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Ethnobotanical survey of traditional medicinal plants used to treat human ailments in Arero District, Borena Zone, Ethiopia

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Abstract

Pastoralist communities have traditionally possessed extensive knowledge regarding the plants and grazing areas in their vicinity, acquired through continuous practice and meticulous observation. As members of the Borana pastoralist communities, the people residing in the Arereo District utilize a variety of plant resources found in their rangelands. In order to evaluate the traditional use of medicinal plants in treating human ailments in Arero District, Borena Zone, an ethnobotanical study was conducted. The primary objective of this study was to document the medicinal plants employed by the local community. Fifty-one key informants were purposefully selected to participate in the study. Data was obtained through the use of questionnaires, focus group discussions, and field observations. In the study area, a total of forty-four medicinal plant species belonging to thirty-six genera and twenty-four plant families, were identified and documented. These plants were reported to be used in the treatment of thirty-five different human ailments. Among the various plant parts used for medicinal purposes, roots were found to be the primary source of remedies (47.7%), followed by leaves (13.6%). Of the remedies documented, 59.7% were prepared for internal use, with oral consumption being the most common method (53.73%). Additionally, 40.3% of the remedies were intended for external applications. The decoction was the predominant method of remedy preparation, accounting for 41.8% of the remedies known in the study area. The findings indicated that the local community possessed valuable knowledge regarding the use, preparation, and application of medicinal plants for the treatment of human ailments. However, it was also noted that certain medicinal plants in the study area, such as Vachellia nilotica and Vachellia tortilis, were reported to be locally threatened. It is crucial to pay adequate attention to prevent further threats to these medicinal plants and to conserve them, along with the associated local knowledge. Efforts should be made to safeguard the medicinal plant resources in the study area, ensuring their sustainable use and preservation for future generations.

Keywords/Phrases: Borena, Human ailments, Indigenous knowledge, Medicinal plant, Traditional healers

1 Introduction

Plants play a crucial role in the lives of human beings, providing essential resources for their well-being and fulfilling their basic needs. The utilization of plants by humans can be traced back to the process of domestication, which originated about 10,000 years ago (Martin, 1995). Over time, indigenous communities have developed their own specific knowledge regarding the use, management, and conservation of plants in their local environments. This indigenous knowledge (IK) is continuously adapted to changing circumstances, passed down through generations, and deeply intertwined with cultural values (Cotton, 1996).

Ethiopia is recognized for its rich plant biodiversity, boasting approximately 6,000 species of higher

plants (Hedberg *et al*., 2009). Throughout various regions of the country, people have long relied on medicinal plants to treat human and animal ailments. Traditional Ethiopian medicine has relied heavily on the use of plants for centuries (Debela *et al*., 1999; Fullas, 2007), becoming an integral part of Ethiopian society due to its long-standing practice (Kaba, 1998). In fact, it has been estimated that around 80% of Ethiopians rely on traditional herbal remedies (Abebe, 1996). The high prevalence and interest in medicinal plants in Ethiopia can be attributed to their acceptability, accessibility, and biomedical benefits (Abebe, 2001).

The southern and southwestern regions of the country, known for their biological and cultural diversity, exhibit a particularly rich diversity of medicinal plants (Tadesse & Demissew, 1992). Knowledge and services related to traditional medicinal plants are passed down from family members, neighbors, and communities, ensuring their continuity across generations (Yirga, 2020).

Traditional healers and those who have benefited from these practices have been the primary disseminators of information regarding medicinal plants and their applications (Punjani, 2010). However, the restricted availability of this knowledge to the wider public has led to its concealment, making traditional medicinal plant knowledge and skills more hidden (Abbink, 1995). Consequently, the potential loss of this valuable knowledge looms as traditional healers and elderly community members pass away.

In Ethiopia, the documentation of local knowledge concerning traditional medicinal plants and their uses remains incomplete (Abbink, 1995; Getahun, 1974). As much of this knowledge is transmitted orally from one generation to the next, the disapproval of traditional medicine practitioners jeopardizes the future preservation of the country's cultural heritage (Kibebew, 2001).

The Borana pastoralists, with their diverse cultures, unique traditional practices, and distinct livelihood systems, utilize a variety of plants for traditional medicines, food, forage, construction materials, household implements and utensils, firewood, and more, much like other ethnic groups in Ethiopia. Additionally, certain plant species hold ritual and commercial significance and provide shade.

The Arero District, situated within the pastoralist areas of Borana, boasts a wealth of indigenous medicinal plant knowledge. Community members often rely on herbal remedies derived from medicinal plants to address a wide range of human ailments. However, the knowledge held by the community has been largely overlooked by researchers. The indigenous knowledge associated with the use and practices of medicinal plants in this region remains poorly documented, limited to traditional healers and a select group of community members. This situation poses a significant risk to the future preservation of medicinal plants, traditional knowledge, and their utilization. Therefore, the objective of this study was to assess and document the medicinal plants used in the treatment of human diseases and associated practices in the Arero District.

2 Research Methodology

2.1 Description of the Study Area

The study was carried out in Arero District, Borana Zone, Southern Ethiopia, as described by the Dalle (2020). Arero District is situated approximately 660 km south of Addis Ababa. Geographically, the district is located between $38^0$15' - $39^0$30' East longitude and $3^0$45' - $5^0$15' North latitude (Figure 1). It covers a total area of 3660 km^2 and exhibits a diverse landscape characterized by plains, undulating topography, hills, and gorges. The elevation of Arero District ranges from 700 to 1,600 meters above sea level.

The study area, as mentioned by the Dalle (2020), is primarily recognized for its semi-arid agroclimatic conditions. It experiences a bimodal rainfall pattern. Based on data obtained from the National Meteorological Agency (NMA, 2021) for the Yaballo Meteorology Station, the mean annual rainfall and temperature in the area are recorded as 603 mm and 20^0C, respectively.

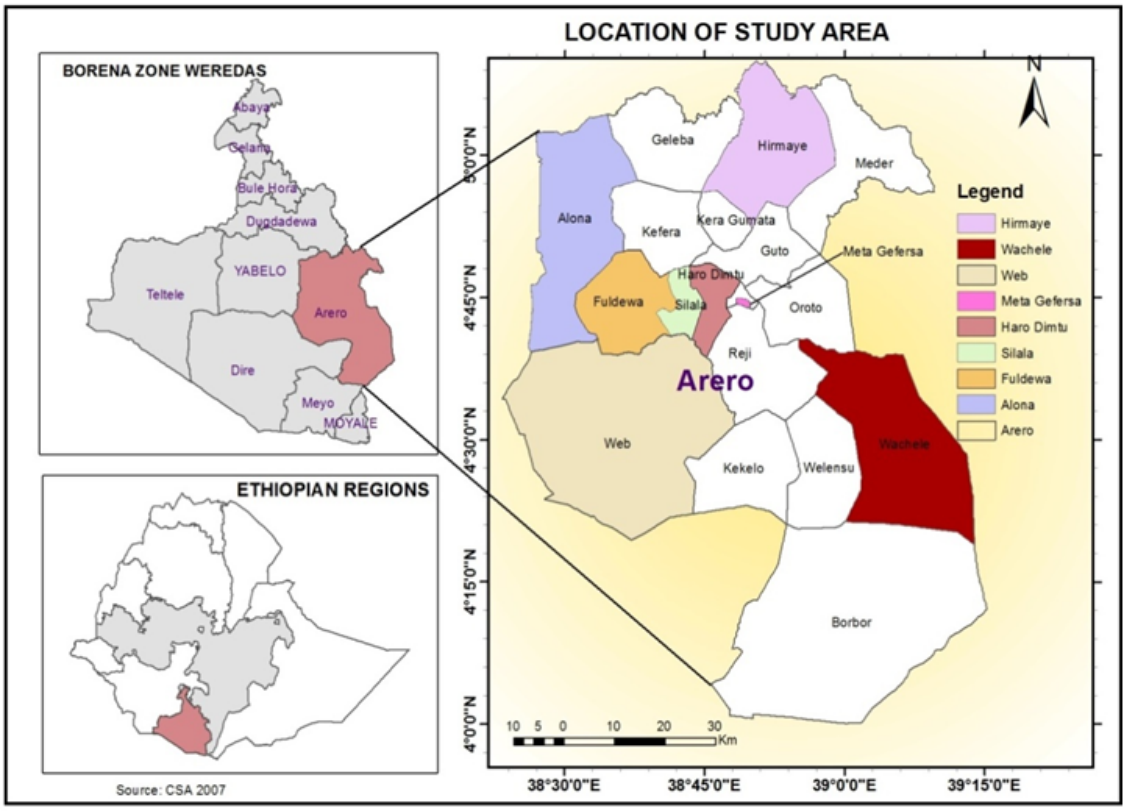

Figure 1. Map of the study area (right), Ethiopia (bottom left), Borena Zone (top left)

2.2 Sampling

For the sampling process, a total of fifty-one traditional healers (37 male and 14 female) residing in eight *Kebeles* within Arero District were purposefully selected, following the approach outlined by Martin (1995). The selection of traditional healers was based on information acquired from the elderly and local community leaders in the respective *Kebeles*. In accordance with the "Rule of Thumb'' for purposive sampling, which suggests a sample size of at least 10% of the population or 30 for smaller populations, a sample size of 30% of the total traditional healers (170) in the study area was deemed appropriate. Consequently, a proportional number of traditional healers from each *Kebele* were included in the sample (Table 1). The selection of key informants was based on their profile, experience, and history of practice.

Table 1. Number of traditional healers in the study area and sampled

Name of the *Kebeles*	Number of traditional healers in the *Kebele*	Number of traditional healers sampled
Alona	20	6
Fuldowa	16	5
Silala	23	7
Haro-dimtu	21	6
Mata-Gafarsa	24	7
Wachile	24	7
Web	19	6
Hirmaye	24	7
Total	171	51

2.3 Ethnobotanical Data Collection

To collect ethnobotanical data, standard methods of ethnobotanical techniques and herbarium preparation, as described by the Martin (1995) and Alexiades (1996), were employed. The techniques used included focus group discussions with various groups of people, including traditional healers, *Kebele* authorities, and elderly community members (both male and female). Semi-structured interviews with traditional healers and field observations were also conducted. The primary source of ethnobotanical data was the interviews conducted with the traditional healers.

During the interviews, the following information was gathered from the informants: human ailments treated by traditional healers using medicinal plants, local names of medicinal plants used for specific ailments, plant parts used for preparing remedies, methods of remedy preparation and administration, knowledge transfer related to medicinal plants, and threats to medicinal plants.

In addition to the interviews, a focus group discussion was conducted to rank the preference of medicinal plants for snake bites, which is a frequently occurring incidence in the area. The discussion also included topics such as knowledge transfer and threats to medicinal plants.

2.4 Data Synthesis or Analysis

Descriptive statistics were utilized to summarize and describe the collected ethnobotanical data, with percentages and frequencies used for data presentation. Microsoft Excel 2016 was employed to organize quantitative data, calculate proportions, and create tables and graphs. For the analysis of qualitative data obtained through interviews and focus group discussions, NVIVO 12, a software for qualitative data analysis, was utilized.

According to the traditional healers, snake bites were reported as the most prevalent incidence among community members seeking traditional medication. The preference ranking of five medicinal plants used for preparing remedies for snake bites was conducted by seven key informants, following the methodology outlined by Martin (1995). During the focus group discussion, the informants compared the given medicinal plants based on their knowledge of their effectiveness in treating the illness and assigned scores ranging from 1 to 5, with 5 indicating the most effective and 1 indicating the least effective. The scores assigned to each medicinal plant species were then totaled to determine the overall rank of preference.

Furthermore, a direct matrix ranking, a more complex version of preference ranking (Martin, 1995; Cotton, 1996), was performed to assign scores to seven medicinal plants reported to have multiple uses in addition to their medicinal value. The seven multipurpose plant species included *Boscia mossambicensis*, *Grewia tembensis*, *Grewia villosa*, *Lanea rivae*, *Pappea capensis*, *Vachellia nilotica*, and *Vachellia tortilis*. These plants were reported to be used for various purposes in the study area, such as forage, medicine, traditional cleansing, construction of houses or corrals, firewood, charcoal, farm and household implements, shade, rituals, and wild edible food. Seven randomly selected key informants (traditional healers) were asked to score each multipurpose plant based on its uses. The attributes considered were medicinal use, firewood, charcoal, construction, live fence, and fodder. Each key informant independently assigned scores ranging from 0 to 5 (where 0 = not used, 1 = less used, 2 = moderate, 3 = good, 4 = very good, and 5 = the best) for each medicinal plant in relation to its preferred uses. The scores given for each attribute and corresponding multipurpose plant species were summed up to obtain a total score for each plant. The seven multipurpose plant species were then ranked based on their respective total scores.

3 Results and Discussion

3.1 Demographic Feature of Informants

In this study, a total of informants participated. Among them, 72.54% were male, while 27.45% were female. The informants were categorized into three age groups for the collection of basic ethnobotanical data. Specifically, 7.84% were between 20 and 35 years old, 31.37% were between 36 and 55 years old, and 60.78% were above 55 years old (Table 2).

Table 2. Demographic profile of the informants

Demographic Attributes	Characteristics	Male	Female	Total	Percentage (%)
Sex:	Female	-	14	-	27.45
Sex:	Male	37		-	72.54
Age group:	20-35 years	4	-	4	7.84
	36-55 years	7	9	16	31.37
	Above 55 years	26	5	31	60.78
Literacy:	Illiterate	30	12	42	82.35
	Literate	7	2	9	17.64
Livelihood category:	Agropastoralist	4	2	6	11.76
	Pastoralist	33	12	45	88.24

3.2 Species Composition of Medicinal Plants

The plant family with the highest number of medicinal plant species in this study is Fabaceae, which includes eleven species. This is followed by Solanaceae with four species, Euphorbiaceae with three species, and Anacardiaceae, Apocynaceae, Capparidaceae, Cucurbitaceae, and Tiliaceae with two species each. Additionally, sixteen other families were represented by one species each (Table 3).

The ecological success of the Fabaceae family can potentially be attributed to its ability to form root nodules containing nitrogen-fixing bacteria, although it is important to note that not all Fabaceae species fix nitrogen. This finding aligns with the results of previous studies conducted by Hunde (2001), Teklehymanot & Gidey (2007), Amenu (2007), Tolosa (2007), Yineger & Yewhalaw (2007), and Tamene (2011), where the family Fabaceae also emerged as the predominant family of medicinal plants in their respective study areas.

Table 3. Plant families, number of medicinal plant species and proportions

Plant family	Species richness	Percentage	Plant family	Species richness	Percentage
Fabaceae	11	25.0	Ascelpiadaceae	1	2.3
Solanaceae	4	9.1	Asparagaceae	1	2.3
Euphorbiaceae	3	6.8	Asteraceae	1	2.3
Anacardiaceae	2	4.5	Balantaceae	1	2.3
Apocynaceae	2	4.5	Boraginaceae	1	2.3
Capparidaceae	2	4.5	Ebenaceae	1	2.3
Cucurbitaceae	2	4.5	Lamiaceae	1	2.3
Tiliaceae	2	4.5	Plumbaginaceae	1	2.3
Acanthaceae	1	2.3	Rutaceae	1	2.3
Aloaceae	1	2.3	Sapindaceae	1	2.3
Amaryllidaceae	1	2.3	Sapindaceae	1	2.3
Apiaceae	1	2.3	Vitaceae	1	2.3
Total	44	100.0	Total	44	100.0

Because of the remote nature of the study area and limited access to medical facilities, pastoralists in the study area heavily rely on traditional remedies (Dale *et al*., 2005). The medicinal plants documented in the current study were utilized for the treatment of 35 different human ailments (see Annex). As the

community in the study area consists of pastoralists, they do not cultivate medicinal plants in gardens. Instead, these medicinal plants are sourced from the wild. Due to the nomadic lifestyle of pastoralists, who move with their cattle in search of pasture and water, there is no practice of cultivating medicinal plants near residential areas.

Among the total documented medicinal plant species in the study area, 47.7% were shrubs, 29.6% were trees, 13.6% were herbs and 9.1% were lianas (Figure 2).

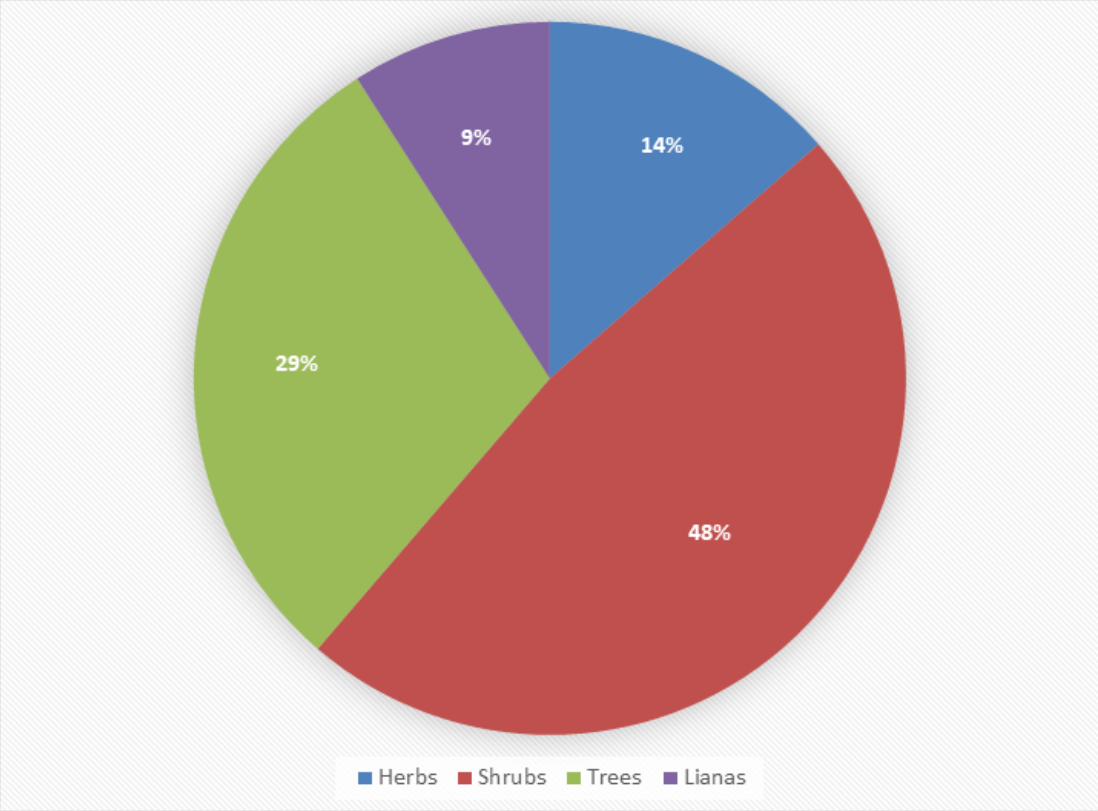

Figure 2. Proportion of growth forms of medicinal plants documented in the study area

Shrubby medicinal plant species were found to be prevalent in the study area and were frequently used due to their year-round availability. This finding is consistent with a study conducted by Hunde (2001) in Boosat District, where shrubs ranked first (at 59%), followed by herbs (14%). Similar findings were reported by Tamene (2000) in semi-wet lands of Cheffa area in South Wello, Tolasa (2007) in Gimbi District of western Wellega, Yineger & Yewhalaw (2007) in Sekoru District, and Tamene (2011) in Wondo-Genet Natural Forest and adjacent *Kebeles*, where shrubs were the most commonly encountered forms of medicinal plants. Additionally, Bekele & Ramachandra (2015) identified the widespread utilization of shrubs for medicinal purposes in the Dugda-Dawa and Abaya District of Borana Zone. Their study reported that shrubs, trees, herbs, and climbers accounted for 45.2%, 26.7%, 18.5%, and 9.6% of the total medicinal plants, respectively. However, the findings of Gebre (2005) in Konso Special District of SNNPRS and Amenu (2007) in Ejaji of Chelia District in West Shewa differed from these findings, reporting that herbaceous plants were the most commonly harvested for medicinal purposes. This disparity could be attributed to agroecological variations in these areas.

3.3 Medicinal Plant Parts Used for Remedy preparation

Among the medicinal plants documented, roots were widely used for the preparation of remedies, accounting for 47.7% of the total medicinal plants, followed by leaves (13.6%). Medicinal plants with barks being used accounted for 9.1%, while both roots and

leaves were used in 9.1% of cases, and other plant parts accounted for 9.1% (Figure 3). These findings contrast with previous studies conducted by Abebe & Hagos (1991), Tamene (2000), Amenu (2007), Tolosa (2007), and Yineger & Yewhalaw (2007), which found that leaves were the most commonly used plant parts for remedy preparations to treat health problems, followed by roots.

The variation in the relative abundance of herbaceous and woody medicinal plants resulting from agroecological differences and factors such as grazing and encroachment may contribute to these differences. However, it is important to note that the harvesting of plant parts such as roots and barks may have a negative impact on the survival and sustainability of medicinal plants in the study area.

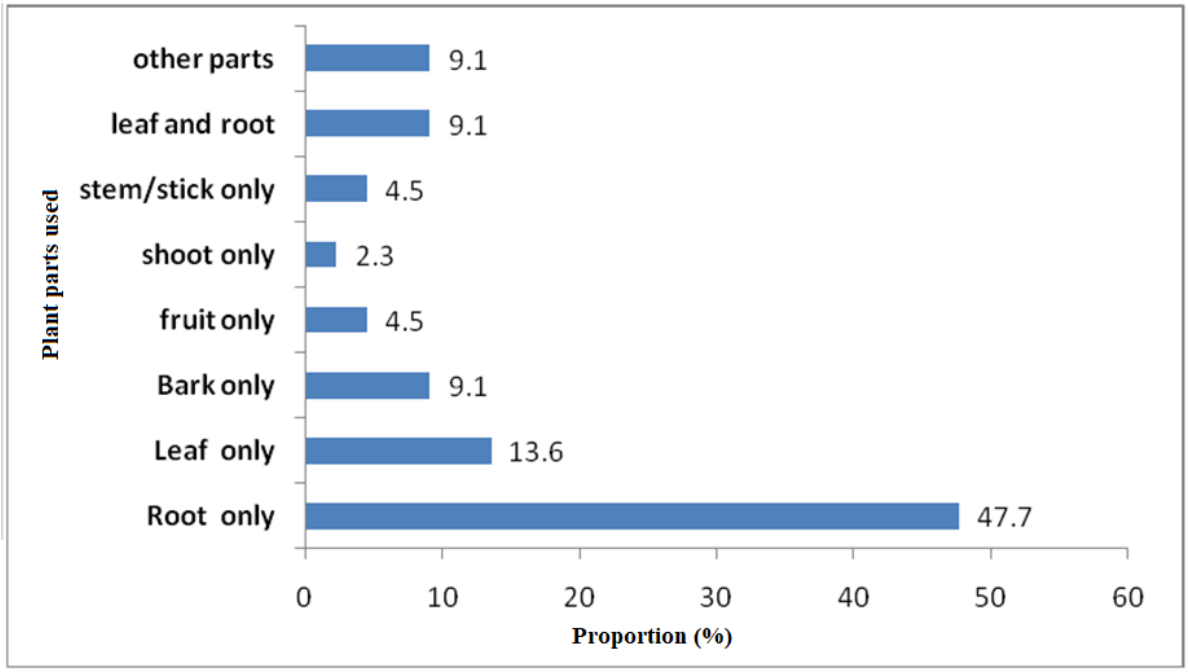

Figure 3. Medicinal plants parts used for preparation of remedies

3.4 Method of Preparation of Remedies

According to Dale *et al*. (2005), Borana pastoralists extensively utilize the available plant resources in their rangelands. It was observed that certain medicinal plants were used to prepare remedies for multiple diseases. The preparation of remedies from these medicinal plants can involve various methods. For example, a leaf of *Solanum giganteum* is rubbed to treat nasal bleeding, while decoctions from the same plant are used to treat the evil eye. Similarly, the latex at the shoot tip of *Croton macrostachyus* is used to treat *Tenea corporis*, while decoctions from the root of the same plant are used for rabies and snake bites, and the bark of *Croton macrostachyus* is utilized for intestinal parasites. In the current study area, decoction was found to be the most commonly employed method for remedy preparation, accounting for 41.8% of the remedy preparation methods, followed by rubbing, juice extraction, and hot and cold infusions (Figure 4).

It is important to note that the methods of remedy preparation utilized by communities may vary from one place to another or from one district to another. For instance, previous studies conducted by Abebe & Hagos (1991), Tamene (2000), Yineger & Yewhalaw (2007), Amenu (2007), and Tolosa (2007) have reported that pounding and powdering, or crushing and squeezing, were the most commonly used methods for remedy preparation.

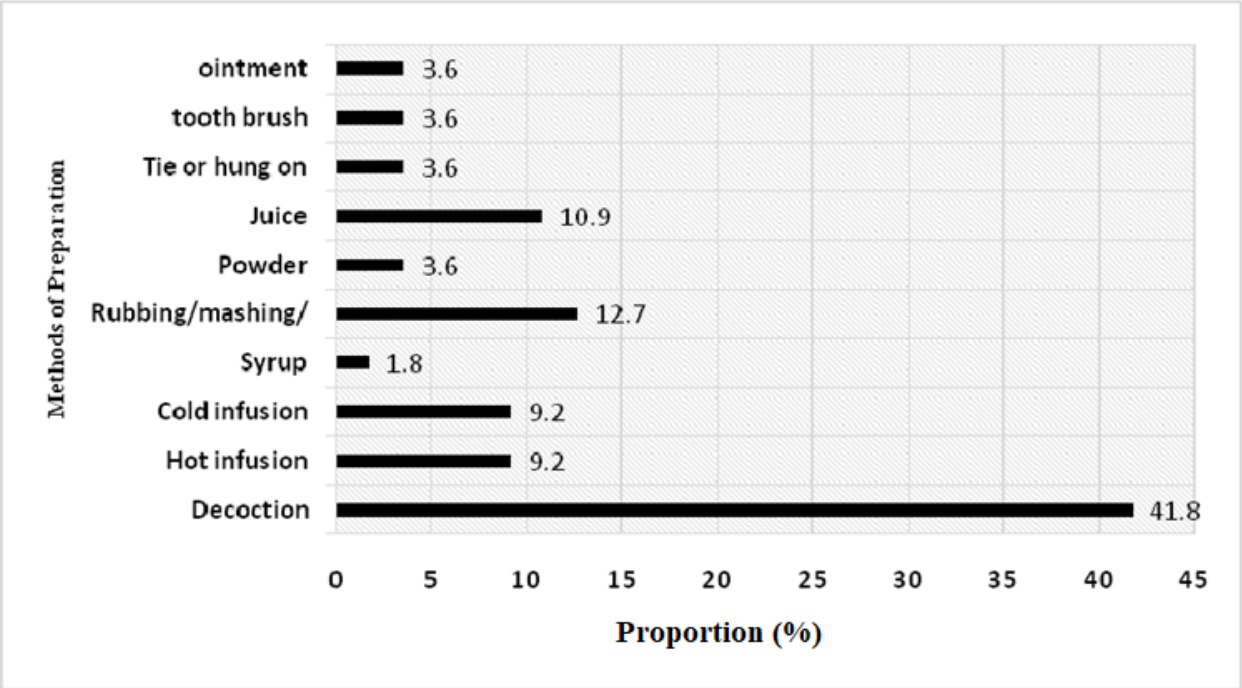

Figure 4. Modes of remedy preparations

Remedies in the study area were prepared either from a single medicinal plant or a combination of multiple medicinal plant species. The analysis revealed that 88.46% of the remedies were prepared from a single medicinal plant, while 11.54% were prepared from a combination of plants. This finding aligns with the results of Hunde (2001) and Tolasa (2007), where a higher proportion of remedies were also prepared from a single medicinal plant.

Borana pastoralists extensively utilized the available plant resources in their rangelands (Dale *et al*., 2005). Certain medicinal plants were found to be used for the preparation of remedies targeting multiple diseases. These remedies can be prepared using different methods. For example, the leaf of *Solanum giganteum* is rubbed to treat nasal bleeding, while decoctions from the same plant are used to address the evil eye. Similarly, the latex found at the shoot tip of *Croton macrostachyus* is used to treat *Tenea corporis*, whereas a decoction made from the root of the same plant is employed for the treatment of rabies and snake bites. Additionally, the bark of *Croton macrostachyus* is utilized for addressing intestinal parasites.

Regarding the forms in which medicinal plants were used, the majorities (77.27%) of the encountered plants in the study area were used in fresh form, while 22.73% were used both in fresh and dry conditions (Table 4). This reliance on fresh plant material limits the availability of medicinal plants during different seasons of the year. During the dry season, community members reported having to travel long distances in search of specific medicinal plants, as they were not readily available in the vicinity of their homes.

Table 4. List of medicinal plants in the study area used in fresh and both fresh & dry forms

Medicinal Plants used in fresh form	Medicinal plants used in both fresh and dry forms
Albizia anthelmintica (A. Rich.) Brongn.	*Acokanthera schimperi* (A.DC.) Schwevinf
Aloe secundiflora Engl.	*Boscia mossambicensis* Klotzsch.
Asparagus racemosus Wild.	*Carissa edulis* Vahl.
Balanites aegyptica (L.) Del.	*Croton dichogamus* Pax
Barleria spinesepala (Ait.) Benth.	*Croton macrostachyus* Del.
Bidens hildebrandtii O. Hoffm.	*Ehretia cymose* Honn.
Calpurnia aurea (Ait.) Benth.	*Euclea divinorum* Heirn
Capparis tomentosa Lam.	*Grewia tembensis* Fresen
Cissus quadrangularis L.	*Grewia villosa* Wild
Crinum abyssinicum Hochst. Ex A. Rich	*Zanthoxylum chalybeum* Engl.
Cucumis dipsaceus Ehrenb. ex Spach	
Dichrostachys cinerea (L) Wight et Arn.	
Euphorbia nubica NE.Br.	
Euphorbia schizacantha Pax.	
Gnidia stenophylla Gilg.	
Indigofera volkensii Taub.	
Kedrostis pseudogijef (Gilg.) C. Jiffrey	
Lanea revea (Chiov.) Sacleux	
Ocimum lamiifolium Hochst. Ex Benth	
Ormocarpum trichocarpum (Taub.) Engl	
Pappea capensis Eckl. & Zeyh.	
Plumbago zeylanica L.	
Searsia tenuinervis (Engl.) Moffett	
Senegalia brevispica (Harms) Seigler & Ebinger	
*Senegalia mellifer*a (Vahl) Seigler & Ebinger	
Solanum giganteum Jacq.	
Solanum incanum L.	
Solanum somalense Franchet	
Steganotaenia araliacea Hochst	
Sterculia stenocarpa H. Winkler	
Vachellia etbaica (Schweinf.) Kyal. & Boatwr.	
Vachellia nilotica (L.) P.J.H.Hurter & Mabb.	
Vachellia tortilis (Forssk.) Galasso & Banfi	
Withania somnifera (L.) Dunal	

3.5 Routes of Administration of Remedies

Internal routes of administration accounted for the highest proportion (59.7%) compared to external modes of administration (40.3%). Among the internal routes, oral application (53.73%) of remedies was relatively more common. Similarly, painting and washing (7.46% each) were relatively more prevalent among the external routes of administration (Table 5).

For remedies administered orally, it was observed that they were often consumed with milk tea, curdled milk, honey, salts, or '*Maqado*' and sugar. These additional ingredients were used to mitigate the smell, discomfort, potency, and taste of the medicine.

Table 5. Modes of administrations/applications of remedies

Mode of use	Routs of application	Percentage (%)
Internal	Oral (solid, semi-solid, or liquid form)	53.73
	Inhale vapor of decoction, infusion, or smoke	5.97
External	Chewing & spitting on the affected body part	5.97
	Steam or vapor bath	5.97
	Poultice	2.99
	Hanging	2.99
	Compressing	2.99
	Painting or rubbing	7.46
	Washing	7.46
	Using the plant as a tooth brush	4.47

Remedies administered by traditional healers often lack precise measurements and standards for preparation and administration. Measurements are often estimated using terms such as hand full, pinch, finger length, or a number of leaves. Oral remedies are measured using units like '*kookii*', '*nyaree*', '*galasa*', and '*Xaasaa*' (cup, glass, or tin). Furthermore, the administration and measurements can vary among different traditional healers. This finding is consistent with the studies conducted by Getahun (1976), Sofowora (1993), and Abebe (1986), which also highlighted the lack of precise measurements and standardization as a drawback in the traditional healthcare system.

Traditional healers believe that if a person is given an overdose of a remedy, consuming milk can counteract its effects. Additionally, adverse effects of traditional medicines can be mitigated or regulated by consuming milk or other additives such as honey, coffee, or tea. Similar results have been reported by Giday *et al*. (2009), Tamene (2000), and Amenu (2007). Abebe (1986) also identified the use of additive substances in the preparation of herbal remedies.

Informants mentioned that there are specific pre- or post-conditions that patients need to fulfill before or after taking certain remedies. Failure to meet these conditions can lead to severe adverse effects or even death. For instance, a patient using *Aloe secundiflora* should avoid consuming meat and milk until the treatment is completed, as it may have fatal effects. There are also situations where patients are advised not to look into water or a mirror, avoid washing or bathing, and expose themselves to the sun for specific periods of time continuously for seven to fourteen days while undergoing treatments for rabies. Similar practices have been reported by Amenu (2007) and Tolosa (2007).

Certain medicinal plants are well-known among community members, while others are kept secret and known only by traditional healers. For example, *Ocimum lamifolium*, *Solanum giganteum*, *Euphorbia schizacantha*, and *Croton macrostachyus* are commonly used at home by community members for preparing remedies to treat febrile illness, nasal bleeding, influenza (common cold), and ringworm, respectively. However, the treatment of other ailments such as evil eye, hemorrhoids, gonorrhea, ulcers, rabies, and snake bites is entrusted to traditional healers who specialize in preparing remedies based on the stage, complexity, and condition of the patients. Similar practices have been reported in the studies conducted by Tolosa (2007) and Tamene (2011). Therefore, depending on the nature or type of health problem, local people in the study area attempt to manage their health issues at home before seeking other options.

The diagnosis and treatment methods employed by traditional healers depend on the specific ailment. When a patient visits a local traditional healer, the practitioner typically conducts an interview and vi-

sually inspects the patient to identify the illness or health problem. The interview focuses on gathering information about the symptoms and the onset of the health problem. The practitioner then visually examines the patient's eyes, tongue, skin color, urine color, body temperature, and checks for sores or wounds before preparing and prescribing remedies.

According to the respondents, three main factors influence their choices for treatment when they fall ill. These factors include the ease of access to treatment, the perceived effectiveness of the treatment, and the cost associated with it. In terms of access, local healers are conveniently located within reachable distances from modern healthcare institutions in the locality.

In this community, there is a traditional rule of 'pay once and be treated until you are cured' that is followed by traditional healers and their clients. This finding is consistent with the study conducted by Tolosa (2007). According to this rule, once payment is made for the treatment of a particular health problem, no further payment is requested by the traditional healer until the patient is cured. Clients typically present coffee beans and chewable tobacco ('*Buna-fi-tambo*') as a gift or payment after receiving treatment from a local healer. This gift is locally known as '*Darara*'. After the patient recovers from their illness, it is customary for them to invite the healer to their home, hold a '*Bunaqala*' ceremony, and receive blessings from the healer. In cases where a patient is unable to make a payment, they may offer a few blades of fresh grass to the healer as a sign of respect and acknowledgment of the treatment. This is known as '*Irressaa*' in the local context. In some regions of the country, monetary payments are made instead. According to the informants, if the practice of '*Darara*' is avoided, they believe that the curative value of the remedies will fail, and the disease may reappear in the patient.

3.6 Medicinal Plants Knowledge Transfer

According to the information obtained from the local administration in 3.6 of the study, it was found that there is a higher number of male traditional healers compared to female traditional healers in the study area. The transfer of medicinal plant knowledge and healing practices among traditional healers is typically passed down to a family member or a close relative. However, the choice of individuals for knowledge transfer is not the same among family or community members. In this context, parents (traditional healers) in the study area tend to prefer boys over girls for the transfer of medicinal plant knowledge. This preference is attributed to boys spending more time on farms and fields with their parents compared to girls. Consequently, boys have a better opportunity to learn about various medicinal plants in their locality while engaging in activities with traditional healers.

The informants have indicated that the transfer of medicinal plant knowledge to males holds greater importance compared to females. This belief stems from the assumption that there is a higher likelihood of losing medicinal plant knowledge within the community or village when females marry individuals from outside their community and relocate to other areas. However, there are exceptions where females in the community may have the chance to acquire medicinal plant knowledge from their healer parents and be entrusted to practice healing. This typically occurs when they are trusted by their parents to maintain secrecy about the knowledge and healing practices or when there are no boys in their family. This situation has contributed to a relatively higher number of male healers in the study area. Similar findings were reported by Tamene (2011) and Teklehaymanot & Giday (2006), who noted that traditional knowledge is primarily passed down from a parent to an elder son. Tamene (2011) also observed that female traditional healers tend to stay within close proximity to their residence or village and do not frequently venture far in search of medicinal plants. Thus, the medicinal plant knowledge of female traditional healers is often limited to cultivated plants in their home gardens or those found in the vicinity of their homesteads.

Most traditional healers prefer not to impart knowledge about medicinal plants and healing practices to their family members at a young age. Instead, they select a trusted individual within the family whom they believe will maintain secrecy regarding medicinal plant knowledge and traditional healing practices. Training typically begins when the traditional healer is advanced in age and can no longer travel to search

for medicinal plants in the field. The chosen individual is gradually trained by allowing them to search for and collect medicinal plants from the garden or field, but they are not initially allowed to perform healings.

A person who receives medicinal plant knowledge and healing practice from their healer parent is required to take a solemn oath (referred to as '*Kaku*' locally) to keep all the acquired knowledge about medicinal plants and traditional medications confidential. Finally, the individual who is trained to become a healer receives blessings from their parent or transferrer, which empowers them to administer traditional medicines to patients in need, carrying the curative abilities inherited from their parent.

According to key informants, the transfer of knowledge regarding medicinal plants and traditional medicine in the study area faces challenges due to the lack of interest displayed by most youths in acquiring traditional medicine knowledge. It was mentioned that this disinterest among the younger generation may be attributed to the influence of Western religions, modern education, the proliferation of health centers, and the community's attitude towards modern medicine. These findings align with the works of Gebreegziabher (1991), Hunde (2001), Gebre (2005), and Tolosa (2007), who have reported that older individuals possess relatively more knowledge about medicinal plant use compared to younger members of the same community. This indicates a decline in traditional medicine knowledge, alongside the practice of secrecy. The diminished knowledge among younger community members may be linked to their lack of interest in traditional medicines, which can be attributed to the impact of modernization, including increased access to modern education and health services.

3.7 Preference Ranking

Among the medicinal plants used to treat snake bites in the study area, certain plants are more popular and preferred. According to the preference ranking results (Table 6), *Senegalia mellifera* holds the highest preference for treating snake bites. It is ranked first among the five medicinal plants used for this purpose in the area. Following *Senegalia mellifera*, *Dichrostachys cinerea* and *Senegalia brevispica* are ranked second and third, respectively, indicating their relatively high preference. On the other hand, *Kedrostis pseudogijef* and *Searsia tenuinervis* are ranked fourth and fifth, respectively, suggesting their lower preference compared to the other plants.

Not all medicinal plants contain the same content and concentration of chemical compounds or phytochemicals. The preference ranking of medicinal plants based on their efficiency reveals that traditional healers in the study area, drawing from their life experiences, have identified the most effective medicinal plants for addressing specific ailments.

Table 6. Preference ranking of medicinal plants used to treat snake bite

Factors	Informants							Total	Rank
	I1	I2	I3	I4	I5	I6	I7		
Senegalia brevispica	3	2	3	4	3	3	4	22	3^{rd}
Senegalia mellifera	5	5	4	2	5	5	5	31	1^{st}
Dichrostachys cinerea	4	4	5	5	4	4	3	30	2^{nd}
Kedrostis pseudogijef	1	1	0	3	4	2	1	12	4^{th}
Searsia tenuinervis	2	3	1	1	0	0	2	9	5^{th}

Note: I = Informant

3.8 Direct Matrix Ranking

Despite their medicinal value, several medicinal plants in the study area have been reported to serve multiple purposes beyond medicine. These include forage, traditional cleansing, construction of houses and corrals, firewood, charcoal, farm or household implements, shade, rituals, and as a source of edi-

ble wild plants. Based on the direct matrix ranking, *Lanea rivae*, *Vachellia tortilis*, and *Grewia villosa* emerged as the top three preferred medicinal plant species due to their diverse range of uses (Table 7). Conversely, *Vachellia nilotica* received the lowest score and was ranked last, indicating its relatively lower preference compared to other multipurpose plants listed in the table. In terms of total scores in the direct matrix (Table 7), these multipurpose medicinal plants were primarily favored for their forage value, followed by their use in house and corral construction, and as a source of medicine.

Table 7. Direct Matrix ranking of seven selected medicinal plants

Multipurpose plants	Forage	Medicine	Traditional cleansing	House/Corrals construction	Firewood	Charcoal	Farm/House implements	Shade tree	Ritual	Wild edible	Total Score	Rank
Boscia mossambicensis	21	16	17	24	10	10	6	30	35	0	169	6^{th}
Grewia tembensis	31	21	0	21	28	20	22	0	0	30	173	5^{th}
Grewia villosa	28	35	0	28	17	4	21	0	30	20	183	3^{rd}
Lanea rivae	35	30	35	26	13	0	27	0	20	19	205	1^{st}
Pappea capensis	35	28	0	12	35	12	23	0	0	32	177	4^{th}
Vachellia nilotica	12	13	0	35	15	35	24	28	0	0	162	7^{th}
Vachellia tortilis	22	17	13	35	19	35	20	35	0	0	196	2^{nd}
Total Score	184	160	65	181	137	116	143	93	85	101		
Rank	1^{st}	3^{rd}	10^{th}	2^{nd}	5^{th}	6^{th}	4^{th}	8^{th}	9^{th}	7^{th}		

According to Dale *et al*. (2005), Borana pastoralists extensively utilize the available plant resources in their rangelands, with nearly half of the plant species in Borana serving multiple purposes, similar to other regions in the country. While medicinal value is the primary use category for many indigenous rural communities (Coe & Anderson, 1999), it ranks second in importance for the community in the present study area. The local community exhibits a high dependence on plant resources for forage, reflecting the area's predominant livestock production system. This finding aligns with the conclusions drawn by Dale *et al*. (2005).

3.9 Threats to Medicinal Plants and Associated Knowledge

Herbal remedies hold significant importance for the rural population in Ethiopia, as modern medications are often inaccessible or prohibitively expensive. Abebe (1996) reported that approximately 80% of Ethiopians rely on traditional herbal remedies, and this also holds true for the pastoralist community in the current study area. Traditional healers in the area express concerns about the gradual decline of some of the most beneficial medicinal plants. Limited efforts have been made to conserve medicinal plants in the study area, as observed by key informants and through personal observations. Human-induced factors, compounded by prolonged dry seasons, pose threats to the survival of medicinal plant species. Livestock grazing, bush encroachments, wood cutting for construction, charcoal production, and firewood collection were identified as major threats to medicinal plants in the area. Among these threats, livestock grazing and charcoal production ranked first and second, respectively, based on their severity (Table 8).

The prevalence of woody medicinal plants (shrubs and trees) in the study area, compared to herbaceous species, suggests that herbs are more vulnerable to various hazards such as livestock grazing, trampling of seedlings, climate change, and encroachment. Traditional healers in the area employ several methods, such as crushing and storing powdered forms of medicinal plants, to preserve the ingredients when they are unable to obtain fresh plants during the dry season. This finding is consistent with the research conducted by Duguma & Mesele (2019).

Table 8. Factors threatening medicinal plant

Factors	Informants						Total	Rank
	I1	I2	I3	I4	I5	I6		
Charcoal production	5	7	6	7	6	7	38	2^{nd}
Cultural taboo	2	1	2	1	1	1	8	6^{th}
Firewood collection	4	5	5	4	2	3	23	4^{th}
House construction	6	4	4	5	3	4	26	3^{rd}
Livestock grazing	7	6	7	6	7	6	39	1^{st}
Over utilization	3	3	3	3	5	5	22	5^{th}

Note: I = Informant

Moreover, cultural beliefs and traditional practices in the study area may have an impact on medicinal plants, as well as the associated local knowledge and practices. Key informants have revealed that medicinal plant knowledge and associated practices are often kept secret by traditional healers, with the information being shared only among practitioners. Traditional healers refrain from disclosing the names of medicinal plants or showing the actual plants to patients, believing that the effectiveness of traditional remedies would diminish if patients were aware of the plant sources. In some cases, traditional healers assign names to medicinal plants by adding the prefix '*Qorsa*' to the name of the corresponding illness, aiding in their identification. For example, a plant used to treat Mich is named '*Qorsa Michi*', signifying the medicine for Mich.

Lack of conservation efforts for ethnomedicinal plant species, despite their perceived importance, has also been highlighted by the traditional healers in the study area.

4 Conclusion

The pastoral community of Arero District possesses a rich indigenous knowledge of medicinal plants and traditional medicine, which they rely on to address a wide range of ailments. Despite the availability of modern medicine, traditional medicine remains highly valued due to its affordability, accessibility, therapeutic efficacy, and cultural significance. Traditional healers play a crucial role in simplifying healthcare complexities within the community. However, the lack of standardized dosing of remedies should be addressed, as it may pose risks to patients' health, potentially leading to fatal outcomes.

The knowledge of medicinal plants is primarily limited to traditional healers and a few elderly individuals within the community. The secretive nature of medicinal plant knowledge, coupled with gender biases and a lack of motivation, poses a threat to the preservation of local medicinal plant knowledge and practices in the study area. Without appropriate interventions, there is a risk of losing this valuable knowledge in the near future, exacerbated by the oral transmission of knowledge. It is important to recognize that medicinal plants not only serve as a source of traditional medicine but also hold potential for the development of new drugs. However, numerous medicinal plant species are reported to be under threat from factors such as encroachment, climate change, overharvesting, fire, and overgrazing. Traditional healers in the study area have also acknowledged their limited involvement in conservation activities for medicinal plants in their surroundings. To ensure sustainable management of the pastoral system and improve healthcare within the pastoralist

community, development programs should prioritize the sustainable use and conservation of plant resources, with a specific focus on medicinal plants.

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Conflict of Interest

The authors declares that there is no conflict of interest.

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Annex

List of medicinal plant species encountered in the study area, growth form, and use (S = Shrub, T = Tree, H = Herb, C = Climber, WC = Woody Climber)

Scientific name	Vernacular name	Plant family	Growth form	Plant parts used	Ailments treated	Application
Acokanthera schimperi (A.DC.) Schwevinf	Qaraaruu	Apocynaceae	T	Root & Stem	Rabies	Taking an extract/juice of the plant orally.
Albizia anthelmintica (A. Rich.) Brongn.	Awaachoo	Fabaceae	S	Root	Liver disease, Impotence, & Gonorrhea	Washing body with its decoction, inhaling the vapor, and drinking a cup of it daily for 3-7 days.
Aloe secundiflora Engl.	Hargeessa	Aloaceae	S	Leaf & Root	Rabies, Sinus, Common cold, Eye disease, & Cancer	Ingesting hot infusion mixed with *Panicum ruspolii* bark for 3-7 days to treat Rabis; ingesting cold infusion & placing few drops of its latex on the head to treat Sinus Common cold, & Eye disease; & ingesting decoction with *Croton macrostachyus* bark for 7 days to treat Cancer.
Asparagus racemosus Wild.	Sariitii	Asparagaceae	C	Leaf	Skin burns	Rubbing leaf and mounting on a burned area.
Balanites aegyptica (L.) Del.	Baddanalu'oo	Balantiaceae	T/S	Root	Torn removal and torn wound	Chewing/mashing and mounting on a wound.
Barleria spinesepala (Ait.) Benth.	Qilxiphee	Acanthaceae	H	Root	Prolonged diarrhea and vomiting	Taking the decoctions with yoghurt or curdled milk.
Bidens hildebrandtii O. Hoffm.	Abunee	Asteraceae	S	Root & Leaf	Common cold & Skin infection	Ingesting decoction orally to treat Common cold; and washing an infected body parts with cold infusion for 3 days to treat Skin infection.
Boscia mossambicensis Klotzsch.	Qalqacha	Capparidaceae	T	Bark	Hemorrhoid & Evil eye	Ingesting decoction with juice from *Solanum incanum* root to treat Hemorrhoid; & ingesting tea made from the powder to treat Evil eye.
Calpurnia aurea (Ait.) Benth.	Ceekataa	Fabaceae	S	Leaf	Ecto-parasites (ticks, mites, bedbugs, fleas)	Washing cloths & beds with the cold infusion mixed with salt.
Capparis tomentosa Lam.	OgooraGaalaa	Capparidaceae	S	Root	Skin rush and body pain	Inhaling hot infusion vapor, washing infested body part with it, and drinking small amount.
Carissa edulis Vahl.	Dhagamsa	Apocynaceae	S	Root	Glandular swelling, Headache, & Toothache	Ingesting decoction daily for 7 days to treat Glandular swelling & Headache; and putting hot/boiled root on tooth during the tooth pain.
Cissus quadrangularis L.	Cophiisoodduu	Vitaceae	WC	Root	Hemorrhoids	Ingesting decoction orally.
Crinum abyssinicum Hochst. Ex A. Rich	Butewarabesaa	Amaryllidaceae	H	Root	Rabies	Taking a cupful of cold infusion, that was left for 2-3 days, daily for 7 to 14 days.
Croton dichogamus Pax	Mookofa	Euphorbiaceae	S	Root	Common cold; Allergy	Taking a hot infusion mixed with milk.
Croton macrostachyus Del.	Makkaniisa	Fabaceae	T	Shoot, Root, & Bark	Rabies; Snake bite, Intestinal parasites including *Tenea corporis*, & Cancer	Rubbing a sap on infected body part until recovery to treat Rabies & Snake bite; and taking decoction orally for 3-7 days to treat *Tenea corporis*, other intestinal parasites, & Cancer.
Cucumis dipsaceus Ehrenb. *ex* Spach	Buratee	Cucurbitaceae	C	Fruit	Stomachache & Breast ache	Ingest decoction to treat Stomachache; & heating the fruits & painting the hot sap on the injured breast to treat Breast-ache.
Dichrostachys cinerea (L) Wight et Arn.	Jirimee	Fabaceae	S	Leaf & Root	Wound	Washing the wounded part of the body with a hot infusion
Ehretia cymose Honn.	Ulaagaa	Boraginaceae	S	Root	Liver disease	Inhaling decoction vapor, wash the body with its water, & drink some amount for 5-7 days.
Euclea divinorum Heirn	Mi'eessaa	Ebenaceae	T/S	Root	Mitch	Taking droplets of water diluted powder orally.
Euphorbia nubica NE.Br.	Aannoo	Euphorbiaceae	S	Root, Shoot, & Bark	Rabies, Stomachache, Menstruation irregularity, Gonorrhea, & Common cold	Ingesting decoction mixed with milk to treat these health problems.

Scientific name	Vernacular name	Plant family	Growth form	Plant parts used	Ailments treated	Application
Euphorbia schizacantha Pax.	Harkeena	Euphorbiaceae	S	Root	Gonorrhea & Common cold	Taking the decoction mixed with milk for 3 days.
Gnidia stenophylla Gilg.	Aarsaa	Ascelpiadaceae	H	Root	Gonorrhea	Drinking a cup of decoction every morning for 7-14 days.
Grewia tembensis Fresen	Dheekkaa	Tiliaceae	S	Stem	Magic; Evil spirit	Brushing teeth with stick of the plant when needed
Grewia villosa Wild	Ogomdii	Tiliaceae	S	Root	Snake bite	Taking cold infusions orally every day till recovery.
Indigofera volkensii Taub.	Gurbiihoolaa	Fabaceae	H	Leaf	Bleeding due to cut of body part	Mounting mashed leaves on the injured body part.
Kedrostis pseudogijef (Gilg.) C. Jiffrey	Gaaleeadii	Cucurbitaceae	C	Stem	Snake bite	Applying the exudates on the affected body part for 3 days.
Lanea revea (Chiov.) Sacleux	Handaraka	Anacardiaceae	T	Bark	Abdominal Pain	Taking the juice extract during the pain.
Ocimum lamiifolium Hochst. Ex Benth	Hancabbii	Lamiaceae	H	Leaf	Fibril illness	Applying cold infusion on body or drink with coffee until recovery.
Ormocarpum trichocarpum (Taub.) Engl	Buutiyyee	Fabaceae	T	Root	Intestinal parasite & Ulcerated wound	Taking 1-2 water cups of the decoction orally before having a breakfast for 3 days to treat Intestinal parasite; and applying a chewed root on wound for 3 days to treat Ulcerated wound.
Pappea capensis Eckl. & Zeyh.	Biiqqaa	Sapindaceae	T	Bark	Rabies & Snake bite	Taking hot infusion orally.
Plumbago zeylanica L.	Igaaji	Plumbaginaceae	H	Shoot	Glandular swelling	Mounting mashed leaf on swelled part or wound for 2 days in 2–3-days gap.
Searsia tenuinervis (Engl.) Moffett	Daboobessa	Anacardiaceae	S	Leaf	Skin allergy	Applying juice on infected area at night before bed.
Senegalia brevispica (Harms) Seigler & Ebinger	Hammareessa	Fabaceae	T	Root	Epilepsy	Applying 2-3 drops of extract/juice through nose
Senegalia mellifera (Vahl) Seigler & Ebinger	Saphansagurracha	Fabaceae	S	Root	Snake bite	Chewing & spitting juice/extract on an infected body part
Solanum giganteum Jacq.	Hiddiiloonii	Solanaceae	S	Leaf & Root	'*Dingetegna*', Nasal bleeding, & Evil eye	Rubbing and smelling leaf immediately to treat '*Dingetegna*' & Nasal bleeding; and taking a tea cupful of decoction of root with milk orally twice a day for Evil eye.
Solanum incanum L.	Hiddiiwaatoo	Solanaceae	S	Root	Evil eye & Hemorrhoids	Ingesting decoction with milk twice a day for Evil eye; and taking decoction orally every morning until recovery to treat Hemorrhoids.
Solanum somalense Franchet	Hiddiigaagee	Solanaceae	S	Root	Cancer appearing on an external body part	Applying powder on the affected body part.
Steganotaenia araliacea Hochst	Luqaaluqqee	Apiaceae	T	Root	Menstruation problem (Irregularity)	Mixing 2-3 glasses of decoction with sheep butter ('*dhadhahoola*') and taking orally every morning for up to 3-7 days.
Sterculia stenocarpa H. Winkler	Qararrii	Sterculiaceae	T	Bark	Nasal bleeding	Tying the bark on head.
Vachellia etbaica (Schweinf.) Kyal. & Boatwr	. Alqabeessa	Fabaceae	T	Bark	Nasal bleeding	Tying a bark of the plant on head during bleeding.
Vachellia nilotica (L.) P.J.H. Hurter & Mabb.	Burquqqee	Fabaceae	T	Fruit	Sinus & Ulcerated wound	Ingesting decoction to treat Sinus; & spiting the juice on a ulcerated wound every morning, before breakfast, for 3 days.
Vachellia tortilis (Forssk.) Galasso & Banfi	Dhadacha	Fabaceae	T	Seed & Latex	Urine retention problem & Asthma	Ingesting decoction of fresh seeds boiled with *Sansevieria ehrenbergii* to treat the Urine retention problem & Asthma.
Withania somnifera (L.) Dunal	Hiddiixirooftuu	Solanaceae	S	Root	Evil eye	Feeding milk mixed cold infusion to infants.
Zanthoxylum chalybeum Engl.	Gaddaa	Rutaceae	T	Leaf & Root	Asthma magic	Taking 1-2 cups of syrup orally & brushing teeth with it.