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E J E D

# ETHNOBOTANICAL STUDY OF MEDICINAL PLANTS IN ALE SPECIAL DISTRICT, SOUTHERN ETHIOPIA

**Orkaido Geta**[1], **Abreham Assefa**[*1], **and Tamru Demsis**[1]

[1] *Department of Biology, College of Natural and Computational Sciences, Dilla University*
[*] *Corresponding author; E-Mail: abrehamas@du.edu.et*

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## Abstract

*An Ethno-botanical study was carried out to investigate the type, associated knowledge and practices of medicinal plants used by the local people in Ale Special District, SNNPR, Ethiopia. Ninety informants were selected by preferential sampling technique. Ethnobotanical data about traditional medicinal plant names and associated knowledge such as use, remedy preparation, administration, and others were collected using semi-structured interview, field observation, and focus group discussion. Informant consensus, preference ranking, direct matrix ranking, informant consensus factor and fidelity level were computed. A total of 72 medicinal plant species belonging to 68 genera and 39 families were documented. Among the plant families, Lamiaceae was found to be the richest plant family with 11 species followed by Asteraceae (5 species). From medicinal plants recorded in the study area 80.56% were used only to treat human ailments, 8.33% were used only to treat livestock ailments, and 11.11% were used to treat both human and livestock ailments. Regarding plant habits, herbs accounted for 51.39% followed by shrubs for 20.83%, trees accounted for 19.44%, and climbers accounted for 8.33%. The most frequently utilized medicinal plant part was leaf. The most widely used method of preparation was crushing followed by chopping, and powdering. The common route of administration was oral followed by dermal application. From the plants in the study area, Plumbago zeylanica, Cucumis ficifolius and Hypoestes forskaolii are popular in the area and some medicinal plants are more effective in curing ailments like snake bite and malaria (ICF=0.93). Agricultural expansion, over grazing, over harvesting of plants for different household utensils and other human induced problems were the major threats of natural habitat in general and medicinal plants in particular. The area is known for its diverse medicinal plant utilized for curing various ailments in the study area. There was little practice of medicinal plants conservation in the area. The local government and other concerned groups shall give emphasis on the conservation of medicinal plants used for treating various types of human and livestock ailments in the area.*

**Keywords**: Ale Special District, Ethnobotany, Indigenous knowledge, Medicinal plants

## 1 Introduction

Plants provide various benefits for peoples including food, shelter, clothing, cosmetics, dyes, and medicine. People categorize plants based on their growth form or plant habit, value or use they provide for the people, location, *etc.* (Cotton, 1996). Traditional medicines are used to explain the traditional practice that has been in existence, even before the advancement of modern medicine (Getachew Addis

*et al*., 2002). It is widely used in among societies for prevention and treatment of physical and mental disorders (Tesfaye Awas and Sebsebe Demissew, 2009). It is reported that more than 3.5 billion people in the developing countries depend on traditional medicines of plants for the treatment of both human and livestock diseases (FAO, 1997). 70 to 80% of people in Africa consult traditional practitioners for their health care. According to Cotton (1996), over centuries, indigenous people have developed their own locality specific knowledge on plant use, management, and conservation. Conservation of ethnobotanical knowledge as part of living cultural knowledge and practices between communities and the environment is essential for biodiversity conservation (Martin, 1995; Balick and Cox, 1996).

In Ethiopia, though there were some ethnomedicinal studies carried out by various scholars, there is limited development of therapeutic products. Knowledge about the use of plants is transferred for one generation to another (Fiseha Mesfin *et al*., 2014). In most places of the country, knowledge on medicinal plant's use has been passed verbally from one generation to the next through traditional healers (Haile Yineger and Delenasaw Yewhalaw, 2007; Tesfaye Awas and Sebsebe Demissew, 2009; Gidey Yirga, 2010a; Gidey Yirga, 2010b; Fiseha Mesfin *et al*., 2014). In this course of knowledge transfer, valuable information can be lost whenever a traditional medical practitioner or healer passes away without transferring his/her traditional medicinal plant knowledge and its practice to others.

Indigenous knowledge on usage of medicinal plants as folk remedies are getting lost owing to migration from rural to urban areas, industrialization, rapid loss of natural habitats and changes in life style (Gidey Yirga, 2010c). Population pressure, environmental degradation, agricultural expansion, loss of forests and woodlands, overharvesting, fire, cultivation of marginal lands, overgrazing and urbanization appeared to be the major threats to the medicinal plants in the country (Abebe Demissie, 2001). Endemic medicinal species restricted to Ethiopia are of primary concern to Ethiopia and to the world as well and thus need serious attention (Endashaw Bekele, 2007).

Even though the country has high potential of traditional plants and associated indigenous knowledge, the effort to use this available resource and knowledge scientifically is less. The knowledge and technical skills regarding preparation of remedies from traditional medicinal plants are fragile and may easily be forgotten as most of the medicinal plants are kept secret (Gidey Yirga, 2010a). Documentation of medicinal and other ethno-botanical uses of medicinal plants in the country is an urgent task to rescue the rapid loss of the natural habitat of these plants and the knowledge and practice of medicinal plants use. Thus, this study was conducted with the aim of investigating medicinal plants used by the Ale people for the treatment of various ailments and documenting the indigenous knowledge of the community on use and conservation of various medicinal plants in Ale District.

## 2 Material and Methods

### 2.1 Description of the Study Area

Ale Special District is situated between of 05°20′ - 05°4′ N latitude and 37°00′ - 37°25′ E longitude (Figure 1). The Special District was one of the five former Districts of the Segen Area People's Zone in SNNPRS. Kolango was the administrative town of the Special District which is located at a distance of 645 *km* south of Addis Ababa.

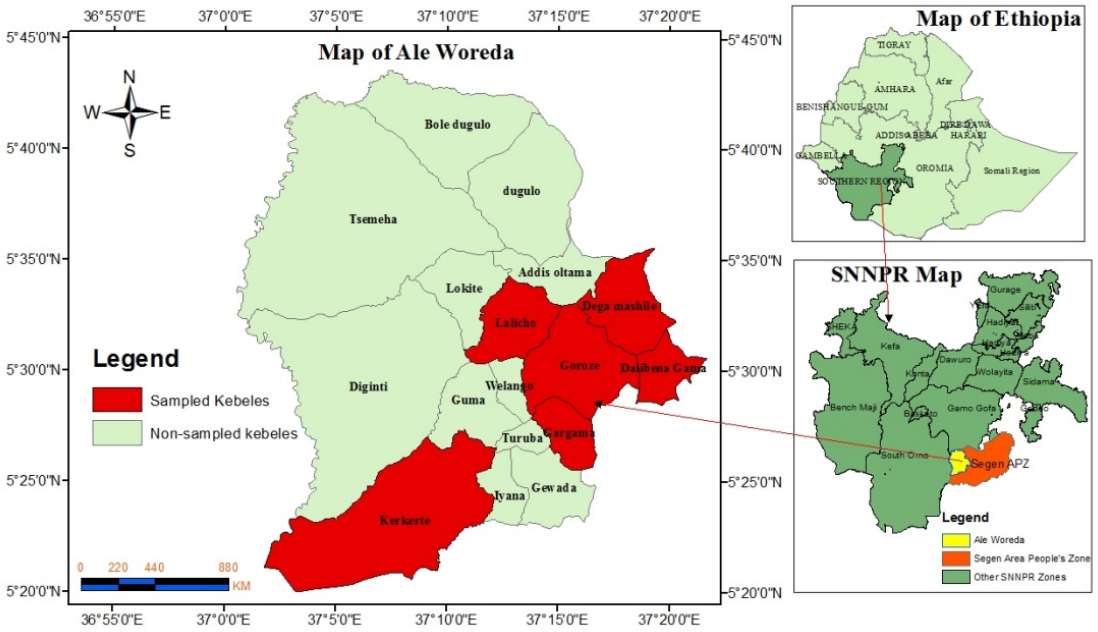


**Figure 1** Map of the Study Area

Elevation of the study area ranges from 500 meter above sea level (*masl*.) at '*Datane*' to 2800 *masl*. at '*Tosho*'. Based on the data obtained from National Meteorology Agency (2020), the monthly mean temperature of the study area was at the range of 16 $^{\circ}C$ to 26.8 $^{\circ}C$, whereas the mean annual rainfall of the area was 860 *mm*. and had a bimodal rainfall pattern. From the total 1039 $km^2$ area of the District, 35.2% was characterized by arid ('*kola*') agroecology, 47.2% was characterized by sub-humid ('*woina-dega*'), 17.6% of the area of the Special District was characterized by humid ('*dega*') agroecology (AWOFED, 2020).

## 2.2 Research Methods

### Data Collection Sites and Informants Selection

Six *kebeles* were randomly selected from the 17 *kebeles*of Ale Special District. Traditional healers in these six *kebeles* were considered as target population. Yamane's formula of sample size determination (Yamane, 1967) was used to determine the sample for this study at 95% confidence level (*Equation 1*). At 95% confidence coefficient, the degree of variability was 0.5 with the level of precision or sampling error of 5%.

$$n = \frac{N}{(1+Ne^2)} \tag{1}$$

Where,
$n$ is the required sample size; $N$ is the traditional healers in the selected six *kebeles*; and $e$ is the level of precision, which is 0.05.

$$\text{Thus, } n = \frac{N}{(1+Ne^2)}$$

$$n = \frac{116}{(1+116^*.05^2)} = \frac{116}{1.29} = 90$$

90 traditional healers (hereafter, named as informants) whose age was over 20 years were used as samples from the 116 traditional healers existing in the selected six *kebeles*. Proportional sample of informants from each sampled *kebele* was taken purposively based on experience on the medicinal plants usage and practice of treating ailments. The sampled *kebeles*, their respective elevation, and proportional sample size is given in Table 1. Moreover, 12 informants (2 from each *kebele*) were taken for the Focus Group Discussion (FGD), where one of the two informants selected in each *kebele* was participated in FGD only.

**Table 1** Sampled *kebeles* for data collection and their proportional sample size

| **Sampled *Kebeles*** | **Elevation range** (in $masl.$) | **Number of traditional healers** | **Proportional Sample Size** |
|---|---|---|---|
| *Dega-Mashille* | 2000 – 2800 | 12 | 9 |
| *Delbena-Gama* | 1600 – 1900 | 22 | 17 |
| *Gargama* | 1700 – 1800 | 19 | 15 |
| *Goroze* | 1650 – 2100 | 21 | 16 |
| *Lalicho* | 1900 – 2300 | 16 | 13 |
| *Qerqerte* | 500 – 1500 | 26 | 20 |
| **Total** | | 116 | 90 |

## 2.3 Data Collection and Analysis

### Types of Data Collected and Method of Collection

In the study area, relevant primary data regarding the medicinal plants used to treat human and livestock ailments and the associated knowledge such as plant parts used, plant habits or growth forms, remedy preparation methods, route of administration of remedies, dosage, disease treated, threat to medicinal plants, and conservation practice were gathered. Semi-structured questionnaire and FGD guide were developed and utilized for data collection. Moreover, guided field observation was taken place as a means of data collection methods. Medicinal plants mentioned by the local healers were observed and recorded.

Voucher specimens were collected pressed, dried, and taken to the National Herbarium (ETH) for taxonomic characterization and identification. Plant identification was made using published volumes of Flora of Ethiopia and Eritrea and comparing with the existing plant specimens in the Herbarium.

### Preference Ranking

Preference ranking, one of the techniques used for ethno-botanical and ethno-medicinal studies data collection (Martin, 1995) was applied in this study during the FGD. During the preference ranking exercise, five medicinal plants that were reported in the study area for their potential to cure tonsillitis (the most frequently reported ailment in the study area) were ranked by ten randomly selected members of FGD participants using the scale of 1 (least preferred) to 5 (most preferred).

The medicinal plants that were used for preference ranking were *Acmella caulirhiza*, *Crabbea velutina*, *Encostema axillare*, *Plumbago zeylanca*, and *Rhaminus prinoides*. Each informant was undertaken the ranking independent of the other informants.

The overall ranking of the medicinal plants presented for this particular ranking exercise was then made by taking the sum of all rank values given for each medicinal plant. Similarly, ranking was done in a similar manner for threats to the existing medicinal plants in the study area.

### Direct Matrix Ranking

Direct matrix ranking was undertaken to compare medicinal plants commonly reported for their multipurpose use (Martin, 1995; Cotton, 1996) in the study area. Besides the medicinal value, medicinal plants in the study area was categorized based on their use value as fodder, edible, construction materials and farm implements, firewood, charcoal, live fence, and timber. Six medicinal plants were presented for ten randomly selected FGD participants to independently give a score of 0 to 5 (0=not used, 1=less used, 2= moderate, 3= good, 4= very good, and 5= the best) for each medicinal plant based on its use category. The overall ranking of the multipurpose plants under investigation was made by comparing the sum of all use values given to each plant.

### Informant Consensus Factor

The Informant Consensus Factor (*ICF*) is the factor used to calculate the level of homogeneity between information provided by different informants (Trotter and Logan, 1986). Accordingly, ICF was calculated using *Equation 2* for each category of ailments in the study area showing agreement of informants on the reported use of medicinal plants for curing group of ailments (Heinerich *et al*., 1998).

$$ICF = \frac{n_{ur} - n_r}{n_{ur} - 1} \quad (2)$$

Where, $ICF$= informant consensus factor; $n_{ur}$= number of use citation in each category; and $n_t$ = number of species used

### Fidelity Level

Fidelity Level ($FL$) was used to indicate the use of a given medicinal plant for a particular purpose in a given cultural group or area (Friedman *et a*l., 1986). Relative healing capacity of each medicinal plant in the study area was analyzed by $FL$ index (*Equation 3*).

$$ICF = \frac{I_p}{I_u} * 100 \quad (3)$$

Where, $I_p$ is the number of informants who independently indicate the use of a species for the same major ailments and $I_u$ is the total number of informants who indicate the plant for any major ailment.

### 2.4 Data Presentation and Analysis

Data collected for this study was summarized and presented in tables and charts. Ethno-botanical data analysis methods such as preference ranking and direct matrix ranking for selected medicinal plants Martin (1995) and Cotton (1996) were used for data analysis in addition to percentage and frequency, which are descriptive statistical methods. Moreover, narrative statements were given for some qualitative data gathered through questionnaires.

## 3 Results

### Ethnomedicinal Plant Species Composition in the Study Area

A total of 72 medicinal plants belonging to 68 Generas and 39 Families were documented in Ale Special District (Annex). Of the top five species rich plant families, Lamiaceae had 11 species, Asteraceae contained 5 species, and the remaining three families – Acanthaceae, Fabaceae, and Solanaceae each represented by 4 species of medicinal plants.

Among the medicinal plants documented in the study area, 88.89% were used to treat human ailments and 19.44% were used to treat livestock ailments. 51.39% of the medicinal plants recorded in the study area were herbs and the remaining medicinal plants are shrubs, trees, and climbers (Table 2).

**Table 2** Number of medicinal plant categorized in their growth forms and target of application

| Ailments treated | Herbs | Shrubs | Trees | Climbers | Total | Percentage |
|---|---|---|---|---|---|---|
| Human's only | 30 | 11 | 12 | 5 | 58 | 80.56 |
| Livestock's only | 4 | 0 | 1 | 1 | 6 | 8.33 |
| Both Human's and Livestock's | 3 | 3 | 2 | 0 | 8 | 11.11 |
| **Total** | 37 | 14 | 15 | 6 | 72 | |
| **Percentage** | 51.39 | 19.44 | 20.83 | 8.33 | | |

Detail description regarding the name of medicinal plant species documented at study area, plant growth form or habit, plant parts used to prepare remedies, disease treated, mode of preparation of remedies, and mode of application is given in Annex.

According to the information gathered from the study area, different plant parts are used as medicines by the local people. From the parts reported, the most frequently utilized plant part was leaf. Roots of medicinal plants were the second widely used for medicinal purpose next to leaves (Figure 2).

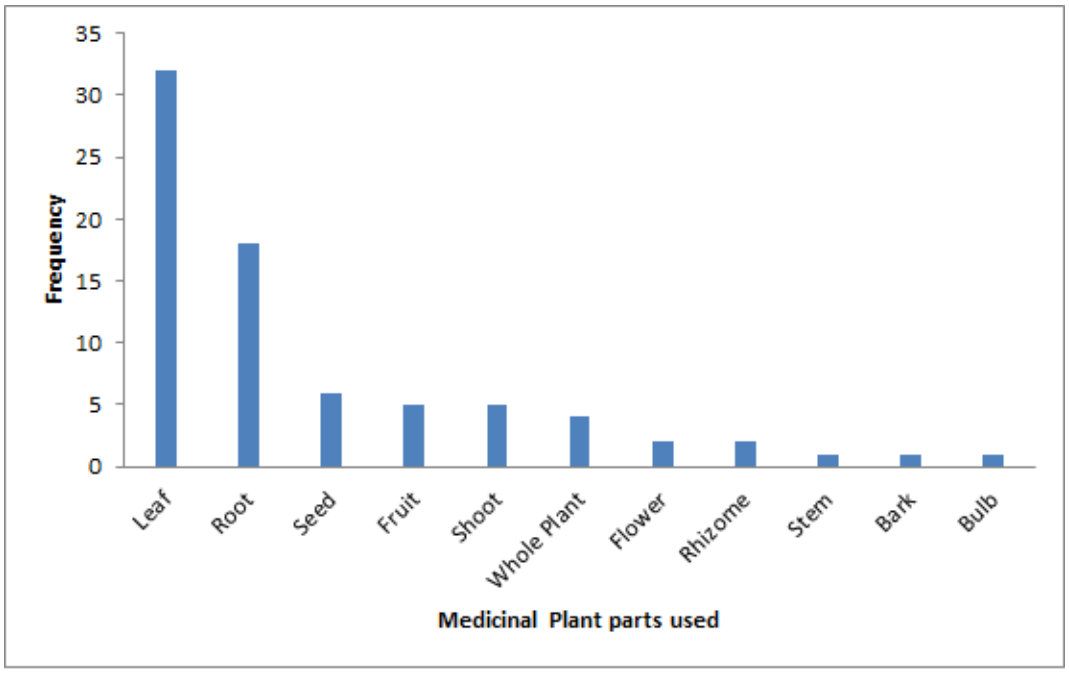


**Figure 2** Medicinal plant parts used for remedy preparation in the study area

### Methods of Remedy Preparation

Though higher number of herbaceous medicinal plants documented in the study area, majority of the remedies were prepared from dry plant materials than the fresh ones.

On the course of remedy preparation to treat human and livestock ailments, the local community employed number of methods of remedy preparation for various ailments. A total of 99 remedies were reported to be prepared from the 72 medicinal plants in the study area. The preparations of remedies vary based on type of disease treated and the actual site of the illness.

The primary method of remedy preparation in the study area was reported to be crushing of plant parts, and was accounted for 32.32% of the reported remedy preparation methods in the study area. Whereas, chopping, powdering, and pounding were accounted for 16.16%, 13.13%, and 10.10% respectively (Figure 3).

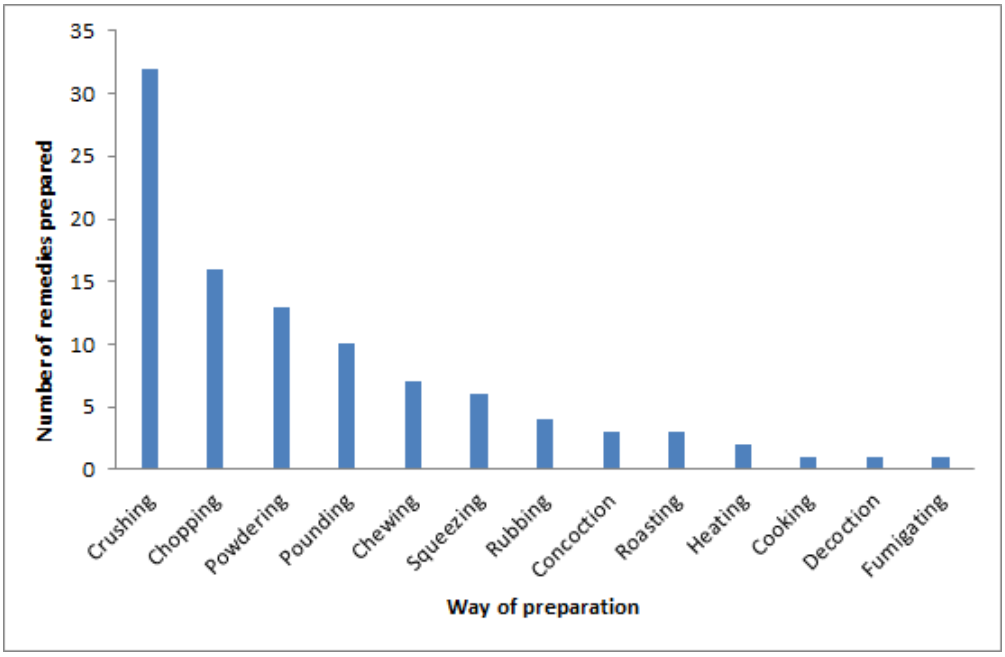


**Figure 3** Percent of mode of administration of remedies

## Modes of Administrations and Dosage of Remedies

The mode of administration of the traditional remedies by traditional healers in Ale District depends on the nature of remedy and the type of disease to be treated. Accordingly, ailments that require oral application of remedies were reported to frequent. As a result, oral application was a primary mode of administration accounted for 59% which is followed by external (dermal) and ocular applications accounted for 24% and 7% respectively (Figure 4).

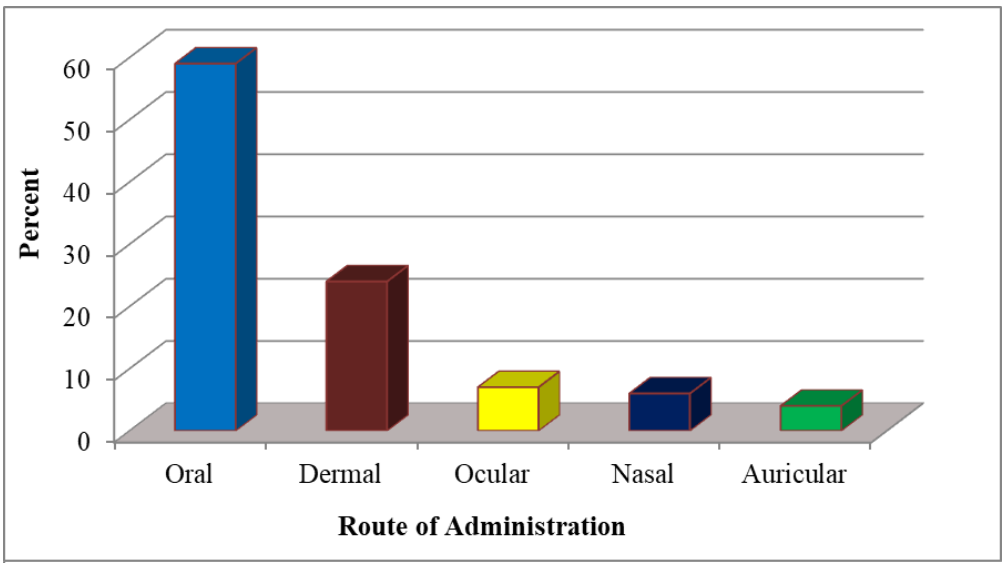


**Figure 4** Percent of mode of administration of remedies

### Preference Ranking

In this study, tonsillitis was reported as the most frequently occurring disease for which several patients in the study area visited traditional healers. Among the medicinal plants reported to cure tonsillitis in the study area, *Plumbago zeylanica* was found to be the most effective medicinal plant against tonsillitis and ranked the first, followed by *Encostema axillare*, and *Crabbea velutina* (Table 3).

According to interview from informants, some medicinal plants were most effective to cure frequently occurring and known ailments than others. This revealed that some medicinal plants were considered to be most effective and used frequently than others.

**Table 3** Preference ranking of five medicinal plants for treating tonsillitis

| Medicinal Plants used to Treat Tonsillitis | Respondents | | | | | | | | | | Total Scores | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $R_1$ | $R_2$ | $R_3$ | $R_4$ | $R_5$ | $R_6$ | $R_7$ | $R_8$ | $R_9$ | $R_{10}$ | | |
| *Acmella caulirhiza* | 3 | 1 | 2 | 2 | 1 | 3 | 1 | 4 | 2 | 3 | 22 | $4^{fh}$ |
| *Crabbea velutina* | 2 | 4 | 5 | 4 | 5 | 1 | 3 | 2 | 3 | 4 | 33 | $3^{rd}$ |
| *Enicostema axillare* | 5 | 3 | 3 | 5 | 2 | 4 | 4 | 5 | 5 | 2 | 38 | $2^{nd}$ |
| *Plumbago zeylanica* | 4 | 5 | 4 | 3 | 3 | 5 | 5 | 3 | 4 | 5 | 41 | $1^{st}$ |
| *Rhamnus prinoides* | 1 | 2 | 1 | 1 | 4 | 2 | 2 | 1 | 1 | 1 | 16 | $5^{th}$ |

### Direct matrix ranking

In additional to their medicinal value, some medicinal plants were used for other purpose. Accordingly, *Cordia africana* ranked 1st as multiuse medicinal plant followed by *Eucalyptus globulus* and *Moringa stenopetalla* which ranked $2^{nd}$ and $3^{rd}$ respectively. On the other hand, the selected plants were used for firewood, which was ranked the $1^{st}$, followed by their values for medicinal purpose and source of construction materials and farm implements as $2^{nd}$ and $3^{rd}$ respectively. The total score of data matrix from informants is given in Table 4.

**Table 4** Direct matrix ranking of six medicinal plants (The numbers under each use category are the sum of all scores given by the ten informants)

| Multipurpose Medicinal Plants | Use Category/Source of | | | | | | | | Total Score | Rank |
|---|---|---|---|---|---|---|---|---|---|---|
| | Medicine | Fodder | Edible Part | Construction | Firewood | Charcoal | Live Fence | Timber | | |
| *Cordia africana* | 32 | 4 | 30 | 50 | 46 | 20 | 21 | 50 | 253 | $1^{st}$ |
| *Croton macrostachyus* | 37 | 0 | 0 | 26 | 46 | 0 | 40 | 6 | 155 | $5^{th}$ |
| *Eucalyptus globulus* | 24 | 0 | 0 | 47 | 50 | 19 | 50 | 47 | 237 | $2^{nd}$ |
| *Moringa stenopetalla* | 44 | 50 | 50 | 0 | 14 | 0 | 30 | 0 | 188 | $3^{rd}$ |
| *Rhamnus prinoides* | 32 | 32 | 13 | 0 | 0 | 0 | 8 | 0 | 85 | $6^{th}$ |
| *Terminalia browni* | 24 | 0 | 0 | 45 | 50 | 50 | 11 | 3 | 183 | $4^{th}$ |
| **Sum** | 193 | 86 | 93 | 168 | 206 | 89 | 160 | 106 | | |
| **Rank** | $2^{nd}$ | $8^{th}$ | $5^{th}$ | $3^{rd}$ | $1^{st}$ | $6^{th}$ | $4^{th}$ | $7^{th}$ | | |

### Informant Consensus

From the total medicinal plants documented, *Plumbago zeylanica* was cited by 39 in informants and ranked the $1^{st}$ accounting for 43.3%. The top ten plants that had higher citation are given in Table 5.

**Table 5** Informant consensus on 10 medicinal plants cited by informants

| Medicinal Plant Species Cited by Informants | Number of Citations | % | Rank on Citation |
|---|---|---|---|
| *Acmella caulirhiza* | 31 | 34.4 | $6^{th}$ |
| *Allium sativum* | 32 | 35.6 | $5^{th}$ |
| *Cucumis ficifolius* | 35 | 38.9 | $2^{nd}$ |
| *Cyphostemma adenocaule* | 30 | 33.3 | $7^{th}$ |
| *Dicrocephala integrifolia* | 29 | 32.2 | $8^{th}$ |
| *Hypoestes forskaolii* | 34 | 37.8 | $3^{rd}$ |
| *Enicostema axillare* | 28 | 31.1 | $9^{th}$ |
| *Jasminum abyssinicum* | 27 | 30.0 | $10^{th}$ |
| *Nepeta azurea* | 33 | 36.7 | $4^{th}$ |
| *Plumbago zeylanica* | 39 | 43.3 | $1^{st}$ |

### Fidelity Level

The result of the study showed that the effectiveness of medicinal plants against a given ailment was varying from one plant to another. Medicinal plants that had the capability of treating a number of specific diseases had given a high *ICF* value. Therefore, the highest *ICF* value (0.93) was obtained from category of problems where snake bite and malaria were contained in. Whereas the least *ICF* value (0.76) was obtained for category consisting muscular rigidity at the neck, swelling around neck region, breast swelling, and mumps. *ICF* or human disease categories in the study area is given in Table 6.

**Table 6** Informant consensus for category of human diseases

| Category | $n_t$ | $n_{ur}$ | *ICF* |
|---|---|---|---|
| Tonsillitis, Headache | 13 | 75 | 0.84 |
| Diarrhea, Blood dysentery, Shigellosis | 10 | 59 | 0.84 |
| Eye illness, Ear pain, Cataract, | 7 | 70 | 0.91 |
| Intestinal parasites, Tapeworm | 3 | 16 | 0.87 |
| Abdominal pain, Gastritis | 9 | 52 | 0.84 |
| Snake bite, Malaria | 4 | 45 | 0.93 |
| Wound, Cut surface, Fire burn, Skin rush | 11 | 60 | 0.83 |
| Muscular rigidity of the neck, Swelling around neck region, Breast swelling, Mumps | 7 | 26 | 0.76 |
| Febrile illness, '*Mich*', Dizziness, Rheumatism | 9 | 35 | 0.77 |

Fidelity level indicates that the comparison of relative healing capacity of medicinal plant species for particular disease. Fidelity levels of top ten medicinal plants are given in Table 7. These medicinal plants were observed to be with high fidelity level indicated that they had good healing capacity from which *Cucumis ficifolius* and *Plumbago zeylanica* both ranked $1^{st}$ with respect to their relative healing capacity of specific ailments.

**Table 7** Top nine medicinal plants with their respective Fidelity level values

| Medicinal Plants Used to Treat Ailments | Ailment Treated | $I_p$ | $I_u$ | $FL$ % | Rank |
|---|---|---|---|---|---|
| *Acmella caulirhiza* | Tonsillitis | 28 | 31 | 90.3 | $5^{th}$ |
| *Allium sativum* | Leech | 30 | 32 | 93.8 | $4^{th}$ |
| *Cucumis ficifolius* | Blackleg | 35 | 35 | 100 | $1^{st}$ |
| *Cyphostemma adenocaule* | Fire burn | 27 | 30 | 90 | $6^{th}$ |
| *Dicrocephala integrifolia* | Headache | 25 | 29 | 86.2 | $8^{th}$ |
| *Jasminum abyssinicum* | Diarrhea | 24 | 27 | 88.9 | $7^{th}$ |
| *Moringa stenopetalla* | Hypertension | 24 | 28 | 85.7 | $9^{th}$ |
| *Nepeta azurea* | Liver problem | 32 | 33 | 97 | $3^{nd}$ |
| *Plumbago zeylanica* | Toothache | 39 | 39 | 100 | $1^{st}$ |

Key: $I_p$ is the number of informants who independently indicate the use of a species for the same major ailments and $I_u$ is the total number of informants who indicate the plant for any major ailments.

## Threats to Medicinal Plants and Conservation Practices

Different anthropogenic factors were threatening medicinal plants in the study area. The information from informants showed the most mentioned threats to medicinal plants include agricultural expansion, wood cutting for different purpose, overgrazing, charcoal making, firewood, timber, and drought. The result of preference ranking of threats to medicinal plants in the study area is given in Table 8. According to the informants and personal observation of the researcher, the natural vegetation in the entire study sites were cleared from the area for the contest of agricultural expansion. Overutilization of plant resources by the local communities were also seen except for some remnant patches in midlands and highlands as well as Afromontane forest of Deneko high lands. These areas were covered by densely populated bushes, shrubs, herbs and trees.

**Table 8** Preference ranking of threats to medicinal plants in the study area

| Threatening Factors | Respondents | | | | | | | | | | Total Score | Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $R_1$ | $R_2$ | $R_3$ | $R_4$ | $R_5$ | $R_6$ | $R_7$ | $R_8$ | $R_9$ | $R_{10}$ | | |
| Agricultural expansion | 5 | 4 | 4 | 5 | 4 | 3 | 5 | 5 | 4 | 5 | 44 | $1^{st}$ |
| Overgrazing | 4 | 3 | 5 | 3 | 5 | 4 | 4 | 4 | 5 | 3 | 40 | $2^{nd}$ |
| Firewood | 2 | 2 | 3 | 1 | 2 | 1 | 3 | 1 | 3 | 2 | 20 | $4^{th}$ |
| Cut for various purpose | 3 | 5 | 2 | 4 | 3 | 5 | 2 | 3 | 1 | 4 | 32 | $3^{rd}$ |
| Drought | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 2 | 1 | 14 | $5^{th}$ |

# 4 Discussion

## 4.1 Ethnomedicinal Plants Composition, Indigenous Knowledge, and Application of Traditional Medicine

Though medical services in the District are improving, number of peoples in the study area was reported to visit local healers in search for traditional remedies that would cure or provide relief from their illness. The result indicated that there was more number of medicinal plants used to treat human ailment than livestock ailment. This might be due to existence of fewer livestock ailments in the study area and/or limited knowledge and skill about animal health. Similar findings were obtained by Mirutse Gidey *et al*., (2009) and Tesfaye Awas and Sebsebe Demisew (2009).

The result showed that leaf is predominantly used for remedy preparation than any other plant part in the study area. The common use of the leaf might be due to the relative ease of finding this plant part which agrees with similar work of Panghal *et al*. (2010). Many studies that were carried out in Ethiopia and other parts of the world showed leaf is the dominant part to prepare the remedy (Haile Yineger and Delenasaw Yewhalaw, 2007; Tesfaye Hailemariam *et al*., 2009; Mirutse Gidey *et al*., 2009; Panghal *et al*., 2010; Fiseha Mesfin *et al*., 2014). The advantage of using leaf for remedy preparation over roots, stem, or the whole plant is that it helps the whole plant not to disappear from the study area and allow the plant to sustain for continuous use.

### Remedy Preparation, Modes of Administration, and Dosage

It was indicated in the result section that remedies to treat human and livestock ailments in the study area were prepared by crushing followed by chopping, powdering, and pounding of parts or the whole medicinal plant. It agreed with the findings of Gidey Yirga (2010a) in which they mentioned crushing is the dominant method of preparation. Predominant practice of crushing exercise over other methods of extracting remedies is an indication of utilizing most medicinal plants in dry form. The use of medicinal plants in dry form has an advantage over the fresh one in that it can be used any time even in drought seasons in which annual herbs were not accessible.

The result of the study indicated that most of the medicinal plant remedies prepared for the specific ailment were taken orally. This is because majority of diseases treated was internal problems and the remedies were more efficient with their potential efficacy when taken orally. This situation coincides with the findings of Haile Yineger and Delenasaw Yewhalaw (2007) and Tesfaye Hailemariam *et al*. (2009) that oral application was reported to be the dominant route of administration of remedies.

Though the concentrations of locally prepared remedies were not scientifically known, the dosage of administered remedies depends mainly on age and body weight of the patient, type of disease, and nature of the remedy. Prescriptions with respect to frequency and duration of application of remedies for a particular ailment vary from healer to healer. However, healers use similar practice of administering remedies for some health problems. For example, to treat a person with abdominal pain in the study area, most healers used to prescribe one coffee cup of remedy prepared from crushed *Thunbergia alata* mixed with butter to be taken orally twice a day until the patient gets recovered. Frequency of the treatment might depend on severity of effect of a disease.

To determine the dosage of remedies, local healers in study area use coffee cup, tea glass, or water glass to measure volume of the administered remedies. Tea spoon and bottle stopper were also used in some cases when the remedies are administered in dry form. A local drink called as '*Warshe*' was used to be mixed with some remedies. Some remedies were prepared from the mix of coffee leaf extract and need to be taken orally with empty stomach early in the morning.

One of the drawbacks of traditional health care system in Ethiopia was that it does not use standard measurement units to determine the concentration

and dosage of remedies administered to treat human and livestock ailments. Variation on the measurement of most remedy administered for particular ailments in the study area was documented from one locality to another as well as healer to healer.

**Values of Medicinal Plants and Preference by the Local Community**

Some medicinal plants such as *Cordia africana*, *Terminalia browni*, *Cupressus lustanica*, *Eucalyptus globulus*, *etc*. have had high use value than others and used for various purpose by the local community beside their medicinal value. It was observed that these plants were highly threatened in the area except *Terminalia browni*, which is highly adaptive in the area and kept as agroforestry tree in the farm lands and fallow lands. The use of these multipurpose medicinal plants for other purpose may contribute for the loss of medicinal plant in the study area since they were frequently used for purposes other than medicine.

Results from informant consensus factor showed that medicinal plants that were used frequently are chosen in advance by the local healers to treat particular problems for which the local people need potential cure. It also implied that these medicinal plants are effective in treating particular ailments and have high importance since they are applied by many people and have been utilized for a long time.

Based on the findings, the *ICF* of some categories of diseases was high and it showed there was a good indicator for a high rate of informant consensus on the frequent use of some medicinal plants for the health problems occurring in the area. This would be due to poor socio-economic as well as personal and environmental hygiene of the people in the study area, indicating that category with high *ICF* was prevalent and that with low *ICF* was relatively rare.

The result of Fidelity level showed that some medicinal plants had high healing potential compared to others according to their *FL* computed. This revealed that some medicinal plants were essential on which local people rely on to cure human and livestock problems that frequently occur in their respective locality and the choice of the informant is mainly depends on the efficacy of the medicinal plants utilized. This indicated that the medicinal value of some plants in the study area was high in relation to other medicinal plants investigated.

**Acquisition and Transfer of Knowledge of Traditional Medicine**

Traditional healers were found to play an important role in the primary health care system of the local people as they treat people who have little access to- and unable to afford the cost of- modern medication (Gidey Yirga, 2010a). The transfer of knowledge takes place only along family line mostly from parents to one of their respective family members verbally. As they indicated this transfer of knowledge takes place when the healer is getting older. This transfer may not take place if the healer passes away suddenly prior to the transfer of the knowledge to his family members. This phenomenon limited the spread of ethno-medicinal knowledge in the study area.

According to information documented from informants and other local elders, most of the traditional healers were not volunteered to show the type of the plant used as a remedy rather they kept as secret and said that knowledge of medicinal plant is one of the income source. They also believe that when the medicinal plants are disclosed, the healing capacity of the plant diminishes. Several similar studies have indicated that traditional healers or local practitioners of traditional medicinal plants were not interested to disclose and publicize their medicinal plants knowledge and practice (Haile Yineger and Delenasaw Yewhalaw, 2007; Mirutse Giday *et al*., 2009; Gidey Yirga, 2010b).

### 4.2 Threats to Medicinal Plants and Conservation Practices

The result showed that the loss of medicinal plants has occurred by anthropogenic and natural conditions. Agricultural expansion was the main threats to medicinal plants in the study area followed by

over grazing and cutting of trees used in household activities. In lowland areas, shortage of rain due to seasonal drought was also considered as threat to medicinal plants in the study area and ranked the least. These threatening factors might be resulted from population increase and the demand for farmlands and grazing lands.

The degree of threats in the study area varies from place to place and species to species. These major factors were perceived as predominant threats that contributed to loss of biodiversity in general and medicinal plants in particular in the study area. This finding is in congruence with the finding of Zemede Asfaw (2001) and Kebu Baleme *et al*. (2004).

The result of the information revealed that some of the medicinal plants such as *Cordia africana*, *Croton macrostachyus*, *Cupressus lustanica*, *Moringa stenpetalla*, *Terminalia browni*, and *Rhamnus prinoides* have been over used and are being highly vulnerable and threatened than other medicinal plants in the area. These medicinal plants were relatively known for their greater multipurpose values than the other medicinal plants.

Some medicinal plants in places of low and erratic distribution of rain fall mainly in the low lands of the District were threatened by drought. This finding is in agreement with the finding of Kebu Balemie *et al*. (2004)

Another threat to medicinal plants might be careless collection of medicinal plants in the area. Some informants harvest the medicinal plants by uprooting, stem cutting or bark pealing. Even though this careless harvesting was carried out by few traditional healers, it contributed to the threatening factor of medicinal plants in the study area.

The medicinal plants existing in homegardens of the study area were not been intentionally cultivated for medicinal purpose except by some traditional healers rather they were cultivated for their primary purpose such as food or spice other than medicinal value. There are no plant parts sold directly in the market purposefully as medicine in the District but those healers who know the plant type as medicine buy the parts from the market to heal others. Consequently, this helped in conservation of medicinal plants indirectly in the area.

Wild medicinal plants were kept in the nearby patches of forest remnants, fallow lands, agroforestry areas, in the farmlands for different purpose but not only for medicinal determination because medicinal values of those plants were known only by the corresponding healers. However, most of informants reported that people in the study area have awareness problem to conserve biodiversity in general. This revealed that there was no considerable conservation practice for medicinal plants in the study area rather they were conserved indirectly when cultivated in home gardens and farm lands for other purposes. Therefore, according to Gidey Yirga (2010a) encouraging the local people to cultivate some medicinal plants in their home gardens, or grow together with other crops in their farmlands, and planting as live fences is greatly important for the conservation of medicinal plants in the study area.

## 5 Conclusion

The study carried out in the area showed that Ale Special District is relatively endowed with wide range of medicinal plant along with its use, practice, and associated indigenous knowledge. These medicinal plants were used for the treatment of both human and livestock ailments in the area.

Utilization of traditional medicines extracted from medicinal plants and the practice was the day to day experience of the local community. The natural vegetation in the study area was a potential source for medicinal plants as most of the medicinal plants were obtained from wild and some were obtained from home gardens that are cultivated for different purposes besides medicinal value. Some medicinal plants were used for other different purposes like firewood, charcoal, construction and others in addition to medicinal purpose. Though the indigenous knowledge of the local people to sustainably use the medicinal plants for their need has contributed to bet-

ter manage and conserve this resource in the area, usage of some medicinal plants for other purpose was threatening the medicinal plants in the study area. Moreover, agricultural expansion, and over grazing were the major threats to the medicinal plants in the study area and in the future, it may affect indigenous knowledge associated with those medicinal plants.

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**Conflict of Interest**

The authors declare that there is no conflict of interest.

## References

Abebe Demissie (2001). Biodiversity conservation of medicinal plants: Problems and prospects. ***In***: (Medhin Zewdu and Abebe Demissie eds.), *Conservation and sustainable use of medicinal plants in Ethiopia*. Proceeding of the National Workshop on Biodiversity Conservation and Sustainable use of medicinal plants in Ethiopia, 28 April-01 May 1998, pp. 56-64. IBCR, Addis Ababa.

AWOFED (2020). Alle District Office of Finance and Economic Development Annual Report.

Balick, M.J. and Cox, P.A.R. (1996). *Plants People and Culture: The science of Ethnobotany*. Scientific American Library, New York, USA.

Cotton, C. (1996). *Ethnobotany: Principles and Applications*. John Wiley & Sons. UK.

Endashaw Bekele (2007). Study on Actual Situation of Medicinal Plants in Ethiopia. Prepared for Japan Association for International Collaboration of Agriculture and Forestry, Addis Ababa, Ethiopia.

FAO (1997). *Non- Wood Forest Products 11: Medicinal plants for forest conservation and health care*. FAO, UN, Rome: 1-165

Fiseha Mesfin, Talemos Seta, and Abreham Assefa (2014). An Ethnobotanical Study of Medicinal Plants in Amaro Special District, Ethiopia. *A Journal of Plants, People and Applied Research: Ethnobotany Research & Applications*, **12**:341-354.

Friedman J, Zohara Y, Amotz D, and Palewitch D. (1986). A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. *J. Ethnopharmacol*. **16**:275-278.

Getachew Addis, Dawit Abebe, Timotewos Genebo, and Kelebessa Urga (2002). Perceptions and practices of modern and traditional health practitioners about traditional medicine in Shrinke District, Arsi Zone, Ethiopia. *Ethiop. J. Health Dev*., **16**(1):19-29.

Gidey Yirga (2010a). Assessment of indigenous knowledge of medicinal plants in Central Zone of Tigray, Northern Ethiopia. *Afr J Plant Sci*, **4**(1):6-11.

Gidey Yirga (2010b). Use of traditional medicinal plants by indigenous people in Mekele town, capital city of Tigray Regional State, Ethiopia. *J. Med. Plants. Res*., **4**(17):1799-1804.

Gidey Yirga (2010c). Ethnobotanical Study of Medicinal Plants in and Around Alamata, Southern Tigray, Northern Ethiopia. *Curr. Res. J. of Biol. Scie*. **2**(5):338-344.

Haile Yineger and Delenasaw Yewhalaw (2007). Traditional medicinal plant knowledge and use by local healers in Sekoru District, Jimma Zone, Southwestern Ethiopia. *J, of Ethnobio. and Ethnomed*., **3**(1):1-7.

Kebu Balemie, Ensermu Kelbessa, and Zemede Asfaw (2004). Indigenous Medicinal Utilization, Management and Threats in Fentale Area, Eastern Shewa, Ethiopia. *Ethiop. J. Biol Sci*., **3**(1):1-7.

Martin, G. J. (1995). *Ethnobotany: A methods manual*. Chapaman and Hall, London, 1-251pp.

Mirutse Gidey, Zemede Asfaw, Zerihun Woldu, and Tilahun Teklehaymanot (2009). Medicinal Plant Knowledge of the Bench ethnic group of Ethiopia: An Ethnobotanical investigation. *Journal of Ethnobiology and Ethnomadicine*, **5**(34):1746-4269.

NMA (2020). Temperature and Rainfall Data. National Meteorology Agency. (unpublished)

Panghal, M., Arya, V., Yadav, S., Kumar, S., and Yadav, J. P. (2010). Indigenous knowledge of medicinal plants used by Saperas community of Khetawas, Jhajjar District, Haryana, India. *J. Ethnobiol. Ethnomed.*, **6**:4-14.

Tesfaye Awas and Sebsebe Demissew (2009). Ethnobotanical study of medicinal plants in Kafficho people, southwestern Ethiopia. ***In***: *Proceedings of the 16th International Conference of Ethiopian Studies*. Pp. 711-726.

Tesfaye Hailemariam, Sebsibe Demissew, and Zemede Asfaw (2009). An ethnobotanical study ofmedicinal plants used by local people in the lowlands of Konta special Wereda, SouthernNations, Nationalities and People Regional State, Ethiopia. *J. of Ethnobio/ and Ethnomed*. **5**:26-40.

Trotter, R.T. and Logan, M.H. (1986). Informant Consensus: a new approach for identifying potentially effective medicinal plants. ***In***: *Plants in Indigenous Medicinal and Diet*, N.L. Etrin (eds), Red grave publishing company, Bedford Hill, NY, pp. 91-112.

Yamane, Taro (1967). *Statistics: An Introductory Analysis*, $2^{nd}$nd Ed., New. York: Harper and Row.

Zemede Asfaw (2001). The Role of Homegarden in Production and Conservation of Medicinal Plants. *textbfIn*: (Medhin Zewdu and Abebe Demissie eds.). *Conservation and Sustainable use of Medicinal Plants in Ethiopia*. Proceeding of the National Workshop on Biodiversity Conservation and Sustainable use of Medicinal Plants in Ethiopia, 28 April- 01 May 1998, pp. 76-91. IBCR, Addis Ababa.

## Annex

### List of Medicinal Plants Used to Treat Human and Livestock Diseases in Ale Special District

**Key to Abbreviations**: Plant habit (T-Tree, Sh-Shrub, H-Herb, and Cl-Climber), Applied to (Hu-Human, Ls-Livestock, and Bo-Both)

| Scientific Name | Family | Plant Habit | Disease treated | Applied to |
|---|---|---|---|---|
| *Acmella caulirhiza* Del. | Asteraceae | H | Tonsillitis | Hu |
| *Allium sativum* L. | Alliaceae | H | Tonsillitis | Hu |
| | | | Leech & Blackleg | Ls |
| *Amaranthus caudatus* L. | Amaranthaceae | H | Diarrhea | Hu |
| *Becium grandifolorum* (Lam) Pic. Serm* | Lamiaceae | Sh | Cataract | Hu |
| | | | Cut surface | Bo |
| *Calotropis procera* (Ait.) Ait. f. | Asclepiadaceae | Sh | Blackleg | Ls |
| *Catha edulis* (Vahl) Forssk. ex Endl. | Celastraceae | T | Tonsillitis | Hu |
| *Clerodendrum myricoides* (Hochst.) V. | Lamiaceae | Sh | Abdominal pain | Hu |
| | | | Internal parasites | Hu |
| *Coffea arabica* L. | Rubiaceae | Sh | Diarrhea | Hu |
| | | | Wound | Hu |
| *Cordia africana* Lam. | Boraginaceae | T | Diarrhea | Hu |
| *Coriandrum sativum* L. | Apiaceae | H | Hemorrhage during birth | Hu |
| *Crabbea velutina* S. Moore | Acanthaceae | H | Tonsillitis | Hu |
| *Crotalaria spinosa* Hochst. ex Benth. | Fabaceae | H | Blackleg | Ls |
| *Croton macrostachyus* Del. | Euphorbiaceae | T | Blackleg | Ls |
| | | | Eye illness | Hu |
| *Cucumis ficifolius* A. Rich. | Cucurbitaceae | Cl | Blackleg | Ls |
| | | | Snake bite | Hu |
| *Cucurbita pepo* L. | Cucurbitaceae | Cl | Tapeworm | Hu |
| *Cupressus lustanica* Mill. | Cupressaceae | T | Thinness | Ls |
| *Cyphostemma adenocaule* (Steud. ex A.Rich) Desc. ex Wild & Dr. | Vitaceae | Cl | Fire burn | Bo |
| | | | Blood dysentery | Hu |
| *Datura stramonium* L. | Solanaceae | H | Pain or '*Waransa*' | Ls |
| | | | Blood dysentery | Hu |
| | | | Ear pain | Hu |
| *Delphinium dasycaulon* Fresen. | Ranunculaceae | H | Shigellosis & Swelling | Hu |
| *Dicrocephala integrifolia* (L. f) Kuntze | Asteraceae | H | Headache | Hu |

*Endemic plants

| Scientific Name | Family | Plant Habit | Disease treated | Applied to |
|---|---|---|---|---|
| *Dodonea angustifolia* L. f. | Sapidaceae | Sh | Mumps | Hu |
| *Eclipta prostrate* (L.) L. | Asteraceae | H | Blackleg | Ls |
| *Eleusine coracana* (L.) Geartn. | Poaceae | H | Diarrhea | Hu |
| *Enicostema axillare* (Poir. ex Lam) A. Raynal. | Gentianaceae | H | Tonsillitis | Hu |
| *Ensete ventricosum* (Welw.) Cheesman | Musaceae | H | Abdominal pain | Hu |
| *Erythrina brucei* Schwein f.* | Fabaceae | T | Abdominal pain | Hu |
| *Eucalyptus globulus* Labill. | Myrtaceae | T | Cough | Hu |
| *Foeniculum vulgare* Miller | Apiaceae | H | Urine retention | Hu |
| | | | Cough | Hu |
| *Gardenia ternifolia* Schumach. & Thonn. | Rubiaceae | T | Skin disease & Abdominal pain | Hu |
| *Gossypium barbadense* L. | Malvaceae | Sh | Wound | Hu |
| *Guizotia scabra* (Vis) Chiov. | Asteraceae | H | Abdominal pain | Hu |
| *Hagenia abyssinica* (Bruce) J. F. Gmel. | Rosaceae | T | Tapeworm | Hu |
| *Hypoestes forskaolii* (Vahl.) R. Br. | Acanthaceae | H | Snake bite | Hu |
| *Hyptis pectinata* (L.) Poit. | Lamiaceae | H | Blackleg | Ls |
| | | | Malaria & Rheumatism | Hu |
| *Indigofera vohemarensis* Baill. | Fabaceae | H | Toothache | Hu |
| *Ipomea kituiensis* Vatke | Convolvulaceae | H | Eye illness | Hu |
| *Jasminum abyssinicum* Hochst. ex DC. | Oleaceae | Cl | Diarrhea | Hu |
| *Justicia schimperiana* (Hochst. ex Nees) T. Anders. | Acanthaceae | H | Febrile illness | Hu |
| *Lagenaria siceraria* (Molina) Standl. | Cucurbitaceae | Cl | Muscular rigidity of neck | Hu |
| *Mimosa pigra* L. | Fabaceae | Sh | Blackleg | Ls |
| *Monopsis stellarioides* (Presl) Urb. | Lobeliaceae | H | Abdominal pain & Swelling around neck | Hu |
| *Moringa stenopetalla* (Bak. F) Cuf. | Moringaceae | T | Hypertension | Hu |
| | | | Cough | Ls |
| *Nepeta azurea* R. Br. ex Benth | Lamiaceae | H | Eye illness, Kidney Problem, Liver problem, & Skin rash | Hu |
| *Nicotiana tobacum* L. | Solanaceae | H | Eye illness | Hu |
| | | | Leech | Ls |

*Endemic plants

| Scientific Name | Family | Plant Habit | Disease treated | Applied to |
|---|---|---|---|---|
| *Ocimum basilcum* L. | Lamiaceae | H | Headache | Hu |
| *Ruta chalepensis* L. | Rutaceae | H | Tonsillitis | Hu |
| *Searsia rosmarinifolia* (Vakl) F. A. Barkley | Anacardiaceae | H | Blackleg | Ls |
| *Solanum incanum* L. | Solanaceae | Sh | Wound | Hu |
| *Stachys jijigaensis* Sebsebe* | Lamiaceae | H | Tonsillitis | Hu |
| *Syzygium guineense* (Willd.) DC. Subsp. *afromontanum* | Myrtaceae | T | Diarrhea | Hu |
| *Terminalia browni* Fresen. | Combretaceae | T | Eye illness | Ls |
| *Thunbergia alata* Boj. ex Sims | Acanthaceae | Cl | Abdominal pain & Swelling around neck | Hu |
| *Verbena officinalis* L. | Verbenaceae | H | Febrile illness | Hu |
| *Vernonia amygdalina* Del. | Asteraceae | T | Gastritis | Hu |
| *Withania somnifera* (L.) Dunal in DC | Solanaceae | Sh | Blackleg | Ls |
| *Zanthoxylum chalybeum* Engl. | Rutaceae | T | Cough & Sneeze | Ls |
| *Zingiber officinale* Roscoe | Zingiberaceae | H | Abdominal pain | Hu |
| *Pentas schimperiana* (A. Rich.) Vatke | Rubiaceae | Sh | Swelling | Hu |
| *Plumbago zeylanica* L. | Plumbaginaceae | H | Breast Swelling, Tonsillitis, & Toothache | Hu |
| *Polygala erioptera* DC. | Polygalaceae | H | Snake bite | Hu |
| *Pouzolzia parasitica* (Forssk.) Schweinf | Urticaceae | H | Wound | Hu |
| *Ocimum lamifolium* Hochst.ex Benth | Lamiaceae | H | Febrile illness | Hu |
| *Ocimum suave* Willd. | Lamiaceae | H | Rheumatism & '*Mich*' | Hu |
| *Ocimum urticifolium* Roth | Lamiaceae | H | Headache | Hu |
| *Olea europaea* L. subsp. *cuspidata* | Oleaceae | T | Blackleg | Ls |
| *Pelargonium multibracteatum* Hochst. ex A. Rich | Geraniaceae | H | Eye illness | Hu |
| *Premna schimperi* Engl. | Lamiaceae | Sh | Diarrhea | Hu |
| *Premna oligotricha* Baker | Lamiaceae | Sh | Tonsillitis, Toothache, & Skin rush | Hu |
| *Pterocephalus frutescens* Hochst. ex A. Rich. | Dipsacaceae | H | Wound | Hu |
| *Rhamnus prinoides* L. Herit. | Rhamnaceae | Sh | Tonsillitis | Hu |
| *Rhus natalensis* Krauss | Anacardiaceae | T | Dizziness | Hu |
| *Ricinus communis* L. | Euphorbiaceae | Sh | Wound | Hu |
| | | | Rabies | Bo |

*Endemic plants