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Ethnobotanical study of medicinal plants used to treat human ailment in Guduru District of Oromia Regional State, Ethiopia

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This research was carried out to document ethnobotanical data and threats affecting medicinal plants. Semi-structured interviews, questionnaires, face to face discussion, and field visit was employed to gather the required data. A total of 92 informants 21 key and 71 randomly selected informants), of which 48 males and 44 females were used. The study documented 57 plants species which belongs to 55 genera and 41 families. Of these famlies, Asteraceae were represented by 4 species (7.123%), followed by Euphorbiaceae, Fabaceae and Rutaceae which is represented by 3 species each. The majority of the species 40 (70%) was gathered from natural habitats while 26% was cultivated and 4%) collected from both. The most widely utilized plants are: Trees 19 (33.3%) species), followed by shrubs 18 (31.6%) species), herbs 16 (28.07%) species), and climbers with 3 (5.3%) species. The society also frequently uses plant parts such as fresh plant materials (68%) and leaves (33%). The most widely used route of medicine application was oral (58%), dermal (23%) and nasal (10.5%). The remaining remedies were taken with some other additives and solvents like water, butter, milk as well as honey. Traditional medicines were prepared by pounding (33.3%), and crushing (24.6%). *Carduus schimper* and *Ocimum forskolei* was medicinal plants with higher informant consensus. The disease classes with highest ICF rate (0.93) were fibril illness. The result reveals that there is high preference for *Ficus vasta* for healing Hemorrhoid disease whereas *Cissus cactiformis* was used for treatment of Rabies by traditional medicine practitioner. *Ekebergia capensis* was the highest multipurpose tree species.

Key words: Ethnobotany, Guduru district, traditional practitioner, medicinal plants, ailment.

INTRODUCTION

Ethnobotany is defined as the study of how people of a particular culture and religion make use of medicinal plants. From the beginning of humanity, indigenous community has developed their own local specific knowledge on plant utililization, protection and management (Cotton, 1996). The study of ethnobotany plays a vital role because of the direct contact that can be established with the authentic information on the uses of

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plants both wild and cultivated. These plants are used for purposes of food, fodder, medicine, clothing, shelter, agricultural implements, hunting, narcotics, poison, gums, dyes, energy, fiber, profits generation and the demand of cultural and spiritual needs throughout the world (Asfaw, 2013). In any case, ethnobotany is broadly defined as the study of interaction and interrelationships among humans and plants (Martin, 1995).

Traditional medicine has remained as the most important and available source of treatment in the primary healthcare system of communities (WHO, 2001). It is practiced throughout the world and depends on locally availabile natural resources and indigenous knowledge (Awas and Demissew, 2009). Particularly, traditional medicine has sustained its popularity in all regions of the developing world where modern medications are limited. Traditional medicine includes a holistic knowledge and practices, oral and written, functional and diagnosis, preventive and curative aspects of illness to promote total well-being (Behura, 2003).

It is estimated that more than 120 of the conventionally used pharmaceuticals were derived from higher plants. Indeed, well into the 20th century, the majority of the pharmacopoeia of scientific medicine was obtained from the herbal lore of indigenous community (Blumenthal, 2003; Toma et al., 2003). Starting from the ancient time, the utilization of traditional medicine has expanded globally and become popular. It has continued to be used for primary health care of the poor in developing countries and also has been used in countries where conventional medicine is predominant in the national health care system. According to WHO, herbal medicines serve the health needs about 80% of the world's population, particularly for millions of people in the immense rural areas of developing countries (Agisho et al., 2014).

It is obvious that the majority of countries in Africa, Asia and Latin America utilize traditional medicine to meet some of their primary health care demands. Particularly in Africa, up to 80% of the population uses traditional medicine for primary health care (WHO, 2001, 2003). Ethiopia is rich in biodiversity with different topographies, agro-ecology and various ethnic-cultures. Therefore, ethnobotanical study is crucial in prosperous biological resource areas for medicinal plants description, identification, documentation, ranking, protection, and sustainable usages (Abera, 2014). Ethiopian plants have shown extraordinary effective medicinal values for many disease treatments that affect people and livestock. About 80% of the Ethiopian peoples were thought to be dependent on traditional medicine for their healthcare system which is obtained from plants. However, indigenous knowledge of medicinal plants is hastily diminishing, because of the influence of western lifestyles, reduction in the number of traditional healers and unwillingness of the younger generations to work on the tradition and associated knowledge (Buwa, 2012) Ethiopia has high diversity of plant species (6500 to 7000 species of higher plants) making the country one of the most diverse floristic regions in the world. Most of these plant species are used in traditional medicine and 60% of plants are said to be indigenous with their healing potential (Edwards and Asfaw, 1992). The remaining medicinal plant of Ethiopia which mainly exists in explored areas still awaits further scientific investigations (Belayneh et al., 2012). In Ethiopia, traditional remedies represent integral components of the cultural beliefs, attitude of people as well as the struggle to fulfill their essential drug demands of people (Koduru et al., 2006).

The study was executed in Guduru district on culturally used medicinal plants, to document about medicinal plants and provide information for the society and other higher researchers about the part of the plants (structures) used as medicine, mode of preparation, dosage, amount used, and disease treated. In this district, cultural medicinal plants were used for many years, since there was shortage of health care service (clinics) and increasing price of commercial (synthetic) drugs people relieve from illness by using cultural medicine. Therefore, the objective this investigation was to file traditional medicinal plant species and associated indigenous knowledge used to treat human ailments in Guduru District, Horo Guduru, Wellega Zone, Western Oromia, Ethiopia.

METHODOLOGY

Description of the study area

The experiment was carried out in Guduru district, Horro guduru, Wellega Zone, Western Oromia, Ethiopia. Guduru district is located at about 372 km west of Addis Ababa, the capital city of Ethiopia and 67 km from the zonal administrative town (Shambu). Guduru district is absolutely located between 9°35' to 9°45' North and 37°24' to 37°44' East. It has an area coverage of 140869.069 hectar (CSA, 2007). The zone is characterized by various land forms like mountains (3%), plateau (57%), plain (40%), hills, and valley with altitudinal ranges between 1500 and 2350 m above sea level (GDLEPO, 2016). The study area is bordered by the Abbaya and Hababo Guduru and Fincha Damp North, Jimma South, Jimma Genet District West and East Gindeberet District of Western Shoa Zone (Figure 1). The district is classified into three agro-climate zones: Dega (18%), Woinadega (62%), and Kolla (20%). There is only one dominant soil type in the study area, commonly known as red soil and therefore, other types of soil are rare to be found. The study area receives about 1450 to 2500 mm rainfall annually. In addition, Guduru district is generally hot during winter seasons with the maximum temperature of 22°C and minimum temperature of 19°C (GDLEPO, 2016).

Eighty five percent of the whole land is used for agricultural activities from which the forest land supports 74.6% of the entire inhabitants of the district. Furthermore, the district was known by fast population growth, which accounts for about 2.9% annual growth rate. Currently, the entire population of the district is 128,041 having 63,765 male and 64,276 females (CSA, 2007). According to the report of Guduru District Health Office (2016), the first ten major diseases in the area are: internal parasites, malaria,

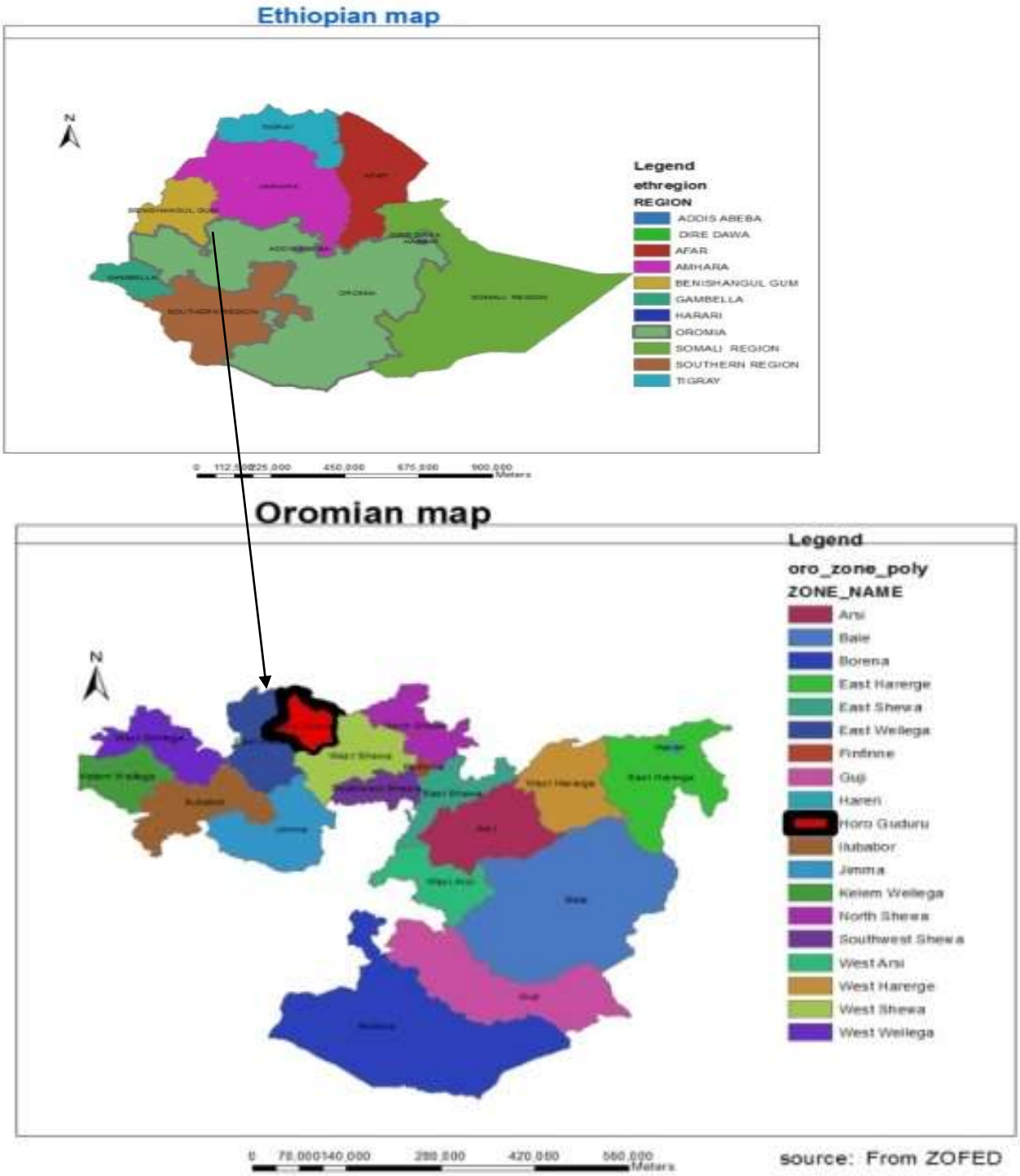

Figure 1. Map of Guduru District, Horo Guduru Zone, Oromia Regional State, Ethiopia.

diarrhea, eye disease, gastritis, wound, skin diseases, rheumatism, tonsillitis and sexually transmitted diseases (STDS). These diseases mostly affect people living in the rural areas where limited number of health services is available and the local communities are unable to afford the high cost of modern drugs and because of being far from health services. In the district, there are 7 health centers, 37 health stations, and 9 private clinics, but no hospital.

Site selection

Totally, there are thirty seven kebeles in Guduru district. From Dega, one kebele (20% out of seven kebele), weyinadega, five kebele (20% out of twenty kebele) and kola one kebele (20% out of six kebele) were selected based on altitudinal relative variation of the seven kebeles. Accordingly, Tokuma biya, Aga, Refgudane,

Walkituma, Gemechisa Bereji, Nubariye efe, and Gudane sonbo wako were considered from thirty seven kebeles. From these kebeles, Tokuma biya (Sonbo, Buru and Hula Ayele), Aga (Karu, Kajes and Gumja), Reef gudane (Agamsa Daso, Agamsa, and Lencha), Welkituma (Laaluu dogomaa, Birbirsa and Ciracha), Gemechisa Berji (Rare Amanuel, Gudane Gutu and Retane Yedal), Nubariye efe (Malka Naga Anchabbi and Kolba), and Gudane sonbo wako (Weljalechisa keru, Walin tane wabo and Gute ararame) were used due to their resourcefulness and altitudinal variations.

Selection of informants

A total of 92 informants' (that is, 48 men and 44 women) in the age group of 20 and above were selected from seven kebeles. Out of these, three key informants per kebele, a total of 21 key respondents (that is, from development agents, health post professionals and kebele leaders) were purposively chosen following Martin (1995). Seventy one informants were selected randomly by tossing a coin from the resident community of the district to understand their general indigenous knowledge on locally available medicinal plants. The residents can be considered as informer when numbered side of the coin was up and if he/she was showing interest to reveal their indigenous knowledge.

Data collection

Ethnobotanical data was collected from February 01 to 30, 2016 and March 1 to April 15, 2016, following Cotton (1996) and Martin (1995). Data collection tools such as questionnaires, semi-structured interview, observations, group discussion, and guided field walks had been employed to obtain indigenous knowledge of the local peoples on medicinal plants utilization, conservation status and threatening factors to the medicinal plants. Medicinal plants name mentioned by each informant both from wild and home gardens were gathered, pressed, dried, and taken to the National Herbarium of Addis Ababa University for identification. Finally, the collected data were summarized and analyzed using descriptive statistics. Data on local names of medicinal plants, parts used, methods of preparation, ailments treated, route of application, amount used, medicinal value, and management methods were recorded at the spot. Discussions were conducted with 28 (30%) of the respondents and local people seeking to understand the traditional medicinal plants use, management, and protection to know how indigenous knowledge is maintained and transferred to the younger generations.

Data analysis

Both qualitative and quantitative ethnobotanical data were collected and subjected to a descriptive statistical and spreadsheet 2007 to analyze and summarize the data on medicinal plants use and associated indigenous knowledge. Accordingly, multipurpose uses of traditional medicinal plants, proportions of variables like growth forms (habits), plant families, parts used, methods of preparation and administration were determined.

Informant consent/agreement

Respondents were contacted atleast two times for the same issue to check the validity of the information during the interview and finally, the validity of the information was proved and recorded. Following this, if the information is contradicting with the original information, it was rejected due to unreliability since only the applicable one was statistically analyzed (Alexiades, 1996). Likewise, factor of agreement (consent) was quantitatively analyzed for thirteen groups of medicinal plant uses reported by respondents. The Informant Censent Factor (ICF) was considered for each category to identify the agreements of the respondents on the reported cures for the ailments of both human and livestock. The ICF were calculated as NUR-NT/NUR (Kefalew et al., 2015), where NUR is a number of used citations in each category and NT is the number of species used. Always, the factor provides a range of 0 to 1, whereas the higher value acts as a good indicator for a high rate of respondents' agreement.

Ethnobotanical preference ranking

Ethnobotanical preference ranking was carried out following Martin (1995). Accordingly, the respondents recognized the six most important medicinal plants used in treating hemorrhoid, as traditional practitioners treat it frequently. Ten key traditional healers were chosen to distinguish the most-preferred medicinal plant species used for treatment of hemorrhoid. Each respondents was provided with six medicinal plants reported to cure this disease with each leaf of medicinal plant used being paper tagged name, and asked to assign the highest value six for plant species most preferred) and the lowest value one for the least preferred plant and in accordance of their order for the remaining ones. Finally, these values were collected and ranks were given to each plant species used against this illness.

Ethnobotanical paired comparison

According to Martin (1995), paired evaluation can be used to understand the degree of preferences or levels of importance of certain selected medicinal plants/parts of plants used. A pair of selected plant specimens with all possible combinations was presented to selected respondents and their responses were recorded and the value was summarized. To this effect, ten respondents were used to show the efficacy and status of five medicinal plants species used to treat the most frequent disease in the study area and rank was made based on the report of the respondents.

Direct matrix ranking

Multipurpose use of medicinal plants and the extent of its utilization versus dominance were done following Martin (1995). Based on information gathered from respondents, seven multi-use tree species were chosen from the total medicinal plants and eight use values of these plants were listed. These use-values include healing, forage, food, firewood, construction, charcoal, fencing, and furniture making. Fifteen key respondents were selected out to conduct this activity and each key informants was asked to assign the following use values (5=very high, 4=high 3=very good, 2=less used, 1=least used and 0=not used) for eight multipurpose medicinal plant species. Accordingly, the average value of each use-diversity for a species was taken and the values of each species was summarized and used for ranking.

Fidelity level

The fidelity levels (FL) were calculated for those frequently reported diseases by informants so as to identify the most important species. Two locations, different in altitude as well as in the prevalence of disease were selected to reveal the fidelity stage of the most frequently reported medicinal plants and the disease treated.

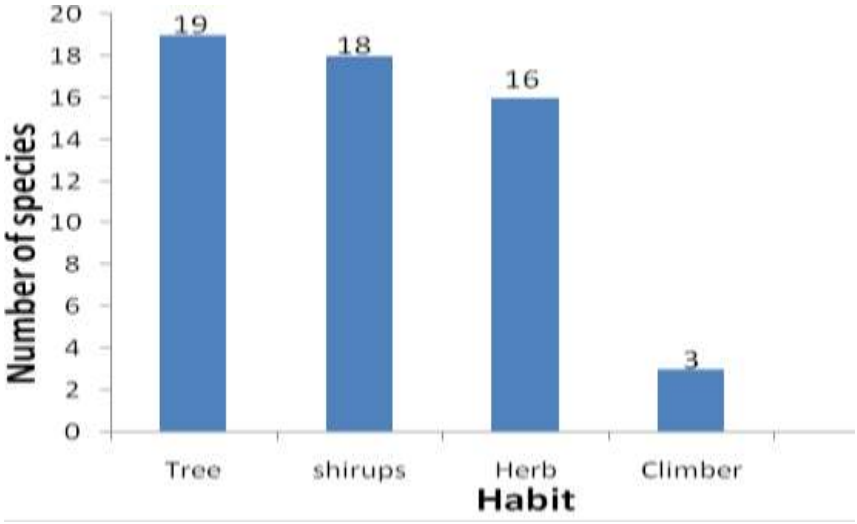

Figure 2. Types of medicinal plants used for human ailment treatment.

Therefore, seven study sites in which the disease is most and/or list frequent were selected and the fidelity level is calculated as: FL = Ni/N × 100, where Ni is the number of respondents who claims the use of a plant species to treat a particular disease whereas N is the number of respondents that use the plant as a medicine to treat any given disease. Therefore, fidelity level is designed to quantify the importance of the species for a particular purpose (Alexiades, 1996).

RESULTS AND DISCUSSION

Medicinal plants documented from the study area

Generally, a total of 57 medicinal plant species belonging to 55 genera and 41 families were documented from the study area. From these, the family Asteraceae was represented by the highest number of species 4 (7.12%), pursued by Euphorbiaceae, Fabaceae, Rutaceae (3 species, 5.26% each); Solanaceae, Rutaceae, Rubiaceae, Rosaceae, Oleaceae, myrsinaceae, Moraceae, and Lamiaceae (2 species, 3.51%) of each and the remaining families represented by one species each. The majority of the plants reported as medicinal plants in this study were also reported as having medicinal properties by different people from different parts of Ethiopia. For instance, Megersa et al. (2013) reported 29 species from similar studies in East Wollega, Meresha. Ashagere et al. (2016) reported 24 species from Lulekal et al. (2013) reported 37 species of medicinal plants from North Shewa Zone. The fact that the same plant species were reported from various parts of the country for medicinal properties may suggest that actual remedial potential of these medicinal plants and information flow between different localities of the country on some medicinal plants. As far as the habitat is concerned, the bulk of medicinal plant species were gained from wild vegetation 40 (70%), followed by cultivated medicinal plants 15 (26%) and for both 2(4%). The finding also quite agrees with that of Eshete et al. (2016), who studied medicinal plants of the Guji, Blue Hora District, Borana Zone, Oromia Regiona State, Ethiopia. This indicates that the community largely relies on wild plants; which as a result indicates the existence of higher threats on the wild medicinal plants.

Plant habit, part(s) used and preparation

The present study result reveals that, the largest proportion of medicinal plants represented by trees 19 (33.3%) followed by shrubs 18 (31.6%), herbs 16 (28.07%), and climbers 3 (5.3%) (Figure 2). The same habit distribution of medicinal plants has been reported by Getaneh and Girma (2014). In contrast, Hunde et al. (2004) and Giday et al. (2003) reported the presence of higher number of medicinal plants as herbs. Furthermore, the Zay people obtain their medicine from herbs partly due to the fact that forests have been degraded and it takes much time as well as effort to harvest plant material from medicinal trees (Giday et al., 2003).

The present study finding also showed that leaves are the most commonly used plant parts accounting for 33% followed by root and seed (Figure 3). Similar studies also indicate leaves being the most widely used plant part for medicinal purpose (Awas and Demissew, 2009; Teklay, 2015; Seyum and Zerhun, 2014; Yineger and Yewhalaw, 2007). According to Seyum and Zerihun (2014), the ordinary use of leaves in the preparation of remedies could partly be because of the relative ease of finding this plant part. Moreover, it was known that over exportation of root, bark and whole plants might kill plants in harvest. Thus, practice of using leaves may help to minimize the

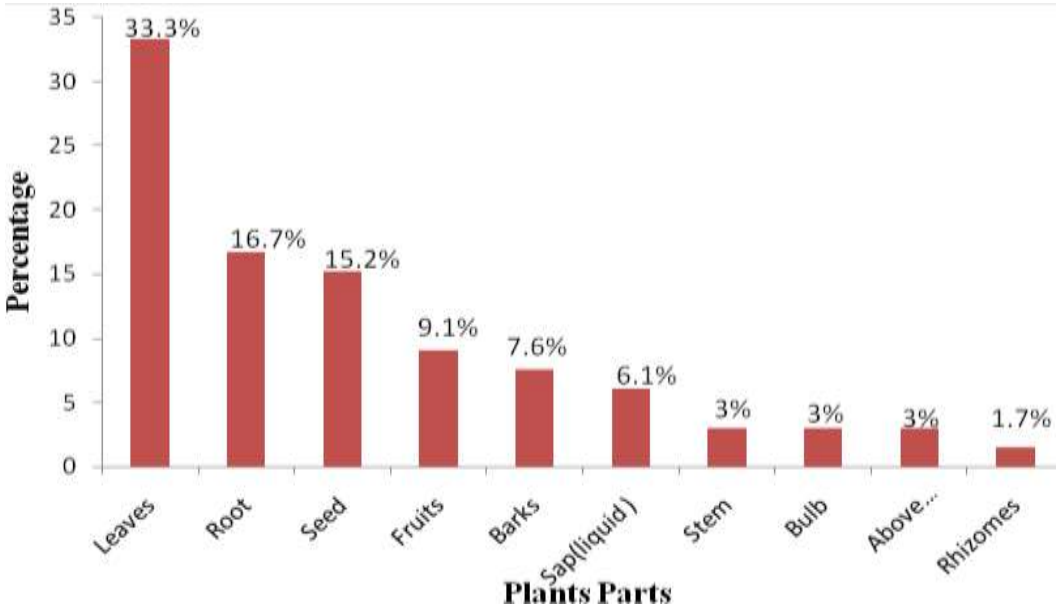

Figure 3. Parts of plants used for treatment of human ailment.

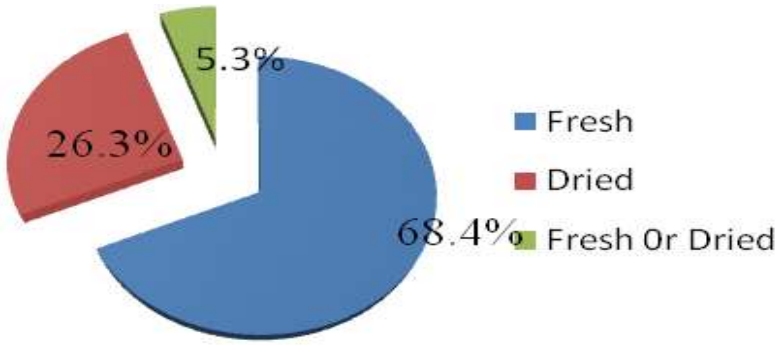

Figure 4. Condition of remedy preparation from plant in the study area.

rate of threat on plant species or helps for sustainable harvesting of plants and hence, the survival of the plant will be ensured (Giday et al., 2003). Abebe and Ayehu (1993) reported that, medicinal plants harvest which includes root, rhizomes, bulbs, barks and stems have serious effect on the survival of mother plants.

About 68.4% of the remedies were made from fresh leaves. Relatively, few medicinal plants (26.3%) were used in dried form whereas the remaining very few medicinal plants were used either fresh or dried (5.3%) (Figure 4). Many researcher also observed similar findings elsewhere (Enyew et al., 2014; Teklay et al., 2013; Abera, 2014; Belayneh et al., 2012; Awas and Demissew, 2009). The main reason for the favorite of fresh plants over dried ones may be due to the biologically active chemicals which are present in the leaves may decrease as a consequence of drying.

The majority of surveyed medicinal plants preparations include the use of solitary plant species or part (73.42%) whereas various plant parts (26.58%) were rarely used in the study area. Several study findings also reveals that, the use of multiple plants or plant parts for a single health problem was rare (Balemie et al., 2004; Megersa et al., 2013; Reddy et al., 2009). This result disagrees with the result of some studies which report as a preparation of traditional medicine drawn from mixtures of different plants or plant parts. For instance, local healers of Sokoru, mainly used more than one plant species or parts to prepare remedy for both human and livestock ailments (Yineger and Yewhalaw, 2007). The present study finding reveals that, most traditional practitioners use multiple plants or plant parts in order to increase strength and efficacy of the traditional medicine. For instance, rabies were treated by mixing the leaves of

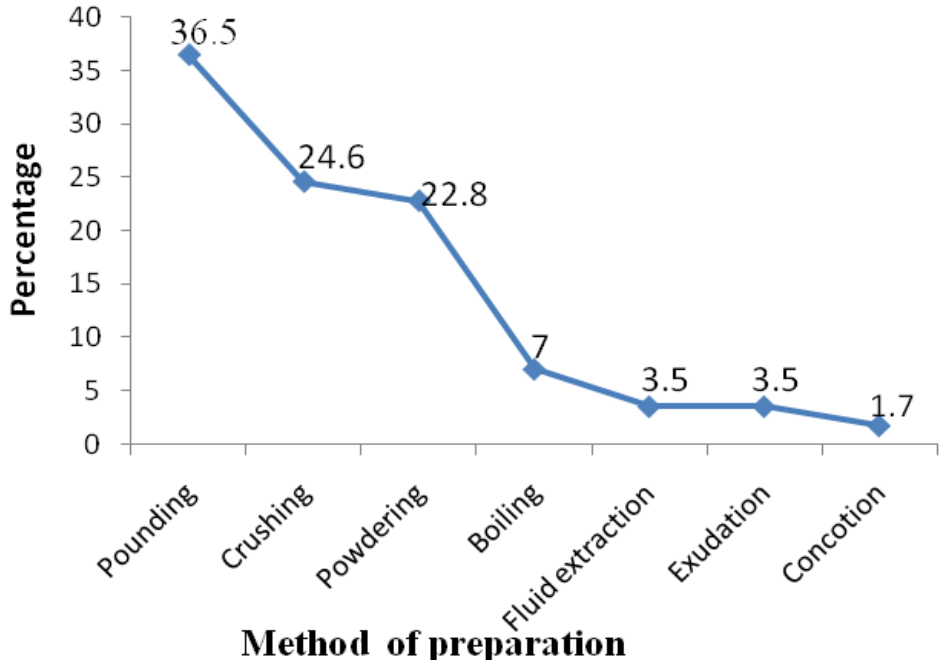

Figure 5. Method of remedy preparation from medicinal plants.

Bersama abyssinica, root of *Cissus cactiformis,* and root of *Clerodendrum myricoides* together.

Traditional practitioners in the study area also used different type of preparations which include pounding type 36.5%, crushing 24.6%, and powdering 23% (Figure 5). This may be due to the possibility of effective extraction of plant ingredients when pounding, crushing and powdering so that its curative potential would increase. This result was in line with Enyew et al. (2014), Megersa et al. (2013) and Eshete et al. (2016) work. But, disagrees with that of Lulekal et al. (2013) who indicates the dominant use of medicinal plants parts in Ankober district decoctions for various ailments might be related to their proven effectiveness over many years of trial and indigenous knowledge accumulated on efficacy of preparations whereas the frequent use of concoctions could be credited to the belief by many healers of synergic reactions (Dawit, 2001). Furthermore, very dominant method of remedy preparation in the Debre Libanose district was through crushing followed by squeezing (Getaneh and Girma, 2014).

The local people also use some additives in their preparations. For example honey, butter, tella, milk, coffee, sugar, yoghurt, white injera and some plant species such as *Allium sativum* are some of the additives that the local people reported to use them as additives. According to the respondents, these additive substances were assumed to increase the flavor and minimize the side effects of vomiting and diarrhea so that the efficacy of the traditional medicine (TM) would be increased. Similar additives have been reported previously by different studies (Seyum and Zerhun, 2014; Megersa et al., 2013; Abebe, 2011).

Dosage and administration methods

The community of the study area mostly apply traditional medicine orally (57.9%), dermal application (23%), nasally alone (10.5%) and others (anal, optical, auditory and gum) accounting to 14% (Figure 6). Similar methods have been reported by previous studies (Lulekal et al., 2013; Alemayehu et al., 2015; Teklehaymanot and Giday, 2007). However, research carried out in Kilte Awulaelo district, Northern Ethiopia (Teklay et al., 2013) and Bench District, South-Western Ethiopia (Giday et al., 2009) revealed that, most external application were dermal creaming accounts for the highest ratio or proportion.

There were no uniformity regarding to the dosage of the medicine between the traditional healers, hence, all the traditional healers agree on the point that the dosage given for patient vary with age and physical strength. They also do agree that some medicines were not allowed to be taken by women when pregnant. Amounts to be administered will be estimated by the use of measurement such as length of a finger (that is, for bark, root and stem length), pinch (for powdered plant parts) and number count (for sap drops, leaves, seeds, fruits, bulb, and rhizomes).

The requirements of dosages vary with age, but not considered for gender variations. Dose of decoction is calculated in different ways which include coffee cup

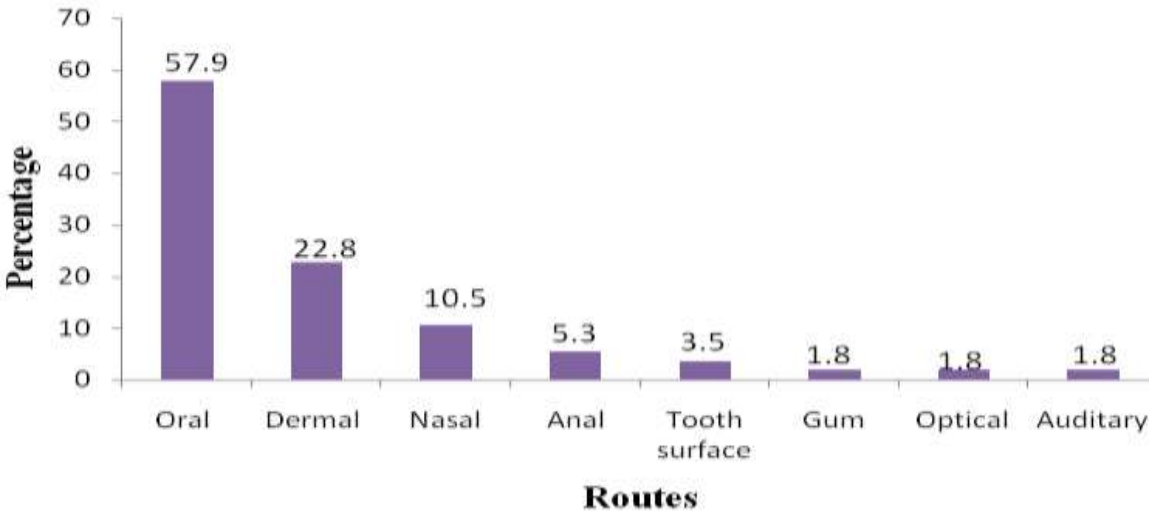

Figure 6. Route of administration of traditional medicine in the study area.

Table 1. Preference ranking of medicinal plants used for treating hemorrhoid disease.

Species	Informant labeled from R_1-R_{10}										Total	Rank
	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9	R_{10}		
Ficus vasta	5	6	6	5	5	6	4	5	4	5	51	1st
Croton macrostachyus	6	3	5	4	3	5	6	4	6	4	46	2nd
Ekebergia capensis	4	5	3	3	6	4	5	6	3	1	40	3rd
Olea europaea	1	4	4	2	2	3	3	2	5	6	32	4th
Rytigynia negelecta	2	1	1	6	4	2	1	1	2	2	22	5th
Phytolacca dodecandra	3	2	2	1	1	1	2	3	1	3	19	6th

*R: Represents respondents.

(locally 'Sini'). For instance, one coffee *Vernonia amygdalina* is taken orally for malaria treatment for five days, as well as a cup, alcohol (caticala-in Amharic) cup,' jok' (in Amharic) equal to a liter and a material which is made up of *Lagenaria siceraria* locally called 'wille'. But, these measurements are not accurate enough to determine the precise amount. For medicinal plants that are taken topically, they do not have clear cut dosage or standardized dosing in the application of traditional medicines in Ethiopia and elsewhere (Abebe and Ayehu, 1993; Bekele, 2007; Hizikias et al., 2011; Bekalo et al., 2009). The recovery from disease, which usually was determined by the disappearance of disease symptoms, was the criterion that the local people of this study area consider to determine the duration of using the medicine.

Ethnobotanical preference ranking

People may show preference of one traditional medicine over the other when different medicines are prescribed for the same health problem. In this study, some cited human diseases were reported to be treated by multiple plant species. Table 1 indicates the preference ranking of six medicinal plants used to treat hemorrhoid disease. Accordingly, *Ficus vasta* scored 51 and leveled the first showing that, it is the most effective in treating hemorrhoid disease pursued by *Croton macrostachyus* and *Phytolacca dodecandra* which is the least effective (Table 1). This indicates that people have alternative plant species to treat a given disease; they do have preference to one over the other based on their long time experience on the relative curative power of the plants.

Informant consent factor (ICF)

The ailment in the study area have been grouped into different categories based on the site of incidence of the disease, condition of the disease as well as treatment resemblance of the disease to the local people. The informant consensus factors have been calculated for

Table 2. Informants consensus factor (ICF) for more prevalent health problems of the study area.

Categories of disease	Plant species	Percent species	Use citation	Percent use citation	ICF
Fibril illness, nerve illness	2	3.1	15	9.3	0.93
Evil eye, evil spirit	2	3.1	10	6.2	0.89
Tonsillitis, toothache	3	4.7	14	8.7	0.85
Respiratory infection, common cold	6	9.4	26	16.1	0.80
Ascaries, tape worm, stomachache	10	15.6	31	19.3	0.70
Skin rash (shife), fungal disease	4	6.3	8	4.9	0.57
Rabies, snake bite, bat poison	8	12.5	16	9.9	0.53
Wound, body swallowing	7	10.9	13	8.1	0.50
Hemorrhoids	6	9.4	9	5.6	0.38
Organ problem (Eye, Ear, and Liver)	5	7.8	7	4.3	0.33
Fire burn , bleeding	4	6.3	5	3.1	0.25
Sexually transmitted diseases	3	4.7	3	1.9	0
Malaria	4	6.3	4	2.5	0

Table 3. Paired evaluations of five medicinal plant species used to treat Rabies.

Plant species	Respondents (R1-8)										Total	Rank
	R1	R2	R3	R4	R5	R6	R7	R8				
Cissus cactiformis	4	5	3	4	5	3	4	2	5	4	39	1st
Brucea antidysenterica	3	2	2	5	4	5	3	1	4	5	34	2nd
Bersama abyssinica	5	3	4	1	3	4	2	4	2	3	31	3rd
Ricinus communis	2	1	5	2	2	2	1	5	3	2	25	4th
Scandxus multiflorus	1	4	1	3	1	1	5	3	1	1	21	5th

each category (Table 2). The results of the study revealed that, diseases that are common in the study area have higher informant consent factor. It is further shown that medicinal plants known by the local community members and assumed to be effective in curing certain diseases will have higher ICF values (Table 2) with the ICF values ranging from 0.93 to 0 per sickness category. Fibril illness had the highest ICF value of 0.93 due to the higher incidence of the disease in the study area whereas sexually transmitted diseases (STDs) and malaria had the lowest (0) may be due to the rare occurrence of these diseases and the fact that most are successfully treated by local healers.

Paired comparison

A paired evaluation was made to decide the most favored medicinal plants among the five species that were used as remedies to treat rabies disease in the study area. The responses of 10 key respondents indicate that, *C. cactiformis* ranked primary followed by *Brucea antidysenterica*. Therefore, this result indicated that *C. cactiformis* is the most preferred while *Scandxus multiflorus* is the least privileged in treating rabies disease (Table 3).

Ethnobotanical direct matrix ranking

Medicinal plants of the study area have been found to have several purposes other than medicinal uses. The key respondents of the study area identified seven medicinal plant species that were used by the local communities for extra function such as charcoal, firewood, buildings, fencing, forage, food, and medicine. The result of the matrix ranking revealed that, *Ekebergia capensis* ranked first followed by *Cordia africana, Eucalyptus globules, C. macrostachyus, Acacia abyssinica, Olea europaea* and *Carissa spinarum* (Table 4). This result indicates that *E. capensis* and *C. africana* appear to have more demand than the others as they were used for more diverse purposes. Although *E. globules* was known to relatively have diverse use next to *E. capensis* and *C. africana,* it is less threatened of over exploitation as it is regularly planted and managed by human. The direct matrix ranking result also shows that the local society harvest the seven multi-use plant

Table 4. Direct matrix ranking for seven plant species and main use in study area.

Plant species	Use categories									
	Charcoal	Construction	Fencing	Forage	Food	Fire wood	Furniture	Medicine	Total	Rank
Ekebergia capensis	3	5	3	4	0	5	5	4	29	1
Cordia africana	4	5	1	2	1	4	5	3	25	2
Eucalyptus globules	3	5	5	1	0	4	2	3	23	3
Croton macrostachyus	5	1	3	1	0	4	3	5	22	4
Acacia abyssinica	1	1	3	3	1	4	2	4	19	5
Olea europaea	2	0	5	1	2	3	0	4	17	6
Carissa spinarum	1	1	4	1	1	5	0	3	16	7
Total	19	18	24	13	5	29	17	26	151	-
Rank	4th	5th	3rd	7th	8th	1st	6th	2nd	-	-

species mostly for fire wood followed by medicinal use, fencing, charcoal, construction, furniture, forage and food (Table 4).

Fidelity level index (FLI)

Fidelity level is a crucial means to determine which plant species has more healing power. Accordingly, those species with high FLI are supposed to be more curative for the respective ailments. Fidelity level value in this study varied from 41.2 to 100% (Table 5). Therefore, traditionally used medicinal plants with high FLI value can be a focus for further pharmacological studies.

Threats to medicinal plants and associated indigenous knowledge in the study area

The cause of threats to medicinal plants can be generally grouped into natural and human induced factors. However, anthropogenic factors such as deforestation due to over exploitation of plants for different uses including cutting and burning of plants to create new agricultural lands, charcoal making, fire wood collection, collection of construction woods, overgrazing, and climatic change were the most common treats for medicinal plants and associated indigenous knowledge. The respondents agree that, agricultural expansion was the primary threat to the medicinal plants pursued by firewood, charcoal collection and lower levels of threats by the other factors. Similar result was found in Blue Hora District of Borana Zone that fragmentation and destruction of their habitats due to agricultural expansion and overgrazing were the main threats (Eshete et al., 2016). Furthermore, the negative impact of deforestation on medicinal plants was also reported (Yirga, 2010).

On the other hand, except some plant species that are commonly known for their medicinal properties, knowledge on most medicinal plants, and known by healers were hidden from general public. Healers never show live plants and the name of traditional medicinal plants to their patients. Because of their believe that showing medicinal plants will incapacitate the healing power of the medicine as well as to avoid competitors in earning income from treating patients. Traditional healers earn income from their knowledge on medicinal plants.

The study indicates that introduction of modernization such as schooling and new religion influenced the acculturation and negligence of the present generation to acquire the knowledge and facilitated the threat to biological resources and associated indigenous knowledge in the study area. Similar finding was reported elsewhere (Hunde et al., 2004; Giday et al., 2003).

However, it was recognized that ethnobotanical knowledge on uses of some medicinal plants was transmitted to one or few family members to use in secrecy. They disclose their knowledge on medicinal plants at old age by the time when they most probably die before teaching the detail of medicinal plants. Ethnobotanical investigation done elsewhere in Ethiopia (Giday et al., 2003; Bekalo et al., 2009) shows that, elders are the owner of herbal remedies knowledge and modernization has a great influence to use traditional medicinal plants. Therefore, a number of combined factors mentioned earlier have

Table 5. Fidelity level value index of traditional medicinal plants to treat diseases.

Medicinal plant	Treated diseases	Ni	N	FL (%)
Rytigynia negelecta	Hemorrhoid	8	8	100
Aioa rivae	Fire burned	11	11	100
Solanum gigantum	Wart	5	5	100
Plantago lanceolata	Bleeding	13	13	100
Brucea antidysenterica	Ascaris	10	11	90.9
Phytolacca dodecandra	Liver problem	9	11	81.8
Vernonia amygdalina	Gonorrhea	3	4	75
Ricinus communis	Tonsillitis	4	6	66.7
Justicia schimperiana	Skin infection	9	17	52.9
Allium satvum	Stomachache	8	16	50
Croton macrostachyus	Rabies	7	17	41.2

resulted in loss of medicinal plant species which requires a great attention of government, NGOs and private sectors to rehabilitate and conserve the remaining vegetation in general and medicinal plants in particular with their associated indigenous knowledge.

CONCLUSION

The medicinal plant species gathered and identified from the wild vegetation are 40 species, 15 species cultivated and 2 from wild or cultivated. Forty one human diseases were healed by traditional medicinal plants of the study area. Herbal remedies were prepared from fresh materials (68.4%), dried plant materials (26.3%) and fresh or dried (5.3%). Trees are highly utilized for medicinal purpose than herb and shrubs. Leaves (33.3%) were the most commonly used for medicinal purpose as compared to other plant parts for preparation of human remedies. The remedies were taken with different additive and solvents and water is more frequently used for this purpose. Most of the medicinal plants are administered orally (57.9%).

The major challenges to medicinal plants and associated indigenous knowledge in the study area include agricultural expansion, firewood collection, charcoal production, climatic change, construction and over grazing. Whereas threats that erode indigenous knowledge come from secrecy, oral based knowledge transfer, refusal of young next generation to gain the indigenous knowledge, unavailability of the species, influence of modern education and lack of awareness were the major ones.

Therefore, it is possible to conclude that, awareness creation activities should be needed to improve local community's knowledge on the importance, conservation and management of medicinal plants as well as among the healers to avoid erosion of the indigenous knowledge and to ensure its sustainable use.

RECOMMENDATIONS

Founded on the findings of the present study, the following recommendations have been forwarded:
(1) Local people should be informed about the use value, management and conservation of medicinal plant of their locality.
(2) The district agricultural workers must involve in identifying medicinal plants and encouraging the local people to cultivate medicinal plants in their home gardens.
(3) Recognition and rational property right should be given to traditional practitioners, through certification to popularize their indigenous knowledge on medicinal plants.
(4) One way of preserving such important indigenous knowledge in the new generation is through integration to school about medicinal plants.
(5) The lesson of medicinal plants and conservation of indigenous knowledge should be included in school curriculum.
(6) Deforestation is still a problem in district of Guduru natural forests. So, the administrative body should take care of the natural habitats.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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