile illness	*Polygala persicariifolia*	13	16	81.25
	Ficuss cycomorus	15	20	75
	Carissa spinarum	13	19	68.42
	Cordia africana	10	19	52.63
	Ximenia americana	11	25	44
	Balanites aegyptiaca	9	23	39.13
	Withtania somnifera	21	101	20.79
Abdominal pain	*Tamarindus indica*	28	41	68.29
	Anogeissus leiocarrpa	6	14	42.86
	Acacia siberiana	6	15	40
	Zizipus spina-christ	7	21	33.33
	Moringa stenopetala	15	76	19.74
	Balanites aegyptiaca	4	23	17.39
	Ximeniaamericana	1	25	4
Evil eye	*Acacia polyacantha*	7	7	100
	Acacia polyacantha	13	22	59.09
	Ziziphus abyssinica	8	19	42.11
	Ficus sur	7	21	33.33
	Carissa spinarum	6	19	31.58
	Polygala persicariifolia	3	16	18.75
	Withtania somnifera	4	101	4
Wound	*Calotropis procera*	13	17	76.47
	Ficus thonningii	8	16	50
	Acacia polyacantha	9	22	40.91
	Stereospermum kunthianum	11	29	37.93
	Citrus lemon	1	3	33.33
	Zizipus spina-christ	7	21	33.33
	Ximenia americana	8	25	32
	Sida cuneifolia	3	19	15.79
Diabetes	*Moringa stenopetala*	42	76	55.26
Hypertension	*Moringa stenopetala*	42	76	55.26
Hepatitis	*Flueggea virosa*	2	2	100
	Combretum sp.	2	2	100
	Acacia seyal	4	4	100
	Terminalia brownie	21	27	77.78
	Combretum aculeatum	6	10	60
	Cordia africana	7	19	36.84
Intestinal parasite	*Tamarindus indica*	30	41	73.17
	Grewia ferruginea	3	31	9.68
Bleeding	*Stereospermum kunthianum*	29	29	100
	Sida cuneifolia	3	9	33.33

Number and type of aliments and associated traditional medicinal trees and shrubs

From the total recorded medicinal plants, 24(60%) of the species were reported as remedies for only human ailments and the rest 27.5% and 12.5% used for livestock and for both ailments respectively. All these recorded species are used for the treatment of 52 types of health problems out of which the majorities (34, 65%) of the aliments were for human health problems, and the rest 13% and 5% aliments are used for livestock and for both human and livestock aliments respectively.This proportion is consistent with the results of most studies (Zewdie, 2009; Abiyu *et al*., 2014; Assegid and Tesfaye, 2014; Mekuanen*et et al*., 2015). From these studies, we concluded that in Metema District and many other areas of the country, indigenous people had more traditional ethnomedicinal knowledge and practice for human health problems than for livestock aliments.

From the total health problems, many number of plant species (eight) were reported to treat wound) followed by abdominal pain, evil eye and febrile illness (treated by 7 species each) as indicated above in fidelity value analysis (Table 3).This indicated that many plants in the area produce chemicals having antibiotic effects for microbes growing on the wound rgion. *Withtania somnifera* is used to treat many number of aliments (8) followed by *Ximenia americana* and *Moringa stenopetala* which are used to treat seven disease types each (Appendix 1).This might be due to the production of different secondary metabolites which have their own antibiotic effects for different pathogens.

Plant parts used and conditions of remedy preparation

A total of 109 preparation types were reported for the treatment of different ailments (Appendix 1). The result showed that leaves were the most frequently used plant parts (for 44 preparations, 40.37%), followed by roots and stem bark (17, 15.60% each) (Fig. 3). This is consistent with many similar studies that leaves were the most frequently used plant parts (Tesfaye *et al*., 2009; Zewdie, 2009; Abiyu *et al*., 2014; Getnet *et al*., 2015; Asfaw and Tarekegn, 2017; Tilahun, 2017). In contrary to this, some other studies indicated that roots were the most widely used plant parts (Fisseha *et al*., 2009; Assegid and Tesfaye, 2014; Mekuanent *et al*., 2015). According to the emic perspectives of the indigenous people of current study area, leaves are highly efficacious (FTUN in Amharic) than other plant parts. This efficacious nature of the leaves could be because of the availability of high amount of plant secondary metabolites on this part of the plant which has high antibiotic effects against pathogens. This may be be directly related to the type of plant species grown in the area.

Results from conditions of remedy preparations indicated that the majority 84 (77.06%) of plant remedies were prepared from fresh plant parts while 16.5% and 6.4% are prepared from dried and fresh/ dried plant parts. Similar results were documented in other studies (Tesfaye *et al*., 2009; Abiyu *et al*., 2014; Getnet *et al*.,

2015; Mekuanent *et al*., 2015). The reason why fresh plant parts is widely used could be due to loss of volatile secondary metabolites when plant parts are dried or cooked. The volatility property of the chemicals evaporated after plants are cut and dried which lead the loss of active constitutes (Wei *et al*., 2020; Jamloki *et al*., 2021).

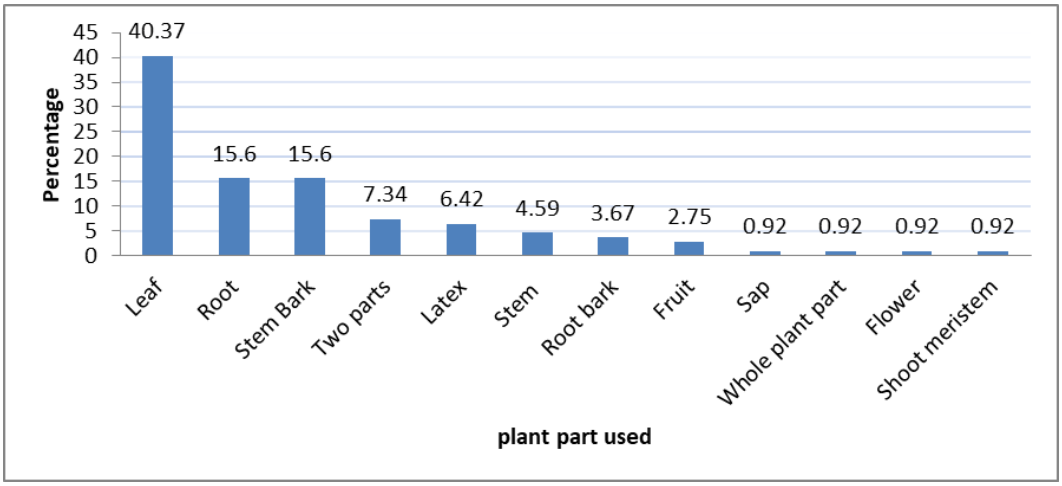

Figure 3. Percentage of plant parts used in remedy preparation

Modes of remedy preparation and routes of administration

Indigenous people of Metema District practiced a total of 23 types of remedy preparation methods. From these, crushing is the main method of preparation (26.6%) followed by squeezing 11.93% (Table 4). Other studies at different parts of Ethiopia also showed similar results (Abiyu *et al*., 2014; Assegid and Tesfaye, 2014; Getnet *et al*., 2015; Tilahun *et al*., 2017). In crushing method of preparation, all components of the plant parts on use are used as remedy. This enables all available chemicals to be used without any residue, and it increases the efficacy. This might be the reason why crushing is the most widely used preparation method.

Most of the remedies (87.16%) are prepared from a single plant species while the rest (12.84%) are prepared from combinations of two or more than two medicinal plant species (Appendix1). Getnet *et al*., (2015) reported similar finding. This indicated that a single plant species could produce chemical metabolites which are strong enough to provide relief. Out of the 87.16% of remedies prepared from a single plant species, 13 (13.68%) are prepared and used with tea, coffee, honey or milk as ingredients.

Prepared remedies are administered mostly through dermal route (43, 39.45%) followed by oral route (39, 35.78%). Other routes have lower administrations (Table 4). But, other reports showed that dermal route is the second frequently used administration route next to oral route (Tesfaye *et al*., 2009; Zewdie, 2009; Getnet *et al*., 2015;

Asfaw and Tarekegn, 2017). This might be related to the type of diseases occured around that area which is also supported by ICF result shown in Table 2.

Table 4. Modes of preparation and routes of administration

Mode of preparation			**Route of administration**		
Mode	preparations number for each	Percentage (%) for each	Route	preparations number / route	Percentage (%)
Crushing	29	26.60	Dermal	43	39.45
Squeezing	13	11.93	Oral	39	35.78
Boiling; Crushing and dilution	8	7.34	Nasal	18	16.51
Chewing; Powdering and boiling; Latex collection; Crushing and squeezing	6	5.50	Oral and dermal	2	1.83
Unprocessed	4	3.67	Teeth catching	2	1.83
Boiling/squeezing; Burning and fumigating; Squeezing/ chewing	3	2.75	Oral and nasal	2	1.83
Ash collection; Burning and rubbing; Heating	2	1.83	Auricular &oral	1	0.92
Cooking; Crushing and boiling; Crushing and infusion; Crushing, burning and fumigating; Diluting; Eating; Infusion; Soaking, crushing and boiling	1	0.92	Optical	1	0.92
Total	**109**	**100**	Dermal &nasal	1	0.92
			Total	**109**	**100**

Collection of medicinal plants

Traditional medicinal plant practitioners in the study area collect the plants during: morning time before sun rises, mid day time, night time after the sun sets on Wednesday and on Friday, or at any time when they need. This is similar with the report of Getu (2017). Based on their emic perspectives, practitioners collect those remedies based on their perception in order to keep the efficacy. The logic behind this might be the difference in chemical composition and amount of metabolites within that plant at the specific time of collection. Li *et al*. (2018) reported that concentration of plant secondary metabolites is dependent on different environmental conditions including temperature and also they indicated the volatility nature of the metabolites. This implied that some chemical metabolites of the plant would be more concentrated at some time of the day and less concentrated at another time of that day as reported by Jamloki et *al*., (2021). Practitioners mostly collect plant

materials at three, five or seven places to increase their efficacy as the deduction of the herbals. Similar result was reported by Getnet *et al*. (2015). The practitioners believed that taking plants at different places with odd number increased their efficacy. This might be valid to determine the dosage or to increase the probability of obtaining required phytochemical composition. Most of the plant materials that have medicinal values are collected secretly. This is also similar to the report of Getu (2017).

Development and transfer system of Indigenous medicinal plant knowledge

Study results indicated that most (98.7%) of the informants developed their knowledge of traditional plant medicines through observing and listening from other knowledgeable individuals mainly from their parents. Others (1.2%) acquired their knowledge through spiritual way. The remaining few individuals (0.1%) developed some of their knowledge through trial and error methods such as the use of *Azadirachta indica* and *Melia azedarach* for the treatment of malaria.

This is similar in line with other study reports (Getnet *et al*., 2015; Mekuanent *et al*., 2015). Indigenous knowledge of the local community of this study area is transferred from generation to generation orally which is similar to the results of other studies else where in Ethiopia (Bekele, 2007; Tilahun and Mirutse, 2007; Mekuanent *et al*., 2015; Asfaw and Tarekegn, 2017).

Marketability of traditional medicinal trees and shrubs in the study area

In Metema District, there is no any open market system on traditional medicinal plants. This is identical with other similar study reports (Miruts *et al*., 2009; Fisha *et al*., 2014; Getu, 2017). Most knowledgeable individuals provide fully processed remedies for sick individuals without charge as social voluntariness considering receiving money as a taboo. But, some herbalists who had more knowledge on traditional medicines in the area, use their knowledge as source of income. They sold fully processed medicinal plants with relatively low cost. But, they didn't sell those remedies in open market like the report of Getnet *et al. (*2015). From the result we recommend that open and legally organized herbal market system should be developed in the District by more knowledgeable healers.

Threats on Traditional medicinal Trees and Shrubs in the Study Area

Plant biodiversity in the district is decreased exponentially from time to time. The main factor is directly related to high population growth in the area.The main depleting factors include: agricultural expansion, constructional materials collection, fire, fire wood collection, charcoal collection and resettlements. All (100%) of the informants have similar idea on the depletion of plant biodiversity in the District. This is agreed with many study reports at different corners of the country (Kebu and Fasil, 2006; Tilahun and Mirutse, 2010; Assefa and Tesfaye, 2011; Ermias *et al*., 2011; Addis *et al*., 2013; Getnet *et al*., 2015; Seada *et al*, 2015).

Ranking on the threats showed that agricultural expansion is the most series factor for the loss of plant biodiversity which is in agreement to the report of Steven *et al*. (2015) followed by firewood and charcoal collection (Table5). Similarly, Habtemariam *et al*. (2011) reported that Metema district showed a 25% decline in forest coverage during the

last three decades. Different studies of the country also reported that agricultural expansion as the first threat for plant diversity loss (Assegid and Tesfaye, 2011; Getnet*et al.,*2015; Dessalegn, 2017).

Table 5: Result of Priority/preference ranking for eight vegetation declining factors based on seriousness (8= most series and 1= least series threatening factor)

	Key informants											
Threat	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Total**	**Rank**
Agricultural expansion	8	7	8	8	8	7	8	8	7	8	77	1st
Fire wood and charcoal	7	8	7	6	7	8	6	7	8	7	71	2nd
Constructional materials	4	6	4	5	6	3	7	5	6	6	52	3rd
Fire	6	5	6	7	4	6	4	4	4	5	51	4th
Formation of new settle-ments	5	4	5	2	1	4	2	1	5	4	33	5th
New road construction	3	3	1	4	3	2	3	6	3	3	31	6th
Urbanization	2	1	3	1	5	1	5	3	2	2	25	7th
Overgrazing	1	2	2	3	2	5	1	2	1	1	20	8th

Conclusion and Recommendations

Conclusion

The result of this work indicated that Metema District is endowed with rich medicinal trees and shrubs that revealed the community of the study area highly dependent on traditional medicinal plants for health care. Inversely, the abundance of medicinal trees and shrubs with the associated indigenous knowledge were being decreased from time to time as a result of different anthropogenic factors.

Recommendations

The results indicated that trees and shrubs which have traditional medicinal values should be given due consideration by preparing and applying appropriate strategies. The following recommendations are presented for the better utilization and conservation of trees and shrubs in the study area:

- Health Science Office and traditional drug healers should work cooperatively to identify medicinal plants and to make drug screening.
- *In-situ* conservation of trees and shrubs should be enhanced through the participation of the local community.
- Traditional healers should be encouraged and well trained to protect the disappearing plants and the knowledge base.

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Appendix 1:List of trees and shrubs that have traditional medicinal value to treat human and livestock health problems in the study area **(Ut,** used to;**MP**, mode of preparation; **CP**, condition of preparation; **PPU**, plant part used; **AR**, administration rout; **No R.**, number of reports; **AT**, Aliment treated; Habit; **S**, shrub; **T**, tree; UT (used to); **Hu**, human; **Li**, livestock; **AR,**administration rout; **D**, dermal; **O**, oral; **N**, nasal; **CT**, catching with teeth; **O,N**, oral and nasal; **D,O**, dermal and oral; **A,O**, auricular and oral; **OP**, optical; **D,N**, dermal and nasal

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Acacia polyacantha Hochst. ex A. Rich (Fabaceae, YM024)	T	9	Wound	Hu	D	Squeezed the fresh leaves and then smeared the juice on the wound region.
		2	Evil eye	Hu	D	Crushed the fresh root and Wrapped it by a piece of cloth then tied on the neck.
		5	Evil eye	Hu	N	Crushed the fresh leaves and roots along with *Withania somnifera* leaves, and then inhaled during sickness.
		6	Evil eye	Hu	N	Crushed the dried roots and leaves then burned by fire and fumigated the smoke.
Acacia seyal Del. (Fabaceae, YM041)	T	7	Evil eye	Hu	N	Squeezed the fresh root after crushing with *Allium sativum,* and then entered the decoction intranasal through left nose.
Acacia siberiana DC (Fabaceae, YM040)	T	4	Hepatitis	Hu	O	Crushed the root after drying, and then taken with tea once a day.
Acanthus sennii Chiov. (Acanthaceae, YM032)	S	3	Rheumatism	Hu	D	Crushed the fresh root and tied using cotton thread.
Adansonia digitata (L.) Del. (Moraceae, YM016)	T	5	Ecto-parasite	Li	D	Crushed the fresh root and then rubbed on the skin of the cattle like soap.
Anogeissus leiocarrpa (A. Rich) Guill &Perr (Combretaceae, YM031)	T	3	Abdominal pain	Hu	O	Chewed the fresh internal part of the stem bark, then swallowed the liquid part OR Squeezed with day water and drunk the juice.
		4	Diarrhea	Hu	O	Crushed and squeezed the fresh root by adding a drop of water, then drunk the juice.
		2	Impetigo	Hu	D	Burned the dried stem with fire and if sap is released out at the opposite side of the fired end, smeared the water on the affected part of the body.
		2	Malaria	Hu	O	Squeezed the fresh leaves then drunk the juice

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Azadirachta indica A. Juss. (Meliaceae, YM058)	T	12	Malaria	Hu	O	Squeezed the fresh leaves by adding a drop of water, then drunk the juice OR chewed the leaves and swallowed the liquid part.
		3	Scorpion bite	Hu	D	Squeezed the fresh leaves and smeared the juice on the bitted site of the body.
Balanites aegyptiaca (L.) Del. (Balantiaceae, YM036)	T	4	Abdominal pain	Hu	O	Ate the fresh fruit directly
		2	Amoebic dysentery	Hu	O	Squeezed the fresh leaves and stem bark with water, and then drunk the juice.
		9	Febrile illness	Hu	N	Boiled the fresh root bark of *Balanites ægyptica* and *Withania somnifera* with water, then fumigated.
		1	Mumps	Hu	D	Crushed the fresh leaves tightly and mixed with water, then showered with the concoction.
		2	skin infection	Li	D	Crushed the fresh leaves and then rubbed the infected skin of cow with the crushed leaves
		5	Anthrax	Li	N	The fresh root is crushed and then soaked in water for an hour, finally administered intranasal after decantation.
Boswellia papyrifera Hochst. ex A. Rich (Burseraceae, YM051)	T	2	Asthma	Hu	N	Burned the dried stem latex (incense), then fumigated the smoke
Calotropis procera L. (Asclepiadaceae, YM050)	S	4	Wart	Hu	D	Burned the dried stem with fire and contacted it to the body on the wart region.
		11	Wound	Hu, Li	D	Smeared the fresh stem or leaves latex on the surface of the wound.
		2	Wound	Hu	D	Crushed the fresh leaves, then bandage on the wound.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Carissa spinarum L. (Apocynaceae, YM003)	S	6	Evil eye	Hu	N	Crushed fresh the root and/or root bark of *Carissa spinarum* with stem bark of *Ficus sur,* root bark of *Polygala persicariifolia* and *Allium sativum*, then inhaled.
		13	Febrile illness	Hu	N	Boiled the fresh leaves with water, then fumigated.
Citrus lemon (L.) Bunnf. (Rutaceae, YM038)	S	1	Wound	Hu, Li	D	Applied the fresh fruit juice on the wound
		2	Somnambulism	Hu	D	Squeezed the fresh flower after crushing and mixed it with water, then showered.
Combretum hartmannianum Schweinf (Combretaceae, YM013)	T	3	Under weight (for child)	Hu	D	Soaked the internal part of fresh stem bark with in water for seven (7) days, and then showered Child's body below the neck with the infusion using bitter fruit of *Lagenaria siceraria.*
		1	Eczema	Hu	D	Crushed the fresh stem bark and shoot meristem and diluted it with whey then washed the body.
Combretum molle R.Br. ex G. Don (Combretaceae, YM009)	T	3	Hepatitis	Hu	O	Soaked the fresh stem bark in water for one day, crushed it and then boiled with water, finally drunk the decoction.
		2	Hepatitis	Hu	O	Prepared the fresh merstematic region of the twig in the form of stew, "wat" then ate with ENJERA.
		1	Hepatitis	Hu	O	Squeezed the fresh leaves by adding water and then drunk the juice.
		4	Tooth ach	Hu	CT	Bitted the fresh leaves by tooth for some time.
Combretum sp. Fresen (Combretaceae, YM021)	T	2	Hepatitis	Hu	O	Crushed the dried root bark and mixed with honey, then taken with tea 3 times a day.
Cordia africana Lam. (Boraginaceae, YM052)	T	10	Febrile illness	Hu	N	Boiled the fresh leaves with *Zehneria scabra* then fumigated.
		7	Hepatitis	Hu	O, N	Boiled the dried leaves with water by crushing it, and then fumigated and drunk the decoction.
		2	Diarrhea	Hu	O	Crushed and Squeezed the fresh leaves by adding a drop of water, drunk the decoction with a cup of coffee.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Dalbergia melanoxylon Guill. &Perr. (Fabaceae, YM060)	T	9	Gum bleeding	Hu	D	Burned the dried stem with fire and collected carbonaceous smoke, and then tattooing the gum with the collected carbonaceous ash.
Dichrostachys cinerea Wight & Am (Fabaceae, YM026)	S	2	LIFIE	Hu	D	Crushed the fresh leaves, then bandage.
		4	Abdominal pain	Hu	O	Squeezed the fresh leaves with the leaves of *Melia azedarach* then drunk the decoction.
		7	Dandruff	Hu	D	Crushing the fresh leaves and rubbed it on the head while washing.
Euphorbia tirucalli Lam. (Euphorbiaceae, YM030)	S	4	QUAQUCHA	Hu	D	Smeared the fresh stem latex on the affected part of the body.
		5	Tumor	Hu, Li	D	Smeared the fresh stem latex on the tumor
Ficus scycomorus L. (Moraceae, YM005)	T	15	Febrile illness	Hu	D, N	Boiled the fresh or dried leaves with water and inhaled the decoction or squeezed and smeared the juice on the face.
		2	Calf warm	Li	O	Crushed the fresh leaves, mixed it with milk and then given to the calf orally.
		3	Spider infection	Hu	D	Smeared the fresh stem latex around the infected region.
Ficus sur Forssk (Moraceae, YM048)	T	11	Spider infection, wound	Hu	D	Smeared the fresh stem latex on the surface of the infection or wound.
		7	Evil eye	Hu	N	Crushed the fresh stem bark by mixing with root and stem bark of Carissa Spinarum, root bark of *Polygala persicariifolia* and *Allium sativum,* then inhaled.
		1	Epilepsy	Hu	N	Crushed the dried stem bark in to powder, and then fumigate the smoke by burning with fire once a day.
		2	Tooth ach	Hu	CT	Held the fresh stem bark by biting with teeth.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Ficus thonningii Blume (Moraceae, YM011)	T	8	Spider infection	Hu	D	Squeezed fresh part of the leaf and smeared the juice around the infected site of the body.
		8	Wound	Hu	D	Smeared the fresh stem latex around the wound region.
Flueggea virosa Yebaria Guill. &Perr (Euphorbiaceae, YM044)	T	2	Hepatitis	Hu	N	Crushed dried leaves and then add 1-2 spoon powder into fire, finally fumigated the smoke.
Grewia ferruginea Hochst ex A.Rich. (Tiliaceae,YM037)	S	7	Dandruff	Hu	D	Crushed the fresh root bark and then rubbed it on the head while washing the hair.
		21	delaying placenta	Li	O	Crushed the fresh stem bark and leaves well, diluted with water and allowed the animal to drunk it by opening their mouth or gave the leaves directly for them to eat.
		3	Intestinal parasite	Li	O	Crushed the fresh leaves and stem bark of *Grewia ferruginea* with fresh leaves of *Tamarindus indica* and diluted it with water, then given to calf.
Lannea fruticosa (Hochst. Ex a. Rich) Engle (Anacardiaceae, YM015)	T	1	Scorpion bite	Hu	D	Heated the fresh internal stem bark with fire, and then rubbed the bitted area of the body with the bark.
Melia azedarach L. (Meliaceae, YM001)	T	14	Malaria	Hu	O	Squeezed the fresh leaves with a drop of water, then drunk OR Chewed and Swallowed the liquid part.
		1	Tonsillitis (for child)	Hu	D, O	Squeezed the fresh leaves then drunk the juice and put the remaining part over the head by saying up up (SIKEL SIKEL).
		5	Poultry disease	Li	O	Crushed the fresh leaves on stationary stone and mixed to water, then allowed to drunk.
		1	Dandruff	Hu	D	Crushed the fresh leaves and smeared the juice on the head.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Moringa stenopetala L. (Moringaceae, YM046)	T	12	Common cold	Hu	O	Dried and powdered or taken the fresh leaves, then used with tea.
		42	Hypertension and diabetes	Hu	O	Dried and powdered or taken the fresh leaves, then used with tea.
		15	Headache	Hu	O	Dried and powdered or taken the fresh leaves, then used with tea.
		3	Abdominal pain, cough	Hu	O	Dried and powdered or taken the fresh leaves, then used with tea.
		4	Cancer	Hu	O	Dried and powdered or taken the fresh leaves, then used with tea.
Oxytenanthera abyssinica (A.Rich.) Mumro. (Poaceae, YM047)	S	4	Tumor	Li	D	Burned the dried stem with fire and collected the charcoal then powdered and mixed it with fresh butter that didn't contacted with water then rubbed it on the tumor.
Polygala persicariifolia DC. (Polygalaceae, YM049)	T	13	Febrile illness	Hu, Li	N	Burned the dried or fresh root by fire then fumigated the smoke.
		3	Evil eye	Hu	N	Crushed the fresh root bark with root of *Carissa spinarum,* stem bark of *Ficus sur* and *Allium sativum,* then inhaled.
Pterocarpus lucens Guill. &Perr. (Fabaceae, YM010)	T	1	Scabies	Hu	D	Crushed the fresh leaves and rubbed on the affected part
Sida cuneifolia Roxb. (Asteraceae, YM027)	S	3	Wound, bleeding and LIKFT	Hu	D	Squeezed the fresh leaves by adding some saliva on it, then apply both the juice and residue on wound region, and then bandaged.
		3	Fever	Hu	N	Boiled the dried or fresh leaf with water then allowed steam vapor to enter through nose.
		2	Bone fracture	Hu, Li	D	Bandaged a piece of dried root on the fractured part of the body.
		1	Allergy	Hu	D	Crushed the fresh leaves then mixed with butter that had not contacted with water, finally smeared the affected part.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Stereospermum kunthianum Cham. (Bignoniaceae, YM019)	T	18	Bleeding	Hu	D	Placed the fresh internal stem bark over the bleeding wound and then bandaged.
		11	Bleeding, wound	Hu	D	Crushed the fresh leaves and applied it on the affected body then bandaged.
Syzygium guineense Wall. (Myrtaceae, YM017)	T	3	Diarrhea	Hu	O	Mixed the fresh stem bark with honey and water after crushing then drunk.
		28	Abdominal pain and intestinal parasite	Hu	O	Diluted the fresh fruit with water by avoiding the fruit external layer, and then drunk the infusion sometimes after mixing.
Tamarindus indica L. (Fabaceae, YM035)	T	7	Typhoid	Hu	O	Chewed the internal part of fresh stem bark and swallowed the juice.
		4	Dyspepsia	Hu	O	Chewed the fresh root and swallowed the juice.
		2	Intestinal parasite	Li	O	Crushed the fresh leaves with fresh leaves and stem bark of *Grewia ferruginea,* mixed it with water, and then given to calf orally.
Terminalia brownie Pers. (Combertaceae, YM055)	T	21	Hepatitis	Hu	O, D	Boiled internal part of fresh stem bark with bean then drunk the concoction; ate the bean and tied the bark on the head for seven days.
		2	Abdominal bloating	Hu	O	Crushed the fresh stem bark and homogenized it with water, then drunk.
		4	Ecto- parasite	Li	D	Crushed the fresh stem bark and homogenized it with water, then washed the infected part.
Terminalia laxiflora Engl.& Diels (Combretaceae, M054)	T	1	Snake bite	Hu	D	Heated the fresh root with fire and then made contact to the body on the site of bite.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Withtania somnifera L. Dunal. (Solanaceae,YM025*)*	S	21	Febrile illness	Hu	O, N	Squeezed the fresh leaves and drunk the juice or boiled with water and then inhaled or drunk the decoction.
		13	Febrile illness	Hu	O	Squeezed The fresh leaves and mixed the juice with coffee and then drunk.
		9	Febrile illness	Hu	N	Boiled the fresh or dried leaves and roots with water and inhaled only.
		14	Common cold	Hu	O	Squeezed the fresh leaves by adding a drop of water, and then drunk the juice.
		17	Diarrhea	Hu	O	Crushed and squeezed the fresh leaves and roots, then drunk the juice with coffee or alone.
		5	Abdominal dryness	Hu	O	Squeezed or boiled the fresh leaves, then drunk.
		4	Evil eye, evil sprit	Hu	N	Crushed the whole fresh part by mixing with *Carissa spinarum*, and then inhaled.
		12	Typhoid	Hu	O	Boiled the fresh or dried root with *Zehneria scabra*, then drunk
		6	Sun strike	Hu	D	Smeared the fresh leaves juice on the face and lip
Ximenia americana L. (Olacaceae, YM018)	S	1	Abdominal pain	Hu	O	Crushed and then squeezed internal part of fresh stem bark and/or stem meristem by adding day water, then drunk.
		11	Febrile illness	Hu	N	Burned the fresh or dried stem bark by fire, and then fumigated the smoke.
		8	Wart, wound	Hu	D	Dried and crushed the internal part of the stem bark, then applied the powder on the surface of wart or wound.
		2	Snake bite	Hu	O	Chewed the fresh root and then swallowed the liquid part.
		2	Scorpion bite	Hu	O	Chewed the fresh root and then swallowed the liquid part.
		1	Calf warm	Li	O, A	Crushed the fresh stem on stationary stone and mixed it with water, then given to calf orally and auricular.

Appendix 1:List of trees and shrubs that have traditional medicinal .....

Scientific name (Family, collection number)	Habit	No R.	AT	UT	AR	MP, CP and PPU
Ziziphus abyssinica Hochst.ex A. Rich (Rhamnaceae, YM002)	T	6	Tumor	Li	D	Crushed the fresh or dried root bark with *Zenheria scabra* and then injected in to the tumor by opening the tumor.
		8	Evil eye	Hu	D	Crushed the fresh root with root of *Capris tomentosa* and whole part of *Withania somnifera* then wrapped by piece of cloth, finally tied on the neck or arm.
		5	Scorpion bite	Hu	D	Chewed the fresh internal stem bark and then applied the chewed components on to the bitted site.
Ziziphus spina-christ (L.) Desf. (Rhamnaceae, YM022)	S	5	Eye disease	Li	OP	Chewed the fresh stem bark before talking anything at the morning, and then applied the juice in to the cattle eye.
		2	LFIE	Hu	D	Crushed the fresh leaves with *Sida cuneifolia* leaf, then mixed it with powder of beetle attacked stem and finally bandaged on the affected site of the body.
		7	Wound	Hu	D	Crushed the fresh leaves very well, then bandaged on the wound.
		3	Abdominal pain	Hu	O	Squeezed the fresh leaves with water, and then drunk the decoction.
		4	Abdominal pain	Hu	O	Boiled the fresh root with water, and then drunk the decoction.