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# Ethnobotanical investigation of traditional medicinal plants commercialized in the markets of Dire Dawa city, eastern Ethiopia

**Atinafu Kebede, Shimelis Ayalew, Akalu Mesfin and Getachew Mulualem**

**Abstract**
Dire Dawa city has enormous traditional knowledge and use of medicinal plant species however; the study done to include medicinal plants and indigenous knowledge of the community in Dire Dawa city in the medicinal record of Ethiopia was limited. The aim of the study was to document the indigenous knowledge of medicinal plants. Thirty informants were selected for this study. A total of 50 major considerable medicinal plant species were documented. There was a significant positive correlation ($r = 0.38$, at $\alpha = 0.05$, $p = 0.04$) between the age of informants and the number of species. However, there was highly significant negative correlation ($r = -0.24$, at $\alpha = 0.05$, $p < 0.001$) between the number of species and informants' educational level. The present study provides basic data for future pharmacological and phytochemical studies.

**Keywords:** Human aliments, Traditional medicine, Urban Communities

## 1. Introduction
Ethiopia is endowed with a huge potential of medicinal plants and their uses that provide a wide contribution to the treatment of human and livestock aliments [9, 29, 31, 39]. These wide and vital uses of traditional medicine in the country could be attributed to cultural diversity and acceptability, psychological comfort, economic affordability, and perceived efficacy against certain type of diseases as compared to modern medicines [16, 53]. In Ethiopia, about 80% of the human population and 90% of livestock is said to be dependent on traditional medicine for primary healthcare services and most of this comes from plants [47, 60]. These medicinal plants are estimated to be over 700 species [37] and most of the studies are confined to the southwestern regions of Ethiopia [1].

The loss of valuable medicinal plants due to population pressure, agricultural expansion, deforestation and environmental degradation is widely reported by different researchers in Ethiopia for example, [5] and [27]. On the other hand, loss of traditional knowledge has been aggravated by the expansion of modern education, which has made the younger generation underestimate its traditional values [27]. Migrations from rural areas to towns and resettlement of people from drought-stricken regions to fertile areas have also resulted in the deterioration of traditional practices [4]. Consequently, the need to perform ethno-botanical researches and to document the medicinal plants and the associated indigenous knowledge must be an urgent task [34, 48]. Like other communities in Ethiopia, traditional medication is believed to be important health care systems in Dire Dawa, eastern Ethiopia which mainly involve the use of nearly available medicinal plants. Furthermore, there is a high expectation of enormous traditional knowledge and use of medicinal plant species in Dire Dawa due to the existence of diverse ethnic groups, cultures, languages and beliefs among the people. Nevertheless, no study was done to include medicinal plants and indigenous knowledge of the community in Dire Dawa city in the medicinal record of Ethiopia. Moreover, the traditional medicinal knowledge and associated practices are not documented. This study believed to add up the communities' knowledge in the country's database of traditional knowledge. In addition, the present study represents significant ethnobotanical information on medical plants which provides baseline data for future pharmacological and phytochemical studies. The present study has been afterward initiated with an objective to document the knowledge and practices on use of medicinal plants by people of Dire Dawa City, eastern Ethiopia. This paper, therefore, answers the questions: what kind of medicinal plants are used by the local people to

treat diseases and ailments? Which parts of the plants are used? What types of diseases are common and treated by the plant species? And how do the local people treat various ailments?

## 2. Materials and Methods

### 2.1. Description of the Study Area

Dire Dawa city is located in the eastern part of Ethiopia between $9^0$27'N and $9^0$49'N latitude and $41^0$38`Eand $42^0$19`E longitude, and in the eastern marginal catchment of A wash basin. East Hararge Administrative zone of Oromia Regional State borders it in the south and southeast and Shinele zone of Somalia Regional State in the north, east and west. Dire Dawa city is accessible by air, railway and road, and is about 515kms road distance to the east of Addis Ababa and 311kms to the west of Djibouti port. The urban population was 233,224 men population comprises the majority (50. 2%.). While, female constitute (49.8%) Dire Dawa city has nine urban kebeles. Dire Dawa is characterized by an arid and semi-arid climate with low and erratic rainfall and a mean annual temperature which lies between 17 $^0$C and 27 $^0$C. The Administration enjoys a bi-modal type of rainfall with April as a peak for the small rains and July for the big rains. The rainfall pattern is characterized by small rains in spring, big rains in summer. The mean annual rainfall varies from 410 millimeters to 800 millimeters and above. The average duration of the dry season is 6 to 7 months. However, recently, rainfall pattern has become much more unpredictable with receiving extremely minimum and maximum rainfall per year [3].

### 2.2. Study Site Selection

Reconnaissance survey in the city revealed that there are study sites (kebeles) where a number of fresh and dried herbal plants are sold regularly. The selected study sites (kebeles) were Melka jebdu (01), Sabian (02) and kefira (06). Relatively higher number of herbal sellers and traditional healers resided in the selected kebeles as compared to other kebeles of the city. Kebele is the smallest administrative unit in Ethiopia (Figure 1).

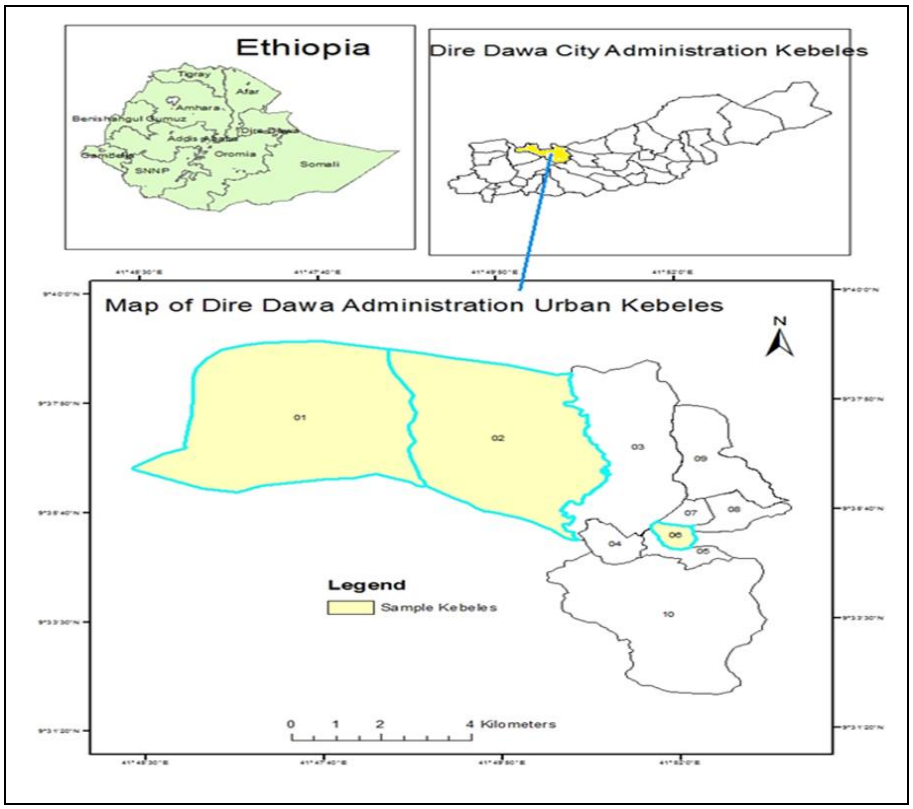


**Fig 1:** Map of study area indicating the selected urban kebeles.

### 2.3. Informants' Selection

Ethnobotanical information was collected from 60 informants (37male and 23 female). Among the 60 informants, 16 key informants (traditional healers) were selected with the assistance of community leaders, elderly people and members of the local community. As pointed out by [40], Purposive sampling technique was used for selecting key informants, while random sampling was employed to select the other 44 informants. The key informant's interviews were very important as they were considered to be experts on local medicinal plants. Generally, the informants were grouped into three age groups, young (20–35), adult (36–50) and elderly (above 50) to see how the knowledge varies with age groups as described in [14].

### 2.4. Ethnobotanical Data Collection and Specimen Identification

Ethnobotanical data collection was made from March to August 2015 from fresh and dried herbal sellers in Dire Dawa markets. Prior to data collection discussion was made with the informants to explain to them their cooperation is a valuable contribution to the documentation of the traditional knowledge in the study area and to get their verbal informed consent. Semi-structured interview (was conducted in local language (s), Afan oromo and/or Somali) with the help of interpreter, group discussion (average members of 8 per group), and field observation were employed to collect basic information on the local name(s) and traditional description of the medicinal plant species, diseases

treated, parts used, method of preparations and routes of administration. Moreover, guided field walks with key informants were employed to collect specimens of medicinal plant species from their natural habitats. Identification of common and well known species were made using the published volumes of the Flora of Ethiopia and Eritrea while for unknown plant specimens identification was made by the help of experts in the National Herbarium, Addis Ababa University.

### 2.5. Data Analyses

Descriptive statistics using frequencies and percentages were used to summarize data using Microsoft excel 2013. The MS Excel Spreadsheet was also utilized for drawing bar graphs. Preference ranking was computed according to [40]. Informant consensus factor (ICF) values were calculated following [35], to evaluate the consistency of the information provided by the informants.

$$ICF = \frac{Nur - Nt}{(Nur - 1)}$$

Where,

Nur: Number of use-reports for a particular use category

Nt: Number of taxa used for a particular use category by all informants

The Pearson Correlation Test was calculated using SPSS 17.0.1 software package and employed to evaluate whether there was significant ($p < 0.05$) correlation between i) the age of the traditional healers' and the number of medicinal plant species reported, and ii) the educational level of traditional healers' and the number of medicinal plant species reported. The informants who cannot read and write were considered as illiterate while, those respondents attended formal education were considered educated.

Jaccard's similarity coefficient was estimated for comparing medicinal plant species composition of the study area with five randomly selected studies areas. Jaccard's similarity coefficient (JSC) was calculated for comparing medicinal plant species composition as recommended by [38]. The formula JSC =c/(c+a +b), where, a= number of medicinal plants present in markets of the study area and absent in the corresponding study site, b=number of medicinal plants absent in the study area and present in the corresponding study site, c = number of medicinal plants common in the study area and the corresponding study site.

The Fidelity Level (FL) index was calculated based on the formula recommended by [21] which is used to quantify the importance of a given species for a particular purpose in a given cultural group or to determine the most preferred plants for a treatment of a particular disease and calculated as:

$$\mathbf{FL} = \frac{\mathbf{Np}}{\mathbf{N}} \times \mathbf{100}$$

Where,

Np: Number of use-reports cited for a given species for a particular ailment

N: Total number of use-reports cited for any given species

## 3. Results and Discussions

### 3.1. Characteristics of Respondents

A total of 30 traditional healers (18 males and 12 female) from the age of 25 to 87 years were sampled. The respondents were with an average age of 48 years. Males were dominant representing (63.3 %) of the respondents. Generally, (60 %) of the respondents were above 50 years (Figure 2). The majority (67%) of them was illiterate and those who attended grades one to four constituted (16%) while (17%) attended grades nine to twelve. There was a significant positive correlation (Pearson correlation coefficient, r =0.38, at α = 0.05, $p$ = 0.04) between the age of informants and the number of species reported by the informants (older respondents reported large number of species).This might be due to exposure to modern education younger people showed minimal interest in learning and practicing ethnomedicinal practices. According to [11], less medicinal knowledge in relation to young age might be attributed to the fact that traditional knowledge is built with years of experience. Advancement in science and technology is quickly pushing the younger generation into a new tradition [46]. Differences in medicinal plants knowledge among age

Groups was also reported in other studies [10, 19, 24, 51, 54, 57, 61, 62, 63]. However, there was highly

Significant negative correlation (r = -0.24, at α = 0.05, $p$ < 0.001) between the number of species reported and informants' educational level (illiterates reported large number of species). Similarly, [41] reported a highly significant negative correlation (r = -0.34, $p$ < 0.001) between the number of medicinal plant species reported and the education level of informants.

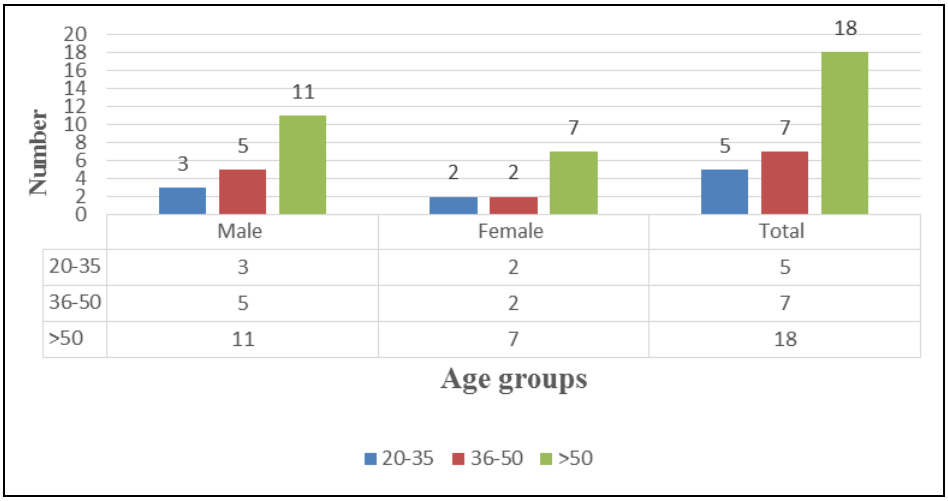


**Fig 2:** Characteristics of respondents

### 3.2. Medicinal Plants Reported

A total of 50 plant species distributed among 50 genera and 35 families were documented as traditional medicines against human ailments (Figure 3). *Lamiaceae* had a relatively high number of species (5), followed by *Fabaceae* (4), *Euphorbiaceae* (3), *Apiaceae*, *Brassicaceae*, *Myrsinaceae*, *Myrtaceae*, *Rutaceae* and *Solanaceae* each with 2 species and the rest 26 families had (1) species each. This result is in line with the study reported by [8] and [20] indicated that family *Lamiaceae* was classified as the highest species in their study areas. The preference of *Lamiaceae* family by the traditional healers may be related to their availability, wide range of distribution even in disturbed areas and potential biological properties in their secondary metabolites [20]. Generally, the presence of diverse families indicate that the area surrounding Dire Dawa city consisted of considerable diversity of plant species as much of the medicinal plants are collected from the local suppliers. These plant families are consistently recorded in different ethnomedicinal inventories [32, 50, 56, 58, 60, 56], which could be attributed to their wider distribution and abundance [18] and rich bioactive ingredient contents [22]. Out of the total species reported in the present study, 7 were reported by [14], 6 species were reported by [60], 8 were reported by [43] and 13 species of medicinal plants were reported by [15]. Most of the medicinal plants are widely sold not only for medicinal purposes but also for other different uses such as food and spices. The largest proportion (60%) of marketable medicinal plant species was sold only for medicinal purpose. But only twenty, of which 45% belong to spices, of the total identified commercialized medicinal plants were sold for both food and medicinal purpose.

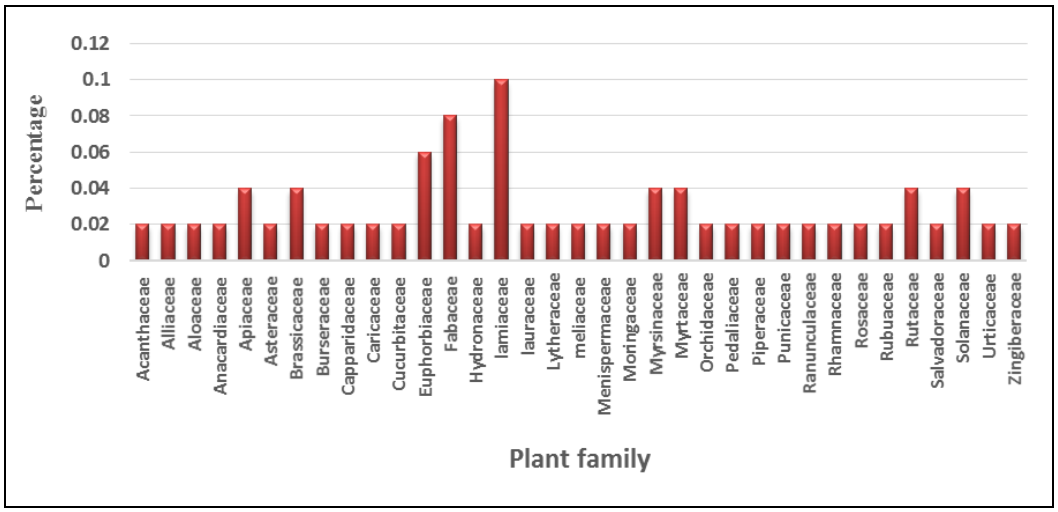


**Fig 3:** Percentage of family of medicinal plants

### 3.3. Growth Habit of the Medicinal Plant

Of the total 50 medicinal plants collected from the study area, 30 species (60 %) were herbs followed by 15 species (30 %) shrubs and 5 species (10%) trees (Figure 4). The highest proportion of growth habit was covered by herbs. This can be related to the floristic composition of vegetation, which is dominated by bush land and scrubland vegetation types around the city administration. According to [3] noted that, more than half of the Zay plant remedies were obtained from herbs because; it takes much time and effort to harvest medicinal trees. However, it is a fact in the country that woody plants (forest and wood land species) are declining and most of the easily available plants become the herbs. Similar patterns were reported by some medicinal plant studies [2, 13, 23, 30, 41, 44, 45, 52, 54] where herbs constituted the largest number for medicinal purpose.

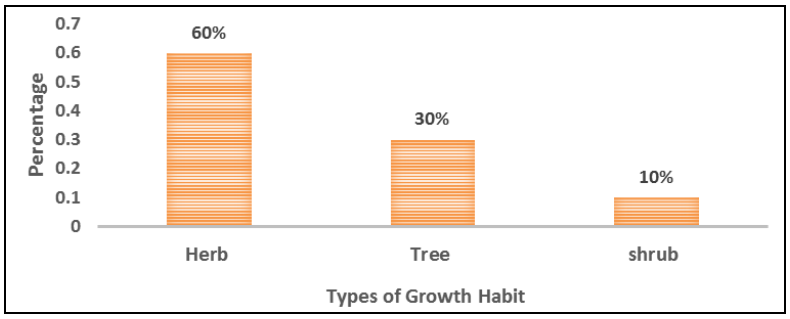


**Fig 4:** Percentage of medicinal plants on the basis of their habits

### 3.4. Habitat of Medicinal Plants

Twenty three (46%) species of the medicinal plants sold on the market were obtained from the wild vegetation followed by 15 (30%) of medicinal species from cultivated areas (Figure 5). This result is in line with other studies [7, 26, 28, 42, 59, 60] conducted in Ethiopia as well as in other countries [54, 55] of the world. The fact that the majority of medicinal plants collected from the wild could be attributed to the need to maintain secrecy of traditional knowledge and the argument that cultivated medicinal plants are less potent compared to plants collected from the wild [54].

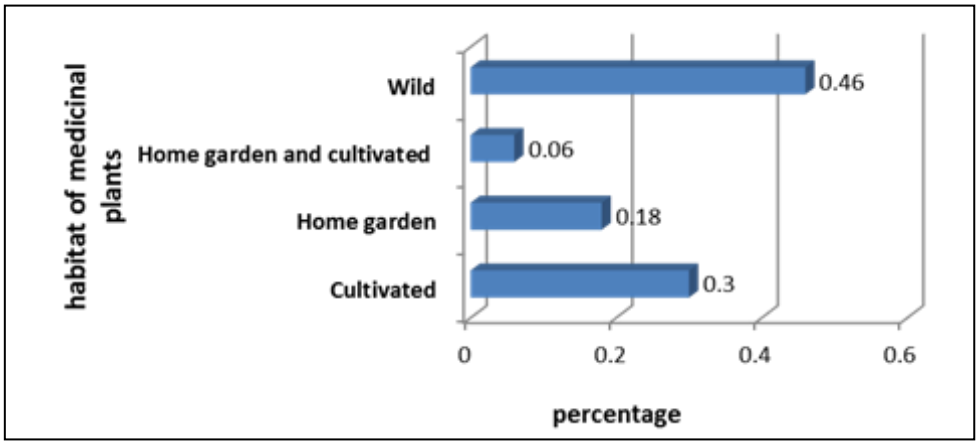


**Fig 5:** Types of habitat of medicinal plants.

### 3.5. Administration Route of Medicinal Plants.

Different routes were used in administration of herbal preparations. The major routs of administration in the study area are oral, dermal, smoke bath, auricular, tooth surface and optical (Figure 6). Oral route contributed (66%) of the total species, followed by dermal (16%), smoke bath (9%), tooth surface (4%), optical (3%). The least used route of herbal administration were nasal and auricular which are (1%) each. As mentioned by several studies like [7, 17, 29, 30,36] oral administration was the dominant route of remedy administration, which constituted 79%, 52%, 72%, 63%, 57.1%, and 54.21%, respectively. Similar pattern of administration were reported by some medicinal plant studies in other countries for instance [54].

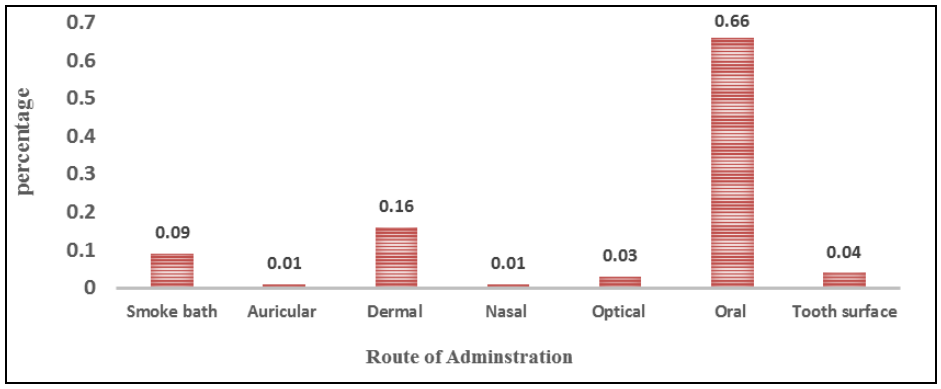


**Fig 6:** Administration route of Medicinal plants

### 3.6. Plant Parts Used for Medicine

According to the ethnobotanical data result; leaves are the most commonly used plant parts accounting for 29% of the total, followed by seed (23%) roots (16%) and stem (13%). Use of other plant parts is as indicated in (Figure 7). In agreement with this study, other studies conducted in different parts of Ethiopia indicated that leaves being used more than the other parts of the plant [28, 33, 41, 42, 60]. Studies by [46, 54] had also reported similar findings. Utilization of leaves for drug preparation is important for conservation of medicinal plants since harvesting leaves may not cause detrimental effect on the plants compared to the root or whole plant collections [6, 29, 41, 42, 49].

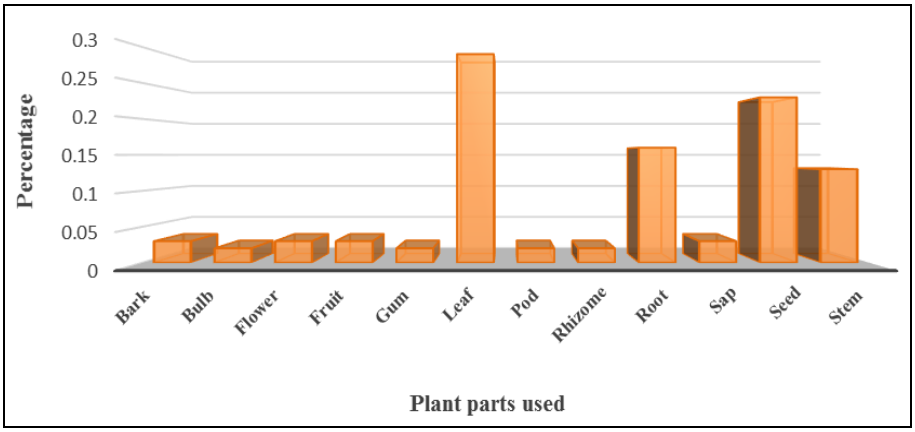


**Fig 7:** Percentage of plant parts used in traditional medicines

### 3.7 Preparation of Medicines

Local communities employ several methods of preparation of plant material for medicinal use including by crushing, squeezing and concocting, smoking, infusion, decoction, powdering, and chewing (Figure 8). Out of the total preparations (21%) are prepared in the form of crushing, followed by infusion (18%) and squeezing (17%). This agrees with the results of studies carried out by [2, 49, 42] they found that the main mode of preparation is crushing, accounting for 26.2%, 29% and 28.2%, respectively.

Most of the remedies are prepared from a single species, mixtures are used rarely. In addition, different plant parts from a single species are prepared in different ways and used to treat the same type of aliment. For example, the fresh leaf and root of *Urtica sinesis* are concocted together and taken orally to treat impotence in men; the root and seed of *Moringa stenopetala* are concocted together and taken oral to treat swollen body part (commonly known as GOFLA by the local community. A number of sources [14, 32, 36] reported similar results stating that a single medicinal plant species was used more frequently for remedy preparations, and that mixtures were used rarely in their respective study sites. With regard to the measurement of the dose of medicinal plants, there is no standardized measurement of herbal remedies in the study area. This indicates that there were variations in the unit of measurement. Studies by [4, 25, 29] reported that lack of accuracy in the unit of measurement and lack of agreement among the informants on the doses of certain remedies prescribed are some of the drawbacks in traditional health care system.

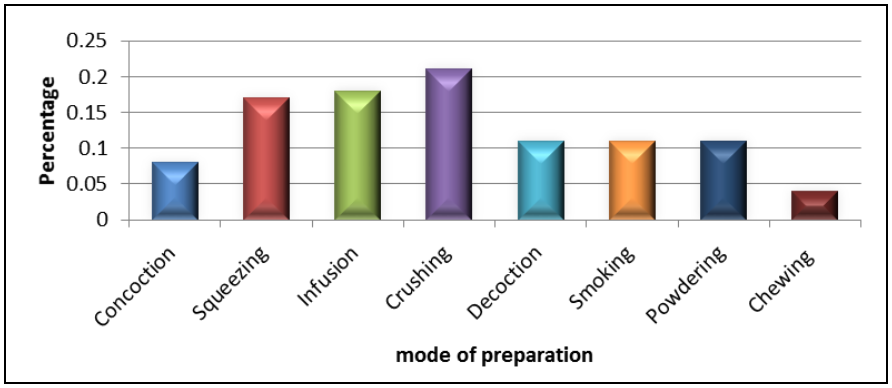


**Fig 8:** Percentage of method of preparation of traditional medicinal plant remedies

### 3.8. Informant Consensus Factor (ICF)

ICF for different ailment categories was calculated to test for homogeneity or consistency of informants' knowledge about a particular remedy for an ailment category. Fic indicated which plants are widely used and thus merit further pharmacological and phytochemical studies. In this study ailments with a relatively high ICF value were gastrointestinal disorders, nerve system disorders, respiratory tract infection and swollen body part/GOFLA that had ICF values of 0.62, 0.61, 0.53, and 0.50, respectively (Table 2). The important medicinal plants used for the treatment of gastrointestinal disorders such as abdominal pain were *Aloe megalacantha*, *Jatropha curcas*, *Commiphora myrrha, and Cissampelos mucronata* while those for expulsion of tape worm were *Embelia schimperi*, *Hagenia abyssinica* and those for constipation included *Carica papaya*, *Tamarindus indica and Sesamum orientale.*

This will attract pharmacologists for further pharmacological investigation of the traditional plant species. Eight ailment categories had ICF of zero (0) since each respondent reported a different species used for the same ailment (Table 2).The most common health problems of the urban communities are gastrointestinal problems, the possible reason behind such ailments might be due to water pollution and lack of proper sanitation. These findings are similar to an ethnobotanical study conducted in the other parts of Ethiopia, where species are locally used for related medicinal purposes [14, 20, 30]. Similarly, gastrointestinal health problems were reported by some medicinal plant studies in other countries [8, 46].

**Table 2:** Informant consensus factor of medicinal plants by aliment categories.

| Aliment category | No of species | No of use citations | ICF (%) |
|---|---|---|---|
| Gastrointestinal disorders ( parasites, abdominal pain) | 17 | 44 | 62.7 |
| Nerve system disorders (paralysis, evil eye, demonic work) | 8 | 19 | 61.1 |
| Swollen body part (GOFLA, BOIL) | 2 | 3 | 50 |
| Respiratory tract infection (common cold, TB and cough) | 7 | 13 | 50 |
| Skin infections and wound | 6 | 10 | 44.4 |
| Organs disease (liver, kidney, heart, eye, teeth, ear) | 13 | 18 | 29.4 |
| Anemia | 1 | 1 | 0 |
| Erectile dysfunction& Impotence | 1 | 1 | 0 |
| Gynaecological issues | 2 | 2 | 0 |
| Head ache fatigue (Migraine) | 1 | 1 | 0 |
| Diabetes | 3 | 3 | 0 |
| Hypertenstion | 1 | 1 | 0 |
| Sudden Illness (DINGETEGNA) | 2 | 2 | 0 |
| Fibrile illness (MICH) | 2 | 2 | 0 |

### 3.9. Jaccard's Coefficient of Similarity

A considerable number of medicinal plants identified in the present study were reported as remedies in other studies conducted in different parts of the country. Higher values of Jaccard`s similarity coefficient (JCS) indicates a higher similarity in medicinal plant species composition between the paired study areas. JCS comparison of medicinal plants revealed that the current study area has the highest similarity coefficient JCS (0.12) with the study area from Shinile district, followed by JCS (0.11) from Harla and Dengego valley (Table 6). The considerable similarity between the current study area and these two study areas could be because they are located in close proximity with Dire Dawa city. JCS is a statistic used for comparing the similarity and diversity between two habitats; factors such as variation in climatic conditions, sample size, topographic features and type of flora may influence the value of JCS [41].

**Table 4:** Similarity in medicinal plant composition of the current study with previous works

| Sample study area | JCS | Source |
|---|---|---|
| Shinile district, East Shinile zone | 0.12 | Mesfin *et al*., (2012) |
| Harla and Dengego valley, Dire Dawa Adminstration | 0.11 | Belayneh and Bussa, (2014) |
| Erer valley, Babile woreda East Harerge | 0.07 | Belayneh *et al*., (2012) |
| Sokoru district, Jimma zone | 0.08 | Yineger and Yewhalaw, (2007) |

### 3.10. Fidelity Level Index

Fidelity level index shows the proportion in percentage of informants claiming the use of a plant species for the same major ailment to the total number of informants who mention the plant for any use.

$$FL = \left({}^{Ip}/_{Iu}\right) X100$$

Where,

Ip = Number of informants who suggested the use of a species for the same major purpose (therapeutic use),

Iu = Total number of informants who mentioned the plant species for any use.

Table 3 shows high fidelity levels of greater than 50 % for eleven plants species which highlights the importance of these species in the treatment of the mentioned diseases in the study area. *Commiphora myrrha*, *Tamarindus indica*, *Azadirachta indica* had a fidelity level of 100 % in the treatment of abdominal pain, constipation and diabetes, respectively. High FL levels for these species indicated their outstanding preference for treating the corresponding aliments.

**Table 3:** Fidelity level index on medicinal plants to treat some specific human aliments

| Human disease | Species | Fidelity level |
|---|---|---|
| Abdominal pain | *Aloe megalacantha* | 76.7 |
| | *Jatropha curcas* | 49 |
| | *Commiphora myrrha* | 100 |
| | *Cissampelos mucronata* | 43.6 |
| Tape worm | *Embelia schimperi* | 74.3 |
| | *Hagenia abyssinica* | 92.6 |
| Constipation | *Carica papaya* | 73.2 |
| | *Tamarindus indica* | 100 |
| | *Sesamum orientale.* | 44.5 |
| Kidney problem | *Thymus serullatus* | 46.7 |
| | *Rosmarinus officinalis* | 49 |
| | *Foeniculum vulgare* | 89.9 |
| | *Citrus aurantiifolia* | 53.6 |
| | *Withania somnifera* | 45.8 |
| Diabetes | *Cinnamomumverum* | 34.3 |
| | *Azadirachta indica* | 100 |
| | *Aloe megalacantha* | 49.3 |
| Tooth ache | *Brassica carinata* | 55.6 |
| | *Datura stramonium* | 48.3 |
| Swollen body part/GOFLA | *Hydnora johannis* | 96.5 |
| | *Moringa stenopetala* | 43.6 |
| | *Withania somnifera* | 46.7 |

## 4. Conclusion

The results of the present study provide evidence that medicinal plants continue to play an important role in the healthcare system of this urban community. They still continue to depend on medicinal plants for the treatment of healthcare problems. The data collected show that majority of the remedies are taken orally. Generally, the present paper represents significant ethnobotanical information on medical plants which provides baseline data for future pharmacological and phytochemical studies.

## 5. Acknowledgements

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