

# Ethno-botanical study of traditional medicinal plants used to treat human and livestock ailments in Raya Alamata District, Northern Ethiopia

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## **Abstract**

Background In Ethiopia, traditional medicine based mainly on medicinal plants, has been used for centuries for the treatment of human and animal health problems. The objective of this study was to document medicinal plants used to treat human and domestic animals ailments as well as the associate indigenous knowledge and conservation methods in Raya Alamata District in Northern Ethiopia. Methods Ethno-botanical data were collected through semi-structured interviews, guided field walks, group discussions, field observations, preference ranking, paired comparison and direct matrix. The data were analyzed by descriptive statistics, informant consensus factor, and various ranking methods. Results The results showed 47 medicinal plant species belonging to 44 genera and 31 families. The plants were used to treat 27 human and 8 livestock diseases. Among others, members of Fabaceae were leading in terms of the number of medicinal plant species composition, consisting of 9 species. Of these species, the majority (53.19%) grew naturally in the wild. Herbs took the lead in terms of the number of plants used in the preparation of remedies, constituting 46.81% of the species, followed by shrubs that constituted 27.66%. Leaves were the most commonly used plant part, constituting 41.94% of the total uses, followed by roots, constituting 20.97%. Dermal route of administration was the most commonly used route of administration (43.55%), followed by oral route of administration (38.71%). Direct matrix ranking showed *Balanites aegyptiaca* L. as the most preferred multipurpose species in the community. Paired ranking indicated that *Aloe megalacantha* Bak. as the most commonly used medicinal plants for healing external wounds. Agricultural activity for new agricultural lands became seriously threatened medicinal plant resources. Many of the local communities with traditional medicinal knowledge gave priority to the immediate use of medicinal plants than to the sustainable uses. Particularly, the collection method of plants or plant parts for medicinal use is mostly destructive. Conclusion local communities heavily depend on traditional medicinal plants and associated knowledge for treating human and livestock ailments. However, medicinal plants and the associated knowledge are eroding mainly due to agricultural expansion, deforestation and land degradation for seeking new agricultural lands and firewood, as well as the unsustainable practices of plant or plant part sampling for medicinal values. Thus, public awareness needs to be raised among local communities and all other stakeholders on sustainable utilization and management of medicinal plant resources and associated knowledge. On the top of that ex-situ and in-situ conservation measures in particular should be taken for the sustainable management of medicinal plants and the indigenous knowledge.

## **Introduction**

Ethno-botany is a broad term referring to the study of the relationship between background people, plants and environment involving a wide range of disciplines [1]. Humans began to employ plants for the intention of health a long time ago, may be at the first moment when they suffered from diseases [2]. Since the antique time plants have been an essential supply for deterrent and healing for humans and livestock [3]. Traditional remedies are the most important and sometimes the only source of therapeutics

for nearly 80% of the population and 95% of traditional medicinal preparations in Ethiopia is of plant origin [4].

Medicinal plants are used as a major source for health promotion, prevention and cure. At the ancient time people primarily select plants for food, in doing that they also select plants by trial and error processes for their health care [5]. In most of the developing nations, the health care need of about 80% of the population depend on traditional medicines [6]. Ethiopia is rich in its biodiversity as a result of the different ecological and climatic conditions [7]. This rich biodiversity is also favored for a wide range of disease causing agents. These diseases were tackled by herbal remedies and religious beliefs now and then [8].

The cultivation and use of the medicinal plants are not new to Ethiopians, because of their acceptability, accessibility and affordability [9]. This means that Ethiopians have a body of expertise concerned with therapeutic properties of the local flora. Many skills such as the use of plants and animal products and religious beliefs are included in Ethiopian traditional medicines [4]. Although most practices and treatments in herbal medicine require specialists or professionals which are called herbalists, self-care using plants is also common in Ethiopia. The promotion of traditional health practices alongside modern health services is the most promising means for ensuring affordable and sustainable heath care for poor communities throughout the developing countries [10].

According to AB Cunningham [11], in situ and ex situ conservations are some conservation measures that have been undertaken around the world aimed at protecting threatened medicinal plants from further destruction. Traditionally used medicinal plants and associated knowledge are disappearing at an alarming rate [4]. Natural and anthropologic factors contribute to these losses, but threatening factors may vary from one region to the other [12]. Literatures show that studies on medicinal plants were conducted in different parts of Ethiopia to document the use of medicinal plants. The studies conducted in Maale and Ari ethnic communities [13], in the environs of Tara – gedam and Amba remnant forests of Kemkem district [14], in Gubalafto district [14] and in Guduru district [15] documented 128, 163, 135 and 57 medicinal plants respectively. In this context, therefore, the present study conducted a full-scale study on the ethno-botany of the traditional medicinal plants in Raya Alamata District in Northern Ethiopia. Local communities of Raya Alamata District has their own way of perceiving nature, their environment and health problems to react to them by making use of their indigenous knowledge and practices, which have been accumulated for generations to come up with both human and livestock ailments. The traditional practices have also their own contribution to the modern ones. Despite this reality, there is lack of proper conservation and management that leads to the shrinking and finally destruction of the plant communities with negative impacts on medicinal plants and related knowledge of the local people. In addition, knowledgeable elders may die without sharing their knowledge to the younger generation. Therefore, the general objective of this research was to identify and document medicinal plant species and associated traditional knowledge in Raya Alamata District, Northern Ethiopia. This study was also conducted with the following specific objectives: (1) to identify medicinal plants species which are used to treat both human and livestock ailments, (2) to document the indigenous knowledge of the people on

the preparation and use of medicinal plants to treat health problem in the study area, (3) to identify the plant parts used for medicinal purposes and (4) to find out the threats and local methods used by indigenous people to manage medicinal plants.

## **Materials And Methods**

### **Description of the study area**

Raya Alamata District is located in the southern zone of Tigray, bordered by Raya Azebo in the North, Ofla in the West, Amhara in the South and Afar in the East. It has latitude and longitude of 12° 25' N and 39° 33'E. It is situated 600 kilometers North of Addis Ababa and about 180 kilometers south of the Tigray Regional Capital city, Mekele. The District has 15 Kebeles: Timuga, Selen Wuha, Limat, Selam Bekalisi, Kulu Gize Lemlem, Garjale, Tao, Laelay Dayu, Tsetsera, Merewa, Sorya, Akojira, Awid Kulu, Waja and Harle. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), Raya Alamata has a total population of 80,840. The number of males and females constitute 39,382 and 41,458 respectively. The altitudinal range is 1,361 m to 3,171 m. a. s. l. According to the National Meteorological Agency (NMA) [16] the District receives 600-700 mm annual rainfall and 23-27 °C annual temperature. The size of the district is 75,502.14 hectares and 23 % of the District is divided in to western highland and 73 % eastern lowland.

The study was conducted in three *Kebeles* in the Raya Alamata District, Northern Ethiopia. The three *Kebeles* - Garjalle, Selen Wuha and Merewa - were selected for ethno - botanical data collection by simple random sampling (lottery method) (Figure 1).

### **Informant selection techniques**

A total of 18 key informants (seven from Garjalle, five from Selen Wuha and six from Merewa kebeles) from the age of 29 to 78 were interviewed. The key informants were selected purposively following G Martin [1] with the help and recommendation of *Kebele* administration leaders, elders, religious leaders and others who have information about traditional healers. This technique was used to get hold of healers who had no official permission for their traditional medicinal practices as the names of non-legalized healers were not registered in the government offices.

### **Ethno - botanical data collection**

The ethno - botanical data was collected from April to May in 2019. The techniques employed for data collection were group discussion, key informant interviews, field observations, and guided field walks. Interview questions were prepared for the key interviews to collect data primarily on the medicinal plants used to treat different ailments, plant parts used, preparation methods of remedies, condition of preparation, administration routes and other uses than medicinal values.

### **Plant specimen collection and identification**

Sample specimens of medicinal plant species were collected from wild and home gardens. Then they were numbered, pressed and dried for identification. The identification of plants cited for their medicinal value was made both in the field and at the National Herbarium of Addis Ababa University. The identification of the plant specimens was done using different volumes of Flora of Ethiopia and Eritrea books, useful trees and shrubs of Ethiopia. Comparison for identification was done with authenticated specimens with the help of experts at the National Herbarium experts from Agricultural Research Office of Raya Alamata and the Institute of Biodiversity and Conservation (IBC) of Ethiopia. Data on disease treated, plant parts used, method of preparation of remedy, details of the administration, dosage, any noticeable side effects, and preservation techniques were collected.

## **Data analysis**

A descriptive statistical method, such as percentage and frequency, were employed to analyze and summarize the data on medicinal plants, their uses and associated knowledge. Data associated to sources of medicinal plants, method of preparation, routes of administration, conditions of preparation, and plant parts and habits used were analyzed through descriptive statistical analysis with MS Excel. According to disease categories in earlier work [17] and with some modification, the human ailments were categorized into seven categories based on the usage reports mentioned by the informants in the study area. The collected data were analyzed through the informant consensus factor and various ranking methods.

### **Informant Consensus Factor (ICF)**

The ICF was calculated for each category to identify the agreements of the informants on the reported cures for the group of ailments. The ICF was calculated as follows: number of use citation in each category (NUR) minus the number of species used (NT), divided by the numbers of use citations in each categories minus one [18].

$$ICF = \frac{NUR - NT}{NUR - 1}$$

Where, ICF=Informant Consensus Factor

NUR=Number of Use Citation

NT=Number of Species

The informant consensus factor was calculated for each category. The informant consensus of medicinal plant usage resulted in ICF ranging from 0.36 to 0.64 per illness category. A high value of ICF (close to 1) indicates that relatively few species are used by a large proportion of people, while a low value indicates that the informants disagree on the taxa to be used in the treatment within a category of illness.

## **Priority ranking**

It is the simplest analytical tool for ethno-botanical studies. According to G Martin [1], priority ranking involves asking people to think of five to seven items and request to arrange those items according to a given criterion. Such criteria may be personal preference, perceived importance in the communities, or the list of plants resources that people feel are becoming increasingly rare in their communal forests. Therefore, in this study the set of 5 plants were selected from the list of medicinal plants that were reported as scarce by most informants in the study area and presented to the 6 key informants to rank according to their degree of scarcity. Each rank was given a numerical value of (1, 2, 3, and so on) with the most important items (most scarce medicinal plant species) given the highest value while the least important item was assigned 1. Then, the number was summed and ranked.

### **Direct matrix ranking**

Direct matrix ranking was done following G Martin [1] in order to compare multipurpose use of medicinal plants. Six multi - purpose medicinal plant species commonly reported by the informants were selected out of the total collected medicinal plants and use diversity of these plants would be listed for the key informants to order them by considering six attributes which included medicine, firewood, charcoal, construction, food and fence were listed and the species were provided to six key informants to give value according to the use of the species for the particular attribute. The scores which were given to each attribute were added, ranked so as to compare use values of the reported plant species. Then, each chosen key informants would be asked to assign to attribute of each species (5 = most valuable, 4 = very good, 3 = good, 2 = less used, 1 = least valuable, and 0 = not used). The values of each species were summed up and ranked.

### **Paired comparison**

Paired comparison 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 were presented to selected respondents and their responses were recorded. To this effect, six key informants were used to show the efficacy and status of five medicinal plants species to treat external wound. Finally, scores of each species were summed up and ranked based on the preference of the six key informants against external wound. In paired wise ranking, relatively few items are included; because the time needed to carry out the task increases exponentially as additional items included and the total number of pairs required increases as shown by the value of  $n(n-1)/2$  where 'n' stands for number of items to be compared [1].

### **Ranking of threats to medicinal plants**

Ranking of threats to medicinal plants that were reported by most of the informants in the study area was conducted using six selected key informants as described by G Martin [1]. As mentioned by most of the informants' six threats were selected and the informants were asked to give six for the most threatening factor and one for the least threatening factor in the study area. This information was used to determine

the highest threatened factor to traditional medicinal plants in the study area and to suggest the necessary appropriate conservation measures.

## Results And Discussion

### Source and willingness to share knowledge of traditional medicinal plants use

Family was the major source of ethno - medicinal knowledge in the study district. Accounting for 66.67 % of the informants, fathers were the major source of knowledge on traditional medicinal plants (Table 1).

Table 1: Knowledge source on the use of traditional medicinal plants

Source of knowledge	No. of informants	Percentage (%)	Rank
Father	12	66.66	1 <sup>st</sup>
Mother	3	16.66	2 <sup>nd</sup>
Friends	1	5.56	3 <sup>rd</sup>
Father and mother	1	5.56	3 <sup>rd</sup>
Brother or sister	1	5.56	3 <sup>rd</sup>
<b>Total</b>	<b>18</b>	<b>100</b>	

The local people of the study area were willing to share and transfer their ethno - medicinal knowledge to their family members. The tendency to share their knowledge on the use of traditional medicinal plants was the highest with the trusted eldest son (50 %), followed by trusted son (27.78 %) (Table 2).

Traditional medicinal knowledge is transferred mostly to the family members. About 50 % of the total key informants transferred their medicinal knowledge to their trusted eldest sons. This is because traditional medical practitioners want their knowledge to be kept secret. It was reported by other studies that traditional health practitioners believed that traditional medicine is effective if done within family members as reported by N Abdurhman [19] in Ofla District, Northern Ethiopia and T Tefera and M Yihune [20] in Tenta district, South Wollo, Ethiopia. When the first son is not trustworthy to keep the knowledge secretly, parents transfer their knowledge to their second son.

Table 2: Willingness to share knowledge of traditional medicinal plants

Willingness to share knowledge	No. of informants	Percentage (%)	Rank
Trusted eldest son	9	50.00	1 <sup>st</sup>
Trusted son	5	27.78	2 <sup>nd</sup>
All members of the family	2	11.10	3 <sup>rd</sup>
Relatives	1	5.56	4 <sup>th</sup>
Friends	1	5.56	4 <sup>th</sup>
<b>Total</b>	<b>18</b>	<b>100</b>	

## Composition of medicinal plant species

A total of 47 plant species, with their medicinal use value, were recorded and distributed among 31 families and 44 genera (Appendix 1). In term of species composition, the family *Fabaceae*, *Solanaceae*, *Euphorbiaceae*, *Asteraceae*, *Oleaceae*, *Cucurbitaceae* and *Rhamnaceae* (Figure 5) were the most frequently cited in the study district. The rest of the species belonged to one family each. The plants were found to treat 35 different health problems, affecting 27 human and eight livestock ailments (Appendix 1).

A total of 33 medicinal plants were used for treating human ailments (Appendix 2), six for livestock ailments (Appendix 3) and eight were used for both human and livestock ailments (Appendix 1). Among the families cited, *Fabaceae* was the leading medicinal family with nine medicinal plants, followed by *Solanaceae* with four medicinal plants in the study area. M Megersa, Z Asfaw, E Kelbessa, A Beyene and B Woldeab [21] reported *Fabaceae* as the leading family with 15 medicinal species, followed by *Solanaceae* with eight species in Wayu Tuka district, Oromia Region of Ethiopia and R Regassa [22] also reported that *Fabaceae* as the leading family with five medicinal species, around Hawassa city, Southern Ethiopia.

## Spatial distribution of medicinal plants

Regarding the distribution of medicinal plants, out of the 47 plant species, 53.19 % of them were grown in the wild, 29.79 % were domesticated and cultivated around homestead, while 17.06 % were grown in the semi-wild areas (Figure 3). The majority of the medicinal plants grew in the wild vegetation. Except for the cultivated and weedy species of medicinal plants, long distance walks were required to collect their samples attributing to their limited occurrence. The sources of the medicinal plants were mainly the wild vegetation, accounting 53.19 % followed by cultivated ones, accounting 29.79 %. This result agrees with the result of F Mesfin, T Seta and A Assefa [23] in Amaro District, South Region and Y Tilahun [24] in and Adigrat town, Tigray Region of Ethiopia, that majority of medicinal plants were collected from the wild,

accounting for 77 % and 76.98 %, respectively. Some others were collected from home gardens. This indicated that the practice of cultivation of plants for their medicinal purpose in home gardens of most of the country is low though many plants are cultivated for other purposes. In a similar way, communities in the study area make less effort to cultivate medicinal plants in their home gardens rather they go to the nearby or far places to harvest the plants.

### **Habits of medicinal plants**

Out of the total 47 medicinal plants collected, herbs comprised 22(46.81%), shrubs 13 (27.66%), trees 10(21.27%) and climber 2 (4.26%) (Figure 4). Herbs and shrubs were widely used in the study area. This might be owing to the relatively higher abundance of those species in the study area. The knowledge about habits, the part used, type, dosage, administration of the medicinal plants is circulating chiefly among practitioners of traditional medicine [25]. Accordingly with regard to habits of medicinal plants herbs were found to be accounted for 19(40.43%) followed by shrubs accounted 15 (31.91%). A Teklay, B Abera and M Giday [26] found herbs to be the most utilized plants, accounted for 44% of the species, followed by shrubs 29% in Kilte Awulaelo district, Tigray Region of Ethiopia and A Enyew, Z Asfaw, E Kelbessa and R Nagappan [27] also found that herbs with 43.87% followed by shrubs accounted for 35.84% in and around Fiche district, Central Ethiopia.

### **Plant parts used for medicine**

Results showed that leaves and roots were the most commonly used plant parts in the preparation of remedies, accounting for 26(41.94% and 13(20.97%) of the total medicinal plant parts, respectively. This was pursued by seeds 8 (12.9%) and fruits 8(12.90%) as well as bulbs 3 (4.48%), latex 3 (4.48%) and bark 1(1.61%) (Figure 5). The use of leaves helped sustainable harvesting of plants. The popularity of the root part next to leaves might be due to the simplicity in using and preparing remedies out of it, such as chewing or inhalation after heating with fire. Roots can be also dried and powdered or homogenized with water.

The parts of the plants which are highly used for the preparation of the remedies were leaves 26(41.94%) followed by roots 13(20.97%). Utilization of leaves for drug preparation may not cause detrimental effect on the plants compared to the root. This work agrees with the work L Kidane, G Gebremedhin and T Beyene [28] that the most commonly used part of the medicinal plants was leaves 129(38.62%), followed by roots accounting 57(17.06%) in Ganta Afeshum district, Eastern Zone of Tigray, Northern Ethiopia.

### **Mode of preparation, route of administration, dosage and side effects**

The study revealed that the highest mode of preparation was in the form of pounding 20(32.26%) and pursued by crushing 17(27.42%), chewing 8(12.91%), powder form 7(11.29%), roasted smoke 5(8.06%), unprocessed 3(4.84%) and in the form of juice 2(3.22%) (Figure 6). This may be due to the possibility of effective extraction of plant ingredients when pounding, crushing and chewing so that it's curative potential would increase. This result is in agreement with a result from a study conducted in Guduru

district of Oromia Regional state of Ethiopia by A Tadesse, B Kagnew and F Kebede [15] that the highest traditional medicines were prepared by pounding which accounted 33.3% pursued by crushing 24.6%.

The most popular route of administration was dermal 27 (43.55%) followed by oral 24 (38.71%), fumigation 6 (9.68%), eye 3 (4.84%) and the least is nasal 2(3.22%). This study agrees with similar studies conducted in Bench ethnic group of Ethiopia by M Giday, Z Asfaw, Z Woldu and T Teklehaymanot [8] that the highest route of administration was dermal which accounted 39% pursued by oral 33%.

Some 14(24.14%) of the remedies were mixed with water, butter, honey and coffee while the remaining were used without addition of any ingredients (Table 3). With regard to standardization of dosage of medicine to be administrated, there was no standardized measure of the dose of herbal remedies in the study area. Coffee cup, tine, finger line, teaspoon, tea glass, the number of powder droplets picked by two finger tips were used for dosage determinations. Lack of precision and standardization was one of the drawbacks for the recognition of traditional health care system. Medicines prepared from *Allium sativum*, *Aloe megalacantha*, *Olea europea*, *Ocimum lamiifolium* and *Euphorbia abyssinica* were reported to have burning sensation, bitter taste, vomiting and sweating. Some side effects were understood as an indication for the working of the herbal medicine. The healers also made different dosages of traditional medicines based on differences in gender, age, physical condition and appearance among patients by using their experiences. With regard to the dosage given to patients in the study area, there is no standardized known unit of measurements of the plant remedies. This means that the same types of medicinal remedies for the same types of ailment might be given with different measurements in the same or different Kebeles of the study District. This study is in line with study made by G Chekole [29] in Gubalafto district, Northern Ethiopia who indicated that lack of precision and standardization as one of the drawbacks for the recognition traditional health care system. Although the measurement types were different, there are some common measurements like coffee cup, teaspoon, finger length and glass. Age, sex, physical condition and stage of illness were also considered in the study area by some healers to determine the amount of the remedies to be given by using their experience. Lack of precision and standardization was one of the drawbacks for the recognition of traditional health care system. This finding is also similar with a finding from a study conducted by M Megersa, Z Asfaw, E Kelbessa, A Beyene and B Woldeab [21] in Wayu Tuka district, Oromia Region of Ethiopia. Based on the information gathered from the key informants taking over dosage or under dosage may lead different health problems.

Table 3: Route of administration of traditional medicine

Route of administration	No. of plant parts	Percentage (%)
Dermal	27	43.55
Oral	24	38.71
Fumigation	6	9.68
Eye	3	4.48
Nasal	2	3.2
<b>Total</b>	<b>62</b>	<b>100</b>

## Method of preservation of the remedies and storage methods

The majority of the remedies was prepared from fresh parts of medicinal plants, which accounted for 29(46.77%), pursued by fresh and dry form, constituting 19(30.65%), while the remaining 14 (22.58%) were in the form of dry (Figure 7). Water was the most frequently used when solvents were needed. Coffee and butter were also used as solvents or additives, to some degree in the preparation of remedies. Healers stored the collected traditional plant medicines in their homes for further usage, mostly in powdered and raw dried forms. In this regard, clothes and plastic bags were used mainly to store the dried medicine. However, the preferences of fresh plant parts for medicine were higher than dried ones. Based on the information gathered from the key informants the highest method of preservation was fresh 29(46.77%) followed by fresh/dry 19(30.65%). In contrast, some traditional healers store the dried plant medicines in different containers in their homes. This is in agreement with the work of M Gebrehiwot [30] that the highest condition of preparation was from fresh material that accounted for 77(49.68%), followed by fresh/dry 55(35.48%), conducted in Seru District, Arsi Zone of Oromia Region, Ethiopia. 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.

## Informant consensus

Application of informant consensus analysis showed that some medicinal plants were more popular than others. Informant consensus value gives good indication about a particular species that serve for particular health problems and about specific medicinal plants used for several health problems. Accordingly, *Ocimum lamiifolium* was cited by 8informants (44.44%) followed by *Datura stramonium*, which was cited by 7 informants (38.89%) (Table 4). Informant consensus values give good indication about particular species that serve for particular health problems and about specific medicinal plants used for several health problems. The informant consensus obtained during this study indicated that some medicinal plant species are more popular than others. Such information underlines the pharmacological significance of the medicinal plants in the study area. It is indicated that *Ocimum lamiifolium*, *Datura stramonium* and *Acacia etbaica* were the three most cited medicinal plant species in

the study area. Wound, tonsillitis and abdominal pain were the most cited ailments in Raya Alamata District. According to A Kefalew, Z Asfaw and E Kelbessa [31] medicinal plants with higher informant consensus need to be seriously considered for further ethno-pharmacological studies because they are the species that are widely applied by many people and may have been utilized for a long period.

Table 4: Informant consensus of medicinal plants used for the treatment of human ailments in study area

Scientific name	No. of informants cited	Percentage (%)	Rank
<i>Ocimum lamiifolium</i>	8	44.44	1 <sup>st</sup>
<i>Datura stramonium</i>	7	38.89	2 <sup>nd</sup>
<i>Acacia etbaica</i>	5	27.78	3 <sup>rd</sup>
<i>Allium sativum</i>	4	22.22	4 <sup>th</sup>
<i>Heliotropium steudneri</i>	3	16.67	5 <sup>th</sup>

### Informant Consensus Factor (ICF)

The most frequently occurring human diseases were grouped in to different categories based on the site of occurrence of the disease, condition of disease as well as treatment resemblance of the disease to the local people. The informant consensus factor was calculated for each category. The informant consensus of medicinal plant usage resulted in ICF ranging from 0.36 to 0.64 per illness category (Table 5). Some of the categories of diseases have high ICF than the other categories. Plants used against illness categories of problems of the abdominal pain, dermal and respiratory have high ICF in the study area. A high value of ICF (close to 1) indicates that relatively few species are used by a large proportion of people, while a low value indicates that the informants disagree on the taxa to be used in the treatment within a category of illness. ICF was determined by different authors such as T Teklehaymanot and M Giday [12] by people in Zegie Peninsula, Northwestern Ethiopia, E Abebe [32] in Debark District, Amhara Region Ethiopia and A Kefalew, Z Asfaw and E Kelbessa [31] in Ada'a district, East Shewa Zone of Oromia Regional State, Ethiopia.

Table 5: Informant consensus factor of human diseases

Disease category	Species	Use citation	ICF
Respiratory diseases (asthmatic reaction, cough, tonsillitis)	8	19	0.61
Dermal diseases (wound, measles and skin diseases)	13	34	0.63
Headache, hypertension, malaria, tooth ache	7	11	0.4
Bone fracture, abortion	8	13	0.42
General diseases (tension, evil eye and evil sprits)	8	12	0.36
Eye and nail problem	5	11	0.6
Abdominal pain, tape worm, jaundice and amoeba	7	18	0.64

## Priority ranking of medicinal plants

Priority ranking of five medicinal plants based on the degree of threats (availability) in the study area was conducted using 6 key informants. The results (Table 6) indicated *Olea europea* is the most threatened in the study area followed by *Acacia etbaica* and *Calpumia aurea* (Table 6).

Priority ranking of five medicinal plants in terms of availability showed that *Olea europea* was the most threatened medicinal plant in the study District. The result of preference ranking showed a particular medicinal plant is more preferred by the local people based on the given criteria. Preference ranking was made in Ethiopia by many authors to see the choice of the local people as reported by A Tora and T Heliso [33] in low land of Konta special District, in Southern Ethiopia and B Kidane, T van Andel, LJG van der Maesen and Z Asfaw [13] in Maale and Ari ethnic communities in Southern Ethiopia.

Table 6: Priority ranking of threatened medicinal plants

No	Plant species	Respondents' ranking						Total	Rank
		R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>		
1.	<i>Heliotropium steudneri</i>	2	3	2	2	3	1	13	4 <sup>th</sup>
2	<i>Acacia etbaica</i>	4	5	4	4	4	5	26	2 <sup>nd</sup>
3	<i>Calpumia aurea</i>	3	1	3	3	1	3	14	3 <sup>rd</sup>
4	<i>Ocimum lamiifolium</i>	1	2	1	1	2	2	9	5 <sup>th</sup>
5	<i>Olea europea</i>	5	4	5	5	5	4	28	1 <sup>st</sup>

\*Key: where R represented respondents

## Direct matrix ranking

The result of the direct matrix ranking showed that *Balanite aegyptia* stood first in being the most multipurpose medicinal plant followed by *Olea europea*, whereas *Euphorbia abyssinica* was the least (Table 7). Direct matrix ranking was performed to assess the relative importance and to check the major impacts on each of the plant. Medicinal plants of the study area were found to have several purposes other than medicinal uses. The key informants of the study area identified five medicinal plant species that were used by the local communities for extra function such as fire wood, charcoal, building, fencing, food and medicine. The result of the direct matrix ranking revealed that *Balanitea egyptiae* stood first in being the most multipurpose medicinal plant followed by *Olea europea*. This result indicated that *Balanitea egyptiae* and *Olea europea* appeared to have more demand than the others as they were used for more diverse purposes. Direct matrix ranking was made in Ethiopia by many authors to see the multiple purposes of medicinal plants, such as S Ayalew, A Kebede, A Mesfin and G Mulualem [34] in Jeldesa cluster, Dire Dawa, Eastern Ethiopia, A Tadesse, B Kagnew and F Kebede [15] in Guduru district of

Oromia Regional State, Ethiopia and L Kidane, G Gebremedhin and T Beyene [28] in Ganta Afeshum district, Eastern Zone of Tigray, Northern Ethiopia.

Table 7: Direct matrix ranking of multiple uses of medicinal plants

Plant species	Use category							
	Medicine	Firewood	Charcoal	Building	Food	Fence	Total	Rank
<i>Olea europaea</i>	2	4	3	5	0	4	18	2 <sup>nd</sup>
<i>Acacia etbaica</i>	2	4	3	5	0	3	17	3 <sup>rd</sup>
<i>Eucalyptus camaldulensis</i>	2	5	1	5	0	3	16	4 <sup>th</sup>
<i>Opuntia ficus</i>	2	0	0	0	5	5	12	6 <sup>th</sup>
<i>Zalanite aegyptiae</i>	2	4	3	4	3	4	20	1 <sup>st</sup>
<i>Acacia abyssinica</i>	0	4	4	4	0	3	15	5 <sup>th</sup>

## Paired comparison

Paired comparison was made to determine the most preferred medicinal plants among the five species that were used to treat external wound in the study area. The responses of 6 key informants showed that *Aloe megalacantha* ranked first followed by *Heliotropium steudneri* (Table 8). Therefore, this result indicated that *Aloe megalacantha* is the most favored while *Allium sativum* is the least favored over the other plant species cited in treating external wound in the study area. Paired wise ranking of medicinal plants treating particular ailments showed that some medicinal plants was preferable than others. The finding indicated pair wise ranking of medicinal plants treating external wound showed that *Aloe megalacantha* became the most preferable plant species in Raya Alamata District. This showed that the preference of plant species against ailments varies from person to person. The most favored species are usually the most efficacious, at least in the local area of the people who use them. Some studies made in Ethiopia pair wise ranking where informants made their choice on individual basis such as G Chekole [29] in Gubalafto district, Northern Ethiopia and A Tadesse, B Kagnew and F Kebede [15] in Guduru district of Oromia Regional State, Ethiopia.

Table 8: Paired comparison of five medicinal plant species used to treat external wound

Plant species	Respondents levelled						Total	Rank
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>		
<i>Aloe megalacantha</i>	4	1	2	3	2	4	16	1 <sup>st</sup>
<i>Allium sativum</i>	2	1	0	1	3	0	7	5 <sup>th</sup>
<i>Hibiscus micranthus</i>	1	2	2	2	3	1	11	4 <sup>th</sup>
<i>Heliotropium steudneri</i>	1	4	4	2	0	3	14	2 <sup>nd</sup>
<i>Datura stramonium</i>	2	2	2	2	2	2	12	3 <sup>rd</sup>

## Status of medicinal plants

The status of medicinal plant species in the study District mostly depended on season. The accessibility of TMPs in the study District was moderate, especially herbs were accessible during the rainy season, but their accessibility was reduced in the dry season. Regarding the availability of medicinal plants, out of the 47 plants species, 22 (46.81%) of the medicinal plants were reported to medium, 13 (27.66%) were rare in the dry season, while 12 (25.53%) were common (Figure 8). This result agrees with the result of A Tadesse, B Kagnew and F Kebede [15], the status of medicinal plant species in their vicinity as medium was the highest with 59.56% that was conducted in Gulomahda and Erob Districts, in Tigray Regional State, Ethiopia.

## Documentation, collaboration, degree of acceptance and effect of modernization on traditional medicinal practice

All of the key informants did not document any traditional medicinal practice. Furthermore, all of them transferred ethno-botanical knowledge mainly oral tradition. They were not interested to collaborate with other knowledgeable people and healers.

Most of the key informants of the study area, witnessed that most of the local people are interested to use herbal medicines. Effectiveness, cheapness and accessibility are the reasons to the local people to prefer the use of herbal medicine, but the tendency of the local people to be treated by herbal medicine has been declining from time to time. All of the key informants and the information gained from group discussion agreed that modernization, including the expansion of education, health service such as clinics, health posts and western cultural influence have affected and interfered with the use of herbal medicines and associated knowledge.

The result of the study showed that the indigenous knowledge of plant medicines of the study area is kept secret to a few practitioners. According to the information gathered from the informants of the study area, the majorities of the professional traditional healers do not show and share their knowledge of medicinal plants freely to anybody, but they share their knowledge of medicinal plants to one or in some cases to their family members who they trust most when they become older and older. In doing this, they told to the person to follow the same principles of secrecy. When the practitioners are asked why they kept their knowledge secret, they answered in such a way that the knowledge of medicinal plant healing power of the plant remedies decreases if the secret is out, medicinal plant is one means of income and derogatory attitudes towards practitioners of traditional medicine have forced healers to keep their knowledge and practices to themselves. It was reported that 80% of Ethiopian population depend on traditional medicine for their primary health care [4]. The plants parts used, method of preparation are often closely guarded secrets. Similar findings were reported, such as M Giday and G Ameni [35] in Ofla

District and Raya Azebo, Northern Ethiopia, N Abdurhman [19] in Ofla District, Northern Ethiopia and G Yirga and S Zeraburk [36] in Gindeberet district, Western Ethiopia.

All of the key informants did not document any traditional medicinal practice. According to this, all of them transferred ethno-botanical knowledge mainly by a word of mouth. Furthermore, they were not interested to collaborate with other knowledgeable people and healers. In this process valuable information can be lost whenever a medicinal plant is lost or when a traditional medical practitioner dies without passing his/her/ indigenous knowledge to others. Similar findings were reported elsewhere, such as T Flatie, T Gedif, K Asres and T Gebre-Mariam [5] in Berta ethnic group, Benishangul-Gumuz Regional state, mid-west Ethiopia, M Megersa, Z Asfaw, E Kelbessa, A Beyene and B Woldeab [21] in Wayu Tuka district, Oromia Regional State, West Ethiopia and Leul Kidane *et al* (2018) in Ganta Afeshum district, Tigray Regional state, Northern Ethiopia. All of the key informants stated that modernization such as expansion of modern education; health services such as hospitals, clinics, health posts and western cultural diffusion also affect the use of herbal medicines. According to M Giday, Z Asfaw, Z Woldu and T Teklehaymanot [8] in Bench ethnic group, SNNPR, the immediate and serious threat to the local medical practice and transfer in Ethiopia arise from the increasing influence of modernization such as increase of modern education, industrialization, changes in life style and migration from rural to urban area. To reduce this tendency, awareness has to be developed through different means among members of the communities' especially young generation, such as health workers, school clubs and mini media need to teach about the usefulness of the knowledge and practice of traditional medicinal plant use. Most young people showed a tendency of ignoring traditional medical practice [8].

During group discussion informants stated that some traditional medicinal plants were becoming scarce from time to time due to natural and anthropogenic factors. Sometimes, it was difficult to find some medicinal plants during the dry season especially herbs. Furthermore, the knowledge on traditional medicinal plants especially of the young generation had seem to decline from time to time because of the expansion of health centers and health posts and the growth of health workers which let them to prefer the western healthcare system than traditional medicine. Thus, modernization led the young generation dislike in the use of traditional herbal medicine. Group discussion also confirmed that trees and shrubs have been heavily exploited at the expense of inappropriate agricultural activities such as cleaning them for new agricultural lands, fire wood, construction and other purposes. In general, key informants and informal informants indicated that local communities used traditional medicinal plants to treat both human and livestock health problems.

Ethno-botanical data collected from the study area by means of guided field walk indicated that most of the local people used traditional medicine prepared from plant parts during infection for both humans and livestock in different ways and dosages based on the type of ailments. The most common health problems mentioned were dermal diseases, abdominal pain, respiratory diseases, leech and many others. They also reflected that accessibility of plants decreased during the dry season when it becomes difficult to find especially the herbs.

## **Factors threatening medicinal plants and conservation practices**

Anthropogenic factors affect the medicinal plants in the study area. The factors include drought, agricultural activities for new agricultural lands, fire wood, charcoal, construction and urbanization. Being a wildness of the cited medicinal plants exposed to various anthropogenic factors. From these factors the main threats to medicinal plants in the study area were, agricultural activities for new agricultural lands for expansion was ranked first by the selected key informants pursued by drought and fire wood respectively (Table 9).

People need plants for their daily life activities. In Raya Alamata District, nearly all key informants and the general group discussants were familiar with one or more than one threats that cause scarcity of medicinal plants in the study area. As mentioned by most of the informants, six threats were selected in the study area. This information was used to determine the highest threats to medicinal plants in the study area and helps to suggest the necessary appropriate conservation measures. Agricultural activities for new lands and drought ranked 1<sup>st</sup> and 2<sup>nd</sup>, respectively, followed by fire wood collection and construction in the 3<sup>rd</sup> and 4<sup>th</sup> places, respectively as the major threats to the medicinal plants in the study area. Similar findings were reported elsewhere in the country such as E Lulekal, E Kelbessa, T Bekele and H Yineger [3] that the main threats to the survival of medicinal plants in the Mana Angetu district were agricultural expansion and drought. These anthropogenic and natural factors coupled with very poor conservation efforts threatened medicinal plants survival in the study area. N Amsalu [37] in Farta District, Southern Gondar Zone of Amhara Region, Ethiopia and F Mesfin, T Seta and A Assefa [23] in Amaro District, South Nations and Nationalities Peoples Region also confirmed the same results. The study also revealed that the type and degree of threats varies from species to species in the study area. In doing that medicinal plant species such as *Acacia etbaica*, *Olea europia* and *Calpurnia aurea* are the most vulnerable than the other medicinal species. In addition, improper use of resources such as harvesting the root of a medicinal plant could be a significant threat to medicinal plants as; the result showed that roots were the second major plant parts (20.97%) of the medicinal plant species to treat ailments.

Table 9: Ranking of threats to medicinal plants

Threat	Respondent's ranking						Total	Rank
	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>		
Drought	6	5	4	5	4	4	28	2 <sup>nd</sup>
Agricultural expansion	5	6	6	6	5	6	34	1 <sup>st</sup>
Firewood	3	4	5	4	6	5	27	3 <sup>rd</sup>
Charcoal	2	3	4	2	2	2	15	5 <sup>th</sup>
Construction	4	2	2	3	3	3	17	4 <sup>th</sup>
Urbanization	1	1	1	1	1	1	6	6 <sup>th</sup>

\*Key: where R represented respondents

The study indicated that many of the people with traditional medicine knowledge give priority to the immediate use of the medicinal plants than to the sustainable uses, as the result of their harvesting style is destructive. However, some places are protected for their spiritual and cultural purposes. Thus, these places are good sites for the protection of the medicinal plants since cutting and harvesting are not allowed in such particular areas. Some medicinal plant species such as *Allium sativum*, *Cicer arietinum* and *Lycopersican esculentum* are cultivated in or near their vicinity. This is good practice for the conservation of medicinal plants.

The anthropogenic and natural threats to the biodiversity, in one or another form led to the scarcity of medicinal pants. Due to these factors, some medicinal plants, especially those growing in the wild with high curative power were hardly available and people walk long distance to collect them. The results of the study by the key informants and the general group discussants indicated that the effort made by the community to conserve medicinal plants is unsatisfactory though their importance is obvious especially traditional healers. Nevertheless, some sites in the District were protected for seasonal grazing for oxen only and spiritual purposes. Such kind of mechanisms helped in the conservation of medicinal plants. The field observation and group discussion with the informants showed that many of the plants growing near the home gardens were mainly cultivated for other purposes than for their medicinal value especial as food and spices, but species like *Artemisia absinthium* are cultivated for their medicinal value. This study agreed with the study of G Chekole, Z Asfaw and E Kelbessa [14] in the environs of Tara-gedam and Amba remnant forests of Libo Kemkem district, Northern Ethiopia, which indicated that the plant species, primarily cultivated for medicinal purposes are few. The results of the study showed that whether the plants are cultivated for their medicinal purpose or other purpose, it has great contribution to the conservation of medicinal plants.

## Conclusions

A total of 47 species of medicinal plants distributed across 44 genera and 31 families were recorded. Fabaceae (9 species) was represented by the highest number plant species, followed by Solanaceae (4 species). Herbs (46.81%) were the dominant growth habits, followed by shrubs (27.66%). Leaves (41.94%) were the dominant plant parts used in the preparation of remedies, followed by roots (20.97%). This is important to ensure the existence medicinal plants. The most common method of remedy preparation was pounding (32.26%), followed by crushing (27.42%). Dermal (43.55%) was the major route of administration, followed by oral (38.71%). Most herbal remedies were prepared and preserved from fresh materials (46.77%), followed by fresh/dried plant materials (30.65%). Of the 47 species of medicinal plants (70.21%) were noted to treat human ailments, while (12.77%) species were used to treat livestock ailments and 17.02% species were used to treat both livestock and human ailments. In terms of abundance, wild habitat (53.19%) was the major source of medicinal plant species, followed by cultivation (29.79%). The use of herbs as the major source of medicinal purpose than trees and shrubs might help to ensure the survival of shrubs and trees. Though wild habitats are the major source of medicinal plants, they are subjected to the loss of a number of plant species due to different anthropogenic and natural factors such as agricultural activities for new lands, drought, firewood and others. With regard to the dosage of traditional medicinal plants, there is no standardized measurement. This might have negative consequence on the health of the society. There is encumbrance in the transfer of knowledge from the elders to the young generation. The major hindrance in this regard might attribute to the introduction of modern education and culture. An effort made by the communities to conserve medicinal plants is unsatisfactory though there are efforts in cultivating medicinal plants. Thus, Ex-situ and In-situ conservation measures should be taken to protect the medicinal plants of the District from further destruction and special attention should be given to the medicinal plants that were indicated by priority ranking exercise as the most threatened ones.

## **Declarations**

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### **Declarations:**

#### **Ethics approval and consent to participate**

Not applicable

#### **Consent for publication**

Not applicable

## Availability of data and material

Plant specimens were deposited in the Department of Biology, Hawassa University, Ethiopia. Furthermore, the authors declare that sequencing data of 47 species identified supporting the findings of this study are available within the article and its supplementary information files as appendix.

## Competing interests

The author declares that there are no competing interests.

## Funding

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## Authors' contributions

Both authors were involved in data collection and writing of the manuscript. Both authors read and approved the final manuscript for submission and publication.

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## Appendices

Appendix 1: Medicinal plants used to both human ailments and livestock diseases (key: SW=semi-wild, C=cultivated and W=wild).

Scientific name	Local name	Family name	Habit	Part/s used	Source	Used for	Method of preparation	Administration route	
<i>Aloe megalacantha</i>	Ret	Aloaceae	Herb	Latex	SW	Dislocated bone	Tying it on the damaged part	External	
				Leaf		External wound	Cutting fresh leaf and spreading latex on wound	External	
						Malaria	Crushing fresh leaves, squeezing juice, filtering and drinking	Internal	
<i>Acacia etbaica</i>	Seraw	Fabaceae	Tree	Root	W	Bronchitis	Roasting fresh or dry root and inhaling smoke	Internal	
<i>Trigonella foenum graecum</i>	Abaeke	Fabaceae	Herb	Seed	C	Abdominal pain	Grinding dry seed, adding water and drinking 1 to 2 cup	Internal	
						Swelling (both)	Grinding fresh or dry seed, mixing with beans and rubbing paste on affected part	External	
						Dislocated bone	Immersing dry seed into water, pounding and tying on the injured part to soften skin	External	
<i>Acacia abyssinica</i>	Karwera	Fabaceae	Tree	Leaf	SW	External wounds infestation	Crushing fresh or dry leaf and tying it on wound	External	
<i>Dodonea angustifolia</i>	Ktkita	Sapindaceae	Shrub	Root	W	Bronchitis	Roasting dry root, pasting and inhaling smoke	Internal	
				Leaf		Dislocated bone(animal)	Crushing dry leaf tie on the damaged part	External	
						Eye infection	Crushing fresh leaf and applying droplets into the infected eye	Internal	
<i>Solanum marginatum</i>	Engule	Solanaceae	Shrub	Root	W	Abdominal pain	Chewing fresh root and swallowing the fluid	Internal	
				Fruit		Breathing problem(Livestock)	Pounding fresh fruit and applying through the nose	Internal	
<i>Acacia laeta</i>	Sabansa	Fabaceae	Tree	Leaf	W	Eye infection	Pounding fresh leaf and applying on affected eye	Internal	
<i>Echinops maracandicus</i>	Dander	Asteraceae	Herb	Root	W	Head ache	Crushing dry root and inhaling	Internal	
						Dislocated bone (animal)	Pounding dry root, tying it on damaged part	External	

Appendix 2: Medicinal plants used to treat human ailments only (key: SW=semi-wild, C=cultivated and W=wild).

Scientific name	Local name	Family name	Habit	Part/s used	Source	Used for	Method of preparation	Administration route
<i>Opennisia tentosn</i>	Harenigama	Capparaceae	Shrub	Leaf	W	Evil eye	Placing fresh or dry leaf on fire for fumigation	External
<i>A opaea</i>	Weyra	Oleaceae	Tree	Leaf	SW	Tonsil	Chewing fresh or dry leaf and drinking the fluid	Internal
<i>Pumia ea</i>	Hatsawits	Fabaceae	Tree	Bark	W	Bronchitis	Roasting fresh or dry bark and inhaling smoke	Internal
<i>Um ivum</i>	Tsaeda shinkurt	Alliaceae	Herb	Bulb	C	Asthma	Crushing about 5 fresh or dry bulbs, mixing with honey, butter and consuming one cup every morning for 5 consecutive days	Internal
						Wound/sore/	Pounding fresh or dry bulb and tying on the affected part	External
<i>Rissa narum</i>	Agam	Apocynaceae	Shrub	Root	W	Evil eye	Smelling dry root or crushing, adding to fire and inhaling smoke	Internal
<i>Iscus ranthus</i>	Chena argi	Malvaceae	Herb	Leaf	W	Wound	Crushing fresh leaf by mixing with saliva and applying on wound	External
<i>Veratolacca ecandra</i>	Shibit	Phytolacaceae	Climber	Whole	W	Abortion	Crushing fresh part, adding water and drinking the fluid of 1 to 2 glass	Internal
<i>Ragulus opilosus</i>	Koremedit	Fabaceae	Shrub	Leaf	W	Tooth pain	Chewing fresh leaf and holding it on the diseased tooth	Internal
<i>Emisia inthim</i>	Atran	Asteraceae	Herb	Leaf	C	Evil eye	Showing fresh leaf and sleeping on it	External
<i>Rus limon</i>	Lomi	Rutaceae	Tree	Fruit	C	Measles	Showing and eating the fresh fruit	Internal
<i>Anum anum</i>	Hintit	Solanaceae	Shrub	Root	W	Abdominal pain	Chewing fresh root and swallowing the fluid	Internal
<i>Ia faba</i>	Ater	Fabaceae	Herb	Seed	C	External wound "buginji"	Crushing dry seed and applying on affected part	External
<i>Liotropium udneri</i>	Amamgimel	Boraginaceae	Herb	Leaf	W	Wound	Pounding fresh leaf and	External

							squeezing liquid on the affected part	
<i>ffea bica</i>	Buna	Rubiaceae	Shrub	Fruit	C	Dandruff	Crushing dry or fresh leaf and applying on the shaved head of sick child	External
						Anti depressant	Roasting dry fruit and mixing with hot water and drinking	Internal
<i>enopodium rale</i>	Hamedmado	Chenopodiaceae	Herb	Leaf	W	Wound	Roasted the dry fruit and crushed it and apply the powder on the wound	External
<i>giber cinale</i>	Zingible	Zingiberaceae	Herb	Root	C	Dandruf	Pounding fresh or dry leaf and applying cream on shaved head	External
<i>cumis folius</i>	Ramborambo	Cucurbitaceae	Herb	Fruit	W	Abdominal pain	Chewing fresh or dry root and swallowing as fluid	Internal
<i>tura ammonium</i>	Mestenagr	Solanaceae	Herb	Leaf	W	Common cold	Pounding fresh or dry root and adding on boiled water and drinking as tea	Internal
						Nail problem	Pressing and pounding fresh fruit by the affected nail and holding it	External
						Dandruff	Crushing the dry or fresh leaf and applying cream on shaved head	External
<i>mum iifolium</i>	Ergo chabe	Lamiaceae	Herb	Leaf	W	Abortion	Crushing fresh leaf, filtering and drinking with a cup of tea	Internal
<i>amnus noides</i>	Gesho	Rhamnaceae	Shrub	Seed	C	Wound	Crushing dry or fresh leaf and applying on affected part	External
<i>nnicarpus</i>	Ezinenchiwa	Nyctaginaceae	Herb	Leaf	W	Snake	Pounding fresh	External

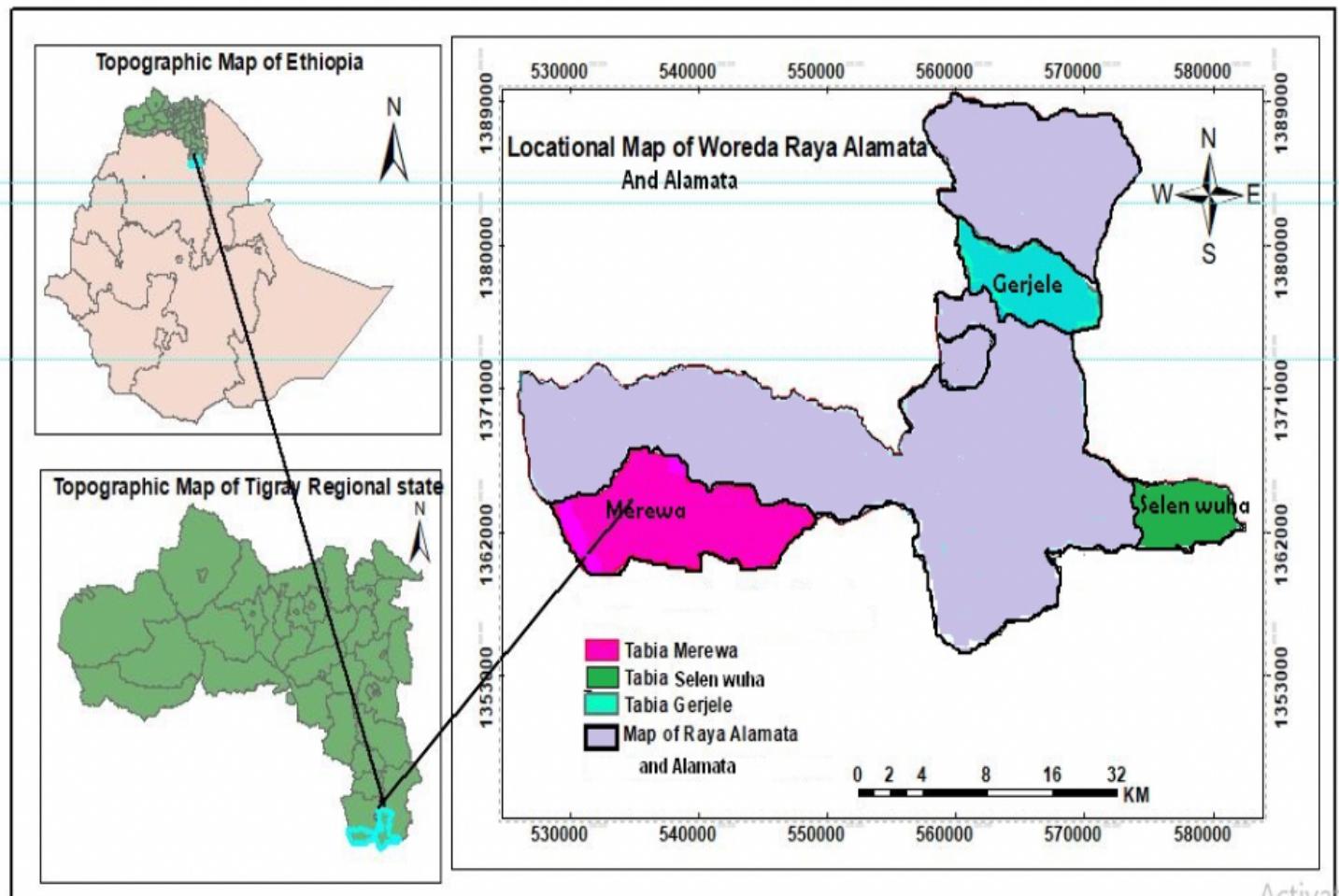
<i>mbagineus</i>						venom	leaf, boiling with butter and water and applying as cream	
<i>minium tissimum</i>	Habitselim	Oleaceae	Climber	Leaf	W	Tooth pain	Chewing the fresh leaf and hold it on the tooth and take in	Internal
<i>anites yptiaca</i>	Bedena	Balanitaceae	Tree	Fruit	W	Amoeba abdominal pain	Immersing fresh fruit into water for 1 to 2 days and drinking juice	Internal
<i>iphus nachristi</i>	Kunkura	Rhamnaceae	Tree	Leaf	W	Dandruff	Drying leaf, grinding and mixing with butter and rubbing on affected part	External
<i>nex ssinicus</i>	Mequmeqo	Polygonaceae	Herb	Root	C	Tooth ache	Pounding dry root and drinking it with boiled coffee	Internal
						Head ache	Pounding dry root to make tea and then drinking	Internal
<i>calyptus naldulensis</i>	Keybeharzaf	Myrtaceae	Tree	Leaf	C	Eye infection	Boiling fresh leaf in water and inhaling its vapour	External
<i>ticia imperiana</i>	Smiza	Acanthaceae	Shrub	Leaf	W	Jaundice	Crushed the fresh leaf and add water and filter the juice and drink depend on age	Internal
<i>ringa nopetala</i>	Shiferaw	Morigaceae	Tree	Leaf	C	hypertension	Drying leaf followed by crushing, adding a cup of water, filtering and drinking	Internal
<i>clea emosa</i>	Dodeho	Ebenaceae	Shrub	Leaf	W	Evil eye	Pounding and rubbing fresh leaf on face and smelling	External
<i>alis niculate</i>	Chewamurakit	Oxalidaceae	Herb	Bulb	W	Tape worm	Peel the external part in fresh form and eat it	Internal
<i>copersican ulentum</i>	Tematim	Solanaceae	Herb	Fruit	C	Fire burn	Rubbing and pounding the flesh part on the burned part	External
<i>er etinum</i>	Shimbra	Fabaceae	Herb	Fruits	C	Malaria gastric	Immersing the fresh fruit in to water, filtering after 1 to 2 days and taking it as meal	Internal

							through chewing and swallowing	
<i>curbita o</i>	Duba	Cucurbitaceae	Herb	Seed	C	Tape worm	Roasting the dry seed, and swallowing	Internal

Appendix 3: Medicinal plants used to treat livestock ailments only (key: SW=semi-wild, C= cultivated and W=wild).

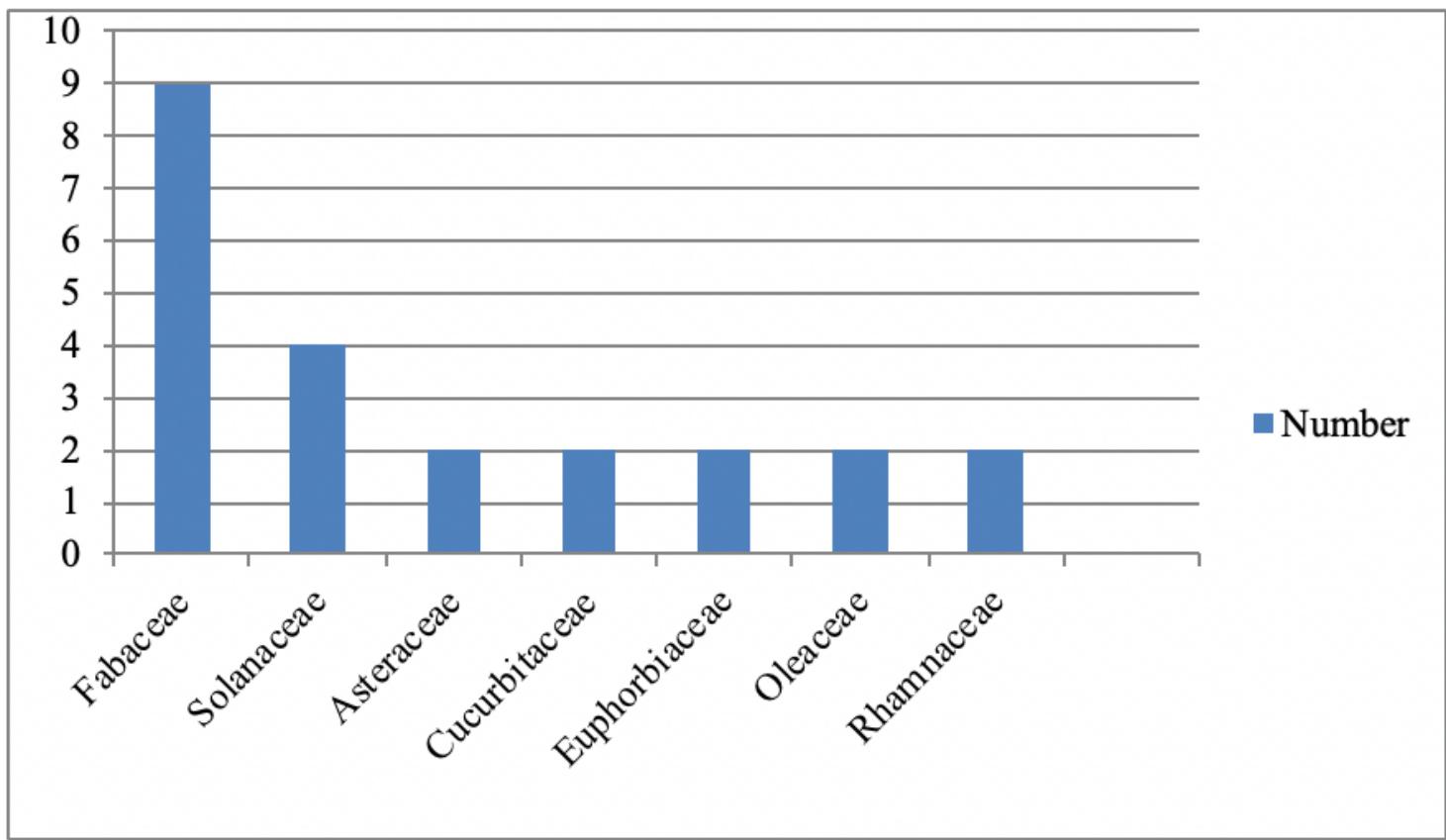
Scientific name	Local name	Family name	Habit	Parts used	Source	Used for	Administration route
<i>hyranthes aspera</i>	Gurbie	Amaranthaceae	Herb	Root	W	Eye disease(animals)	Internal
<i>ave sisalana</i>	Shihqo	Agavaceae	Herb	Root	SW	Leech infestation	Internal
<i>untia ficus</i>	Kulkual	Cactaceae	Shrub	Leaf	SW	Fleas infestation	External
<i>phorbia tirucalli</i>	Kinchib	Euphorbiaceae	Shrub	Latex	SW	Skin haemorrhoids	External
<i>rolobium llatum</i>	Kantefefe	Fabaceae	Shrub	Root	W	Dislocated bone(animal)	External
<i>inus communis</i>	Gulee	Euphorbiaceae	Shrub	Leaf	W	Horn worm	External

## Figures



**Figure 1**

Location map of the study area



**Figure 2**

Medicinal plant species composition in terms of families

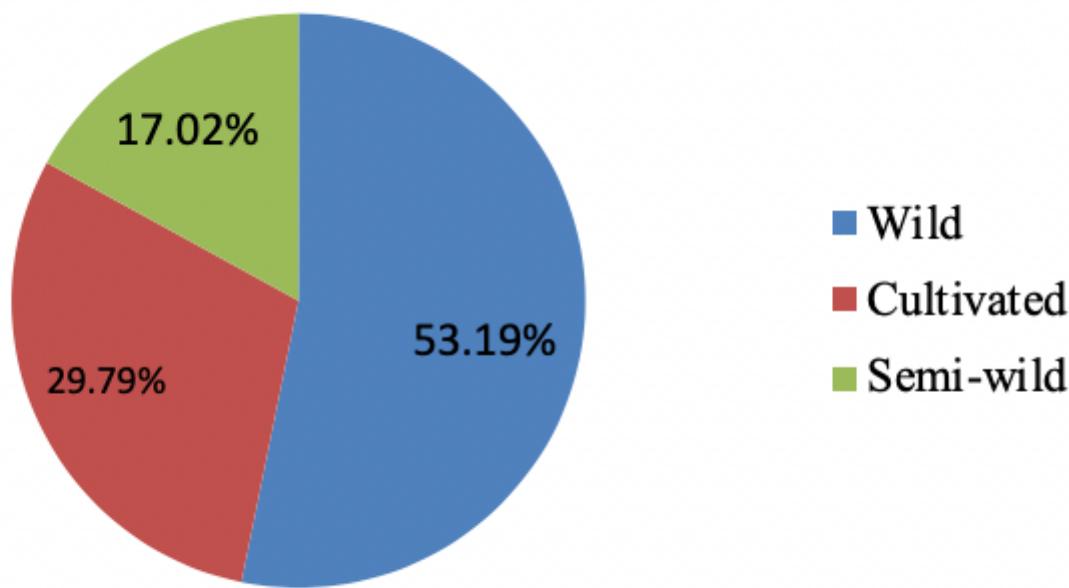


Figure 3

Spatial distribution of medicinal plants

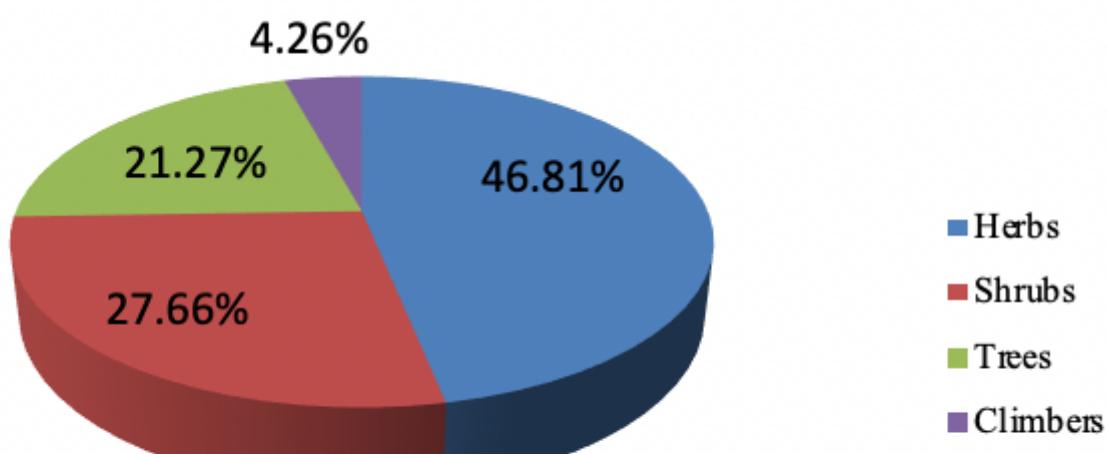
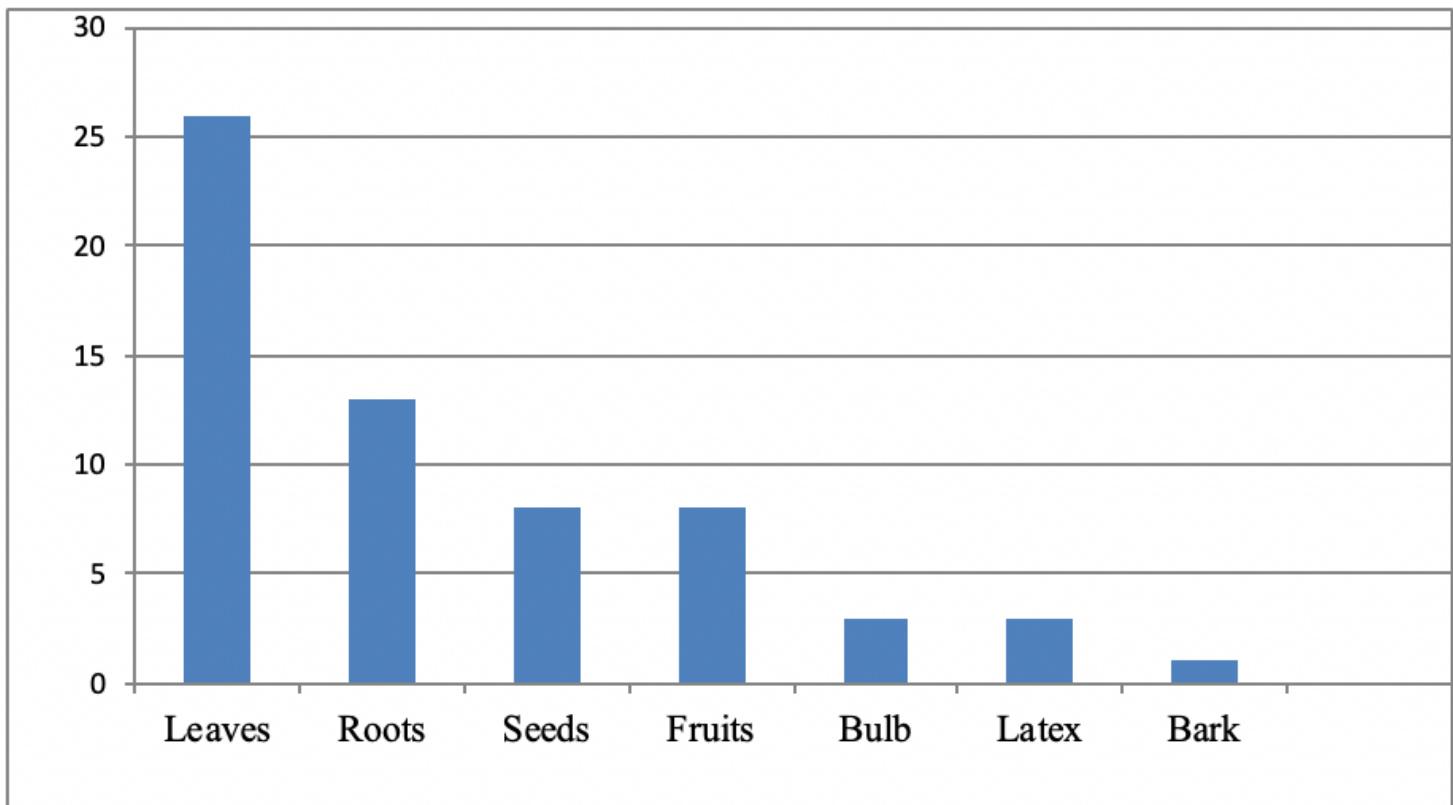


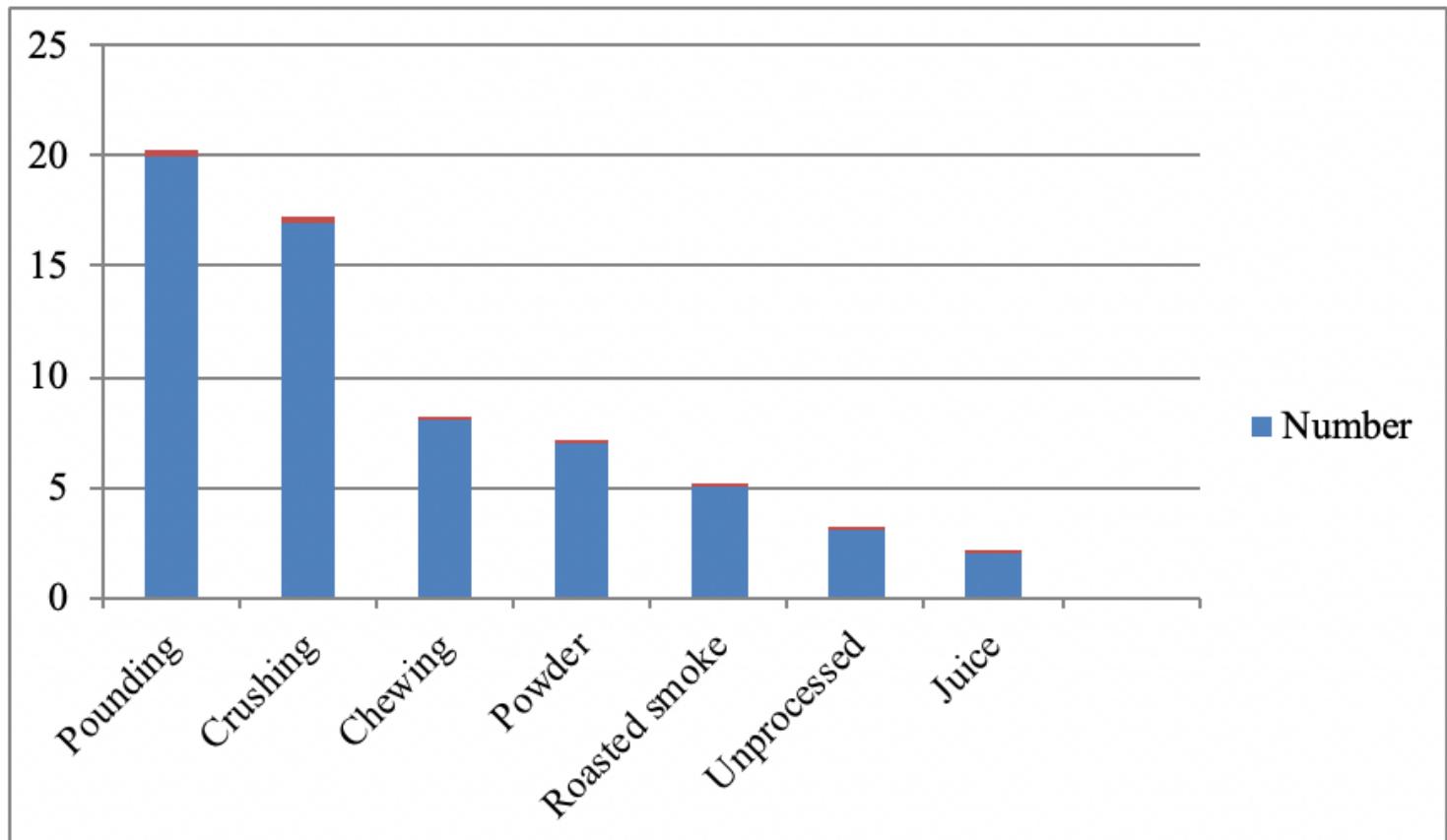
Figure 4

Habits of medicinal plants



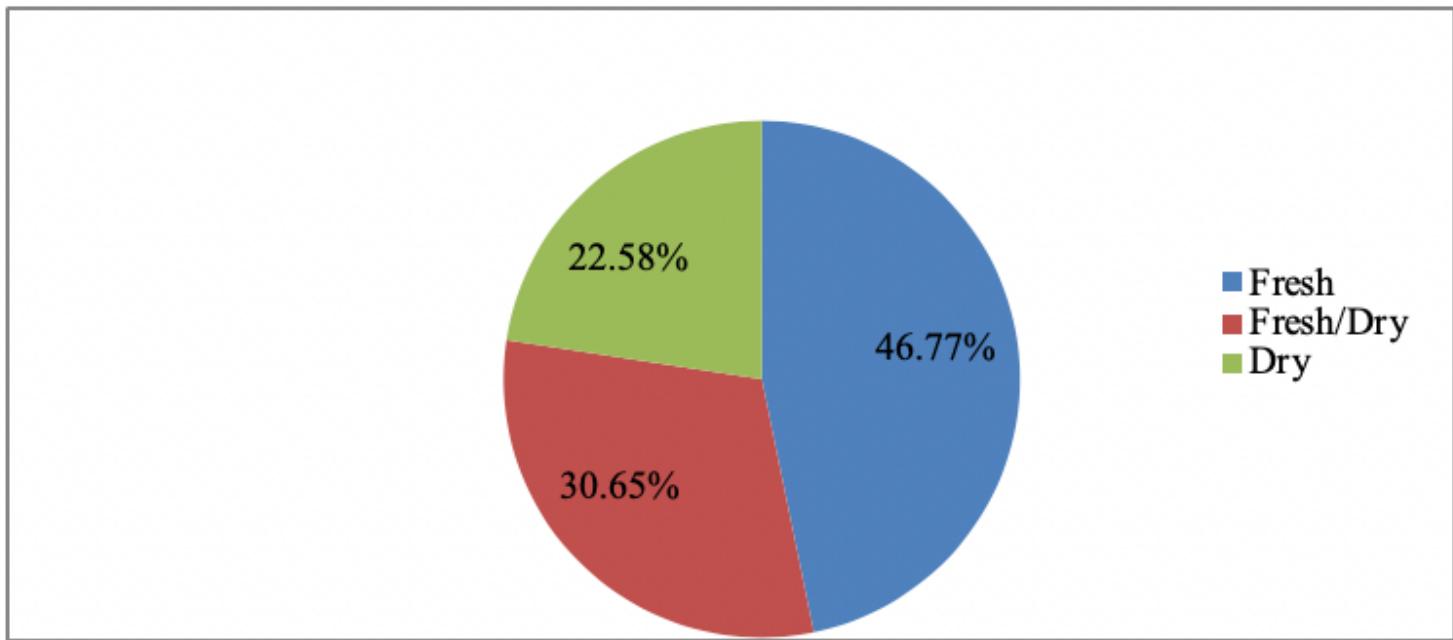
**Figure 5**

Plant parts used for medicine



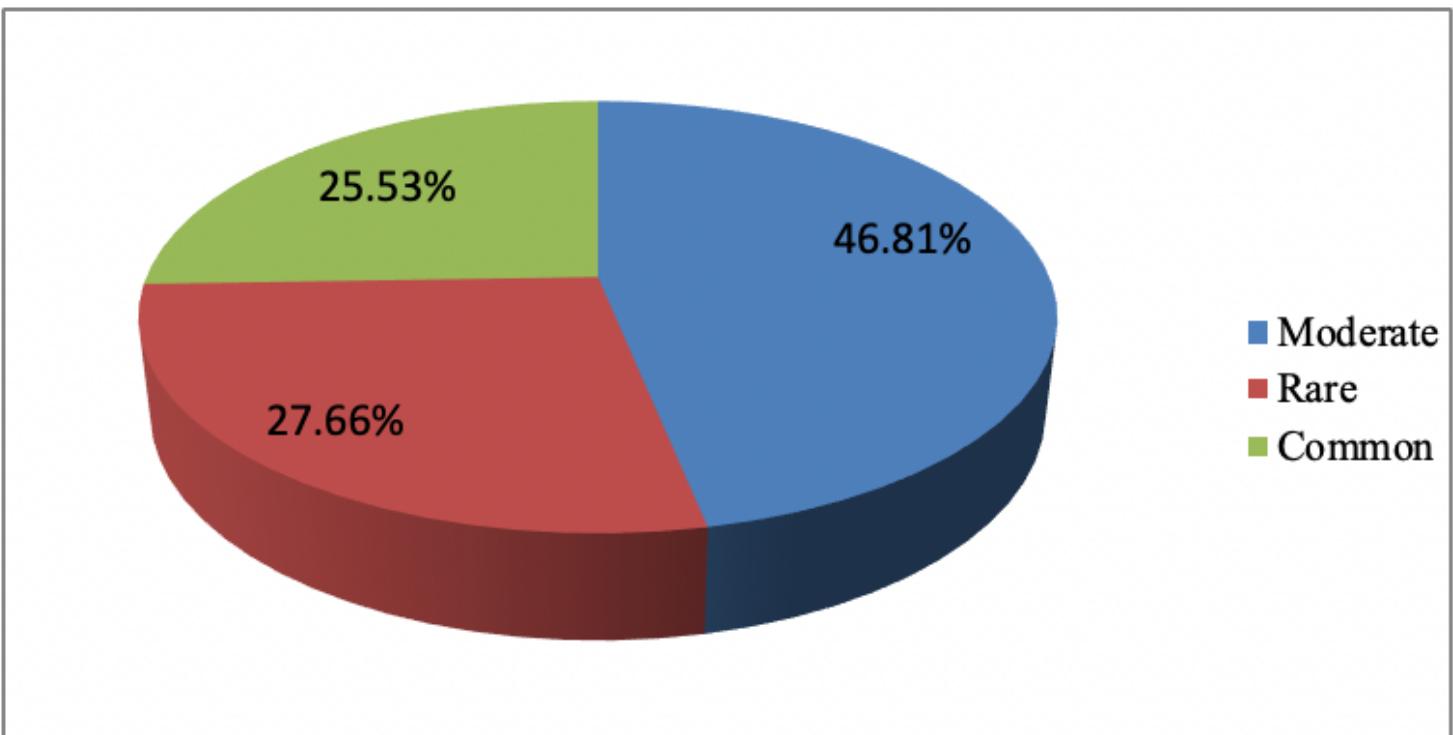
**Figure 6**

Mode of preparation of traditional medicine



**Figure 7**

Condition of plant parts for preparation of traditional medicine



**Figure 8**

## Status of medicinal plants