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Ethnoecological knowledge allied to the management of wild medicinal plants in Ada'a District, East Shewa Zone of Oromia Regional State, Ethiopia

Alemayehu Kefalew[1]*, Sara Sintayehu[1] and Addisie Geremew[2]

[1]Department of Biology, College of Natural and Computational Sciences, Debre Markos University, Ethiopia.
[2]Department of Biology, Faculty of Sciences and Bioscience Engineering, Vrije Universiteit Brussel, Belgium.

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This study assessed and documented ethnoecological knowledge of the indigenous people of Ada'a District that has important contribution in the conservation of wild medicinal plants. Both purposive and random sampling methods were used to collect appropriate data. Quantitative and qualitative ethnobotanical methods were used to analyze the ethnoecological data. A significance test on the indigenous knowledge variation of the average number of reported medicinal plants was assessed. Results indicated that a total of 112 wild medicinal plants belonging to 53 families were recorded. Moreover, the indigenous knowledge about the medicinality of the reported medicinal plants were found to be evenly known (P>0.05) by all informants regardless of their demographic characteristics (gender, age, level of education, marital status, and experiences). On top of this, it was found that the district has important traditional ecological knowledge that has a substantial contribution for the conservation of the medicinal plants in the wild. Therefore, we recommend that the district agricultural organization should synergize the existing traditional ecological knowledge with the conventional scientific approaches that are being promoted and implemented in the district for ensuring sustainable, integrated and long- term management of wild medicinal plants in the study area.

Key words: Ada'a District, ethnoecology, traditional ecological knowledge, Wild medicinal plants.

INTRODUCTION

Biodiversity is correlated with human cultural diversity (Cotton, 1996); and their links are of great concern to ethnobiology as this field of study emphasizes the relationship between indigenous people and the biota where they live (Kefalew and Sintayehu, 2018). To examine the different aspects of these interactions Ethnobiology has moved into a wider multidisciplinary approach (Asfaw and Wondimu, 2007).

One dimension of ethnobiology that focuses on studying the interaction of indigenous people and their ecosystems is ethnoecology (also called ecological ethnobotany) (Martin, 1995; Cotton, 1996). These relationships can be social, economic, symbolic, religious, commercial and/or artistic (Williams and Muchena, 1991; Balick and Cox, 1996). Ethnoecology stresses on documenting traditional ecological knowledge

*Corresponding author. E-mail: alemayehukefalew2011@gmail.com.

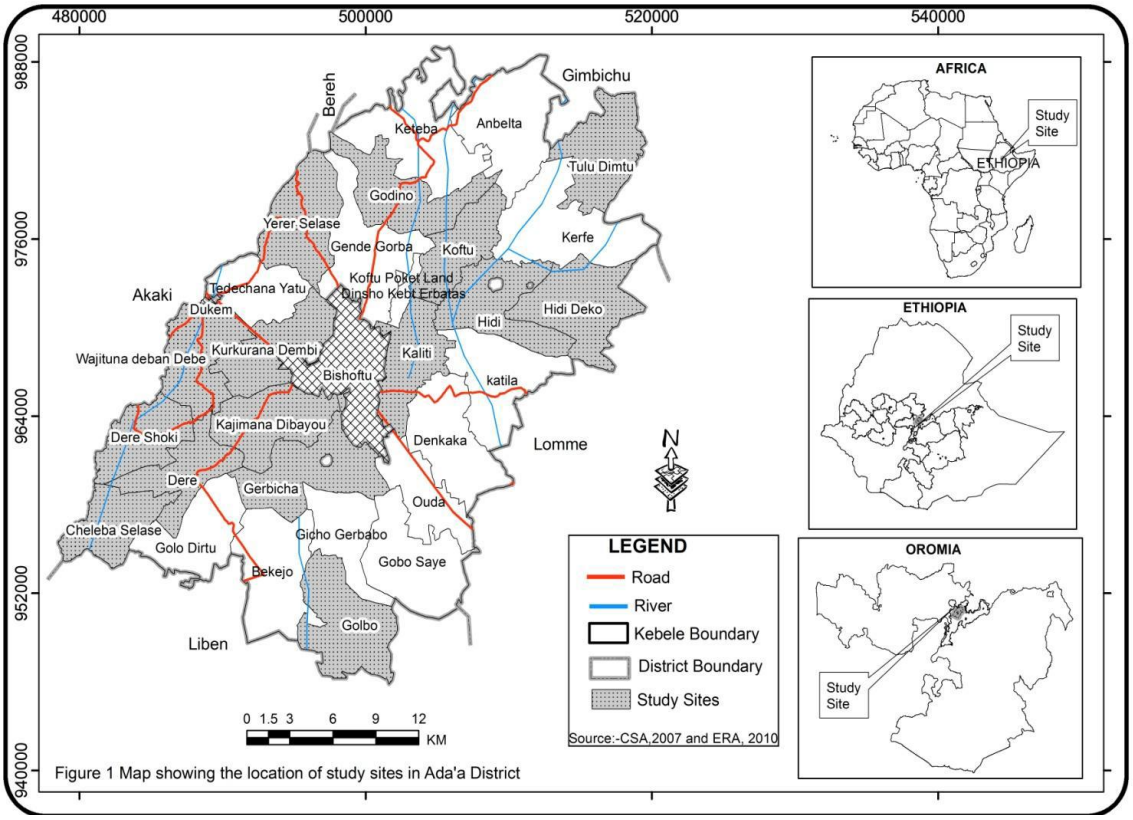

Figure 1. Location of the study sites in Ada'a District.

(TEK), which may include the culture and beliefs that have been handed down through generations by cultural transmission (Balick, 1996).

Ethnoecological knowledge can be applied in long term management and conservation strategies of biodiversity in general (Pedroso-Junior and Sato, 2005; Harisha et al., 2016) and wild medicinal plants in particular (Aumeeruddy and Ji, 2003; Ghimire et al., 2004). In supporting this fact, the International organizations such as the World Wildlife Fund (WWF) and UNESCO in their joint program titled 'The People and Plants Initiative' have been encouraging the role of traditional ecological knowledge (TEK) as well as integration of people's perception and practices in resource management at the local level (Cunningham, 2001). Moreover, the Convention for Biological Diversity (CBD), which has been ratified by 178 countries including Ethiopia on the Earth Summit in Rio de Janeiro, appreciates the role of indigenous knowledge in biodiversity conservation in general and wild medicinal plants in particular especially in its statements under Article 8j. Thus, identifying and promoting traditional ecological knowledge as a new model in environmental management is really a core section of applied ethnoecology and/or ethnobotany (Alexiades, 1996; Turner, 2000; Hamilton et al., 2003).

Despite the increasing recognition of the importance of TEK as a key tool to environmental management and conservation initiatives, such an approach has been poorly implemented around many parts of Ethiopia due to erosion of TEK (Demisse, 2001; Kibebew, 2001). This is also the case in the Ada'a District, East Shewa Zone of Oromia Regional State, Ethiopia which is negatively impacting the people's culture associated to biodiversity conservation and management practices of wild medicinal plants. Thus, this study is initiated to document existing TEK of the indigenous people of Ada'a District that could have important contribution in the conservation of wild medicinal plants.

MATERIALS AND METHODS

Study site

The study was conducted from 2015 to 2017 in Ada'a District, East Shewa Zone of Oromia Regional State, Ethiopia (Figure 1). The district is located in the dry evergreen Afromontane Forest Ecosystem of Ethiopia (Friis et al., 2011). The district is characterized by a monsoonal climate, which is marked by a wet summer (June-September) and a dry winter (February-May). The mean minimum annual temperature ranges from 9.4 to 13.7°C and the mean maximum annual temperature ranges from 24.2 to 29.2°C (EMA, 2015). The study site is characterized by unimodal rainfall with an annual mean precipitation of 73. 43 mm (calculated based on long term data from 2000 to 2015) ranging from 7. 3 to 209.8 mm. About 46.55% of the district is believed to be covered by natural forests (ADAO, 2016).

Ethnobotanical information

Ethics statement

All necessary permits for the described field studies were issued by the Administration Bureau of the district, East Shewa Zone of Oromia Regional State, Ethiopia following the directions in Cunningham (1996) and the Code of Ethics of the Society of Ethnobiology (International Society of Ethnobiology, 1998). Informed consent was also obtained from all informants following a standard ethnobotanical consent procedure.

Informant selection

Informants were representatives of the local/indigenous people of the district who could provide the ethnomedicinal/ethnoecological information. The age of the informants ranged from 18 to 85. Participants were chosen both systematically and randomly. Demographic data for the population of the district were in the ratio of 66:34 for men and women (ADAO, 2016). Keeping the same proportion, a total of 105 informants (69 males and 36 females) were selected from 15 kebeles (7 informants per kebele). Sixty of the total informants (4 per kebele) were randomly selected. This was done in various ways. Some of them were chosen by tossing a coin and using him/her as informant whenever head of the coin was up if he/she had volunteered to participate. Some others were chosen accidentally during random walks made to houses in the selected areas. The other 45 of the total informants (3 per kebele) were local experts (key informants) that were selected systematically based on recommendations from the local people, local authorities and development agents at each study sites. Their socio-demography is summarized in Table 1.

Semi-structured interview

A semi-structured checklist was prepared in advance to ensure informant consensus about the traditional ecological knowledge and medicinality of each herbal, following Cunningham (2001). The interviews were done on and around this checklist and some issues were raised depending on responses of informants. The language that has been used most frequently with the informants was Amharic (common language of the district). Oromiffa (local language of the district) was also used with the help of interpreters who had good knowledge of the local cultures and vegetation. The interviews were done with those born in, or have lived most of their lives in, the district.

Plant interview

This method (Gerique, 2006) was used to know the medicinality of each herbal collected from each study locality. In this method, medicinal plants were collected from the studied field area and brought back to the nearest village and presented to the randomly chosen informants to indicate wheather the species have medicinal qualities. When the freshly collected species were lost due to desiccation, pressed specimens were used during the interviews.

Group discussion

Group discussions, which were employed in each kebele, were used for cross-checking and verifying the information gathered via semi-structured interview and plant interview following Cotton (1996). The discussions were made with key informants, other traditional healers and the local people sometimes altogether or alone in their categories during the field study; and that information was recorded using a tape-recorder. Brief introduction was given to the groups so as to encourage them to discuss sincerely and frankly. The places and time for discussion were arranged based on the availability of the informants.

Methods of data collection on wild medicinal plants

Sampling design

Out of the 27 kebeles (the smallest administrative units) in the District, 15 of them (55.6%) (Chelebaselase, Dere, Dereshoki, Gerbicha, Godino, Golbo, Hidi, Hidideko, Kajimanadibayou, Kality, Koftu, Kurkuranadembi, Tuludimtu, Wajitunadebandebe, and Yererselase) were used for data collection. The selection of the 15 kebeles was made by purposive sampling method based on the availability of key informants identified with the assistance of local authorities and elders. The informants categorized the availability of wild medicinal vegetation of the district into six general habitat types, namely *Laffa Bosoona* (Forest land), *Laffa Mukke* (Wood lands), *Laffa Choroka* (Wet lands), which is in line with the definition given by Ramsar Convention Bureau (1997), *Laffa Merga* (Grass lands), *Laffa hori edu* (Grazing lands) and *Laffa ekiri* (Fallow land). Within each kebele, localities were identified based on these six habitats. This procedure gave a total of 95 localities from which 59 sampling units were selected by taking one locality for each habitat type in each kebele using the lottery method (Table 2). This stratification procedure gave 8 forest land localities, 15 woodlands, 7 wetlands, 11 grasslands, 15 grazing lands and 3 fallow lands. The selection of localities based on stratification by habitat type was chosen as it is the best representative sample for capturing the medicinal plant and ethnomedicinal knowledge in the district. It is noted that not every kebele was represented by each of the habitat types.

Plant identification

Medicinal plant species which were readily identifiable were recorded in the field. Those ethnomedicinal plants, which were difficult to identify in the field, were temporarily stored in a plastic bag; and then were pressed and brought to the National Herbarium (ETH) of Addis Ababa University (AAU) where they were dried, deep frozen and identified. The identifications were done first using keys of published volumes of Flora of Ethiopia and Eritrea (Gilbert, 1989; Demissew, 2006; Friis, 2006; Tadesse, 2004), and later supported with identification by comparisons with already authenticated dried specimen in the Herbarium. At last, all the medicinal plant species were confirmed with the help of taxonomic experts in AAU.

Data analysis

Descriptive statistical methods such as percentage frequency method of data analysis were employed to summarize some of the descriptive ethnobotanical data obtained from the interviews on reported medicinal plants and associated knowledge. Microsoft Excel spreadsheet software (Microsoft Corporation, 2010) was employed for organizing and analysing some ethnobotanical data. Inferential statistical analyses using two sample independent t-tests were performed to check whether there was a significant difference among the different parameters of informants (gender, age, literacy level, informant experience, marital status and living distance from health centre) for their knowledge about the medicinality of the reported medicinal plants. P-value was set at 0.05.

Table 1 . Socio-demographic data of the informants used in Ada'a District.

Informant parameter		Age		Sex		Education level		Informants		Distance (Km)		Marital status		Total
		Youngsters (Age between 18-30)	Elders (Age >30)	Male	Female	Literate	Illiterate	Key	Random	Lives in less than 10 Km	Lives in more than 10 Km	Married	Unmarried	
Age	Youngsters (Age between 18-30)	31												31
	Elders (Age >30)		74											74
Sex	Male	20	49											69
	Female	11	25											36
Education level	Literate	19	23	30	12									42
	Illiterate	12	51	39	24									63
Informants	Key	4	41	36	9	12	33							45
	Random	27	33	33	27	30	30							60
Distance (Km)	Lives in less than 10 Km	5	9	6	8	8	6	6	8					14
	Lives in more than 10 Km	26	65	63	28	36	57	39	52					91
Marital status	Married	12	19	25	6	18	13	2	29	9	22			31
	Unmarried	19	55	44	30	24	50	43	31	5	69			74
Total No. of informants		31	74	69	36	42	63	45	60	14	91	31	74	**105**

*Numbers in each cell refers to the number of informants; and distance is measured from Debre Zeit Town; Number in bold refers to the total number of informants used in the study, age category follows the report of Fantaw et al. (2018).

RESULTS

Ethnotaxonomy and composition of wild ethnomedicinal species

A total of 112 wild ethnomedicinal plants species (locally referred as *Qoricha uruffa* in Oromo language) (Table 3) were identified and documented from the study area. These species can be grouped into 97 genera and 53 families (Appendix 1). Of these medicinal plant species, 10 (9%) were endemic to Ethiopia (Table 4). Shrubs (locally called *Muke* or *Mukaa titika*/*xixina* in Oromo language) took the highest proportion whereas lianas (locally called *Hidda Jebata* in Oromo language) took the least proportion (Figure 2).

Statistical test on the ethnomedicinal knowledge of the local people

The questionnaire respondents represented a diverse array of people including farmers, women, literate, illiterate, youngsters, elders, married and unmarried. Among the 105 informants, 69 (65.7%) were male and 36 (34.3%) were females. The largest proportions of the respondents were elders (70.5%) above 30 years old (Table 5). Most respondents were not able to write and read (60%) whereas about 40% of the respondents were joined at least formal school of grade one and able to write or read. Among the respondents 86.7% of them dwell far away (> 5 Km) from the centre of health centres and/or Bishoftu town; whereas only few (13.3%) of them were living near (< 5 Km) to the Bishoftu town. Inferential statistical test of significance on average number of reported wild medicinal plants by the different groups of informants in Ada'a District is shown in Table 5.

Traditional knowledge on conservation of wild medicinal plants

Semi-structured interview carried out with the key informants revealed the presence of various local beliefs and cultural traditions that have conservation values of medicinal plants. Some of

Table 2. Total number of wild localities and number of sampling units in Ada'a District.

S/N	Kebele	Different categories of the wild environment in Ada'a District												Total	
		Forest land		Woodland		Wetland		Grassland		Grazing land		Fallow land			
		TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL	TNL	CNL
1	Chelebaselase	NR	NR	1	1	NR	NR	1	1	1	1	1 (BL)	-	4	3
2	Dere	NR	NR	2	1	NR	NR	2	1	1	1	1	1	6	4
3	Dereshoki	NR	NR	2	1	1	1	NR	NR	2	1	1 (BL)	-	6	3
4	Gerbicha	NR	NR	3	1	1	1	1	1	1	1	1 (BL)	-	7	4
5	Godino	1	1	2	1	NR	NR	1	1	1	1	1 (BL)	-	6	4
6	Golbo	1	1	2	1	NR	NR	1	1	1	1	1 (BL)	-	6	4
7	Hidi	NR	NR	2	1	NR	NR	1	1	1	1	1 (BL)	-	5	3
8	Hidideko	1	1	2	1	NR	NR	2	1	1	1	1 (BL)	-	7	4
9	Kality	1	1	2	1	1	1	1	1	1	1	1 (BL)	-	7	5
10	Kajimanadibayou	1	1	3	1	NR	NR	NR	NR	1	1	1	1	6	4
11	Koftu	NR	NR	3	1	1	1	NR	NR	1	1	1 (BL)	-	6	3
12	Kurkuranadembi	1	1	2	1	1	1	1	1	2	1	1 (BL)	-	8	5
13	Tuludimtu	1	1	2	1	1	1	NR	NR	1	1	1 (BL)	-	6	4
14	Wajitunadebandede	NR	NR	2	1	NR	NR	1	1	1	1	2	1	6	4
15	Yererselase	2	1	2	1	1	1	1	1	2	1	1 (BL)	-	9	5
Total number of localities		9	-	32	-	7	-	13	-	18	-	16	-	95	-
Total number of sampling units		-	8	-	15	-	7	-	11	-	15	-	3	-	59

TNL-total number of localities, CNL-Chosen number of localities, NR-not represented, BL-bare land.

them are shown in Table 6.

DISCUSSION

Diversity of plant species used medicinally

Results with regard to wild medicinal plant composition (locally called *Qoricha Urufa*) suggest that the district was once primarily a typical dry Afromontane Forest ecosystem of Ethiopia. This is due to the presence of remnant characteristic species for the vegetation type of dry evergreen Afromontane Forests (Demissew and Friis, 2009; Friis et al., 2011). These species include *Croton macrostachyus, Juniperus procera, Olea europaea* subsp*. cuspidata* locally called *Bekanisa*, *Gatira* and *Ejersa,* respectively; and are still retained in the existing landscape of the district as medicinal herbals. The local people use a taxonomically diverse group of wild medicinal plants, about 112 species in 97 genera and 53 families. The availability of diverse medicinal plant species in the wild were also reported from all corners of Ethiopia (Abebe, 1986; Abebe and Ayehu, 1993; Asfaw, 1997, 2001; Abebe, 2001; Asfaw and Tadesse, 2001; Bekele, 2007; Birhane et al., 2011; Assefa and Abebe, 2014; Tolossa et al., 2013; Kidane et al., 2014; Mesfin et al., 2014; Megersa et al., 2013; Belayneh and Bussa, 2014; Seifu et al., 2006; Chekole et al., 2015; Lulekal et al., 2008; Bussmann et al., 2011). This is attributed to the fact that wild habitats are the main storehouse of medicinally useful plants. Some of these medicinal plants were recorded to be economically important plants used for many other purposes in the district. For example, *Juniperus procera, Acacia albida, Croton macrostachyus, Olea europaea* subsp*. cuspidata,* and *Prunus africana* were some of the medicinal plants in the district with multiple purposes other than their medicinal values (Kefalew et al., 2015). Some of the medicinal plants identified in this study were reported elsewhere to have other use values other than their therapeutic quality. For

Table 3. Lists of wild medicinal plants collected from Ada'a District (T=tree, S=Shrub, H=herb, UT=used to treat, An=Animal, Hu=human, Bo=both).

S/N	Scientific Name	Family	Local Name (Oromifa/Amarigna)	Growth form	UT	Ailment treated (English/Amaric)	No. of citations
1	*Acacia abyssinica* Hochst. ex Benth.	Fabaceae	Laaftoo /Girar	T	An	Horse scabies (Yeferse ebitet)	3
2	*Acacia albida* Del.	Fabaceae	Garbii /Gerbi	T	An	Eye bruise (Bilz)	5
3	*Acacia seyal* Del.	Fabaceae	Wachoo /Wachu	T	Hu	Headache (Ras mitat)	3
					Hu	Stomach trouble (Yehod hemem)	11
4	*Achyranthes aspera* L.	Amaranthaceae	Derguu /Etse-tekeze	H	Hu	Abdominal pain in woman after birth (Kurtet)	5
					Hu	RH case (Shotelay)	4
5	*Acmella caulirhiza* Del.	Asteraceae	Guticha	H	Hu	Loose tooth	7
6	*Agave sisalana* Perrine ex Engel.	Agavaceae	Qachaa /Qacha	T	An	Tick	3
7	*Ageratum houstanianum* Mill	Asteraceae	Q/Merzi /Yemerz Medanit/	H	Hu	Poisoning (Merzenet)	5
					Hu	Stomach trouble	8
8	*Ajuga integerifolia* Buch. Ham.	Lamiaceae	Harmmaguusa /Aqorarache/	H	Hu	Cold (Bired)	3
					Hu	Gout (Rihi)	4
					Hu	Hypertension (Dem bizat)	6
9	*Aloe macrocarpa* Tod.	Aloaceae	Argiisa /Ret	H	Hu	Intestinal parasite	3
					Bo	Swelling (Ebach)	3
10	*Alternanthera pungens* Kunth.	Amaranthaceae	*****	H	Hu	Sudden illness (Dingetegna)	3
					Hu	Whooping Cough (Tektik)	6
11	*Artemisia abyssinica* Schtz. Bip. ex Rich	Asteraceae	Tiroo /Chikugne	H	Hu	Stomach trouble	12
					Hu	Eye itching (Ayenen masakek)	9
12	*Asparagus africanus* Lam.	Asparagaceae	Seriiti /Seriti	S	Hu	Amobiasis (Ameba)	7
13	*Asparagus racemosus* Wild.	Asparagaceae	Seriiti / Seriti	S	Hu	Amobiasis	9
14	*Asplenium monanthes* L.	Aspleniaceae	*****	H	Hu	Woumb itching (Mehatsenen masakek)	2
15	*Bersama abyssinica* Fresen.	Melianthaceae	Loliichisa /Azamir	T	An	Horse Scabies (Bech'h)	4
16	*Bidens pilosa* L.	Asteraceae	Chogogitii /Chogogit	H	Hu	Devil sickness (Lekefet)	5
17	*Brucea antidysenterica* J. F. Mill.	Simaroubaceae	Qumegno /Abalo	S	Hu	Evil eye (Buda)	9
					An	Colic (yehod hemem)	6
18	*Buddlejia polystachya* Fresen.	Buddlejiaceae	Qawissa /Anfar	T	An	Leech (Alekit)	12
19	*Calpurnia aurea* (Ait.) Benth.	Fabaceae	Ceekaa /Digita	S	Hu	Scabies (Ekek)	3
					An	Pubic hair louse (Qemanjer)	3
20	*Capparis tomentosa* Lam.	Capparidaceae	Goora /Gumero	CL	Hu	Wound (Kusil)	9

Table 3. Contd.

21	*Carissa spinarium* (Vahl.) Forssk. ex Endl.	Apocynaceae	Agamsa /Agam	S	Hu	Intestinal worms	3
					Hu	Evil eyes	2
22	*Centella asiatica* (L.) Urban.	Apiaceae	*****	H	Hu	Bleeding	4
23	*Clausena anisata* (Wild.) Benth.	Rutaceae	Ulumaa /Limich	S	Hu	toothache	7
					Bo	Wound	4
24	*Clematis simensis* Fresen.	Ranunculaceae	Fiitii /Enderifa	Ll	Hu	Evil eye	4
					Hu	Wart (Kintarot)	4
25	*Clerodendrum myricoides* (Hochst) Vatke	Lamiaceae	Maraasisaa /misirich	S	Hu	Diarrhae	4
26	*Colocasia esculenta* (L.) Schott	Araceae	Godaree /Godore	H	Hu	Swelling	4
27	*Croton macrostachyus* Del.	Euphorbiaceae	Bakaniisaa /Bisana	T	Hu	Febril illness (Megagna)	6
					Hu	Tinea nigra (Kuakucha)	5
28	*Cucumis dipsaceus* Ehrenb.	Cucurbitaceae	Buqee seexanaa /Yesetan kil/	CL	Hu	Depression (Eje seb)	8
29	*Cucumis ficifolius* A. Rich.	Cucurbitaceae	Holoo /Yemidir enbuay	CL	Hu	Abdominal pain (Kuretet)	14
30	*Cyathula cylindrica* Moq.	Amaranthaceae	Derguu/ Yemogn fikir	H	Hu	Stomachache (Yehod hemem)	4
31	*Cyphostemma adenocaule* (Steud. ex .A. Rich.) Descoings ex Wild & Drummond	Vitaceae	Melas golgul	CL	An	Blackleg	7
					Bo	Swelling	3
					Hu	Snake bite	4
32	*Datura stramonium* L.	Solanaceae	Atsefaris/Astenagir	H	Hu	For Intellegency (Letimret)	5
33	*Dodonaea angustifolia* L. f.	Sapindaceae	Etacha /Kitkita	S	An	Wound	3
34	*Dombeya torrida* (J. F. Gmel) Bamps	Sterculiaceae	Daanisa /Wolkefa	T	Hu	Antidot for snake bites	3
35	*Dregea schimperi* (Decne.) Bullock	Asclepiadaceae	Hida /Yeregna missa	Ll	Hu	Eczema (Chiffea)	4
36	*Ekebergia capensis* Sparrm.	Meliaceae	Somboo /Sombo	T	Hu	Syphilis (Kitign)	6
37	*Eleusine floccifolia Forssk*.	Poaceae	Coqorsa /Akerma	H	Hu	Snake bit	3
					Hu	Poisoning	4
38	*Embelia schimperi* Vatke	Myrsinaceae	Hanquu /Enqoqo	S	Hu	Tape worm (Kosso)	8
39	*Erica arborea*	Ericaceae		S	An	Eye disease	2
40	*Euclea racemosa* subsp. *schimperi*	Ebenaceae	Me'essaa /Dedeho	S	Hu	Tonsillitis (Entil siwored)	5
41	*Euphorbia abyssinica* J. F. Gmel.	Euphorbiaceae	Adamii /Kulkual	T	Hu	Haemorrhage	6
42	*Euphorbia ampliphylla*	Euphorbiaceae	Adamii /Kulkual	T	Hu	Haemorrhage	6
43	*Ferula communis* L.	Apiaceae	Dog	H	Hu	Cough	6
44	*Ficus sur* Forssk.	Moraceae	Harbuu/Sholla	T	Hu	Wart on hand(Kintarot)	3
					An	Swelling	2

Table 3. Contd.

45	*Foeniculum vulgare* Mill.	Apiaceae	Insilaalee /Ensilal	H	Hu	Urinary Retention (Shinet leklekelew)	6
					Hu	Stomach trouble	5
46	*Fuerstia africana* Th. Fries	Lamiaceae	Eje Admek	H	Hu	General malaise (Mich)	10
					An	Cattle eye disease	13
47	*Gamphocarpus abyssinicus* Decne.	Asclepiadaceae	Rebu Hunda	H	An	Blackleg (Aba gorba)	9
48	*Grewia ferruginea* Hochst ex . A . Rich.	Tiliaceae	Dhoqonuu /Lenquata	S	Hu	Taeniasis (Kosso)	4
49	*Guizotia scabra* (Vis) Chiov.	Asteraceae	Adaa /Mech	H	Hu	Epilospy (Yemitel beshita)	2
50	*Heteromorpha trifoliata* (Wendel.) Eckl. & Zeyh.	Apiaceae	Demehee /Yejib merkuze	S	Hu	Warding of Sorcery Stealing (Selabi)	5
51	*Hygrophila schulli* (Hamilt.) M. R. & S. M. Almeida	Acanthaceae	Q/Mearzi	H	Bo	poisoning	3
52	*Hypericum quartinianum* A. Rich.	Hypericaceae	Muke fonii	S	Hu	Jaundice (Yewof beshita)	4
53	*Hypericum revolutum* Vahl	Hypericaceae	Hindhee /Ameja	S	An	Eye disease	3
54	*Impatiens rothii* Hook. f.	Balsaminaceae	Buri /Gesherit	H	Hu	Wounds on hand	2
55	*Impatiens tinctoria* A. Rich. Subsp. *abyssinica* (Hook. f.) Grey-Wilson	Balsaminaceae	Ensosilla	S	Hu	Wound on palm	2
56	*Inula confertiflora* A. Rich.	Asteraceae	Mognoree /Weynageft	S	An	Eye disease	3
					Bo	Rabies (Yehebid wusha beshita)	2
57	*Jasminum grandiflorum* L.	Oleaceae	Qamaxee /Tembelel	S	Hu	Evil eye	3
					Hu	Toothache (Yeters himem)	3
58	*Juniperus procera* Endle	Cupressaceae	Gaatiraa /Yehabesha Tid	T	Hu	Demon possesesion (Ganen)	4
59	*Kalanchoe petitiana* A. Rich.	Crassulaceae	Bosoqee /Endahula	H	Bo	Swelling	24
60	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae	Buqqee /Kil	H	Hu	Impotency (Sinfet wosib)	3
61	*Laggera tomentosa* (Sch. Bip. ex A. Rich.) Oliv. & Hiern	Asteraceae	Keskeso	H	Hu	Flu (Gunfan)	3
62	*Leonotis raineriana* Vis.	Lamiaceae	Bokkoluu dimma / Ras kimir /	S	An	Leech	15
					Hu	General malaise (Mich)	10
63	*Leucas martinicensis* (Jacq.) R. Br.	Lamiaceae	Bokkoluu adii / Ras kimir	S	Hu	General malaise (Mich)	8
64	*Lippia adoensis* Hochst. ex Walp.	Verbenaceae	Kusaayee /Kese	S	Hu	Stomach pain (Cheguara)	3
65	*Maesa lanceolata* Forssk.	Myrsinaceae	Abbayyii /Kelewa	S	Bo	Swelling	5
66	*Malva venticillata* L.	Malvaceae	Liitii /Lit	H	An	Swelling	2
67	*Myrica salicifolia* A. Rich.	Myricaceae	Kataba /Shinet	T	Hu	Ascariasis	4
68	*Myrsine africana* L.	Myrsinaceae	Qacama /Kechem	S	Hu	Taeniasis	5

Table 3. Contd.

					An	Worms in donkey	4
69	*Ocimum gratissimum* L.	Lamiaceae	Q/Michii /Mech medanit	H	Hu	General malaise	15
70	*Ocimum lamiifolium* Hochst. ex Benth.	Lamiaceae	Demakessie	S	Hu	General malaise	24
71	*Olea europaea* L. subsp. *cuspidata* (Wall. ex G. Don) Cif.	Oleaceae	Ejersa /Weyra	T	Hu	QOROQOR	4
72	*Olinia rochetiana* A. Juss.	Oliniaceae	Dalecho	S	Hu	Snake bit	2
					Hu	Toothache	4
73	*Osyris quadripartita* Decn.	Santalaceae	Waatoo /Qeret	S	Hu	Eczema	3
74	*Otostegia integrifolia* Benth.	Lamiaceae	Tungiitii /Tungit	S	Hu	Fibril illness (Megagna)	12
75	*Pavetta abyssinica* Fresen.	Rubiaceae	Muke-buniti	S	Hu	Poison	2
					An	Animal diarrhoea	3
76	*Pentas schimperiana* (A. Rich.) Vatke	Rubiaceae	Dasie	S	An	Eye disease	11
77	*Phytolacca dodecandra* L' Herit	Phytolaccaceae	Handoode /Endod	S	An	BECHE'H	10
					Hu	Wart on hand	9
78	*Plantago lanceolata* L.	Plantaginaceae	Qorxobbii /Yehaheya Kote/	H	An	Intestinal parasite	4
79	*Plantago major* L.	Plantaginaceae	Qorxobbii /Yekura wesife/	H	Hu	Poisoning	3
					Hu	Haemorroides	3
80	*Premna schimperi* Engl	Lamiaceae	Urgessa /Chchoho	S	Hu	Eye disease	4
81	*Protea gaguedi* J. F. G.	Proteaceae	Dasie	S	An	Animal jaundice	11
82	*Prunus africana* (Hook. f.) Kalms	Rosaceae	Hoomii /Tikur Enchet	T	Hu	Swelling	4
					Hu	Sudden illness (Dingetegna)	6
					An	Blackleg	2
					An	Anthrax (Abasenga)	2
83	*Pterolobium stellatum* (Forssk.) Brenan	Fabaceae	Harengeemmaa/ Kontir	S	Hu	Rhumantic pain (Kurtimat)	5
84	Rhus glutinosa	Anacardiaceae		S	Hu	Epistaxis (Neser)	2
85	Rhus retinorrhoea	Anacardiaceae	Tilem	S	An	Anthrax (Abasenga)	4
86	*Rhus vulgaris* Meikle	Anacardiaceae	Dabobechaa/ Kimmo	S	An	Diarrhoea	3
87	*Ricinus communis* L.	Euphorbiaceae	Qoboo/ Gulo	T	Hu	Dandruff (Forofor)	6
88	*Rosa abyssinica* Lindley	Rosaceae	Gora /Kega	S	An	Invoking sprit (Aganent)	7
89	*Rubia cordifolia* L.	Rubiaceae	Enchiberii/ Enchibir	H	Hu	Wound	13
					Hu	Cough	6
					Hu	Cough	7
					An	Cataract (Bemora yete-shefene ayen)	5

Table 3. Contd.

90	*Rubus steudnerS.*	Rosaceae	Agogota	H	Hu	Stabbing pain (Wugat)	2
					Hu	Cough	2
91	*Rumex abyssinicus* Jacq.	Polygonaceae	Meqmeqo	H	Hu	Eye bruise	5
					An	Blackleg	2
					An	Scabies (Ekek)	2
92	*Rumex nepalensis*Spreng.	Polygonaceae	Shuultii /Tulet	H	An	Colic (Yehod himem)	3
					An	Blackleg	6
					Hu	Stomach pain (Cheguara)	3
					Hu	Stabbing pain (Wugat)	3
					B	Urinary retention	4
93	*Rumex nervesus* Vahl	Polygonaceae	Dhangaggoo /Embuacho /	S	Hu	Delay in drying circumcision	5
94	Salix mucronata	Salicaceae	Alaletu/ Ahaya	T	Hu	MIKEGNA-SHEREGNA	6
95	*Salvia nilotica* Jacq.	Lamiaceae	Hulegebe	H	Hu	Wound	3
96	*Sida schimperiana* Hochst. ex A. Rich.	Malvaceae	Chefreg	H	An	Rabies	2
					An	Preventing bitch birth	2
97	*Snowdenia polystachya* (Fresen.) Pig.	Poaceae	Muja	H	Hu	Scabies (Ekek)	2
98	*Solanecio gigas* (Vatke.) C. Jeffrey	Asteraceae	Gommana osolee /Yeshikoko gomen/	S	Bo	Retained placenta	7
99	*Solanum anguivi* Lam.	Solanaceae	Hiddi Worabessa/Zerch Enbuay/	S	Hu	Intelligence	3
					Hu	Dandruff	2
					An	Rabies	3
100	*Solanum incanum* L.	Solanaceae	Hiddii /Yehabesha Embuay/	S	An	Tick bite	2
					An	Horse Scabies	2
					Hu	Wounds	2
101	*Solanum marginatum* Linn. f.	Solanaceae	Hiddii /Tileku Enbuay	S	Hu	Long stay menstruation	5
					An	Rabies	6
102	*Stephania abyssinica* (Dillon ex A. Rich.) W	Menispermaceae	Kalaala /Engochit	LI	An	Blackleg	5
					Hu	Unwanted pregenancy	3
					Hu	Wound	3
					Hu	Swelling	5

Table 3. Contd.

					Hu	Sudden illness	4
103	*Tagetes minuta* L.	Asteraceae	Tiro	S	An	KINKIN	4
104	*Thunbergia alata* Sims.	Acanthaceae	Hareg	CL	Hu	Cough	3
105	*Thymus schimperi* R.	Lamiaceae	Xoosanyii /Tosigne	S	Hu	Hypertension	8
106	*Urtica simensis* Steudel	Urticaceae	Dobii/ Sama	H	Hu	Gonorrheae (Chebit)	2
107	*Verbascum sinaiticum* Benth.	Scrophulariaceae	Guraa Haree / Yahaya joro/b	H	Hu	Nightmare	4
					An	Blackleg	2
108	*Verbena officinalis* L.	Verbenaceae	Atuch	H	Hu	Cough	4
					Hu	Tonsilities (Entil siwored)	5
					Hu	Warding off sorcery steeling	5
109	*Vernonia amygdalina* Del.	Asteraceae	Ebicha /Grawa	T	Hu	Malaria	5
					Hu	Abdominal pain	3
110	*Withania somnifera* (L.) Dunal.	Solanaceae	Gizaawaa /Gizawa	S	Hu	Daemon possesesion	6
111	Xanthium strumarium L.	Asteraceae	Yemogne Fikir	S	An	Leech	3
112	Zehneria scabra L.	Cucurbitaceae	Daaymii/ Areg resa	Ll	Hu	Deformed lips (Megagna)	6

example, *Cordia africana, C.macrostachyus, J. procera, Prunus africana, O. europea*, *Ekibergia capensis* were reported for the purpose of timber in different areas of Ethiopia (Lulekal et al., 2008; Mesfin et al., 2013). Similarly other medicinal species such as *Acacia abyssinica, Acacia albida, Acacia seyal* were also reported elsewhere for home garden agro-forestry purposes such as fencing and shading (Hailu and Asfaw; 2009; Awas and Demissew, 2009; Amberber et al., 2013; Abebe et al., 2013; Linger et al., 2014; Tefera et al., 2014); whereas, *Euphorbia ampliphyla, Euphorbia abyssinica, C. macrostachyus,* and *Vernonia amygdalina* were recorded for their purpose of beehive making and/or bee forage (Senbeta et al., 2013).

The findings of this study showed that shrubby herbals were the most dominant form of wild medicinal plants in the district followed by herbaceous forms. Similar findings were noted elsewhere in Ethiopia (Hunde et al., 2004; Yineger and Yewhalaw, 2007; Lulekal et al., 2008; Mesfin et al., 2009). This may be linked with the custom of the local people to use plants that are available almost all the time. In line with this fact, Martin (1995) and Cotton (1996) suggested that knowledge of medicinal plants directly emanates/originates from the type of the plants they are surrounded by. In this regard, shrubby herbals are the most available form of herbals in almost all year as they are tolerant to seasonal variation (Albuquerque, 2006) and might have had a high chance of being chosen by the local people of the study area. On the contrary, the ecological nature of herbaceous medicinal plants is normally an annual and more subjected to influences by small scale environmental variations than shrubs are. Moreover, apart from seasonal variation, grazing intensity in the study area might have contributed to the lesser number of herbaceous medicinal plants than shrubs (Kefalew, 2010).

This effect of grazing on herbaceous medicinal plants was also noted elsewhere (Adnan and Holscher, 2010). The rather fewer contribution of trees for therapeutic purposes in the district may be linked with the less abundance of tree species that resulted from previous over exploitation and habitat modification history of trees mainly for the purposes other than their medicinal values (Aba Geda *Tulema,* Pers. comm).

The plant families such as Asteraceae (11 species, 9.82%), Lamiaceae (11 species, 9.82%), Fabaceae (5 species, 4.46%), Solanaceae (5 species, 4.46%), Apiaceae (4 species, 3.57%),

Table 4. Lists of endemic wild medicinal plants encountered in Ada'a District.

S/N	Botanical Name	Habit	Family	Reference FEE
1	*Acacia abyssinica* subsp*. abyssinica*	Tree	Fabaceae	Hunde and Thulin (1989)
2	*Inula confertiflora*	Shrub/tree	Asteraceae	Tadesse (2004)
3	*Impatiens rothii*	Herb	Balsaminaceae	Tadesse (2004)
4	*Impatiens tinctoria* subsp. *abyssinica*	Herb	Balsaminaceae	Tadesse (2004)
5	*Jasminum stans*	Shrub	Oleaceae	Green (2003)
6	*Kalanchoe petitiana*	Herb	Crassulaceae	Gilbert (1989)
7	*Laggera tomentosa*	Shrub	Solanaceae	Friis (2006)
8	*Lippia adoensis*	Shrub	Verbenaceae	Demissew (2006)
9	*Otostegia integrifolia*	Shrub	Solanaceae	Friis (2006)
10	*Rhus glutinosa* subsp. *neoglutinosa*	Shrub	Anacardiaceae	Gilbert (1989)
11	*Solanecio gigas*	Shrub	Asteraceae	Tadesse (2004)
12	*Solanum marginatum*	Shrub	Solanaceae	Friis (2006)
13	*Thymus schimperi*	Herb	Lamiaceae	Ryding (2006)
14	*Urtica simensis*	Herb	Urticaceae	Friis (1989)

FEE: Flora of Ethiopia and Eriterea.

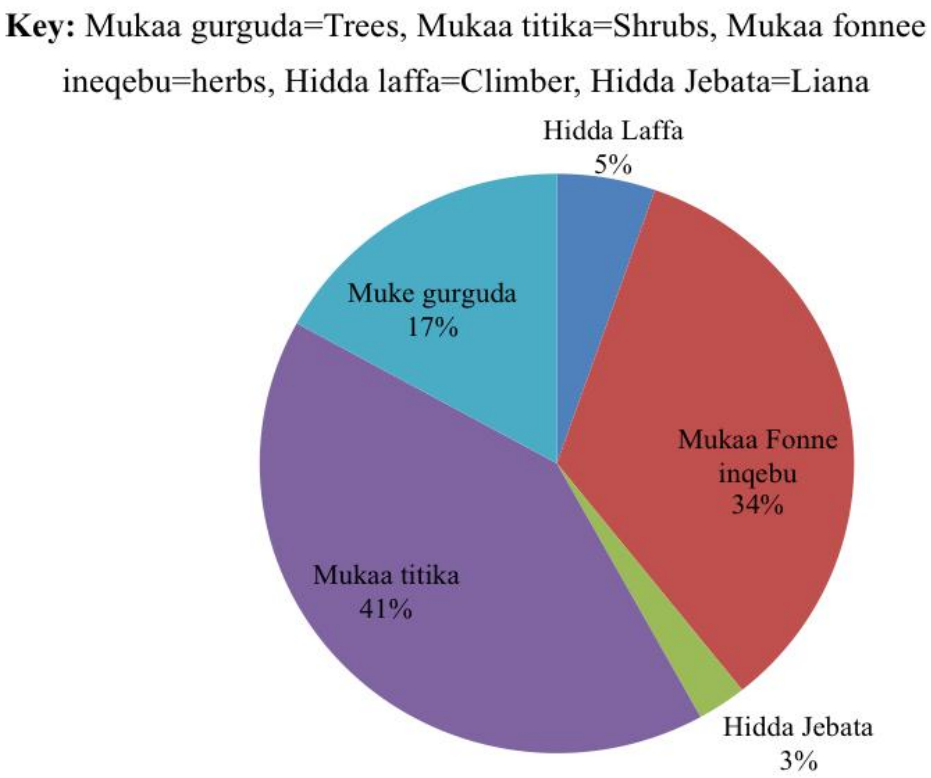

Figure 2. Growth form of wild medicinal plants in Ada'a District (note that growth forms are named using local language as recommended in ethnotaxonomy so as to give more weight for the voices of the local people).

Cucurbitaceae (4 species, 3.57%) and Euphorbiaceae (4 species, 3.57%) are found to be the most common plant families composed of wild medicinal plants in the District. This goes in agreement with most of the ethnomedicinal studies in Ethiopia (Giday, 2007; Giday et al., 2007, 2009, 2010; Giday and Teklehaymanot, 2013; Teklehaymanot and Giday, 2007; Adefa and Getaneh, 2013). This indicates the high contribution of these plant

Table 5. Average number of wild medicinal plants (AWMP) reported by different groups of informants.

Socio economic parameter	Informant groups	Number of informants (n)	Percentage	Total number of citations (N)	AWMP ± SD	t-value	P-value*
Gender	Male	69	65.7	351	34.07±20.47	-1.445	0.149
	Female	36	34.3	191	36.74±20.56		
Age	Youngsters	31	29.5	209	36.11±19.87	-0.985	0.325
	Elders	74	70.5	333	34.33±20.92		
Literacy level	Illiterate	63	60	181	35.03±21.00	-0.012	0.991
	Literate	42	40	361	35.01±20.31		
Informant category	Key	45	42.9	223	35.68±20.42	0.633	0.527
	General	60	57.1	319	34.55±20.62		
Marriage	Married	31	29.5	516	34.83±20.53	-0.925	0.355
	Unmarried	74	70.5	26	38.65±20.47		
Distance from health centre	Close to the health centre	14	13.3	42	44.50±18.29	-3.142	0.002*
	Far from the health centre	91	86.7	500	34.22±20.52		

*Indicates significant difference (P<0.05) between averages of the paired categories (note that the p-level reported with the t-test represents the probability of error involved in accepting research hypothesis about the existence of a difference).

families to most of the medicinal flora of the country, Ethiopia. The relatively high contribution of these families other than other families may originate from their high species richness in the Flora of Ethiopia and Eritrea (Kelbessa and Demissew, 2014). In line with this notion, Saqib et al. (2011) have found a strong positive correlation (r = 0.88) between the overall species richness of vegetation and the associated ethnomedicinal plant species richness in Pakistan. Moreover, critical observation on the finding of Giday (2001), Lulekal (2005), Yineger (2005), Giday (2007), Awas (2007), Lulekal (2014) and Regassa (2016) on the joint study of vegetation and ethnomedicinal plant diversity showed that the species richness of both the general vegetation and medicinal flora follow the same pattern and seem to be directly related. In line with this Erdelen et al. (1999) and Edwards (2001) concluded the presence of greater concentration of medicinal plant diversity at the areas where there is higher concentration of biological and cultural diversity.

The finding of this study showed that about 10% of the collected medicinal plants are endemic to Ethiopia, which follows almost the same proportion of endemism for the Flora of Ethiopia and Eriterea (Kelbessa and Demissew, 2014). This endemic medicinal flora in Ada'a District includes *Acacia abyssinica, Inula confertiflora*, *Impatiens rothii*, *Jasminum stans*, *Laggera tomentosa*, *Lippia adoensis*, *Otostegia integrifolia*, *Rhus glutinosa*, *Solanecio gigas*, *Solanum marginatum*, *Thymus schimperi and Urtica simensis* (Kelbessa et al., 1992; Friis, 1989; 2006; Giibert, 1989; Tadesse, 2000, 2004; Green, 2003; Vivero et al., 2005; Demissew, 2006; Ryding, 2006). Some of these medicinal species reported in this study were also reported elsewhere by Lulekal et al. (2013, 2014) for Ankober District in North Shewa Zone, Hunde et al. (2004) for Welechiti area in East Shewa Zone, and Amenu (2007) for Cheliya District in West Shewa Zone of Ethiopia.

Conservation implication of the indigenous ecological knowledge of Ada'a District

This study also found important belief and cultures of the local people that have important actions on the conservation of some of the wild medicinal plants. For instance, cutting plants that are of importance for religious purposes (e.g., *Acacia* spp., *Ficus* spp.) is considered as committing a curse since these plants and many others are respected for religious reasons. Thus, the local people protect and preserve the plant species that are strongly associated with beliefs and religion and hesitate to destroy them. This study also found that forests on the highland areas are protected as these areas are perceived to be a sacred area. This may be attributed with the tradition that the *Qallus'*, who are supposed to serve between the human and *Ayyanna* (spirit) and has a role equivalent to the role of Bishop in the Christian word and of Imam in the Muslim word, often build their *Gelma* (traditional Oromo ritual hall/church) on such high land areas. Hence, highland forests are believed to be a special place where the *Qallus'* live and

Table 6. Traditional ecological knowledge (TEK) of the people of Ada'a District which are having conservation implications of traditional medicinal plants in particular and ecology of the district at large.

S/N	Traditional knowledge	Description of the knowledge	Conservation implication
1	ADIBAR	ADIBAR is a term referring to the sacred plants in the district; and mainly applied to *Ficus* spp. *Acacia abyssinica*, *Olea europaea* subsp. *cuspidata*, *Cordia africana* are also regarded as place for ADIBAR festival. These are locally believed to be blessed trees and hence serve as a place where they believe; and not really what they believe. Thus, these plants are better protected by the local people as many people afraid of cutting them.	This culture contributes for the conservation of common umbrella species of the district.
2	BORENTICHA	BORENTICHA is supposed to be the spirit of a river; and makes the river and adjacent vegetation sacred. In this tradition, individuals are required to prepare traditional beer, Niger seed, and large local bread cooked only on one side and celebrates the *Borenticha* ritual at the river bed and/or other wet lands to appease the spirit of the river.	This tradition protects wet lands not to be naked
3	CAGINO days	In the tradition of the district some medicinal plants are only cut in Cagino days (selective days) if they need to be efficacious. For example, GIZAWA (*Withania somnifera*), TUNGIT (*Otostegia integrifolia*), SERITII (*Asparagus africanus*), YEAHEYA JORO (*Verbascum sinaiticum*), AGAM (*Carissa spinarium*), BISANA (*Croton macrostachyus*), and CHIFREG (*Sida schimperiana*) among many others are only cut on Wednesdays and/or Fridays. If cut in other days a devil sprite will attack while the healer is collecting.	This tradition avoids the frequent exploitation of medicinal plants; and has a role for sustainable utilization of these MPs
4	ENTUKEN	This tradition refers to a condition in which once the patient is healed (e.g *Sebeta Wakayo*, equivalent term for Jaundice) due to a particular plant part (such as *Acacia* sp.), then this healed person never cut that plant anywhere in the district. If he/she committed to cut the plant, then the disease is believed to reappear to him/her.	This tradition contributes for the conservation of some of such species that are very vital both ecologically and ethnobotanically.
5	ERECHA	ERECHA is a term refering to festival of shelters. It is the famous festival known in the district. It is thanks giving day. People hold flowers, fruits, grasses or other plants which are sign of God's gift and go to the lake or rivers to thanks him.	This tradition is helpful in conserving wet areas where plants are most frequently available.
6	GERBI ATETE:	GERBI ATETE refers to Gerbi (*Acacia albida*) whose main stem branched in to two from its base and hence it is a place for *Adibar*, or shelter for other cultural meetings. These plants are not most often cut by the indigenous people.	An important taboo of the area for the dominancy of the plant *Acacia albida* in the district
7	MELKA	MELKA refers to the area along streams or rivers where people passed by. It is a place where people give respect. Most frequently people put '*Erecha'* here while moving through it. Plants nearby Melka are not allowed to cut.	This tradition conserves wetland vegetation in general MPs in particular
8	ODAA NEBI	ODAA is a local term refering to *Ficus* spp. and NEBI is a local term referring to the acient Ayyanna of the Oromo; and equivalent to Jesus in the Christian word. Thus, *Odaa Nebi* is believed to be a *Ficus* species from Jesus. This is a known plant in the culture of '*Tulema Oromo'* where they produce laws of do's and not to do's. Otherwise the laws are believed to be unaccepted by '*Nebi'*.	This specific belief pays attention for the conservation of *Ficus* spp, which is an umbrella and keystone species in the district.
9	QALLUMAN EYEMEMME	This refers to the utilization of medicinal plants only by selected families who have divine power locally referred as *Qallu* in the community. But if other healers harvest the medicinal plant, it doesn't heal as it is believed to loss its efficacy.	This tradition reduces the level of exploitation
10	RAKOO	RAKOO is a term refering to a young man who hasn't got married; and according to the tradition *Rakoo* are not allowed to cut straight up growing trees.	The presence of more young people saves straight up growing trees
11	BOSSONA TULU GUBA	This refers to forests on top of the mountainous area. Usually this place is regarded as a place to worship God (*Waqayoo* in the local Oromo language) as their church (locally named as *Gelma*) is often bulid here.	This tradition conserves highland vegetation in general and MPs in particular

worship and therefore considered as sacred place where cutting of any plant is considered as sin. This study also found another traditional ecological knowledge which is very vital in the conservation of vegetation in general and medicinal plants in particular that are adjacent to water bodies and wet-lands. According to the culture of the study area, wet lands should not be expected to be "exposed" and need to be covered by vegetation as such places are areas to worship the spirit of the river or wet lands in general (locally called *Borenticha*). In line withthis, Martin (1995), Cotton (1996) and Cunningham (2001) have indicated the contributions of cultural and traditional beliefs in the conservation of plant species and ecosystems. Studies conducted elsewhere in Ethiopia have found related cultural beliefs and traditional practices, which contribute to the conservation of medicinal plants in particular, and biodiversity as a whole. For example, Tolosa (2007) listed out various local beliefs and cultural traditions used for the conservation of medicinal plants (MPs) in Gimbi District of Western Ethiopia. Tefera et al. (2015) similarly assessed the importance of local ecological knowledge associated with conservation of some plants on agricultural landscapes of Debark District in the Northern Ethiopia. Abbink (1995) explored medicinal plants that have ritual and conservation values for the Ethiopian southwest people. Mesfin (2007) also documented cultural and spiritual beliefs used for the conservation of MPs in Wonago District of the Southern Nations, Nationalities and Regional States of Ethiopia. Moreover, the Geda cultures of Oromo people of Ethiopia also have an important contribution in biodiversity conservation (Keller, 1995; Wemlinger, 2008; Mergo, 2014; Getahun, 2016), which creates a conducieve enviroment for wild medicinal plant conservation. Similarly, Wassie (2008) also noted the tradition of Ethiopian Orthodox Church (EOC) in the northern part of Ethiopia for the conservation of Biodiversity in general and hence medicinal plants, basically, due to the words in Genesis 2: 8-10 and 2:15 of the Holy Bible. Likewise, a number of rituals, ceremonies and customs related to sacred trees with medicinal value were documented elsewhere in the Middle East (Dafni, 2007) and north-eastern Brassil (Albuquerque et al., 2008).

Knowledge of informants about the medicinality of herbs

In ethnobotanical science an herb is a plant or plant part valued for its medicinal, aromatic or savoury qualities (Martin, 1995). Unlike many other studies that show significant variation of the knowledge of traditional medicinal plants among the genders of informants, ages of informants, educational status of informants, experiences of informants and marital status of informants (Teklehymanot, 2009; Lulekal et al., 2013, 2014), this study found that there was similar knowledge of traditional medicinal plants among these informant parameters. The similarity in the indigenous knowledge of herbals among traditional healers may be attributed to equal access of their family members to the existing indigenous knowledge regardless of age, gender, level of education and marital status. A similar observation was revealed by Yineger and Delenasaw (2007) in Sekoru District of southwest Ethiopia.

CONCLUSION AND RECOMMENDATION

This study documented 112 wild medicinal plants that can be grouped into 97 genera and 53 families. This study also found that there are traditional perspectives and cultural beliefs which would maintain the ecology of medicinal plant species. Thus, integrating the ethnoecological perspectives of the local/indigenous people would be helpful for better ecosystem management in general and wild medicinal plants in particular. Moreover, active formal and/or informal local institutions should be developed to sustain this traditional knowledge in the district.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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