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RESEARCH ARTICLE

Ethno-botanical Survey Of Plants Used For Prevention Against Mosquito Bites And Control Of Malaria In Assosa District, Western Ethiopia

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ABSTRACT

Traditional medicinal plants have played a major role in the enhancement of health care in developing countries around the world. Ethiopia has been practicing traditional botanical medicine for the curing of human biological, mental or physical disorders. Ethno botanical study was carried out to survey medicinal plants and their uses for malaria control in Assosa district. Information was collected from 150 medicinal plants users and traditional medicine healers via interviewer-administered questionnaires. The informants were selected randomly from four different villages of Assosa district, Southwestern Ethiopia. A total of 11 species of ethno botanical medicinal plants used for malaria control were identified. Of eleven ethno botanical plants, *Allium sativum* and *Echinops kebericho* were majorly used for malaria treatment and vector prevention in Assosa district. Leafs were the mostly used part of the plant and most of the medicinal plants were used for treating infections. The indigenous knowledge and practice of traditional medicinal plants in the study area were at risk of getting lost. The communities in the current study area practiced traditional ethno botanical medicine for malaria therapy and disease prevention. The indigenous practices contributed to the sustained use, management and protection of medicinal plants and multiple-use of ethno botany/indigenous trees. The current study suggests that similar studies in areas not previously covered should be carried out in order to get a full picture of the country's medicinal plants potential in the future.

KEYWORDS

Ethno-botany, Medicinal Plants, Mosquitoes, Malaria

HISTORY

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1. INTRODUCTION

The evolution of insecticide resistance strain of all three dominant vector species such as *An. gambiae, An. arabiensis* and *An. funestus* is among the major problem malaria vector control program is facing in most African countries (Coetzee 2004). Because of resistance to conventional insecticides and owing to environmental and human health concerns, naturally occurring compounds and their derivatives are of increasing interest for the development of new insecticidal compounds against vectors of disease-causing pathogens. For instance, natural bioactive products have at least a reasonable advantage over synthetic chemicals in terms of ecological safety. According to Tripathi *et al* (2003), botanical products as successful vector control agents can also be economically feasible, especially if the sources of materials are plants in abundance.

Despite increasing malaria control efforts in Ethiopia, the disease remains a public health problem. Malaria is the leading and principal cause of morbidity and mortality in the country (Zelalem 2011). Malaria is caused by both Plasmodium falciparum (60%) and P. vivax (40%). More than 75% of the environment is prone to malaria infection. An estimate of 68% of the people living in such areas is prone to malaria infections (Federal Democratic Republic of Ethiopia Ministry of Health 2013).

The Federal Ministry of Health of Ethiopia, adopted artemether-lumefantrine (AL) for treatment of complex *P. falciparum* malaria since 2004 due to the increasing drug resistance of malaria. The distribution, coverage and proper utilization of malaria control interventions such as insecticide-treated bed nets and indoor residual spray and environmental management in the country were the most promising. (Jima et al, 2005). However, there has been a great distress about the availability and affordability of the drugs due to economic and geographical reasons (D'Alessandro et al, 2005). On the other hand, these interventions are limited by shortage of sustainable distribution of free mosquito nets, season and variation of malaria transmission. Also poor knowledge and attitude of the people with regards to preventing and treating malaria is also a challenging factor. To this end, malaria control programmers are forced to divert their attention from the usage of synthetic compounds to environmentally sound and easily accessible medicinal plants as control intervention options. More than 2000 plant species are known to produce chemicals and metabolites playing a part in pest control programmes. Plant families such as Solanaceae, Labiatae, Asteraceae, Oocystaceae, Cladophoraceae, Miliaceae and Rutaceae have various types of larvicidal, adulticidal or repellent activities against different species of mosquitoes (Shaalan et al, 2005).

Various types of plants such as herbs, shrubs and large trees were used for extraction of mosquito toxins. Different plant parts such as fruits, leaves, stems, barks and roots of larger plants or trees could be used for insecticidal agent preparation (Berhanu et al, 2006; Karou et at, 2007; Bekele et al, 2014). Ethiopian vegetations are estimated to contain about 7000 species of higher plants of which about 800 species of plants are used in the traditional health care system to treat nearly

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300 biological, mental and physical disorders.

Dissimilarities pattern of habitats and vegetation zones in Ethiopia are due to variation of geographical and ecological settings (Edwards 2001).

Moreover, variations in languages, ethnicity, cultures and beliefs have contributed to the diversity of traditional knowledge and practices of medicinal plants. Knowingly or unknowingly, plants have been used as sources of medicine in Ethiopia from time. More than 95% of the population in Ethiopia still depends on the use of traditional medicines. The wide spread use of traditional medicine in Ethiopia could be attributed to cultural acceptability, efficacy, physical accessibility and affordability (Endashaw 2007; Zellalem 2011).

Studies in Ethiopia indicates that numerous medicinal plants are employed for the treatment of malaria as they serve as larvicides, insecticides and mosquito repellents (Berhanu et al, 2006; Bekele et al, 2012, 2014; Tolossa et al, 2013). Accordingly, medicinal plants are commonly used in traditional healthcare in many indigenous communities of the country. The cultural practice of using traditional herbal remedies for treating various range of illnesses including malaria and its associated symptoms still remain important.

Traditional healers of different ethnic groups in different regions of the country play a crucial role in the delivery of primary health care to those who prefer traditional medical care and to those who have poor access to modern health services (Yirga 2010; Zerabruk and Yirga 2012 and Bekele et al, 2014). Recently, there are efforts to screen and record anti-malaria herbs used in the ethno medicinal practice of Ethiopia (Zelalem 2011), but these studies are limited to some geographical regions which are not fully exploratory; most of them focus on the review of medicinal uses of the plants rather than focusing on pharmacological screenings. Understanding medicinal value of ethno-botanical plants is a step towards evaluating their safety and efficiency as insecticides, mosquito repellents and anti-malaria. However, data on mosquito repellent, insecticides and anti-malarial plant product as well as dosage, efficacy and safety of the ethno botanical uses of the plants are lacking in the current study.

Therefore this study was focused on the investigation of ethno botanical plants used for malaria treatment, as insecticides and mosquito repellents in Assosa district, western Ethiopia. The objectives of this study were to: (i) identify plant species and parts of plants used as mosquito repellents, insecticides and anti-malaria (ii) determine ethno botanical plants' condition and method of application in Assosa district (iii) document the indigenous knowledge and practice associated with the use and conservation of anti-malarial, insecticides and insect repellent medicinal plants and (iv) investigate the knowledge, attitude and practice of the community toward malaria control and prevention.

2. MATERIALS AND METHOD

2.1 Description of study area

The current study was carried out in Assosa district, Western Ethiopia between February and October 2013. Assosa district is one of districts in Benishangul Gumuz Regional State (Figure 1) with a total area of 1,519 Km^2 and a population of 104,147 (52,968 male and 51,179 females). It has a population density of 19.1/Km^2 (Central Statistical Agency 2008). The district and regional capital Assosa is located west of Addis Ababa at a distance of 687 km and located at 10°4.0002' N, 34°31.9998' E and altitude of 1560m a.s.l.

The study was conducted in four villages namely: Assosa, Gambella, Amba 5 and Amba 37. Assosa and Gambella are native villages. The former is composed of different ethnic groups while the latter is composed of mainly Berta ethnic group. Amba 5 and Amba 37 villages are new settlements formed by settlers emigrated from Wollo province, Northern part of Ethiopia due to drought in the area same time in the past.

The socio-economic activity of the local population is mainly mixed farming which involves both cultivation of crops and rearing of livestock. Maize *(Zea mays)* and sorghum (*Sorghum bicolor*) are some of the crops cultivated during the major rainy season (May - September) and the short rainy season (October - December). Mango (*Mangifera indica*), Papaya (*Corica papaya*) and other vegetables and fruits are some other sources of incomes. Mining particularly gold is also a source of income for Assosa district inhabitants.

2.1. Study design and sampling procedure

Among the villages prone to malaria infections in Assosa district, four villages including Assosa, Gambella, Amba 5 and Amba 37 were selected based on traditional drug using habit of residents, proximity to potential mosquito breeding sites (drainage areas), accessibility and prevalence of malaria cases.

The study was therefore targeted towards households and individuals permanently living in the study villages and traditional medicinal plant healers. For traditional botanical medicine healers, 35 households were surveyed of which four healers were selected as key informants per village by snow ball sampling. Traditional medicinal plant users were addressed by systematic sampling in which every 20th household head of each village was considered. Only 5% of the study population was considered as it was believed that the villages except Assosa were remote rural villages of the district and had similar access to modern medication facilities. Sample size proportionate to size of the study villages was considered.

Data were collected through interviewer-administered questionnaires to evaluate knowledge, awareness and practice of participants toward malaria intervention methods and to collect ethno-botanical data. The data were analyzed and interpreted using graphs, tables and in verbal forms.

Figure 1: Map of study area.

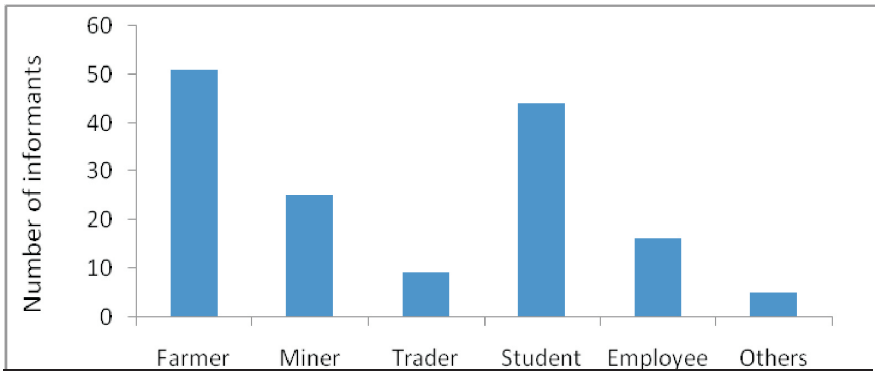

Figure 2: Occupation and traditional medicinal plant users in Assosa district.

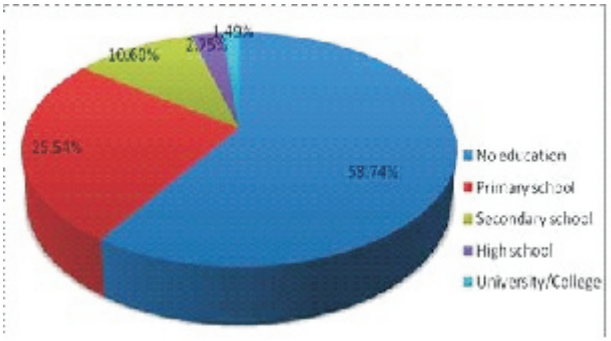

Figure 3: Educational status and traditional drug users.

Figure 4: Traditional ethno botanical drugs of indigenous ethnic groups in Assosa district (Photograp by Desta E.).

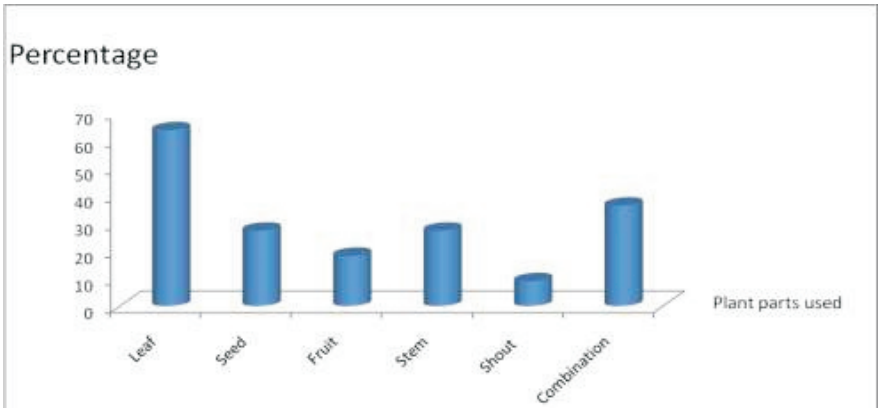

Figure 5: Plant parts used in preparation of remedies for malaria prevention.

Table 1: Habitual use of ethnobotanical medicines in four villages of Assosa district .

Villages studied	Using habit of plants
Assosa	27 (18%)
Gambella	83 (55.33%)
Amba 5	23 (15.33%)
Amba 37	17 (11.33%)
Total	150 (99.99%)

Table 2: Traditional medicinal plants and their particular purpose .

Local name	Family	Scientific name	Use (%)	Plant used as		
				insecticide	repellents	Anti malaria
Moringa	*Moringaceae*	*Moringa stenopetala*	9.29		x	x
Papaya	*Coricaceae*	*Corica papaya*	7.49			x
Kulubi adi	*Amaryllidaceae*	*Alium sativum*	22.48		x	x
Agnaneshewe	*Flacourtiaceae*	*Flacourtia indica*	6.44			x
Almim	*Meliaceae*	*Melia azedarech*	4.65	x	x	
Mala	*Fabaceae*	*Tamaridus indica*	1.95			x
Heten	*Asteraceae*	*Venamia spp.*	2.1			x
Amurusam	*Rhamnaceae*	*Ziziphus mourtiania lam*	1.8			x
Nech bahrzaf	*Myrtacae*	*Eucalyptus citriodora*	13.49			x
Keberecho	Asteraceae	*Echinops kebericho*	15.44		x	x
Yegumuz mitimta	Anacardiaceae	*Schinus molle*	14.99		x	x

Table 3: List of medicinal plants, report of use and ways of preparation .

Local name	Family	Scientific name	Administration or mode of preparation
Moringa	Moringaceae	*Moringa stenopetala*	Boiled and eaten, mixed with water and drunk
Papaya	Coricaceae	*Corica papaya*	Chopped, mixed with water and drunk
Kulubi adi	Amaryllidaceae	*Alium sativum*	Chopped, mixed with water, drunk
Agegnush	Flacourtiaceae	*Flacourtia indica*	Eaten
Almim	Meliaceae	*Melia azedarech*	Chopped, boiled with water and drunk
Birbrisa	Fabaceae	*Tamaridus indica*	Boiled with water and washed/drunk the suspension
Heten	Asteraceae	*Venamia spp.*	Chopped, boiled with water and sugar and drunk
Amurusam	Rhamnaceae	*Ziziphus mourtiania*	Chopped and dispersed in water then drunk
Nech bahrzaf	*Myrtacae*	*Eucalyptus citriodora*	Sliced and smelled
Mitimta	Anacardiaceae	*Schinus molle*	Seed pod chopped and eaten with food
Zembaba	Arecaceae	*Phoenix reclinata*	Stem, root & terminal shout chopped and eaten
Keberecho	Asteraceae	*Echinops kebericho*	Leaf, stem, and root dried and smoke

Table 4: Means of administration of traditional medicines.

Local name	Family	Scientific name	Administration
Moringa	Moringaceae	*Moringa stenopetala*	Oral
Papaya	Coricaceae	*Corica papaya*	Oral
Kulubi adi	Amaryllidaceae	*Alium sativum*	Oral
Agnaneshewe	Flacourtiaceae	*Flacourtia indica*	Oral
Almim	Meliaceae	*Melia azedarech*	oral and skin
Mala	Fabaceae	*Tamaridus indica*	Oral
Heten	Asteraceae	*Venamia spp.*	Oral
Amurusam	Rhamnaceae	*Ziziphus mourtiania lam*	Oral
Nech bahrzaf	Myrtacae	*Eucalyptus citriodora*	Oral
Keberecho	Asteraceae	*Echinops kebericho*	oral and fumigant
Yegumuz mitimta	Anacardiaceae	*Schinus molle*	Oral
Zembaba	Arecaceae	*Phoenix reclinata*	Oral

As described in Table 4, the administration routes of almost all plants were oral.

Table 5: Added values of traditional medicinal plant species .

Local name	Family	Scientific name	Added values
Moringa	Moringaceae	*Moringa stenopetala*	Food,
Papaya	Coricaceae	*Corica papaya*	Food
Kulubi adi	Amaryllidaceae	*Alium sativum*	Food, medicine for other diseases & spice
Agnaneshewe	Flacourtiaceae	*Flacourtia indica*	Food, medicine for other diseases
Almim	Meliaceae	*Melia azedarech*	Construction, live fences
Mala	Fabaceae	*Tamaridus indica*	No use
Heten	Asteraceae	*Venamia species*	No use
Amurusam	Rhamnaceae	*Ziziphus mourtiania lam*	Live fence, food
Nech bahrzaf	Myrtacae	*Eucalyptus citriodora*	Construction
Yegumuz mitimta	Anacardiaceae	*Schinus molle*	Food/spice
Keberecho	Asteraceae	*Echinops kebericho*	No use
Zembaba	Arecaceae	*Phoenix reclinata*	Rope, mat, bag

3. DATA COLLECTION

3.1. Socio-demographic data collection

Information related to socio demography of the informants was collected through interviewer administered questionnaires. Socio- economic statuses, life standard, occupation, educational levels of the community were documented. The demographic structure such as age, gender, house hold number, religion, culture, settlement and other details were also recorded. Demographic characteristics, prevalence of perceived illnesses, factors associated with preference of health care seeking options, traditional medicinal plants as well as some healers' socio-economic characteristics were collected using sets of semi-structured questionnaires. The data were collected from household heads and traditional healers. Moreover, focused group discussions were conducted with different heterogeneous groups with respect to sex, age and income levels.

3.2. Ethno-botanical data

Data of ethno-botanical plants were surveyed from the healers. The plant species, ecological distribution, medicinal values and additional uses were collected. Plant parts used, rout of administration, preparation methods and other indigenous knowledge of the native people were collected.

4. DATA ANALYSIS

Data were organized, checked for comprehensiveness and entered into Microsoft excel sheet. Variables such as demographic characteristics of household's respondents, choice of treatment options and ethno botanical medicinal plants were entered into Microsoft excel sheet, analyzed and interpreted by table and charts/graphs. Preference of respondents toward plants species, plant parts and ethno-botanical plants in regard to insecticides, replants and anti-malaria were analyzed. Futhermore, knowledge, practice and attitude toward ethno-botanicals for malaria control, preparation of plant remedies and way of administration for patient were employed for analysis.

5. RESULT

5.1. Demographic structure of study population

From a total of 208 individuals interviewed, 150 (86 females and 64 males) reported that they have used traditional ethno-botanical medicine at least once in their life time.

As indicated in Table 1, Gambella village inhabitants were investigated as being the most users of ethno botanicals 83 (55.33%) followed by Assosa town inhabitants 27 (18%), Amba 5 inhabitants 23 (15.33%) and then Amba 37 inhabitants 17 (11.33%).

Of the total traditional drug users, 51 (34%) are farmers, 44 (29.33%) are students, 25 (16.66%) are miners, 16 (10.66%) are employees, 9 (6%) are traders while 5 (3.33%) represent others (Figure 2).

With regards to educational status, all of the healers interviewed did not have formal education as illustrated in Figure 3. Most of the traditional drug users 88 (58.74%) did not have formal education followed by those who had primary school education 38 (25.54%), secondary school education 18 (10.60%), high school education 4 (2.75%) and higher institution 2 (1.49%).

5.2. Ethnobotanical studies

The current study identified various ethno botanical medicinal plants practiced by native ethnic groups in Assosa district (Figure 4). The result showed that about 11 plant species were used by healers for the prevention of mosquito bites and treatment of malaria. According to the respondents of Assosa district, some medicinal plants were obtained from wild sources and there was no special protection or care given to these plants. These ethno botanical medicinal plants were given protection just like any other plant that has no medicinal values. Although some of these were even available only during the rainy season, the wild medicinal plants are treated just like other wild trees.

As indicated in Table 2 of all medicinal plant species identified, the most cited in all the villages was *Allium sativum* (22.48%) followed by *Echinops kebericho* (15.44%). As indicated in Table 2, most of the botanical plants were reported as being used for the treatment of malaria (90%), insect repellents (45%), insecticides (9%) and for other purposes (45%). Most of the plants used for malaria control were prepared in the form of juice for intake. The units of measurements to determine dosage were not standardized; coffee cup, finger length and teaspoons. The quantity of plant parts used is measured by number of leaves, seeds, fruits, and length of root. According to the result of this study, there were various methods of preparation and application for different types of ailments.

The users and healers had various preparation forms such as chopping/powdering, crushing, chewing and mixing with water. The result indicated that most of the botanical plants were prepared by chopping and mixing with water followed by oral intake and few were dried and smoked **(Table 3).**

According to the respondents, leaf was the most widely used plant parts (63.63%) followed by seed (27.27%), stem (27.27%), root (27.27%), fruit (18.18%) and bark/shout (9%). The remaining (36.36%) is a combination of one or more plant parts **(Figure 5).**

Beside their medicinal use, inhabitants rely on ethno botanical plants for various purposes such as forage, firewood, spice, construction and food. It was found that 81.8% of medicinal plants have values other than their medicinal role. Among additional values of plants 54.55% are used for food, 36% are used for construction, 18% are used to cure other diseases and 18% have no known additional value **(Table 5).** Although there is an extensive use of plant for insecticide, mosquito repellent and antimalarial agents, an indigenous knowledge and customs of the traditional healers and users in each ethnic group were passed from one generation to another by words of mouth. Some traditional healers transfer their indigenous knowledge while others kept the knowledge with them for the sake of secrecy.

6. DISCUSSION

Recently, the uses of synthetic insecticides and anti malarial drugs are becoming a problem due to the resistance development of mosquitoes towards chemical insecticides and the spread of drug-resistant malaria parasites (Ibrahima et al, 2012). These are some of the conditions that initiated the search for alternative control measures. It was discovered that different ethnic groups in the study villages rely on traditional medicinal plants for malaria prevention and treatment. Eleven medicinal plant species traditionally used for as anti malarial, mosquito repellent and insecticidal agents in Assosa district were identified. Among the eleven species, the major plant species used for malaria prevention were *Alium sativum (*22.48%), *Echinops kebericho (*15.44%*)* and *Ziziphus mourtiania lam (*1.8%).

This finding is similar to previous reports documented by other scholars from different parts of Ethiopia (Berhanu et al, 2006; Flatie et al, 2009; Bekele et al, 2012, 2014). Plant species such as *Carica papaya* and *Schinus molle* were not previously identified as can be used for malaria treatment. However in the present study the reason why most informants depend on traditional medicinal plants could be due to low economic status, traditional belief, culture and inaccessibility of health facilities and synthetic pharmaceutical drugs.The gender distribution of traditional medicinal plant users was 86 (57.33%) and 64 (42.67%) for males and females respectively. Difference in the use of traditional medicine may be due to socio-economic differences ranging from purchase of pharmaceutical drugs, perceived illness, educational status and others. The constant prevalence of malaria in the area could also be a factor why males could develop acquired immunity while females and children are susceptible to the infection.

This susceptibility to malaria could be the reason for the frequent use of traditional medicines. Among the ethno botanical medicine users and practitioners, 88 (58.74%) have no formal education. Those with primary school status are about 38 (25.54%), the least are those who joined higher institution 2 (1.45%). Most of the informants were farmers (34%) followed by students (29.33%) and least are those who were engaged in different occupation and who have no recognized job (33.33%). This is in agreement with reports documented in Gideberet district, Western Ethiopia (Zerabruk and Yirga 2012). Plant species were reported to be used for malaria treatment, insect repellent and insecticide. Majority of the plant species were used for malaria treatment (90%) insect repellents (45%), insecticides (9%) and multiple purposes (45%) in study villages.

The possible reason why plants are more used for the treatment of malaria than for insecticide and repellants could be related to knowledge, attitude and practice against malaria control and prevention. It could also be because many seek treatment only after having been infected. Similar investigation has been reported previously elsewhere in Ethiopia (Flatie et al, 2009; Bekele et al, 2012; Tolossa et al, 2013). The most commonly used plant parts for herbal preparations in the area were leaves (63.63%) followed by seed (27.27%), stem (27.27%) and root (27.27%). Medicinal plants are prepared and applied in various forms; some are grinded into powder forms, some are meant to be chewed, some smoked, others chopped and yet others are homogenized in water. Some are by oral intake, suspension and those

used as repellants are sprayed. This finding is similar to several studies carried out previouslpy elsewhere in Ethiopia (Filatie *et al*, 2009; Yirga, 2010; Zerabruk ; yirga, 2012).

However, though harvesting of whole plants were not often practiced in the area; herbal preparation involving roots, bulbs, barks, stems or whole parts have effects on the survival of the mother plants. Extensive administration routes of traditional medicinal plants were oral by either chewing or drinking after being chopped and mixed with water. This finding is in accordance with the reports of Yirga (2010), Yineger and Yewhalaw (2007) that indicated oral intake as the predominant route of application. Informants reported that determinations of drug dosage were not standardized. Leaf number, glass/beaker, coffee cup, finger length and teaspoon were unit of measurements. Accordingly, there was inaccuracy in the determination of doses in the study area. This finding is in agreement with the report of Yirga (2010) and Zerabruk and Yirga (2012) in different parts of Ethiopia.

In addition to medicinal value, inhabitants in the study villages relied on ethno botanical medicinal plants for various purposes such as food, spice, construction, fire wood and fence Yirga (2010). This finding indicated that those medicinal plants are being widely exploited for other purposes apart from their medicinal value; that special focus should be given for the conservation of these plants. The study population indicated that indigenous knowledge of elders and healers of medicinal plants were passed from one generation to the next by oral tradition and practice within families and/or communities (Yirga 2010; Zerabruk and Yirga 2012). This mode of knowledge transmission may be due to lack of education and documentation.

It was discovered that negative attitudes towards traditional practitioners may have forced healers to keep their knowledge and practices to themselves. For instance, fear of possible alienation from the society based on the belief that apart from curing, traditional practitioners can also kill. It is believed that the wisdom of traditional medicine and practice comes from God and bestowed to a particular race and/or family. The practice of traditional medication did generate income for the healers and this could also be a factor that contributed to the disappearing of the indigenous knowledge associated with the conservation and use of medicinal plants.

7. CONCLUSION

The indigenous knowledge and practice of traditional medicinal plants is central to the rural communities in the study area. This indigenous knowledge of traditional medicine was passed from one generation to the next by means of oral tradition among family members. Those who are into herbal healing practice in the study area are mostly male illiterate farmers. Eleven plant species have been studied. Some are used for malaria prevention and treatment; others are used as insecticides while there are those specially used as insect repellents. In Assosa district, *Alium sativum* is the principal ethno botanical medicinal plant used for malaria control. The next is *Echinops kebericho.* The leaves are the most widely used part of the plants.

8. ACKNOWLEDGMENTS

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