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Determination of informant consensus factor and fidelity level of ethnomedicinal plants used in Misha Woreda, Hadiya Zone, Southern Ethiopia

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In developing countries, traditional medicines occupy a central place among rural communities since they contribute to provide health care to them. However, studies on the identification and documentation of medicinal plant (MP) species used for treatment of various ailments, plants parts used, remedies, preparation and administration of herbal drugs have been scarce, especially to determine the consensus factor among local communities and evaluate the potential for new drugs of herbal origin. This paper aims to determine informant consensus factor and fidelity level of ethnomedicinal plants used in Misha Woreda, Southern Ethiopia. A total of 200 informants were selected randomly for the study. Data were collected through semi-structured interview, focus group discussions, observation and guided field walks with informants. The secondary source data were collected from previous annual reports, documented information and relevant literatures. Data were analyzed by using suitable statistical tools such as correlation coefficient, Mann-Whitney U test, informant consensus factor (ICF*),* Fidelity Level (FL), and various ranking methods. A total of 126MP species belonging to 110 genera and 50 families were recorded. Of the total identified species, 66 were used to treat 34 human ailment, 13 MPs to treat 28 livestock ailments, and 47 MP species were common for both human and livestock treatment. Leaves forming 41% and herbs making 52% of the total identified MPs were dominantly harvested plant parts and plant growth forms, respectively. The dominant mode of remedial preparation was crushing (44%), and most MPs (61%) were administered orally. The highest ICF values were recorded for oral & pharyngeal, and respiratory (0.95 each), depicting the agreement among informants knowledge on MPs used to treat these aliments categories. Medicinal plans species such as *Datura stramonium, Prunus africana,* and *Ruta chalepensis* had the highest fidelity level (100% each) indicating the concordance of knowledge on species of best healing potential. Preference ranking indicated that *Allium sativum* was ranked first and found most effective MP to cure Pneumonia. Therefore, the documented MPs can be used for future pharmacological research, and awareness creation among the traditional healers and community at large becomes vital so as to preserve the indigenous knowledge associated with MP species.

Key words: *Ethnobotany,* Indigenous knowledge, Medicinal plant, Misha*, Informant consensus.*

INTRODUCTION

The usage of natural products with therapeutic properties is as ancient as human civilisation and, for a long time,

products of plant and animal continued as the main sources of traditional medicines (De Pasquale, 1984). People have used plants as sources of traditional medicines in such a way that they interact with their surrounding environment (Abbott, 2014). Such inter-actions have contributed to enrich the ethno-medicinal knowledge of people that often involves traditional diagnosis, collection of raw materials, preparation of remedies and prescription to the patients (Gidey et al., 2011). Ethno medicines playing an important role in human health care practices are sources of tradition and culture of many ethnic groups. The importance of such medicinal practices has driven the increase of demands at international and local levels because these herbal medicines are cheap, more effective, and easily available and supposed to have no side effects (Mequanente, 2009), which is also true in many parts of the African continent. In tropical Africa, more than 4,000 plant species are used for medicinal purposes and 50,000 tons of medicinal plants (here after MPs) are used and consumed annually (Yirga, 2010). In Ethiopia MPs are widely used and they contribute to play an important role in treating and preventing a variety of diseases (Mequanente, 2009). WHO (2011) has highlighted that about 90% of human populations rely on traditional medicines. In addition, more than 800 plant species have been employed as MPs in Ethiopia (Tesema et al., 2002). According to Edwards (2010), more than 480 species of wild trees, shrubs and herbs are known as useful forest-food sources and MPs vital for local food and health security. The greater concentrations of MP species are found in the south and south western parts of Ethiopia. This has to do with the important concentration of biological and cultural diversity encountered in the areas (Edwards, 2001).

Traditional medicines have been practiced by all cultures for ages, and they are often part of a local community's culture and traditions (Megersa et al., 2013). Some of the key reasons for the wide spread of the traditional health care system are among the following: i) traditional healers are found within a short distance in a community, ii) uses fall within the patient's culture and environment, and iii) the costs associated with disease treatment are minimal compared to modern medicine (Abebe, 2001), including among minority nationalities in Ethiopia such as the Hadiya. Despite the previously mentioned advantages, MPs species are subjected to increasing anthropogenic pressures that contribute to threaten the resources base (Maryo et al., 2015). Among the well-known drivers of MPs include land clearance for agricultural filed, fuel wood collection, construction, recurrent drought, and overgrazing (Kelbessa et al., 1992). Although the importance of MPs has been overlooked in the past by the Ethiopian government, however there is a new and increasing emphasis of the government to promote and document indigenous knowledge based on MPs as approach to preserve traditional knowledge before it diminishes (Abebe and Ahadu, 1993). Such promotion and documentation of traditional knowledge would contribute to prepare a database of MPs, conserve and manage MP species in a sustainable way (Abebe and Ahadu, 1993; Maryo et al., 2015). This is particularly true in the case of Misha *woreda* (stands for a district) where MPs play a crucial role in the lives of many ethnic groups and traditional healers. The purpose of this study was to document MP uses and associated indigenous knowledge in Misha *Woreda*, Hadiya Zone, Southern Ethiopia; which is a part of initiative to document baseline data for future phytochemical and pharmacological studies.

MATERIALS AND METHODS

The study was carried out from February 2014 to March 2015 in Misha *woreda*, Hadiya zone, Southern Ethiopia. Misha *woreda* is 204 km distant from the capital city of the Southern Nations, Nationalities and Peoples Regional State, Hawassa. The study area covers a total area of 43976 ha (Figure. 1). Fifty four percent of the study *woreda* lies in the *Dega* agro-climate (highland 2400-3200m a.s.l) whereas 39% the *Woyna Dega* falls within the (mid highland, 1800-2400m a.s.l), and 7% lies in the *Kola* agro-climate (lowland, Semi desert, 500-1800m a.s.l). The *Woreda* comprises undulating topography with the major characteristic vegetation of mild tropical rainforest type (Friis et al., 2011). The highest rainfall named locally as "Hagayye" is encountered during summer (from May to September). The rainfall distribution of the area is unimodal with mean annual temperature and rainfall representing 16.7°C and 172.9 mm respectively (MWAO, 2014). As a result of its agroclimatic situation, the region is highly suitable for both human habitation and agricultural production. Agriculture is one of the dominant economic activities in the woreda. Annual crops are the major components of land use patterns followed by perennial crops such as enset and coffee. Seasonal crop accounts for 71.12% (31276 ha) of the area, followed by perennial land crop 13.16% (5786 ha) and other crop types 15.72 % (6913 ha). Among the dominant soil types in the *Woreda* include: clay loam, red clay loam and black grey loam (MWAO, 2014).

Selection of Study Sites and Informants

Misha *Woreda* has long been occupied by people who have a long tradition of using MPs to treat human and livestock ailments. Permanently increasing population growth combined with overexploitation of MPs, and agricultural land expansion threatened MPs in the area. Thus, in order to document the ethnomedicinal knowledge of the people reconnaissance survey was carried out before the sampling exercise in the *kebeles* (*Kebele* is the lowest administrative part in Ethiopia), of the *Woreda*. An ethnobotanical study was carried out in Misha *Woreda* on 10 rural *kebeles* that

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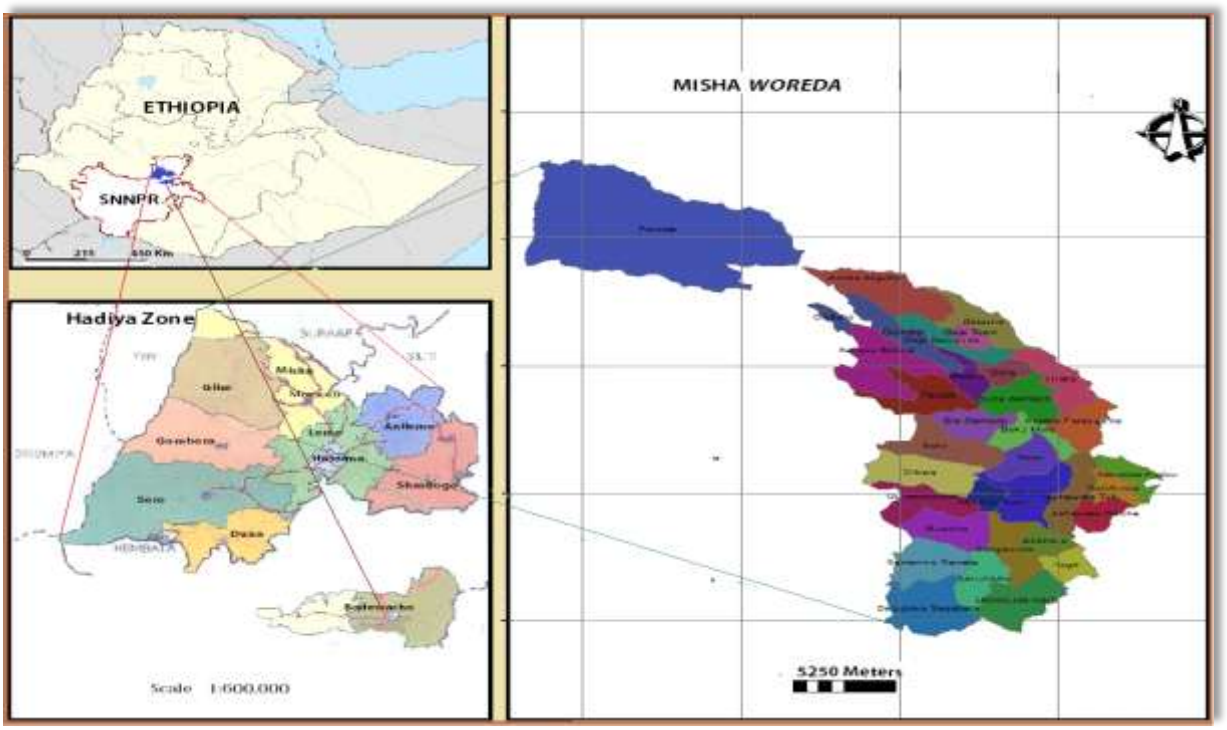

Figure 1. Administrative map of the study area

were randomly selected. Similarly, sampled villages in each kebele were randomly selected following Martin (1995) and Cotton (1996) approaches. As a result, a total of 200 individual informants (118 males and 82 females) whose age ranging from 22 to 70 were selected from 10 rural *kebeles* (20 from each). Out of the total number of individual informants 95 were males and 70 female, making a total of 165 people. The selection of the general informants was also random (23 males and 12 females) constituting 35 people. On the contrary, ten key informants were selected purposively from the entire list of informants based on their MP knowledge and long experience in the area, and the selection was facilitated by the local elders and local authorities (*kebele* administrators and development agents, DAs).

Ethnobotanical data collection

To answer and validate the research questions, ethno botanical data were collected from both primary and secondary sources. Primary data source were collected from the field study conducted in the sample kebeles and the secondary data source were collected through annual reports and relevant literatures. Participatory Rapid Appraisal (PRA) methods were used to collect the primary data sources. A designed questionnaires and key informants interview were elaborated and directed to the traditional healers and the knowledgeable elders, followed by field observation, semi-structured interviews, group discussions, preference ranking and market survey using the local language “Hadiyisa”. Information about medicinally useful plants used and grown in their natural habitats including parts used, methods of preparation, dosage, marketability, the role of multipurpose MP species and the associated threats to plant genetic resources and their conservation status were collected following the methods described by Martin (1995) and Cotton (1996). Group discussions with key informants were made in 5 kebeles to complement the data already gathered and cross-check them along with and the informant consensus methods. In addition, focus group discussions were held to gather data on the status of MPs and traditional medicinal knowledge of the community and its transferability from generation to generation (Martin, 1995). This method assumes that there are variations in informants’ opinions, experiences and knowledge related to MPs. Field observations were used to assess the healers and households’ knowledge. All the plants collected were tagged and the details of the plants were recorded while information provided by the local healers on MPs was kept secret.

A visit to the local markets provides an idea of the market availability of the MPs **(**Worede, 2002). Market surveys were made to record the diversity, quantity of MPs and the parts sold in the local markets as well as market value records. In total, three local markets, namely Wasgebeta, Morsuto and Geja were visited twice in the study area. Semi-structured interviews were conducted with herbal drug sellers to assess the varieties and amounts of plant materials sold in the market, and to see the income generation from local market. Finally, the voucher specimens of MPs were reported twice or more during key informant visits were collected, pressed and taken to the National Herbarium of Addis Ababa University for further identification, and preserved as Dilla University data base.

Data Analysis

Data were entered into the MS Excel spreadsheet for statistical analysis. Both descriptive and inferential statistics were applied. Proportions, preference ranking, direct matrix ranking, informant consensus factor (ICF), and species consensus (Fidelity level) were employed, and the results were presented using tables, graphs and percentages following Martin (1995). The ICF was calculated to see the agreement of informants for a plant species in treating a

Table 1. The diversity of MP species and their families in the study area

S.No	Family name	No.of species	Percent (%)	S.No	Family name	No.of species	Percent (%)
1	Acanthaceae	1	0.79	26	Loganiaceae	1	0.79
2	Aloaceae	1	0.79	27	Malvaceae	2	1.58
3	Alliaceae	2	1.58	28	Moraceae	1	0.79
4	Amaranthaceae	1	0.79	29	Musaceae	1	0.79
5	Anacardiaceae	2	1.58	30	Myricaceae	1	0.79
6	Apiaceae	1	0.79	31	Myrsinaceae	2	1.58
7	Arecaceae	1	0.79	32	Myrtaceae	3	2.38
8	Asclepiadaceae	2	1.58	33	Oleaceae	1	0.79
9	Asphodalaceae	1	0.79	34	Phytolaccaceae	1	0.79
10	Asteraceae	9	7.14	35	Pittosporaceae	1	0.79
11	Boraginaceae	2	1.58	36	Poaceae	6	4.76
12	Brassicaceae	3	2.38	37	Podocarpaceae	1	0.79
13	Caricaceae	1	0.79	38	Polygonaceae	2	1.58
14	Caryophyllaceae	1	0.79	39	Ranunculaceae	2	1.58
15	Celastraceae	3	2.38	40	Rhamnaceae	1	0.79
16	Convolvulaceae	1	0.79	41	Rosaceae	4	3.17
17	Crassulaceae	1	0.79	42	Rubiaceae	3	2.38
18	Cucurbitaceae	4	3.17	43	Rutaceae	4	3.17
19	Cuppressaceae	1	0.79	44	Santalaceae	1	0.79
20	Ebenaceae	1	0.79	45	Sapindaceae	2	1.58
21	Euphorbiaceae	4	3.17	46	Salicaceae	1	0.79
22	Fabaceae	10	7.94	47	Simaroubaceae	1	0.79
23	Flacourtiaceae	1	0.79	48	Solanaceae	10	7.94
24	Lamiaceae	13	10.32	49	Verbenaceae	2	1.58
25	Linaceae	1	0.79	50	Zingiberaceae	2	1.58
						126	100

particular disease using a formula, **ICF = (nuc –ns)/(nuc – 1)**, where **nuc** = number of use citations, **ns** = number of species used for each use citation following Heinrich et al (1998). Fidelity Level (FL) values were also used to estimate the relative healing potential of each MPs based on the proportion of informants who agreed on its use against a given ailment category (Friedman et al ., 1986). This method has contributed to recommend that a particular MP species could be suggested effective and that it can be further analyzed for its bioactivity and therapeutic properties. FL was calculated using FL (%) = **SF/TF** (100), where SF = frequency of citation of a given specie for a specific ailment and TF = total number of citations of that species. Finally, traditional knowledge dynamics on the use of MPs against the socio-economic profile of the respondents including gender, informants types, and educational status were statistically tested by Mann-Whitney U test using IBM SPSS version 20. Direct matrix ranking exercises were also used to relate the multiple uses of a given plant species following the methods recommended by Cotton (1996) and Martin (1995). The multipurpose uses of the seven MPs species were selected out of the total MPs. The uses of these plants were enumerated by ten key informants. These key informants were asked to assign use values to each of the seven MPs species as followed: (5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used and 0 = not used). The average values (scores) of each species were summed up and ranked. Finally, preference ranking from informants responses on issues related to disease treatment was analyzed following Martin (1995). According to their preferences ranking they ranked individually those selected MPs in treating the mentioned aliments on the basis of the method described by Cotton (1996). A direct matrix ranking exercise on perceived threats to seven MPs species was conducted for multipurpose species were conducted with ten key informants following previous scholars (Martin, 1995; Cotton, 1996). The selection of multipurpose species was carried out and their uses were also listed while the key informants were asked to assign use values to each species. The average scores of each species were summed up and ranked. Finally, the ten key informants were also involved in priority ranking exercise that was focusing on perceived threatening factors of the MPs species (Martin, 1995; Cotton, 1996).

RESULTS

The diversity of medicinal plants

The diversity of the MPs species encountered in the area is shown in Table 1. In total, 126 MPs species belonging to 110 genera and 50 families were identified in the study area. Among the identified families of MPs, Lamiaceae contributed to the maximum number of species (13 species= 10%) followed by Asteraceae, Fabaceae and Solanaceae (10 species each).

Indigenous knowledge of the community

Of 126 medicinally important plants identified in the study

Table 2. Statistical test of significance, Mann-Whitney U, on average number of reported MPs among different informant groups in Misha *Woreda*, 2015.

Parameter	Informant group	N	%	Average ± SD	Z- value	p-value
Gender	Male	118	59	10 ± 5.72	-1.2	0.23
	Female	82	41	8.7 ± 4.35		
Age	Young (≤ 40years	120	60	7.98 ± 4.23	-4.8	0.000**
	Senior (≥ 40 years)	80	40	11.69 ± 5.81		
Educational status	Illiterate	60	30	13.13 ± 6.02	-5.8	0.000**
	Literate	140	70	7.89 ± 3.93		
Informant	Key informant	35	18	1.58 ± 6.99	-0.22	0.82
	General informant	165	83	9.22 ± 4.75		
Total			100			

Note: **Significant difference ($p < 0.05$)

Table 3. Proportion of plants for human and livestock remedial preparation

Target organism	No of Species	% total	Growth forms (%)				Part used (%)				
			Tree	Herb	Shrub	Others	Leaf	Root	stem	Seed	Others
Human only	66	52	8	27	12	5	23	9	3	8	9
Livestock only	13	10	3.9	0.7	3.9	1.5	3.9	2.2	1.5	1.5	0.9
Human & livestock	47	38	9.5	15	10.5	3	13	5	5	3	12
Total	**126**	**100**	**21.4**	**42.7**	**26.4**	**9.5**	**39.9**	**16.2**	**9.5**	**12.5**	**21.9**

area, 39 species (31%) were mentioned by male informants, 36 species (29%) by female informant and 51(40%) by both sexes. In the current study, more number of MPs were reported by male informants than female informants but the difference was not significant ($P > 0.05$) (Table 2). However, there was a significant difference ($P < 0.05$) in the number of MPs reported by senior members of the community (41–70 years old) and young to middle aged members (22–40 years old). The result also showed significant difference when the educational status (illiterate and literate) of informants compared with the MP Knowledge. The difference was not significant in the case of key and general informants. However, more information on MPs was given by senior informants (above 40 years age) and key informants than young and general informants. There was a significant difference ($P < 0.05$) in the number of MPs reported by elderly members of the informants (41–80 years old) and young aged ones (20–40 years old) where more information on MPs was given by senior informants (> 40 years age) than young ones. The age and MP knowledge were directly correlated as the age of informants increases, traditional ethno medicinal knowledge also increase (Table 2).

There was statistically significance difference between the number of MPs reported and the educational level of informants where illiterate informants reported large number of MPs than literate informants (Table 2). The Spearman correlation analysis also showed that education correlates negatively and significantly with the knowledge of MP species ($r= -0.27$, $P<0.05$).

Growth forms and medicinal plant parts used

Medicinal plants used to treat human ailments were more in number than those used to treat livestock ailments, which could be associated with the prevalence and abundance of human disease. The most common growth forms used to treat human and livestock ailments were herbs (43% = 54 MP species), followed by shrubs (26%). However, leaves were the most common plant parts (40% = 50 MP species) used by Hadiya community to treat ailments (Table 3).

Modes of remedy's preparation

The analysis from the informants response showed that remedies were mainly prepared from freshly harvested plant parts (71%) to treat human ailments, followed by dried plants parts (25%), and the combination of fresh

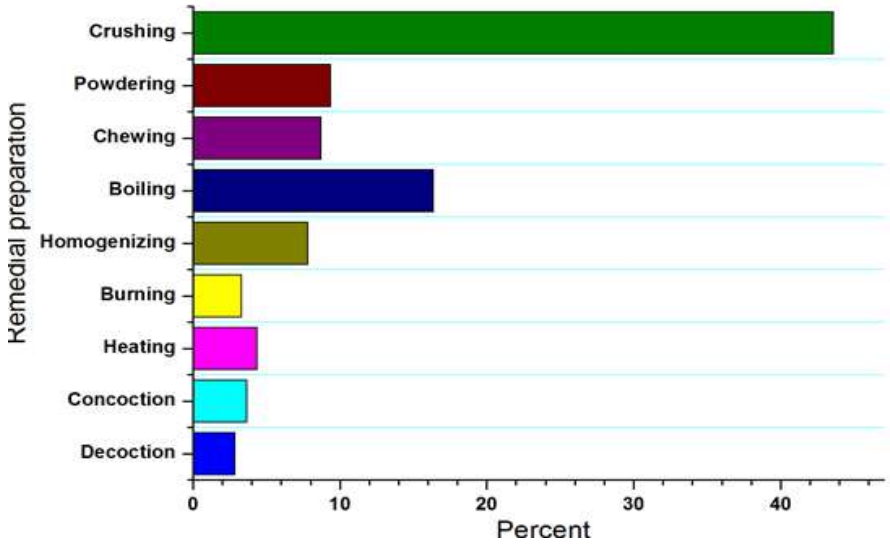

Figure 2. The various modes of remedy preparation to treat human ailment in the study area

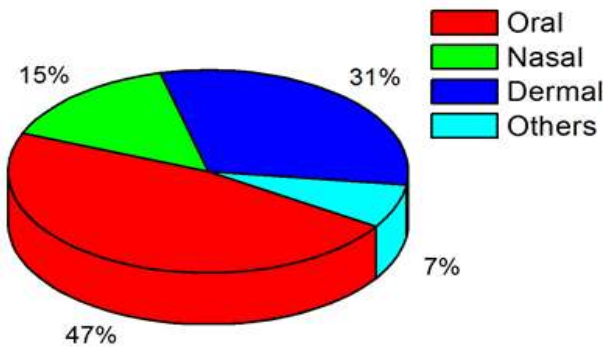

Figure 3. The common routes of administration of traditional medicinal remedies

and dried plant parts (4%). Figure 2 depicts the various modes of remedy preparations in the study area. The most common mode of remedy preparation was crushing 44%, followed by boiling (17%), powdering (10%), chewing (9%) and others (20%).

Routes of Administration

The current study indicated that the oral administration (47%) to treat human ailment was the major route (includes drinking, chewing, and eating) followed by dermal (pasting, creaming, and washing) (31%), and nasal (smoke inhaling, and sniffing) (15%) routes (Figure 3). This emphasizes on the diversity of approaches used by traditional healers to prepare traditional remedies from MPs. Table 4 shows the proportion of various local units of measurements used by traditional healers to quantify/ measure liquid herbal preparations, which include cup (see Figure. 4), mug, and bottle. About 44% of the healers quantify herbal medicines in liquid form. Most informants indicated that the doses for liquid preparations are prescribed through estimation such as full, half or ¼ of a coffee cup, mug, bottle or other measures depending on the situation being treated. Similarly, traditional healers use various cultural units of measurement like finger length, pinch, and numbers (for leaves, flowers, seeds and fruits).

Marketability of medicinal plants in the study area

The market survey revealed that twenty one percent (n= 27 species) of the identified MPs were marketable (Figure 4 and Table 5). The availability and quality of traditional medicines in the markets was uncommon. Only 7% of the total identified MPs were sold for medicinal purpose. However, ninety three percent of the MP species was sold for food e.g., *Allium sativa, Nigella sativum, Lepidium sativum, Aframomum corrorima, Allium cepa, Brassica carinata, Carica papaya, Coffea arabica, Cucurbita pepo, Ensete ventricosum, Guizotia abyssinica, Hordeum vulgare, Linum usitatissimum, Pisum sativum* and *Zingiber officinale.* These are occasionally applied as medicine when the need arises.

The seeds were measured using a cup or mug in local markets and the average price was 7.5 Ethiopian Birr per cup or mug, whereas for leaves and pieces of stems such as *Echinops kebericho* were sold by estimation or counting pieces and the powder form such as *Nicotiana tabacum* was sold by pinching, the root materials were

Table 4. The proportion of various local units of measurements used by traditional healers in the study area.

Local unit of measurement	Frequency	Percent
Number/Handful (Leaf, Seed)	5	4
Finger length (Root)	8	6
Pinch/Teaspoon (powder)	13	10
Cup/Mug/Bottle/Can/Jog (Liquid form from varied plant parts)	56	44
Drop	3	2
Undetermined	41	33
Total	**126**	**100%**

Figure 4. Some marketable MPs and their measurements (Photo: at Geja local market)

sold using bunch or using hypothetical measurements.

Efficacy of medicinal plants

The reported MP species were found to treat different human and livestock ailments. As shown in Table 3 the highest proportion (40%) of MP parts were leaves, harvested to treat 55% of the total ailments. Table 6 highlights informant consensus factors (ICF) values for 15 ailment categories that were recorded in Misha *Woreda.* In the current study more than eleven different disease categories were reported by the respondents in the study *Woreda*. Respiratory, oral and pharyngeal had the highest ICF values (0.95 each), followed by gastro-intestinal and parasitic and external injuries each accounting for 0.94. In this study most values for ICF were greater than 0.7 which may indicate that ailments were common in the community.

Fidelity level

The percentage of informants claiming the use of a certain plant for the same major ailment was calculated for the most frequently reported ailments to evaluate species consensus. Table 7 showed the Fidelity level (FL) values for some MPs that were claimed to be used by informants against the corresponding ailment. The highest FL of 100% was recorded for MP species such as *Cucumis ficifolius, Datura stramonium, Guizotia abyssinica, Hagenia abyssinica, Prunus africana, Rumex nepalensis,* and *Ruta chalepensis,* followed by *Calpurnia aurea* (88.9%), and *Millettia ferruginea* (85.7%). The highest FLvalue (100%) was obtained under the internal therapeutic category (dry coughing, mental illness,

Table 5. Medicinal plants those were observed in the markets of the study area

S.No	Scientific name	Local name	Functional group	Parts of MP sold
1	*Aframomum kororima* (Braua.)Jansen	Wokkaashsha	Spice	Seed
2	*Allium cepa* L.	Kashar sunkurutta	Spice	Bulb
3	*Allium sativum L.*	Tuma	Spice	Bulb
4	*Brassica carinata L.*	Shaana	Spice	Leaf
5	*Brassica niger (*L.) Koch	Sanaaficca	Spice	Seed
6	*Carica papaya L.*	Papaayya	Fruit	Fruit
7	*Citrus lemon (L.)* Burm. F.	Loome'e	Fruit	Fruit
8	*Coffea Arabica L.*	Buna/Qaawwa	Stimulant	Seed
9	*Cucurbita pepo L.*	Dabaaqula	Fruit	Fruit
10	*Ensete ventricosum* (Welw.) Cheesman	Weesa	Root & Tuber	Corm
11	*Guizotia abyssinica L.*	Shuqoota	Spice	Seed
12	*Hordium vulgare L.*	Heemach So'o	Cereal	Seed
13	*Lepidium sativum L.*	Shuumfa/Feexo'o	Medicinal	Seed
14	*Linum usitatissimum L.*	Talba	Oil	Seed
15	*Lippia adoensis Hochst.*	Kosarata	Spice	Seed
16	*Nicotiana tabacum L.*	Tambaa'a	Stimulant	Leaf
17	*Nigella sativum L.*	Heemachchenja	Spice	Seed
18	*Ocimum basilicum L.*	Gimmenja	Spice	Leaf
19	*Ocimum tenuiflorum L.*	Qadaalenja	Spice	Leaf
20	*Piper longum L.*	Qaare'e	Spice	Pod
21	*Piper nigrum L.*	Mixmixo'o	Spice	Pod
22	*Pisum sativum L.*	Gite'e	Pulse	Seed
23	*Rhamnus prinoides* L'Herit	Geesho'o	beverage	branch
24	*Ruta chalepensis L.*	Qantalaama	Spice	Leaf
25	*Zingiber officinale Rosk.*	Jaanjubeela	Spice	Rhizome
26	*Cymbopogon citrates* (DC.) Stapf	Xejsaara	Spice	Whole plant
27	*Echinops kebericho* Mesfin	Qebericho	Medicinal	stem

threatened MP species are among the forest resources diarrhea, taeniasis) while the lowest FL value (6%) were found for external disease categories (skin cuts and wounds, and black leg).

Ailment treatments

From the focus group discussion a total of 62 disease types (34 for human and 28 for livestock) were recorded during our survey period. Bronchitis, typhoid, intestinal disorders (diarrhea and taeniasis), fibril illness, and tonsillitis were among the most commonly reported health problems, especially under the human disease's category. On the contrary, hypocalcaemia, bloat and hypotrotonemia and bacterial diseases (such as anthrax) were the most commonly reported health problems, under livestock disease category. Informants responses indicated that the treatment process of the patient, visual inspection (skin color, eye color, tonsillitis or throat, tongue, status of sores, bleeding, infections and sensing body temperature) and questioning for symptoms identification were the common method that were used by traditional healers to diagnosis the patient prior to the application of any herbal medicine prescription in the community. Patients with skin infections were reported to be treated by rubbing and pasting herbal preparations whereas those with sore problems were treated by chewing the part of the MP and spitting the juice on the sore area. On the contrary, for internal ailments in most cases, herbal preparations were prescribed to be administered orally and for a general malaise steam bath and vapor inhalation were commonly prescribed.

Direct Matrix Ranking

In this study, the output of the direct matrix ranking (DMR) exercise on seven multipurpose MPs was aimed not only to identify the type of multipurpose plants species under pressure in the area but also to identify the corresponding factor threatening the resources base. The most threatened MP species ranked first was *Cordia africana*, followed by *Eucalyptus globulus, Podocarpus*

Table 6. Informant consensus factors (ICF) values for 15 ailment categories in Misha *Woreda*

S. No	Sickness category	Number of Species (ns)	Number of use reports (Nuc)	ICF
1	Gastro-intestinal and parasitic	24	376	0.94
2	Oral and pharyngeal	11	240	0.95
3	Respiratory	14	291	0.95
4	Dermatological	11	102	0.90
5	Urogenital and venereal	8	81	0.91
6	Fibril illness (*Mitch*)	13	162	0.92
7	External injuries	12	216	0.94
8	Liver infection	3	27	0.92
9	Evil spirit	9	114	0.92
10	Bites and bleeding	4	18	0.82
11	Constipation and appetite loss	7	53	0.88
12	Others	10	213	0.95

Table 7. Fidelity level (FL) values for some MPs claimed to use by informants against corresponding ailment

Name of MP used	Ailment	TF	SF	FL
Acanthospermum hispidum DC.	Skin cuts and wounds	15	6	40
Ajuga remota L.	Abdominal pain	46	27	58.7
Allium sativum L.	Evil eye illness	28	19	67.9
Brucea antidysenterica J. F. Mill	Stomachach	59	38	64.4
Calpurnia aurea (Ait.) Benth	Skin bits	18	16	88.9
Cucumis ficifolius A.	Dry coughing	14	14	100
Datura stramonium L.	Mental illness	7	7	100
Euclea divinorum Hiern.	Tonsilitis	23	16	69.7
Guizotia abyssinica (L,f.) Cass	Diarrhea	10	10	100
Hagenia abyssinica (Bruce). F. Gmel.	Taeniasis	28	28	100
Lagenaria abyssinica (Hook.f.) C.Jeffrey.	Body swelling	14	10	71.4
Millettia ferruginea (Hochst.) Bak.	Nose bleeding	21	18	85.7
Myrica salicifolia A. Rich	Ascariasis	31	26	83.8
Ocimum lamiifolium Hochst. ex Benth.	Fibril illness *(Mitch)*	45	37	82.2
Prunus africanus (Hook. f.)Kalms	Anthrax *(Abasanga)*	7	7	100
Rumex nepalensis Spreng.	Black leg *(Abagorba)*	6	6	100
Ruta chalepensis L.	Abdominal pain & evil eye illness	87	87	100
Solanum incanum L.	Skin bites (Snake, Ticks)	15	12	80
Teclea nobilis Del.	Anthrax	11	8	72.7
Thymus schimperi Ronniger	Hypertension	79	56	70.9
Vernonia amygdalina Del	Intestinal worms & exoparasites	66	49	74.2

N.B: **FL**= Fidelity Level, SF= is the number of informants who independently cited the importance of a species for treating a particular disease, and TF= total number of citations.

falcatus and *Millettia ferruginea* (Table 8). The most that were also used as construction material and firewood. From the socioeconomic study respondents indicated that MP species of the study area were used by the community for different purposes including medicinal use only 34(27%), fire wood 23(19%), food and spices 21(17%), and others such as adding soil fertility and farm tool making 12(9%) (Figure 5).

Preference Ranking

The informants' simple preference ranking for ten MPs that was used to treat pneumonia is shown in Table 9.

Table 8. Average DMR score results of ten informants for seven multipurpose MPs species. (5 = best, 4 = very good, 3 = good, 2 = less used, 1 = least used and 0 = no value)

Species name	Use categories								Total	Rank
	Md	Fw	Co	AT	Fu	Fo	LF	Ch		
Prunus africanus	5	4	3	3	2	0	1	3	21	5
Cordia africana	4	4	5	5	5	2	2	2	29	1
Juniperus procera	4	3	5	4	4	0	0	0	20	6
Millettia ferruginea	5	4	3	3	3	1	3	3	25	4
Eucalyptus globulus	5	5	5	4	3	0	5	0	27	2
Podocarpus falcatus	5	5	5	3	4	0	3	1	26	3
Hagenia abyssinica	5	3	4	0	3	0	2	1	18	7
Total	33	28	30	22	24	3	16	10	166	

Description: Md= Medicine, Fw=Firewood, Co=Construction, AT=Agricultural tools, Fu=Furniture, Fo=Forage, LF=Live fence, Ch=Charcoal

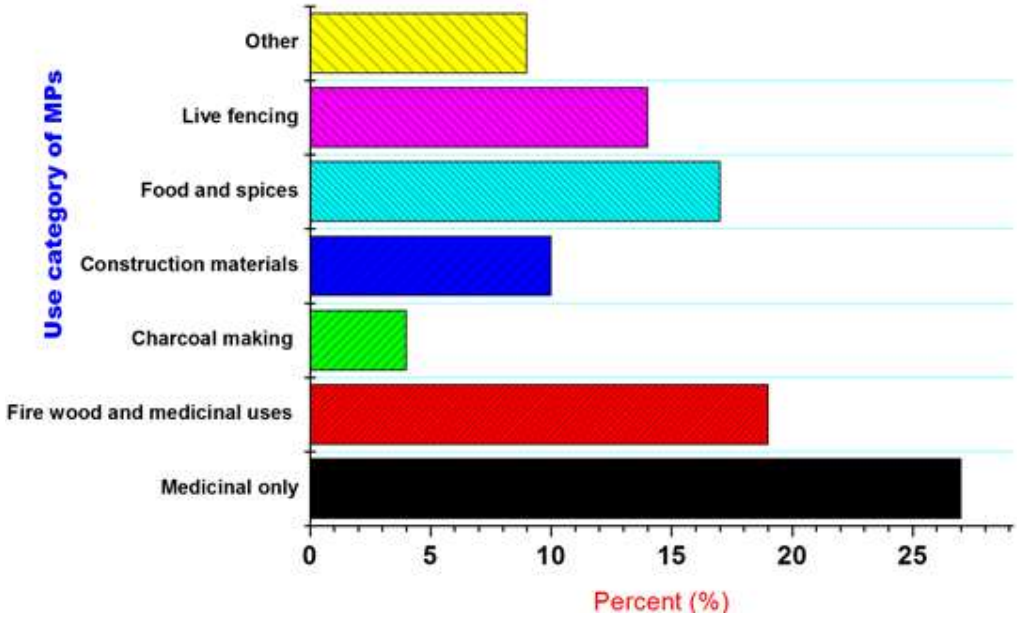

Figure 5. Use categories of MPs of the study area

Table 9. Results of a simple preference ranking for ten MPs against Pneumonia. (5 = the most preferred but 1 is the least preferred)

MPs Species reported	Key Informants (A to L)												Total score	Rank
	A	B	C	D	E	F	G	H	I	J	K	L		
Cucumis ficifolia	5	5	4	4	5	5	5	4	5	4	4	5	55	2
Allium sativum	5	5	4	5	5	5	5	4	5	5	4	5	57	1
Nigella sativum	4	3	5	5	5	3	2	5	3	5	3	5	48	6
Leucas acquistylosa	4	3	5	5	5	3	2	5	2	5	3	5	47	7
Lepidium sativum	5	3	4	4	3	5	4	4	4	4	5	5	50	5
Clausena anistata	5	3	4	4	3	5	4	5	4	4	5	5	51	4
Ocimum lamiifolium	5	5	4	3	5	5	5	4	5	4	3	5	53	3
Arthemisia afra	4	4	3	2	2	3	3	5	4	5	2	3	40	9
Eucalyptus globulus	4	4	3	4	2	3	3	5	4	5	4	3	44	8
Cymbopogon citirates	3	2	2	3	5	2	3	2	4	2	2	3	33	10

The preference exercise indicated that *Allium sativum*, *Cucumis ficifolius* and *Ocimum lamiifolium* were the most preferred MP species to treat pneumonia in the study area.

DISCUSSION

A total of 126 MP species were identified to manage diverse human and livestock ailments in the study area. Such MP species diversity may depict the contribution of MPs as well as the traditional health knowledge held by the Hadiya ethnic group in assisting the primary health care needs of the *Woreda*. Similar indigenous ethno-medicinal knowledge were reported by various workers from different regions of Ethiopia, including the 120 MP species from Konta special *Woreda* (Tesfaye et al., 2009), 126 MP species from Wayu Tuka district (Megersa et al*.,* 2013), and 145 MPs species from Kambata Tambaro Zone (Maryo et al., 2013). The local people in the study area traditionally use various MPs to treat the variety of ailments. Among the documented MPs, sixty six species were used to treat 34 diverse human ailments, 13 MP species to treat 28 livestock ailments, and 47 MP species were used to treat both 41 human and livestock ailments. Of the total MP species identified, herbs (43% = 54 MPs) were the most dominant growth forms, followed by Shrubs 32 MPs (27%). trees 21%, and others mainly climbers (9%). This finding agree with the works of Gidey (2001), Endalew (2007), Tesfaye et al. (2009), Megarsa et al. (2013), and Maryo et al. (2015) who have reported herbs to be the most harvested growth forms. However, the findings of Yineger et al .2008) indicated that woody plants species (shrubs) were the most harvested growth form of the MPs used by local people.

The study revealed that leaves were the most widely used plant part for the human remedial preparations that accounted 41%, followed by root 26%. This result is in agreement with the previous works (Gidey, 2001; Gidey, 2010; Gidey et al., 2011; Maryo et al*.*, 2015). On the other hand, there are other works which had indicated that roots are the most commonly used MP parts to treat ailments (Alemayehu, 2010; Ermias Luleka et al., 2013). The observations of most informants and researchers showed that the main cause for the incidence of common ailments is associated with poor sanitation practice. The actual observations of the researchers to the life style of the local people of the study area do support this fact. The reason could be due to low income and weak economic status. Most of these plants were collected from wild habitats (72%) indicating the existence of pressure on wild plants. The findings of many Ethiopian researchers (Gidey, 2010; Maryo et al*.,* 2015) indicated that the majority of MPs were obtained from wild vegetation source. Various Methods of remedy preparations from traditional MPs were used in the study area. The most popular mode of preparation was crushing which accounted 44% (Figure. 2). Similar results were also reported by different earlier researchers (Gidey, 2001; Tesfaye et al., 2009; Habtamu et al., 2014; Maryo et al., 2015).

The current study result confirmed that family Lamiaceae has contributed the highest number of plant species for medicinal purposes, which is in agreement with studies conducted elsewhere in Ethiopia (Abraha et al., 2013; Alemayehu, 2010). Most of the MP species investigated in this study were also medicinally useful in other parts of Ethiopia and elsewhere in Africa (Kebu, 2004; Bayafers, 2000). The study confirmed that the main route of administration was oral, which accounted 47%, of which drinking (remedial preparations in liquid form) was the dominant as claimed by the informants. This is in agreement with many previous studies (Gidey, 1999; Kalayu et al., 2013, and Megersa et al., 2013). These routes of remedial administrations were represented by drinking and/or swallowing, washing and/or creaming, smoke inhaling and drop application into eyes. The finding of the current study revealed that 71% the MP preparations were in fresh form, 25% dried and 4% was the combination of fresh and dried forms. Most informants explained that remedies prepared from fresh plant materials are effective in treatment as the contents are not lost before use as compared to the dried forms. Similarly, other studies reported that freshly harvested plant parts to be dominant in the remedial preparations (Ermias et al., 2013; Gidey, 2010; Megersa et al*.,* 2013; Maryo et al*.,* 2015). The similarity may indicate the dependency of local people on freshly available plant materials. This can strongly affect the diversity and existence of medicinally valuable plants if fresh plant materials are harvested and used directly without the replacement as described by Maryo et al. (2015). Traditional people are collecting and using MPs with less attention when seen from the conservation viewpoint of plant resources. This may call for the domestication of wild MP species around the homegarden as reported by Maryo et al. (2015). According to the informant response, leaves were being the most harvested plant part of remedial preparation in the area but the destruction of mother MP found to be minimal as compared to rampant destruction to the mother plant, which could happen when the root is harvested. Medicinal plant harvest that involves roots, stems, barks, bulbs and rhizomes have destructive effect on the survival of mother plant (Cotton, 1996). On the other hand, many other researchers (Etana, 2007; Ermias et al*.,* 2008; Ermias et al., 2013) reported that roots to be the most popular plant part used for remedial preparation followed by leaf. There were cases where one species may be used to treat a single disease or a number of diseases. Likewise, one ailment can be used in combination with using several plant species or with a single plant part. For example, abdominal pains are treated with 5 different MP species.

Similar results were reported by Maryo et al. (2015). Remedial preparations of MPs in the current study area did not have standardized doses. In the most cases practitioners determined dosages depending on the age, sex and the strength of the patients treated. Some of the MP remedial preparations were measured in a small cup, a mug, spoonful, a pinch and others. Herbal preparations could have side effects, which may result in diarrhea and vomiting unless special care is taken. To avoid this, practitioners use antidotes like milk, honey, milk whey, yogurt, butter, coffee, *atakana* (soft food made from *Ensete ventricosum* product called *kocho*) and homogenized powder of bean, pea or barley. Comparable results were described by Maryo et al. (2015). However, the dosage of some herbal preparations that is considered harmless depends on the interest and/or the capacity of the patient to chew a particular plant for a given health problem (*e.g*. chewing the leaves of *Ruta chalepensis* to get relief from abdominal pain).

With regards to dosage unless special care is not given, some herbal preparations have side effects and resulted in diarrhea and vomiting (Ermias et al*.,* 2008). When such conditions happen, antidotes like milk, honey, milk whey, yogurt, butter, coffee, *atakana* (soft food made from *Ensete ventricosum* product) and homogenized powder of bean, pea or barley were used by most practitioners in Misha *Woreda* to reverse the condition. The current study showed that the knowledge of MP is directly related to the age of the informants where elderly people conveyed large number of MP than young people. Many former investigations confirmed that the age of respondents being positively correlated with the number of MPs reported (Mohammed and Berhanu, 2011; Kalayu et al*.,* 2013; Ermias Lulekal et al., 2013; Habtamu et al., 2014; Maryo et al., 2015). On the contrary, some investigations revealed that age and MP knowledge have inverse correlation (Mohammed and Seyoum, 2013). The indigenous knowledge on the use of traditional MPs found that there is a top secrecy in passing within the family or close relatives otherwise kept hidden from others (Gidey, 2010; Ermias et al*.,* 2013). Most of the knowledge on herbal remedies (42%) was handled by the elderly members of the community in Misha *Woreda*. Informants in the study area claimed that traditional healers transfer the indigenous knowledge on MPs to their selected family member or close relative by the words of mouth. Such knowledge transfer is poor, which may cause the attrition of local ethno-medicinal knowledge. Similar works were reported from Kambata Tembaro Zone (Maryo et al., 2015). However, the ethno-medicinal works like the current studies are advisable to document the local knowledge. Fourty percent of the MPs recorded in this study are also medicinally useful in other parts of Ethiopia (Kefyalew, 2010; Tamene, 2011; Maryo et al., 2015). Some of those MPs reported by the informants in the study area include *Ajuga remota, Artemisisa absinthium, Brucea* antidysenterica*, Solanum incanum, Croton macrostachyus, Buddleja polystachya, Citrus lemon, Erythrina brucei, Pittosporum abyssinimum, Cucumis ficifolius, Rumex nepalensis, Datura stramonium, Hagenia abyssinica, Ocimum lamiifolium, Phytolacca dodecandra, Ruta chalepensis, Leucas acqistylosa, Clausena anisata,* and *Carica papaya* are few among others. Such similarity in the use of MP species in different localities of the country have been tested by different cultures can be taken as an indication of their pharmacological effectiveness.

The introduction of modern medicine has lead to decrease in use of herbal medicines in the study area. Nowadays, young people in the study area preferred modern medicines to traditional remedies. This being a cause currently people don't give special attention to the traditional MPs. The current finding agrees with the previous reports by Maryo et al. (2015). The people in Misha *Woreda* owns indigenous ethno botanical knowledge with the diverse use of MPs. Most of the MPs of the study area play vital roles in fire wood, construction and furniture making. Some of these use categories are destructive whereas others are not. The multiple role of some plants other than medicinal significance was report as one of the threats for plant biodiversity conservation (Maryo et al., 2015).The current study indicated that there is a statistical significance in the MP knowledge between two age groups (young and elder). Similarly, there was a statistical significant difference was observed in the MP species knowledge between educated and illiterate people. This study is consistent with Ermias et al*.,* (2013) where the education correlates negatively and significantly with the knowledge of MP species ($r = -0.27$, $P<0.05$), showing that education has influenced MP knowledge, which in turn can affect MP knowledge and distribution. However, a study done by Yinger et al. (2008) in Bale, Ethiopia showed that education correlates with the knowledge of MP. The result of our finding calls for the awareness rise among the young and educated generation the fact that still most in rural areas of Ethiopia, including the poor largely depends on traditional MP, which should be conserved properly, including its knowledge.

CONCLUSION

The current study on traditional MPs in Misha *Woreda*, Hadiya Zone, Southern Ethiopia has disclosed that a diversity and various uses of MPs to treat a wide range of diseases in the community. The wide use of MPs based on the high values of ICF and FL could validate the effectiveness and efficacy of the ethno botanical practices of Hadiya communities. MPs are largely distributed in the wild habitat, and the dominant growth forms of MPs are herbs where leaves are preeminent MP parts used for remedial preparation, which could have less impact on the conservation of MPs. Medicinal plant remedies are

mostly administered orally showing the prevalence of internal ailments in the study area. There is a gap in MP knowledge transfer where ethno-medicinal knowledge is hardly being transferred to young people. The knowledge tends to decline as community members get educated for they largely depend on modern medicine. Thus, there is a need to raise awareness on the significance of ethno-medicinal plants for the primary health care. Similarly, farmers need to be assisted in domesticating some of the commonly useful MPs of wild origin, which assists to the conservation of MPs. Lastly, Plants with high ICF and FL values can be subjected to bioassay investigation whereas those with low use value scores require analysis of their bioactivity to vindicate their use for treating a given ailment.

Conflict of Interests

The authors have not declared any conflict of interests.

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