Ethnobotanical study of medicinal plants in and around Aba-Asrat Monastery following Chemoga River, east Gojjam zone, northwestern Ethiopia

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Research Article

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Abstract

Background: The study was undertaken with the general objective of providing documentation of traditional medicinal plants (MPs), and associated indigenous knowledge of the people inhabiting in and around Aba-Asrat Monastery, East Gojjam Zone, North western Ethiopia.

Methods: Ethnobotanical data were collected using semi-structured interviews, observation and focus group discussions in the field. A total of 160 (100 males and 60 females) informants were interviewed. The collected data were assessed quantitatively using various measures like fidelity level (FL), paired comparison, preference and direct matrix rankings.

Results: Results of ethnobotanical study revealed a total of 81 medicinal plant species belonging to 77 genera and 48 families were recorded which are used to treat human and livestock ailments. Asteraceae with nine (9.68%) species and Solanaceae with seven (7.53%) species were families represented by more species in the study areas. Herbs were found to be the most widely used life forms which account for 42 (45.16%) followed by shrubs 29 (31.18%). The most frequently used plant parts were the leaves followed by the roots. The highest FL values were recorded for *Plumbago zeylanica* and *Prunus africana* having highest scores (100%) that treat diseases like wounds, eczema and fibril illness. *Nicotiana tabacum* was the most preferred plant species against leech for livestock.

Conclusions: The major threats to plants in the study area were overgrazing, fire wood collection, agricultural expansion and charcoal. It is therefore, recommended that the declining plants species in the study area call for encouragement of sustainable use, conserve and manage it together with the MPs sheltered in it.

Introduction

Ethiopia is a country endowed with diverse ecosystems that are inhabited by diverse animal, plant and microbial species. This is because of the combined effects of topographic, wide spectrum of habitats and climatic factors [1,2]. As a result, Ethiopia is one of the countries in the world with high level of biodiversity. Owing to the long history of agriculture and the diversity of the environment, Ethiopia is again one of the 12 Vavilov centres of crop genetic diversity [3].

After the completion of the Ethiopian Flora Project, there were 243 families of vascular plants in the Flora area, of which 175 were found in both Ethiopia and Eritrea, 63 only in Ethiopia and five only in Eritrea [4] The same authors indicate that the country has about 6027 taxa (species and subspecies) are found in the Flora area (3,875 taxa in Ethiopia only, 1882 common to both and 270 taxa in Eritrea only). In addition Fabaceae, Poaceae and Asteraceae are the top three families having 678, 609 and 472 taxa, respectively.

Ethiopia is also ethnobotanically rich as there are diverse ethnic groups with diverse cultures. The knowledge and skills used in medication have been held by certain families and have passed down orally from parent to children, often a much loved one [1] About 1, 000 medicinal plants (MPs) of Ethiopia have

been identified and documented [5]. In Ethiopia, the knowledge on traditional MPs which was developed for millennia is now subjected to loss since it has mainly been stored in the memories of elderly persons and handed down mostly by word of mouth, which is prone to loss at each point of transfer [6]. Moreover, deforestation, overexploitation, overgrazing, habitat loss and degradation, agricultural land expansion and acculturation continuously threaten Ethiopian traditional MPs and linked knowledge [7].The loss of medicinal plant taxa is a common problem in Ethiopia for sustainable use of the resources [8] In addition to this, the rapid economic growth and cultural changes threaten the traditional lifestyle of indigenous people. Therefore, the knowledge of the community is currently being eroded and lost due to loss of traditional cultural systems and conversion of plant community and forest ecosystems to other purposes. Thus, the research is intended to study and document traditional MPs and local knowledge of the community in and around Aba-Asrat Monastery following Gorge of Chemoga River East Gojjam Zone, Northwestern Ethiopia [9 ,10] recommended that ethnobotany is also useful to define local community plant resource utilization and management. Therefore, the conservation of ethnobotanical knowledge as part of living cultural knowledge and practice between communities and the environment is essential for biodiversity conservation [11].

In connection with ethnobotany, several works have so far been done in the country so as to document and enhance related knowledge [12, 1,13–18]. Thus, this study seeks to understand the contributions of IK, its cultural value, detail assessment of plants species used in herbal medicine and their significance in biodiversity conservation in the study area.

Materials And Methods

Description of the study area

The study was carried out in and around Aba-Asrat Monastery following Chemoga River in the three Districts namely, Aneded, Debre Markos and Gozamin in East Gojjam Zone, Ethiopia. Most of the Chemoga watershed is located in Gozamin and Anded Districts East Gojam Administrative Zone, in the northwestern highlands of Ethiopia (within 1129643'N to 1147198'N and 37044'E to 37019'E) (Fig. 1) and characterized by a humid climatic condition. As measured at Debre Markos (10020’N & 37040’E and elevation 2446 m.a.s.l). According to the Zonal information, the topography of the districts is characterized by the three major agro-climatic zones within altitude range of 500–3500 meter above sea level: Highlands Mountain and Valley [19].

Demography, Health And Socioeconomic Status

Debre Markos is the town of East Gojam Zone and Gozamin district as well which is located about 300 km from Addis Ababa, the capital city of Ethiopia. The town is divided into 7 *Kebeles* (the smallest administrative unit/locality) with a population estimated to be 62,469, of whom 29,921 are men and 32,576 women [20] The total population of the Gozamin district has an estimated size of 173, 300 of

which 87, 178 males and 86,122 females: the highest population (80, 294) is in the age range of 0–14 w whereas, the lowest one is above the age of 60 which accounted 7, 837 in number [19] On the other hand, Aneded district has a total population of 91, 224, of whom 45,408 are men and 45,816 women; 1,778 or 1.95% are urban inhabitants. The majority of the inhabitants practiced Ethiopian Orthodox Christianity, with 98.87% reporting that as their religion, while 1.1% of the population said they were Muslim [20].

Agriculture, predominantly rain-fed, is the main stay of the whole East Gojjam zone area's economy. Similar to most of other parts of the region, agricultural practice in this area is an age-old practice, however, there is no change in cultural practice. The land resources in the East Gojjam zone are among the intensively used areas in the region. Sedentary rain feed agriculture is practiced and the economy of the people primarily based on mixed cereal agriculture with the farmers growing tef, finger millet, sorghum, maize, barley, wheat, as well as pulses, oil crops, vegetables and fruits [21].

The document stated that crop production and livestock husbandry are the main economic activity of the study areas. Farmers in the Districts follow mixed farming system to make their living. Regarding to crop cultivation, one can say that it is the pivotal activity of the Districts. *Teff*, wheat, barley, maize, peas and bean are the major crops produced in the areas [21] Soil, vegetation type and rainfall pattern: The study area is covered by different soil types. Aneded and Gozamin are covered with Nitosols and Alisols; areas around midland and slopping lands are equipped with Nitosols, Alisols and Leptosols [22].

According to [23] Dry Evergreen Afromontane Forest and grassland complex (DAF) occurs in areas between 1800 and 3000 meter altitude and with rainfall < 1700 mm. The same authors indicated that there are four subtypes of DAF recognized. Undifferentiated afromontane forest; dry single–dominant afro-montane forest of the Ethiopian highlands; afromontane woodland, wooded grassland and grassland and transition between afromontane vegetation and *Acacia- Commiphora* Bush land on the Eastern Escarpments. Furthermore, findings indicate that the natural vegetation of the study area can be broadly classified as “dry evergreen montane forest forest” with *J. procera* and/or *Olea europaea* ssp. *cuspidata* as dominant species [24].

The driest months are November, December, January and February (locally known as *bega* season), when less than 5% of the annual total rainfall occurs. Since the Chemoga watershed lies at a higher elevation (between 2420 and 4000 m.a.s.l) than Debre Markos (2,446 m), temperatures must be significantly lower and rainfall higher than these values. The rainfall pattern is unimodal, stretching from May to September. The highest monthly rainfalls were record in July-284.67mm and August-298.03mm and the lowest ones were observed in January (14.52mm) and February (10.6mm).The mean annual rain fall distribution is 1322 mm. The mean annual maximum and minimum temperature records of the study site were 26.2 0C and 8.8 0C respectively. Rainy months are blackened and dry months are dotted as indicated in Fig. 2.

Data Collection

Site selection

Reconnaissance survey was made during the last week of May 1 to 5, 2016 in order to obtain an impression of the site conditions and to select sampling sites. Following the reconnaissance survey, the following appropriate methodologies were developed for in-depth data collection. Identification of specimens has been carried out both in the field and later at ETH using taxonomic keys, descriptions and illustrations in the Flora of Ethiopia and Eritrea (ETH) by comparison with authenticated herbarium specimens and consulting with the professional (plant systematist) as well. Finally, the voucher specimens were kept at the Department of Plant Biology and Biodiversity Management, Addis Ababa University, National Herbarium of Ethiopia.

Sampling study sites and selection of informants

For this study, a total of six *kebeles* (localities) were selected primarily based on the availability of high number of traditional healers identified with the assistance of district and *kebele* authorities in and around the Monastery. The following *kebeles* were selected in the three Districts, namely Yewebi-Eneficho from Anded District, *Kebele* 1, 2 (including the Monastery) and 7 from Debre Markos, and Chemored Yezangera and Kebi from Gozamin District.

The total number of informants involved in the ethnobotanical survey from the six *Kebeles* of the Districts was 160 (100 males and 60 females). Informants' ages ranged from 25–85 years (76 were 46–85; 40 were 25–29 and the remaining 44 were 30 to 45 years old). Of the total informants, around 27 informants including monks per Kebele in and around Aba-Asrat Monastery were selected.

Purposive and random sampling methods were employed to select representative of general informants and knowledgeable traditional herbalists (key informants). Selection of informants was performed following [11] who indicated that when recording IK held by knowledgeably traditional healers or by certain social groups the choice of key informant is crucial. Purposive sampling is especially exemplified through the key informant technique [26] wherein one or a few individuals are solicited to act as guides to a culture.

Methods Of Ethno Botanical Data Collection

Ethno botanical data were collected during three different field visits within six *Kebeles* in Districts between 11 June 2016 to 1 April 2017 to record plant diversity along with the ethno botanical knowledge associated with the (MPs) used by the people in and around the Monastery of the three Districts. A semi-structured interview was conducted to 81 informants in order to determine the medicinal plants and their uses in traditional therapies. Ethno botanical data were also collected by closely interacting with informants using guided field walk, group discussion, preference rankings.

Prior to the collection of data, permission was secured from East Gojjam Zone of Amhara Region. Special ethical considerations were taken based on the cultural view of the local communities in the study area.

Data Analysis

The collected ethnobotanical data were analyzed following survey and analytical tools for ethnobotanical methods, which is recommended by [11] .Descriptive data analysis method was employed to summarize some of the ethnobotanical data obtained from the interviews on reported medicinal and associated knowledge. Appropriate software and descriptive statistics were computed in fidelity level, pair-wise comparison, preference and direct matrix rankings.

Fidelity level (FL)

The relative healing potential of each reported medicinal plant used against human and livestock ailments were evaluated using an index of fidelity level (FL) [27], given by FL = Ip/Iu X 100, where Ip is the number of informants who independently cited the importance of a species for treating a particular disease and Iu the total number of informants who reported the plant for any given disease.

Preference and direct matrix rankings

Values or scores given by key informants on use-preference and/or use diversity of MPs were ranked in order to get the outputs of the preference ranking and direct matrix ranking exercises, respectively, following [26,27] Preference ranking was conducted to determine the relative importance of six commonly reported (MPs) used in the treatment of livestock's disease leech. The traditional healers in the locality do treat livestock although the frequency of livestock disease is not comparable to human illness. Direct matrix was also used to analyze the major threaten factors of MPs and to compute them in treating toothache of human being in the study areas.

Paired Comparison

A paired comparison of five highly cited MPs used to treat a highly cited human ailment (toothache) was done using seven informants. Finally, scores of each species were summed up and ranked based on the preference of the key informants against toothache.

Results And Discussion

Ethnobotany of medicinal plants

The people in the study area use diverse plant species for traditional medicinal purpose to treat both human and livestock ailments. The results of the ethnobotanical study revealed that 81 medicinal plant species distributed in 77 genera belonging to 48 different families were frequently used for the treatment of various ailments in the study sites. Of the total plant species, eight that are endemic to Ethiopia were being used by the local people in their traditional medical lore (Appendix 1 and Appendix 2).

Of the total collected MPs, 68 plant species were used for the treatment of human ailments and 24 species were used against livestock diseases and 10 common plants species were listed in both cases which used to treat both livestock and human ailments. In the study site, large numbers of MPs were used to treat human ailments than livestock ailments (Appendix 1 and Appendix 2). According to the

informants, the other possible reason is female informants were fewer than males. This is because livestock production is usually a cultural care for males. As a result, there could be acquiring low knowledge of MPs to treat livestock ailments than knowledge of MPs treating human ailments. Similar ethnobotanical findings were reported in [17].

Different families of MPs were recorded. Among them Asteraceae is the most dominant family that held 9 (11.11%) plant species followed by Solanaceae 6 (7.41%) species and Lamiaceae 5 (6.17%) species. Other taxa commonly used were Cucurbitaceae having 4 (4.94%) species, and Euphorbiaceae and Fabaceae (each 3 species, 3.70%). The remaining forty two (42) families hold fifty one plant species. Of which nine of them account two species. The rest of the families signify one species (Figure 3). The domination of medicinal plant species families mentioned above may possibly be attributed to their wider distribution and abundance in the flora area [28]. This is also further confirmed by regular recording of ethnomedicinal uses of species from the above mentioned families in different other Ethiopian ethnobotanical studies [15, 16, 29]

Habits of medicinal plants which treat diseases

The finding indicated that the most widely used MPs growth form in the different *Kebeles* of the study areas were herbs 33 (41%) followed by shrubs 27 (33%). Trees and climbers account 14 (17%) and 7 (9%) respectively (Figure 4). This study confirmed that herbs are the largest in number this may be due to the plant species exhibit high level of abundance and easy to access them. This finding agreed with the findings of other indigenous researchers [30, 16].

Medicinal plants in natural habitat and home-gardens

Most MPs were collected in their natural habitat (Chemoga forest patch) which account for 51 (67%) whereas, 18 (22%) of them from home-garden and nine (11%) from both home-garden and wild (Figure 5). Similarly, various studies conducted in Ethiopia reported as majority of MPs harvested from wild [16-18] Here, the findings revealed that relatively many MPs were also obtained from home-gardens. This indicated that the people and the local healers have started cultivating MPs in their gardens. Similar results were reported in[8].

Plant parts used in medicine preparation

Every part of different plant species are used against a variety of ailments. As per the informant's response, the most commonly used part is the leaf (29), followed by root (16), seed (11), fruit (7), stem (3), flower, leaf and stem, and bark (2, each) (Figure 6; Appendix 1 and Appendix 2). In some cases, more than one organ of the same plant species, particularly a combination of parts, are used in the preparation of different therapies.

Traditional method and condition in remedy preparations

The popular method of preparation of traditional medicine was crushing and squeezing account 37 (34%) followed by powdering (powder form) 26 (24%). It was also recorded that 15 (14%) were prepared in juice form, 8 (7%) - chewing form, and 7 (6%) in the form of fumigation and boiling (each), 4 (4%) immersion. Other methods such as paste form, raw form and the like accounted 5 (5%) (Figure 7). Methods can be used for human and livestock problem except chewing which is used only for humans.

The result in the conditions of plant part used indicated that most medicines about 71% of traditional MPs were prepared from fresh plant materials in the study site whereas 26% and 3% MPs were reported to be used dry and both in dry or fresh form respectively (Figure 8; Appendices, 1 & 2). The common usage of fresh material was also noted in other parts of the country in [31, 17, 18, & 29].

Routes of administration

Oral application was the most commonly used route of administration accounting for 70 (59.8%), followed by dermal (31 preparations, 26.49%) and nasal (11 preparations, 9.40%), Nasl/oral (4 preparations, 3.42%) and anal (1 preparation, 0.9%) (Figure 9; Appendix 1 and Appendix 2). Similar route of administration was also reported by [17,29].

Dosage

Traditional healers reported to estimate dosages using *mankia* (lid spoons), *woket* (handfuls) (for powder preparations) *sini* (cup), *tassa'* (can) and *birchiko* (glass) (for liquid mixtures to be administered) for medicinal preparations. Furthermore some other healers reported that numbers or in some cases handfuls (for leaf, seed and fruits) and *atik (*tip of finger*)* (for roots, stems or barks) were used. The measurements used to determine the dosages are not standardized and depend on the age, physical appearance of the patient, degree of the illness, diagnosis and experience of individual herbalists/or knowledgeable person. Additional study confirmed that children are given less than adults, such as, one fourth of a coffee cup whereas; an adult is given up to one glass depending on the type of illness and treatment[12].

Fidelity Level

Fidelity levels were calculated for *Plumbago zeylanica* and *Prunus africana*; having highest scores (100%) each which treated diseases like wounds followed by *Solanum adoens* (90) treated eczema. On the other hand, *Rhamnus prinoides* which treated tonsillitis, skin infection and dysentery had the least score (50%) (Table 1). Plants that are known as remedies of a single ailment have 100% FL as compared to those that are used as remedies for more than one type of aliment. Most of the plants with high FL values have pharmacological effects that have been proven scientifically. The lowest ones indicated less preferred species for treating specific ailments. In contrast, these plants have been widely used against several diseases. Plants with the highest fidelity level values could be targeted for further photochemical investigation to prove the bioactive components that are responsible for their high healing potential [32]

Table 1 Fidelity level values of medicinal plants commonly reported against given ailments

Plant species	Diseases treated	Ip	Iu	FL values (%)
Plumbago zeylanica	Wounds	7	7	100.00
Prunus africana	Wounds	8	8	100.00
Solanum adoense	Eczema	10	10	90.00
Verbena officinalis	Stomachache & intestinal parasite	12	15	80.00
Rumex nepalensis	Blood pressure and stomachache	18	24	75.00
Brucea antidisenterica	Diarrhea, wound and leschmaniasis	15	20	75.00
Laggera tomentosa	Common cold and toothache	25	35	71.42
Carica papaya	Gastritis, malaria and diarrhea	25	45	55.56
Rhamnus prinoides	Tonsillitis, skin infection and dysentery	20	40	50.00

Key: FL= Fidelity Level, Ip = Number of informants who independently cited the importance of a species for treating a particular disease, Iu = Total no of informants who reported the plant for any given disease.

Preference ranking

If a number of species are prescribed for the same ailment, people will tend to show preference of one over the other. Thus, preference ranking of six MPs which were reported against leech (livestock disease) was conducted after selecting six key informants. The informants were asked to compare the given MPs based on their efficacy, and to give the highest number (5) for the medicinal plant which they thought most effective against leech and the lowest number (1) for the least effective plant in treating the disease. The results showed that *Nicotiana tabacum* was the most preferred followed by *Rhamnus prinoides* and *Solanum marginatum* (See Table 2). Result of the preference ranking exercise also indicated that *N. tabacum* is the most-preferred ethno veterinary MPs used to treat leech. This may be attributed to the occurrence of bioactive compounds against leech in this species.

Table 2 Preference ranking of medicinal plants against leech in livestock

Medicinal Plants	Respondents (R_1-R_6)						Total	Rank
	R_1	R_2	R_3	R_4	R_5	R_6		
Nicotiana tabacum	4	4	3	4	5	5	25	1st
Rhamnus prinoides	4	4	3	4	4	4	23	2nd
Solanum marginatum	4	4	3	4	4	4	23	3rd
Otostegia integrifolia	1	4	3	3	3	2	16	4th
Lagenaria abyssinica	3	2	2	3	2	2	14	5th
Guizotia abyssinica	3	2	2	2	2	1	12	6th

Paired comparison

In this study, seven key informants made the pair wise comparisons of five MPs and the values were summarized as follow. It was found that *Acmella caulirhiza* species stood first followed by *Laggera tomentosa* for the treatment of toothache. *Olea europaea* subsp*. cuspidata, Solanum marginatum* and *Momordica foetida* were placed 3rd, 4th and 5th respectively (Table 3).This rank is because of the effectiveness of the plant in the point of view of the indigenous people of the study areas.

Table 3 Paired comparison of medicinal plants used to treat toothache.

Medicinal Plants	Respondents (R_1-R_7)							Total	Rank
	R_1	R_2	R_3	R_4	R_5	R_6	R7		
Acmella caulirhiza	3	4	4	4	3	5	3	24	1st
Laggera tomentosa	3	4	3	3	3	3	4	23	2nd
Olea europaea subsp. *cuspidata*	2	3	3	3	3	2	3	19	3rd
Solanum marginatum	3	2	2	3	2	2	2	16	4th
Momordica foetida	1	2	2	2	3	2	2	14	5th

Direct matrix ranking

Many MPs were found to be used for different purposes in addition to their medicinal values. The major uses include firewood, furniture, forage, charcoal, and edible. For ranking seven key informants were asked to give value, 5 to the most used plant for that particular purpose and 0 to the least. In view of that, *Cordia affricana* was found to be the most multi-purposed plant scoring 93, followed by *Carissa spinarum* scoring 87 and the least one was *Croton macrostachyus* having 72 scores (Table 4). The highest direct matrix ranking on the topic of *C. africana* was also reported in [33]. This confirms that as the value getting high, the plants have multiple uses in the context of the local community.

Table 4 Direct matrix ranking for the multipurpose of six medicinal plants.

Medicinal plants	Use Categories						Total	Rank
	Medicine	Fire-wood	Furniture	Forage	Soil con.	Edible		
Cordia africana	24	20	24	5	10	10	93	1st
Carissa spinarum	27	17	5	10	12	16	87	2nd
Prunus africana	20	21	20	5	8	8	82	3rd
Olea europaea subsp. *cuspidata*	20	22	14	5	9	5	75	4th
Vernonia amygdalina	30	20	15	0	8	0	73	5th
Croton macrostachyus	29	19	18	0	6	0	72	6th

Characteristics of the informants

The informants were local inhabitants aged between 25–85 years (Table 5). Most of traditional healers range within the age group of 46-85 years, 76 (47.5%). These are followed by those who are around 30-45 years of age, 44 (27.5%) who also constitute a reasonable number, thus in most cases these are newly inaugurated traditional healers. The remaining 40 (25%) of informants were between the ages of 25-29 (Table 4). They are within this range because it is at this stage whereby they have completed necessary rites of passage, notably initiation school. With regards to sex, 100 (62.5%) of the total informants were males whereas, the remaining with 60 (37.5%) were reported as females. In terms of numbers, females are small in number. In the case of knowledge difference between the two sexes, females tend to mention little number of MPs as compared to males (Table 4). The educational rank of the informants exemplified that most of them were literate i.e. having modern education (diploma holders, students and those who able to read and write) which accounted for 66 (41%) followed by those who are uneducated ones but conventionally knowledgeable informants accounted with 54 (34%) and the least number of respondents were reported as church education attendants with 40 (25%). Concerning to the marital status of the

informants, majority of them were married people which accounted for 42 (52.5%) followed by the unmarried ones 32 (40%) and others were divorce which was reported as six (7.5%).

Indigenous traditional plant knowledge transfer

The most important way of transfer of IK on types of use of MPs, mode of preparations, way of administration, traditional idea of illnesses, methods of diagnosis and treatment among indigenous herbal practitioners of the community was by word of mouth to a family member.

The selection of the elect was based upon his/her good conduct and ability to keep the secret with regards to the ethnobotanical plant use knowledge. Furthermore it was reported that at family level, it is restricted to the elders (men and women), followed by elder son or daughter or their trustworthy person when the mother or the father is getting old or near to die as in Ankober District [16] and Farta District [29].

Table 5 Socio-demography of the informants in the study area.

Informants		Categories	No.	%
Sex		Male	100	62.50
		Female	60	37.50
		Total	160	100
Age		25-29 years	40	25.00
		30-45 years	44	27.50
		46-85 years	76	47.50
		Total	160	100
Marital Status	Married	Male	54	33.75
		Female	30	18.75
		Total	84	52.50
	Single	Male	40	25.00
		Female	24	15.00
		Total	64	40.00
	Divorce	Male	8	5.00
		Female	4	2.50
		Total	12	7.50
	Grand total		160	100
Educational Status		Modern education	66	41.00
		Church education	40	25.00
		Illiterate	54	34.00
		Total	160	100

Threats, conservation and management practices of IK associated with MPs

The data collected through both group and individual discussions with key informants indicated that the most mentioned threats to medicinal plants of the study area were overgrazing 29 (19.4%) firewood collection 28 (18.80%), agricultural expansion 26 (17.44%), charcoal making 24 (16.11%), construction 22 (11.68%) and fencing 20 (13.42%) (Table 6) hence have effects in threatening the medicinal plants and associated IK of the study community. Findings of [17] indicated that intense deforestation became the major threat on MPs in their respective study sites. Others [30] reported agricultural expansion as the major factors contributing to the local decline medicinal plants.

In the study area, threats which erode IK were caused by secrecy, oral based knowledge transfer, and unwillingness of young to gain the knowledge, influence of modern education and awareness factors. Group discussion confirmed that the knowledge of the local community especially the young age group has diminished from time to time. According to [29] 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 areas.

In the study site, irregular remnants of aged dry afromontane evergreen forests mainly around the Ethiopian Orthodox Tewahido Churches, unreachable areas and Monastery are contributing much a lot to the conservation of MPs. According to the informants, in most cases attempts regarding to conservation was weak. However, very few management practices were carried out in the home-gardens in and around Chemoga forest patch by the indigenous people. Few traditional healers in the study area have brought the different curative plants and other cultivated plants from different corners and started to conserve the plants in the home-gardens. The plants under this category were *Allium sativum*, *Artemisia abyssinica*, *Foeniculum*, *vulgare*, *Lippia adoensis*, *Nicotiana tabaccum*, *Ocimum lamiifolium*, *Ruta chalepensis*, *Rhamnus prinoides* and *Verbena officinalis*. Management practices like intercropping and crop rotation were also observed among very few farmers of the study area. In so doing, herbal remedies are continued to exist because of the existence of other plant species.

Table 6 Ranking of threats on medicinal plants (values 1-5: 1= the least destructive and 5 = the most destructive)

Threats	Respondents (A-G)							Total	%	Rank
	A	B	C	D	E	F	G			
Overgrazing	5	4	4	3	4	4	5	29	19.46	1st
Fire wood collection	4	4	5	4	3	3	5	28	18.80	2nd
Agricultural expansion	3	3	4	3	4	5	4	26	17.44	3rd
Charcoal making	4	4	3	4	2	3	4	24	16.11	4th
Construction	3	2	3	4	3	4	3	22	14.77	5th
Fencing	4	3	3	2	2	3	3	20	13.42	6th

Conclusions And Recommendations

The result of ethno botanical study indicated that the people in the study area reported using diverse plant species (81) in their herbal medical system that were used to treat different ailments. Of the total collected medicinal plant species in the study areas, 42 were used against human diseases, 26 against

livestock diseases and 10 were used against both human and livestock diseases. Thus, results from this investigation reveal that the local people depend on medicinal plants to meet their basic healthcare needs. The family Asteraceae had the highest number of species followed by Cucurbitaceae and Lamiaceae. Most of the medicinal plants used in traditional medicine are herbs mainly harvested from the wild and some from home-gardens. Leaves followed by roots and seeds were the dominant plant parts used for preparation of most remedies. The result in the conditions of plant part used indicated that the majority were prepared in fresh form. Remedies were prepared mostly from freshly harvested plant parts. The popular method of preparation of traditional medicine is crushing and squeezing followed by powdering (powder form). The largest proportions of remedies are administered for internal ailments through oral route followed by dermal application. Doses were not standardized for most medicinal plant preparations and prescriptions to patients. The main threat for MPs in the area arises from overgrazing, firewood and charcoal production, deforestation, agricultural expansion, timber production and drought. Finger-counted traditional healers in the study area have brought the different medicinal plants from natural habitats and started to conserve in home-gardens. In addition unreachable areas, Churches and Monastery are contributing much a lot to the conservation of MPs. Threats which erode IK were caused by secrecy, oral based knowledge transfer, unwillingness of the young to gain the knowledge, influence of modern education and awareness factors. Furthermore, the findings disclose that there is a paramount importance of traditional MPs whereas the local community holds wide indigenous medicinal knowledge in assisting the primary healthcare needs (of both humans and livestock) in and around the Monastery. However, the communities inhabiting in and around the Monastery are not fully aware of the importance of the conservation measures. Thus, the present study helps in recommending and focusing the attention towards the management and conservation of plant diversity in the study area. Additional study on indigenous knowledge has to be documented and conserved for the next generations. For the validity of reported medicinal plants, phytochemical analysis should also be carried out to detect pharmacological properties.

Declarations

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Authors' contributions

NA identified the research area and title, collected field data, plant identification, interpretation of data and writing of the manuscript **RR** analyzed and interpretation of the data, writing of the manuscript and grammar editing of the manuscript. Both authors read and approved the final manuscript.

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Availability of data and materials

Herbarium specimens are available in the National herbarium of Ethiopia, Addis Ababa University. All datasets on which the conclusions of the paper are based are made available as Appendix 1 and II of the manuscript.

Ethics approval and consent to participate

Ethics approval was obtained from the Ethics Committee of the School of Natural Sciences, department plant biology and biodiversity, Addis Ababa University and all participants freely consented to participate after being informed the aims and methods of study.

Consent for publication

Consent for the publication of this study was obtained verbally from all research participants.

The manuscript does not include personal details, images or videos of the research participants; because, a consent form has not been submitted.

Competing Interest

The authors declare that they have no competing interests.

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Figures

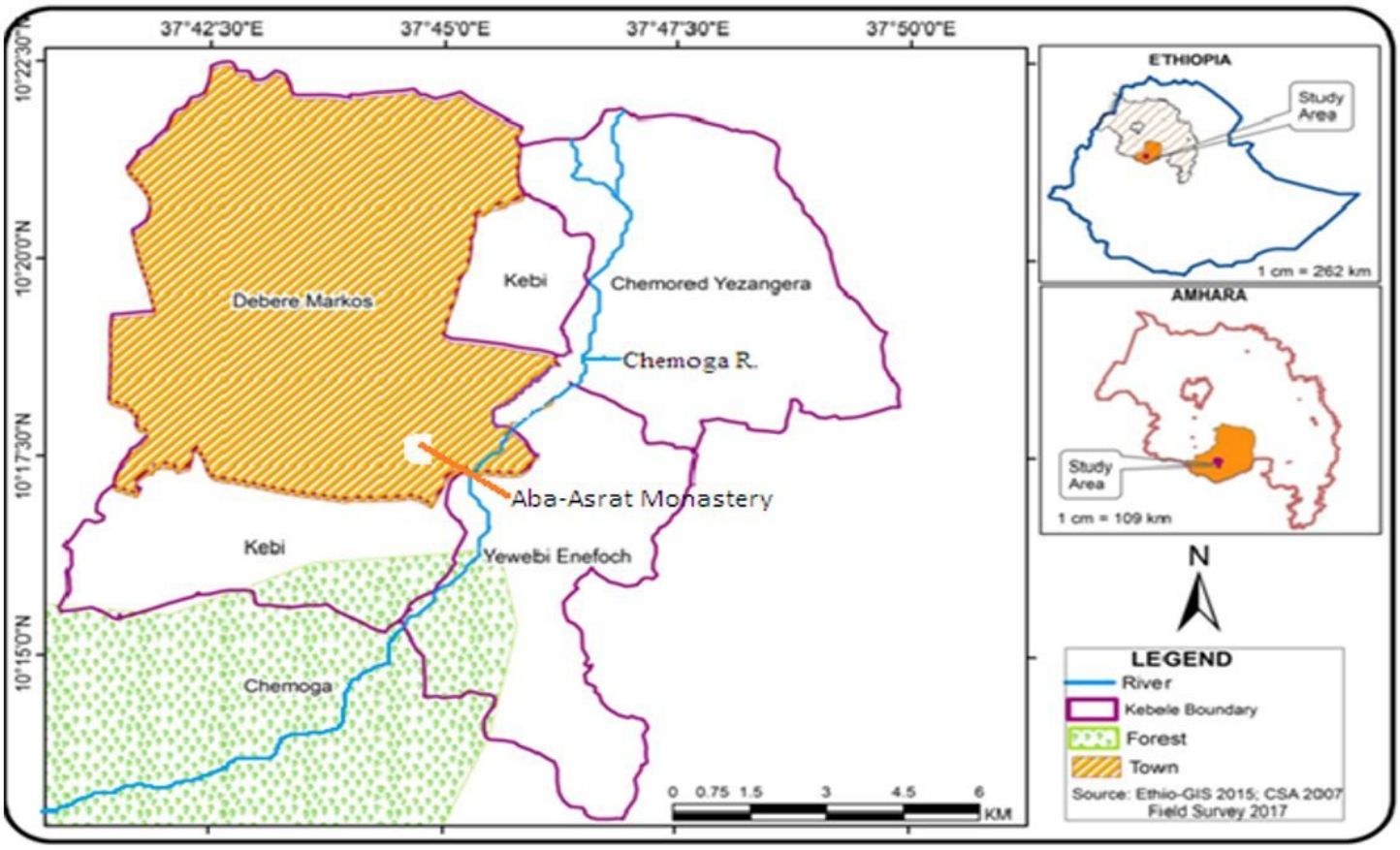

Figure 1

Map of Ethiopia showing the location of the study area.

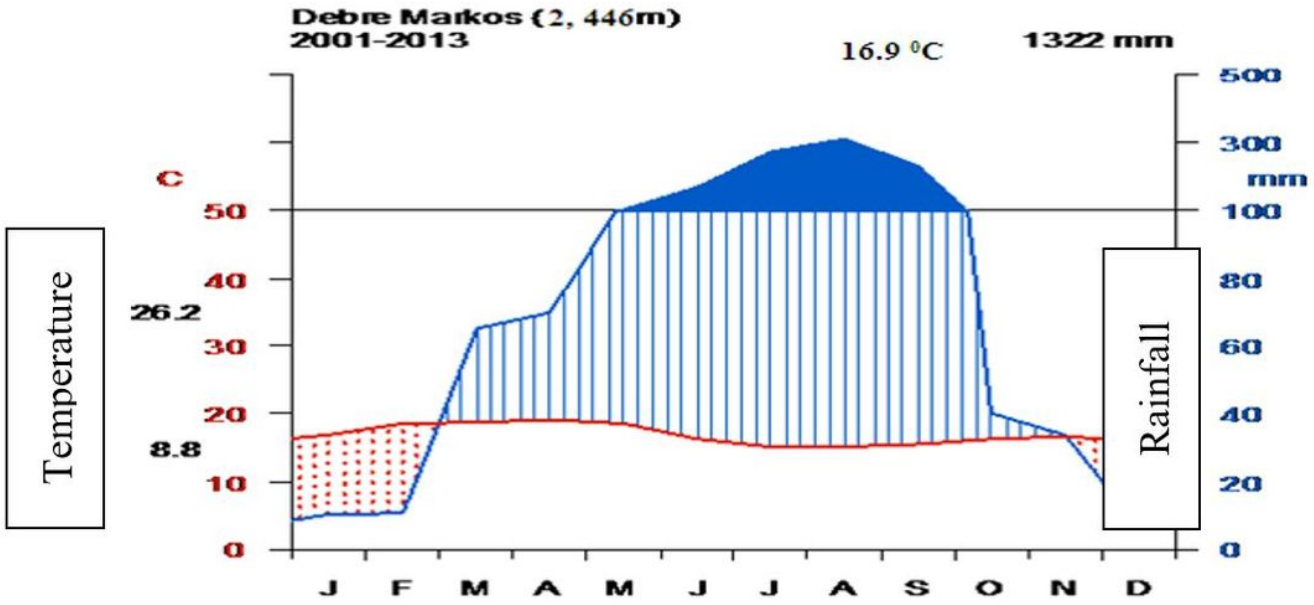

Figure 2

Climadiagram of the study area as recorded at Debre Markos Station [Data source: National Meteorological Service Agency [25].

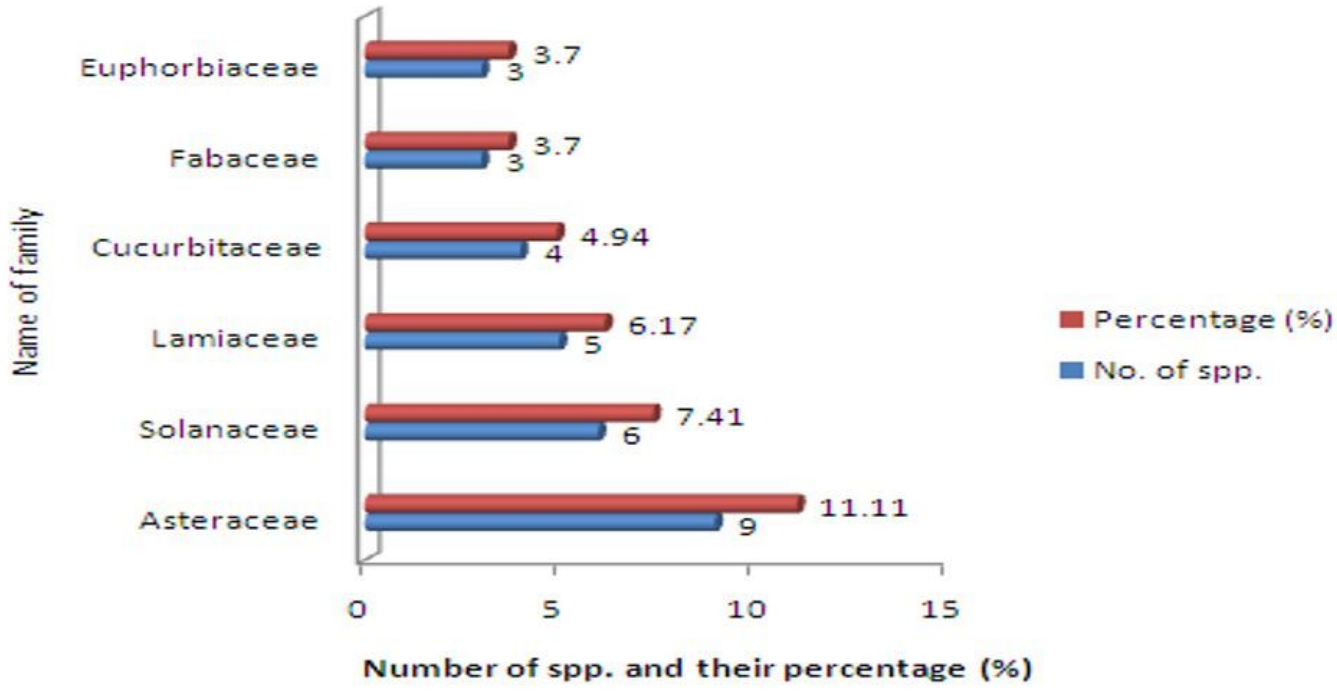

Figure 3

Families represented by highest number of medicinal plant species

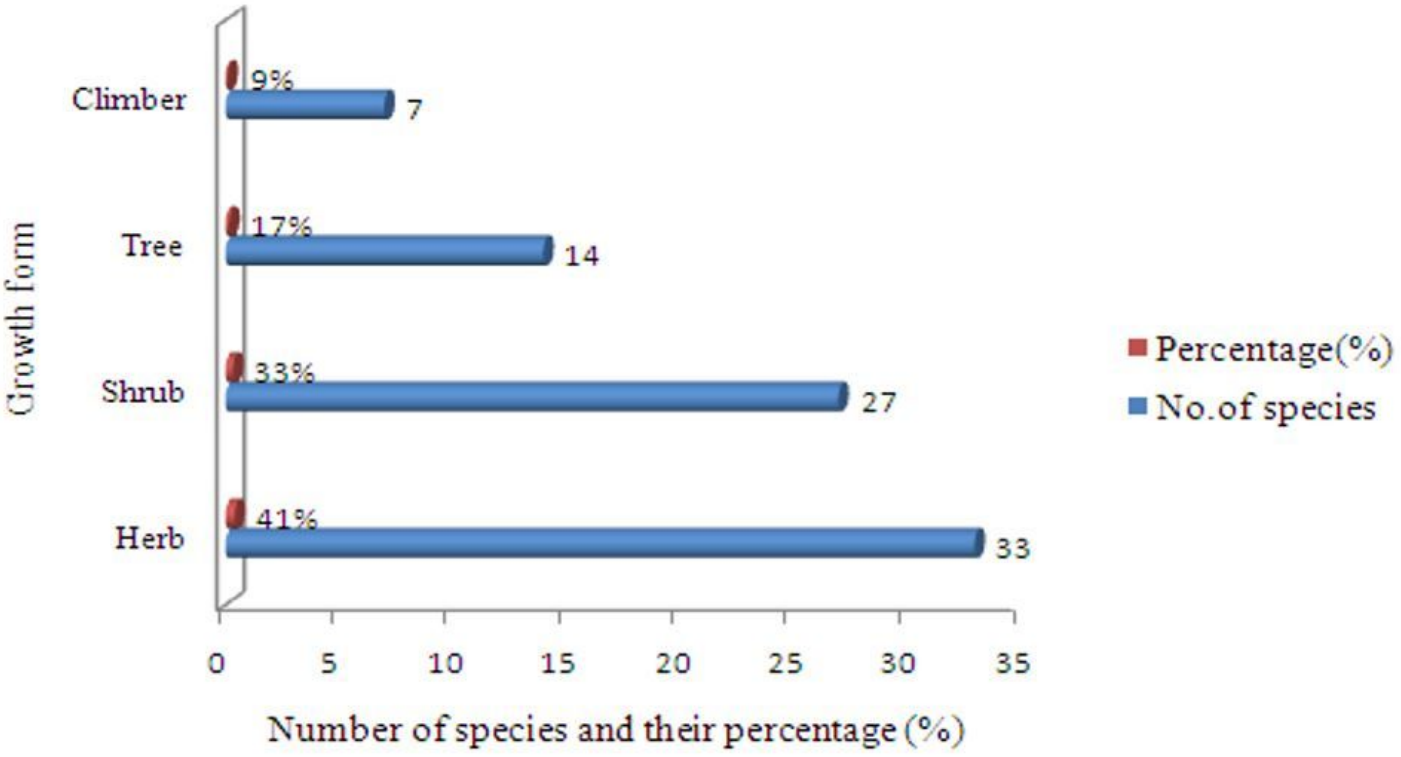

Figure 4

Growth forms of medicinal plants

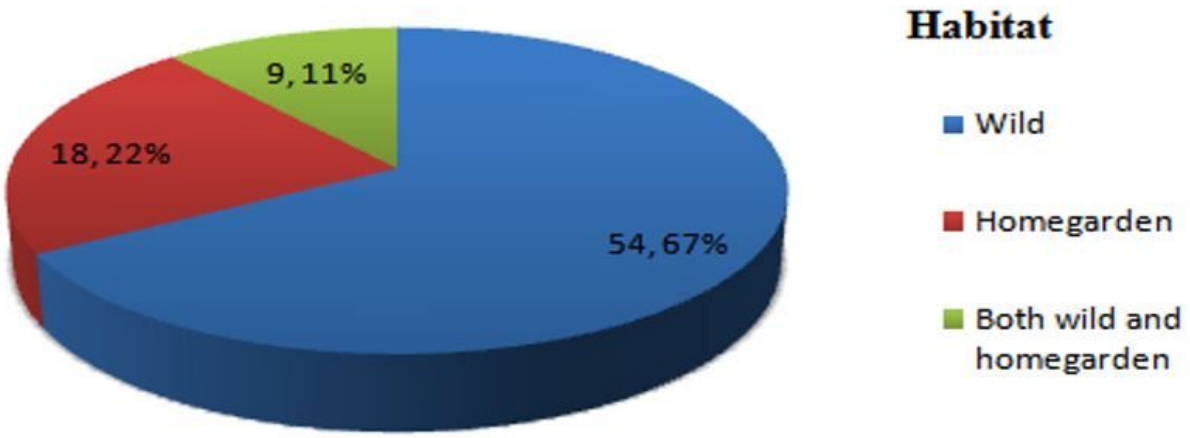

Figure 5

Diversity of medicinal plants in natural habitat and home-garden

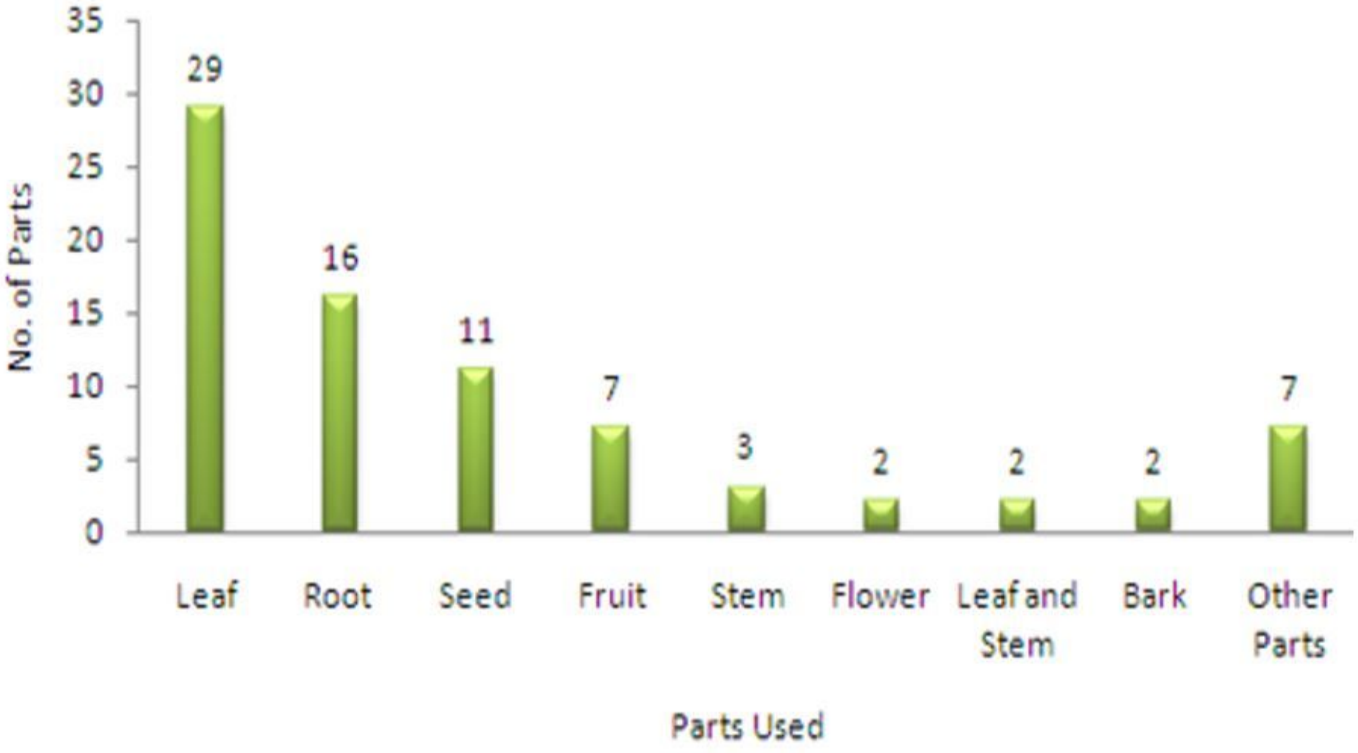

Figure 6

Plant parts used by the community

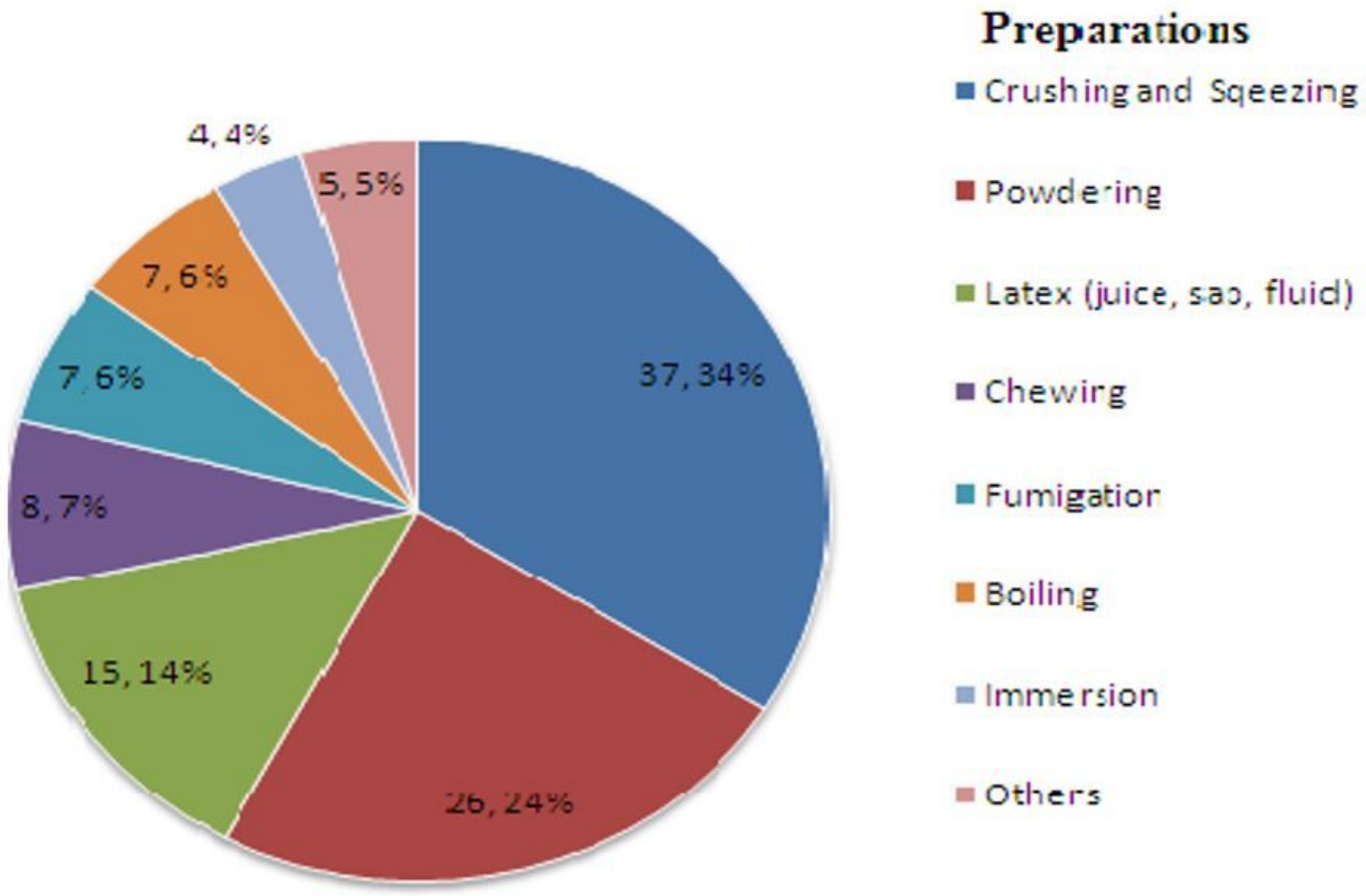

Figure 7

Ways of preparation of traditional medicine in the study area

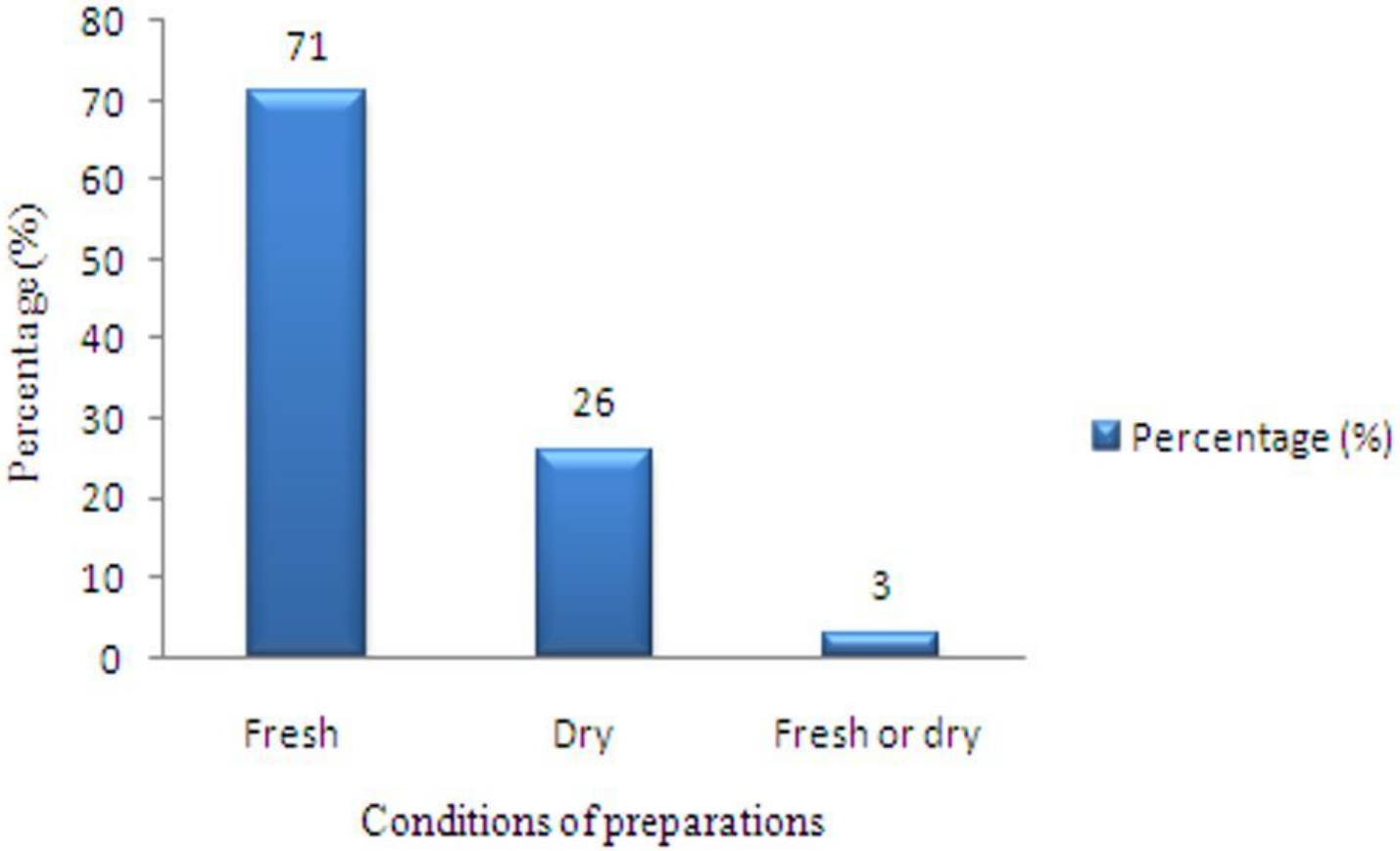

Figure 8

Conditions of preparations of traditional medicine in the study area.

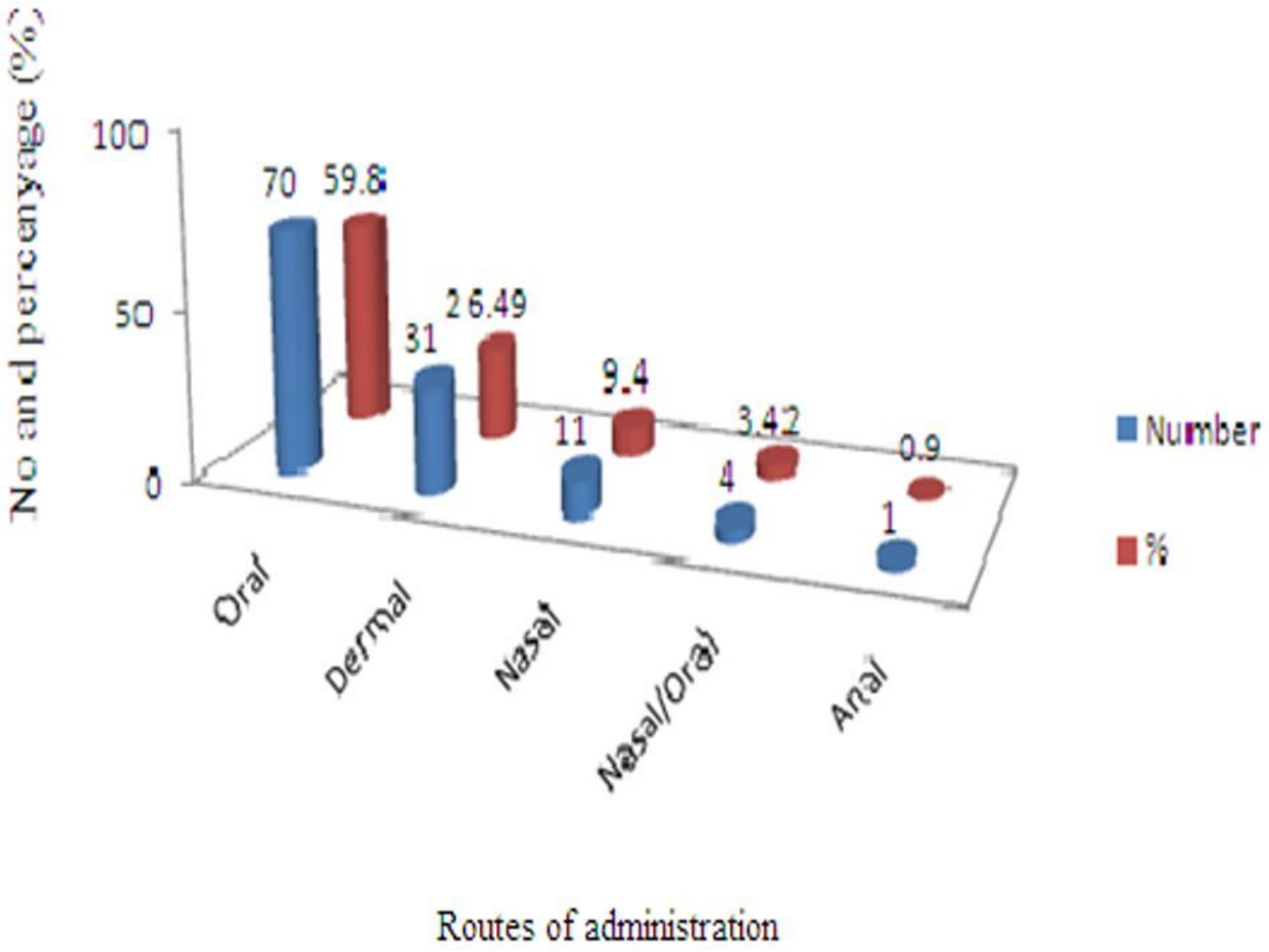

Figure 9

Routes of administrations of some medicinal preparations

Supplementary Files

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- Appendix.docx