

# Medicinal Plants Used by Oromo Community in Kofale District, West-Arsi Zone, Oromia Regional State, Ethiopia

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**Purpose:** The purpose of this study was to record the utilization of medicinal plants by the Oromo people in the Kofale District, Oromia Regional State, Ethiopia, to control human and animal health problems.

**Methods:** Data regarding the use of medicinal plants were collected using ethnobotanical methods from 84 traditional medicine practitioners and 304 general informants sampled employing purposive and systematic random sampling methods, respectively, in the Kofale District. Data were analyzed using different indices, including a preference ranking exercise, informant consensus factor (ICF), fidelity level (FL) and relative popularity level (RPL).

**Results:** In the district, 106 medicinal plants were claimed to be used for the treatment of 43 human and 18 livestock illnesses, of which 75 (71%) were used to manage human health problems, 23 (21.5%) were used to treat both human and livestock ailments and eight (7.5%) were utilized to treat manage livestock health problems. Most (76.4%) plants were harvested from the wild. Leaves were the most commonly used plant part (55.6%) in remedy preparations. Skin diseases scored the highest ICF value (0.97), followed by gastrointestinal disorders (ICF = 0.95), cancer (ICF = 0.93), and hemorrhoids (ICF = 0.91). Medicinal plants that record the highest fidelity level (FL) (100%) and rank order priority (ROP) (100%) values included *Justicia schimperiana*, *Embelia schimperi*, *Ekebergia capensis* and *Datura stramonium*, which have been used to treat liver disorders, tapeworm infections, babesiosis, and rabies, respectively. There were significant differences ( $p < 0.05$ ) in the mean numbers of medicinal plants claimed by different social groups: older, illiterate, and traditional medicine practitioners reported higher mean numbers of medicinal plants than younger, literate, and general informants, respectively.

**Conclusion:** This study indicated the richness of medicinal plant species in Kofale District. Medicinal plants with the highest FL and ROP values and those used to treat disease categories with the highest ICF values should be prioritized in future phytochemical and pharmacological investigations.

**Keywords:** ethnobotanical study, traditional medicine, traditional knowledge, herbal medicine practitioners

## Introduction

World Health Organization (WHO) has reported that nearly 60% of people worldwide, and as far as 80% of the population in Africa, directly or indirectly, depend on traditional medicinal plants to solve their healthcare problem.<sup>1</sup> The high reliance on medicinal plants is attributed to a number of claimed reasons that include easy accessibility, cultural acceptability, affordability (cheaper cost), fewer side effects,<sup>2</sup> and the widespread availability of harmful pathogenic microorganisms that are resistant to existing modern drugs.<sup>3</sup> Medicinal plants are valuable sources for the discovery of new therapeutics against different diseases,<sup>4</sup> which may also have a wider therapeutic window than synthetic drugs, and thus prevent the development of drug resistance. Medicinal plants contain a diverse groups of phytochemical constituents such as flavonoids, triterpenoids, glycosides, saponins, carotenoids, volatile oils, amino acids, steroids, quinines, alkaloids<sup>5</sup> and coumarins<sup>6</sup> responsible for multifaceted biological effects.<sup>7</sup> According to estimates, around 80% of the human population and 90% of the livestock population in Ethiopia rely on traditional medicinal plants for their day-to-day primary healthcare.<sup>8,9</sup> Ethiopia is one of the most ethnically diverse countries in

East Africa with the majority of its citizens living in rural areas and thus with limited access to modern healthcare services.<sup>10</sup> Such condition has made the people blessed with rich traditional knowledge and practices on the use of medicinal plants, remedy preparations and administrations as well as illness diagnoses.<sup>8</sup> Even though the majority of the populations in Ethiopia heavily depend on medicinal plants for their primary healthcare needs, very limited work has so far been done to record and analyze the associated knowledge, and validate the therapeutic values of the claimed plants.<sup>11,12</sup> On the other hand, there is an ongoing rapid population increase, indiscriminate deforestation, overexploitation of natural resources, worldwide climate change, which has contributed to the depletion of useful medicinal plant resources and the associated indigenous knowledge.<sup>13</sup> As a result, documenting and protecting medicinal plants and the associated knowledge is becoming a greater priority. A number of ethnobotanical studies conducted in different parts of Ethiopia have reported the common uses of medicinal and wild edible plants.<sup>12,14–27</sup> However, only a few ethnobotanical studies have been conducted in the West-Arsi Zone of the Oromia Regional State Ethiopia<sup>28,29</sup> which were conducted in the Negele Arsi and Nansebo districts, and no such study has been conducted in Kofale District. Like most Ethiopian communities, people in Kofale District are expected to practice traditional medicine, mainly associated with the use of medicinal plants to maintain their health, as well as that of their domestic animals. Therefore, this study was carried out to properly document traditional knowledge related to the use of medicinal plants to manage both human and livestock ailments by the people of the Kofale District, West-Arsi Zone, Oromia Regional State, Ethiopia.

## Materials and Methods

### Description of the Study Area

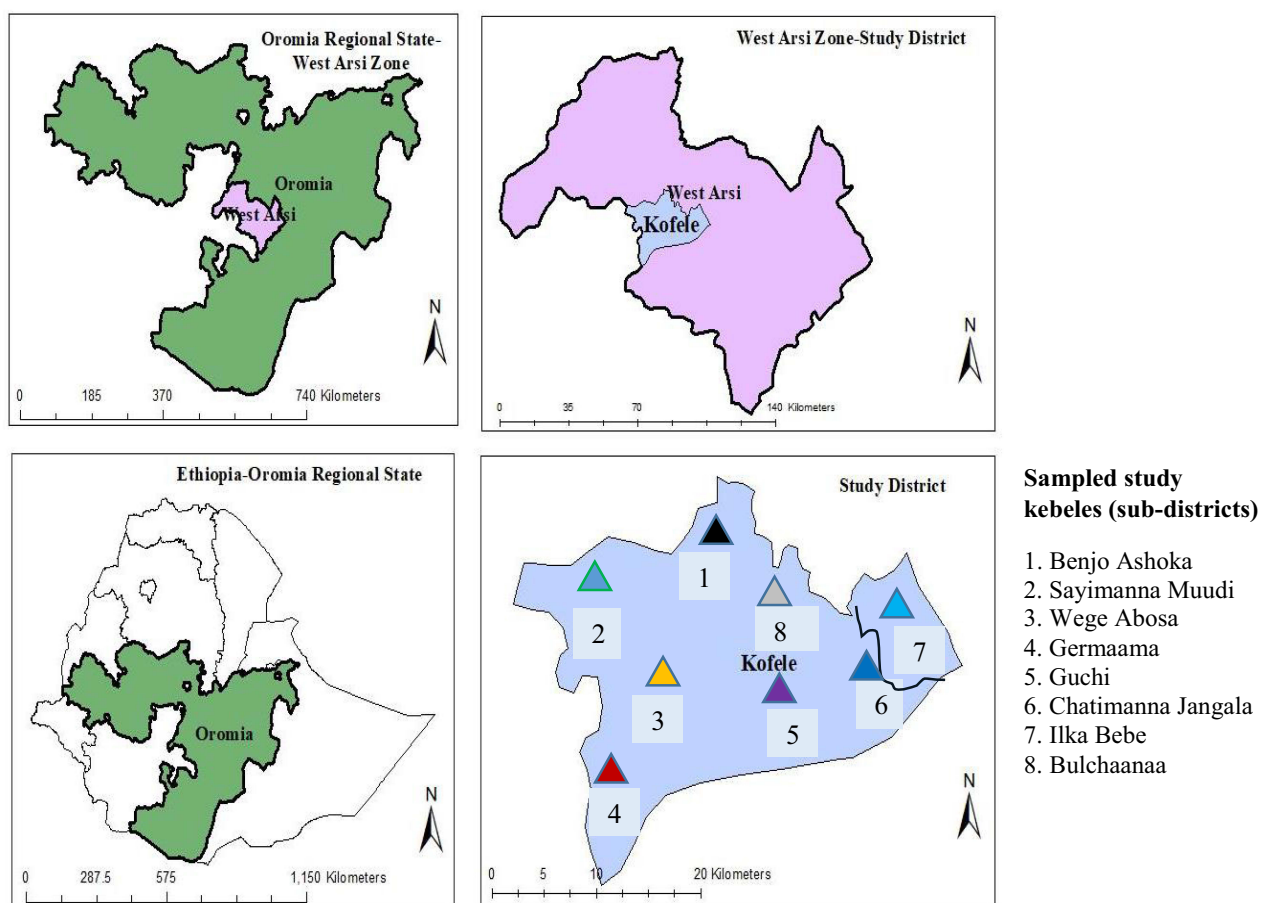
According to 2007 census conducted by the Population Census Commission (PCC) of Ethiopia, the West-Arsi Zone has a total population of 1,975,295.<sup>30</sup> Most inhabitants in the zone belong to the Oromo ethnic group, constituting 88.52% of the total population. The Zone has 12 districts, one of which is Kofale District (Figure 1). Kofale District is geographically located between 6° 50'–7° 9'N and 38° 38'–39° 4'E, south of the capital Addis Ababa. According to Kofale District Healthcare Office (KDHC), the district gets a mean annual rainfall of 1300 mm and a temperature of 10–24°C (KDHC, 2022, unpublished data). The district has a total population of 179,508, of which 90,000 are men and 89,508 are women.<sup>30</sup> People in the rural areas of the study district are mainly dependent on crop farming and livestock production for their livelihood. According to the Kofale District Agricultural Office (KDAO), there are 106,325 cattle heads, 112,570 sheep, 91,400 horses, 9784 goats, 9410 donkeys, and 35,901 chickens in the district (KDAO 2022, unpublished data). Based on data collected during a reconnaissance survey, the district has 43 kebeles (sub-districts) located at different distances from the administrative district center (Kofale town). The top-five human health problems in the district are dermatochalasis, gastrointestinal tract infections (diarrhea, typhoid, stomachache, abdominal pain, and internal parasite infestation), cancer, respiratory infections, and sexually transmitted diseases (KDHC 2022, unpublished data), and the main livestock diseases in the study area include anthrax, black leg, pasteurellosis, dermatochalasis, tick infestations, equine glanders, leech infestation, and rabies (KDAO 2022, unpublished data).

### Selection of Study Sites

A reconnaissance survey was conducted in Kofale District in January and February 2021 to select study kebeles and informants. Health and agricultural professionals in the district played key roles in the identification of herbal medicine practitioners. Of the 43 kebeles in the district, eight (Wege Abosa, Benjo Ashoka, Ilka Bebe, Sayimanna muudi, Chatimanna Jangala, Guchi, Bulchaana, and Garmaama) were purposively selected for the study, taking into consideration the history of use of traditional medicine and availability of practitioners in the area, less exposure of the community to modernization, and agro-ecological representation. Additional information regarding the sampled kebeles and traditional healers was gathered from kebele administration officers, knowledgeable elders, and other local inhabitants.

### Study Design, Sample Size Determination and Sampling Techniques

A cross-sectional study design was adopted to conduct the ethnobotanical survey, and sample size was determined based on the total of household heads in the sampled kebeles<sup>30</sup> using a standard sample size determination formula given below.<sup>31</sup>



**Figure 1** Map of Kofale District, West-Arsi Zone, Oromia Regional State, Ethiopia.

$n = N/(1+N(e)^2)$ , where  $n$  = sample size,  $N$  = total number of households in sample villages/kebeles (11,754),  $e$  = maximum variability or margin of error 5% (0.05) and 1 = the probability of event occurring

Based on this, the total sample size obtained was 388, of which 84 were locally recognized traditional health practitioners (THP) who were identified using purposive sampling method, and 304 were general informants that were sampled using a systematic random sampling method as described by Martin<sup>28</sup> based on the total number of households each kebele (Table 1).

## Ethnobotanical Data Collection

Ethnobotanical data were gathered from February 2022 to March 2023 through individual semi-structured interviews and guided field walks using the methods of Martin<sup>32</sup> and Cotton.<sup>33</sup> Data collected from informants during interviews included sociodemographic information, local name of each claimed medicinal plant, part used, condition of plant part used (fresh/dried), additive used (if any), preparation method, ailment treated, route of administration, dosage, side effects, and antidotes used. Additional data regarding habitat, abundance, and existing threats of medicinal plants were also gathered through guided field walks as described in Martin<sup>32</sup> and Alexiades.<sup>34</sup> Voucher specimens from all mentioned medicinal plants were collected, dried, identified by botanists at ALIPB and the National Herbarium, AAU using published volumes of the Flora of Ethiopian and Eritrea, and deposited for future reference.

## Analysis of Data

Data were analyzed using quantitative tools, including preference ranking exercise, informant consensus factor (ICF), fidelity level index (FL), and rank order priority (ROP) value<sup>32,35–37</sup> to identify the most important medicinal plants in

**Table 1** Number of Households and Informants in Each Sampled Kebele

Kebeles	Altitude	Number of Households	Number of Informants	General Informants			Traditional Health Practitioners		
				Total	M	F	Total	M	F
Garmaama	1500–2660	2726	88	69	65	4	19	18	1
Benjo Ashoka	1918–1945	1091	35	27	25	2	8	8	
Sayimanna Muudi	1938–1961	1148	37	29	26	3	8	8	
Chatimanna Jangala	1970–2500	1551	58	47	44	3	11	11	
Bulchaana	1989–2196	1298	42	33	31	2	9	9	
Wege Abosa	2190–2300	1721	56	43	40	3	13	12	1
Guchi	2200–2786	1262	41	32	36	2	9	8	1
Ilka Bebe	2605–2867	957	31	24	21	3	7	6	1
Total		11,754	388	304	282	22	84	80	4

the district. Analysis of variance (ANOVA) and t-tests were used to determine the effects of sociodemographic factors on respondents' knowledge of traditional medicinal plants. Preference ranking exercises<sup>32</sup> were conducted on seven medicinal plants with the highest number of informant citations to manage the most commonly reported human gastrointestinal complaints and skin diseases by ten traditional medicine practitioners sampled from those who were already involved in individual interviews. Informant consensus factor was computed to determine culturally important human and livestock ailment categories and, by doing so, identify potentially effective medicinal plant species within the respective disease categories using the formula  $ICF = (N_{ur} - N_i) / (N_{ur} - 1)$ , where  $N_{ur}$  is the number of use reports for each disease category and  $N_i$  is the number of species used in that category.<sup>36</sup> Fidelity level index was computed to reveal the level of agreement among informants in selecting medicinal plants used to manage a specific ailment using the formula,  $FL = (N_p / N) \times 100$ , where  $N_p$  is the number of informants who cited or mentioned the use of a medicinal plant against a particular disease and  $N$  is the total number of informants who cited that plant for any other medical use.<sup>35</sup> However, plants with similar FL values but known to different numbers of informants may vary in their healing potential. Thus, a correlation index known as relative popularity level (RPL) was additionally determined to compute the rank order priority (ROP) value, as given by Ali-Shtayeh et al<sup>37</sup> by multiplying the FL value by RPL to differentiate the healing potential of plants with similar FL values.

## Results

### Socio-Demographic Status of Informants

In this study, 388 informants (84 traditional healers and 304 general informants) were involved, the majority (54.12%) of whom were between 41 and 60 years of age. Regarding educational status, 57.73% of informants were illiterate, and 42.27% were literate. Regarding the gender of the informants, 360 (92.79%) were males and 28 (7.22%) were females (Table 2).

### Diversity of Medicinal Plants Reported and Their Growth Forms

The study conducted in Kofale District recorded 106 medicinal plant species that belonged to 90 genera and 56 families, which were reported to treat 43 human illnesses and 18 livestock diseases (Table 3). Of these, 75 (71%) were used to manage human health problems, 23 (21.5%) to treat both human and livestock ailments, and eight (7.5%) to treat livestock diseases. The family Asteraceae was represented by nine species, Fabaceae and Solanaceae by seven species each, and Euphorbiaceae and Lamiaceae by five species each. Five families (Amaranthaceae, Myrsinaceae, Cucurbitaceae, Rosaceae, and Myrsinaceae) were represented by three species each and three families (Urticaceae, Meliaceae, and Rubiaceae) were represented by two species each. Each of the remaining families was represented by

**Table 2** Demographic Categories of Local Respondents

	Socio-Demographic Group	Number of Informants	Percentage
Gender	Male	360	92.79
	Female	28	7.22
Age group	20–40 years old (youngster)	86	22.16
	41–60 years old (middle aged)	210	54.12
	61–89 years old (elder)	92	23.71
Literacy	Illiterate	224	57.73
	Literate	164	42.27
Informant type	Traditional healer	84	21.65
	General informant	304	78.35

single species. Regarding the growth forms of medicinal plants, shrubs contributed the most (37.7%), followed by herbs (28.3%), trees (23.5%), herbaceous climbers (5.7%), lianas (3.7%), and epiphytes (0.9%) (Figure 2).

### Habitat of Medicinal Plants

Most medicinal plants (76.4%) used in traditional medicine in the district were uncultivated that were harvested from forests, riverbanks, grasslands, roadsides, life fences, and school compounds. Some were grown in homestead gardens (15%), and a few were harvested from both wild and homestead gardens (8.6%).

### Medicinal Plant Parts Used in Remedy Preparations

The leaves were the most commonly used medicinal plant parts (55.6%) in the preparation of plant-based remedies in the district, followed by the bark (21.6%), root (14.15%), fruit/seed (11.3%), shoot/apex (3.8%), whole parts (2.8%), and sap (2.6%) (Figure 3).

### Conditions of Plant Parts Used and Preparation Methods

The majority (75.8%) of the medicinal plant parts were claimed to be used in their fresh form, whereas some others were used in their dry (14.15%) and dry or fresh (10.65%) forms. The highest proportion (39%) of remedies was prepared by crushing (39%), followed by squeezing (16%), pounding and squeezing (14.5%), decoction (13%), pounding and powdering (9%), pounding and mixing (7.5%), and chewing (1%) (Figure 4).

### Administration Routes of Remedies

Oral was the most frequently cited route of remedy administration in the district (61.3%), followed by topical/dermal (26.3%), nasal (4.7%), and ocular (3.8%) routes (Table 4).

### Dosage of Medicinal Plants and Use of Antidotes

Most frequently, traditional medicine practitioners' prescriptions were based on patient age, gender, presence or absence of pregnancy and body condition. Different measuring materials, such as waterglass, teacup, coffee cup, teaspoon, bottle cap, handful, and between two fingertips were used to determine the dosage. Traditional medical practitioners employ different antidotes to neutralize possible adverse effects such as vomiting, nausea, diarrhea, headache, and loss of consciousness. Antidotes used mainly included fermented milk, fresh milk, honey, and coffee.

### Commonly Reported Human and Livestock Diseases in the District

Of 43 human health problems occurring in Kofale District, dermatophilosis, gastrointestinal disorders, cancer, and hemorrhoids were the most prevalent reported by 35%, 31%, 18%, and 12% of the informants, respectively. Of the total 18 livestock health problems occurring in Kofale District, wound, tick infestation, leech infestation,

**Table 3** List of Medicinal Plants Used to Treat Human and Livestock Diseases in Kofale District

Species Name	Family Name	Local Name	Habit	Part used	Disease Name Treated	Use	Mode of Preparation	Administration Route	Use citation	Voucher Number	Ailment Managed Elsewhere in Ethiopia
<i>Achyranthes</i> sp.	Amaranthaceae	Qadara	Cl	Wh	Aspiration	Hu/ Ls	Crushed with teeth	Nostrils	12	GN-120	Wound infections, <sup>38</sup> skin diseases <sup>39</sup>
<i>Acmella caulirhiza</i> Delile	Asteraceae	Caanga	H	Wh	Headache	Hu	Crushed and squeezed	Nostril	14	GN-52	Cancer-like symptoms, <sup>39,40</sup> toothache <sup>41</sup>
<i>Adiantum</i> sp.	Adiantaceae	Laaftuu	H	L	Wound		Crushed & squeezed	Topical	5	GN-72	Wound treatment <sup>42</sup>
<i>Agarista salicifolia</i> (Comm.e.x. Lam.) Hook	Ericaceae	Sotra	T	Ba	Bone TB	Hu	Fresh bark is crushed and extract is applied	Dermal	33	GN-59	Abdominal pain <sup>24</sup>
<i>Albizia gummifera</i> (J.F.Gmel.) C.A.Sm.	Fabaceae	Qarcacee	T	Ba	Aspiration	Hu	Fresh bark is crushed and chewed	Oral	34	GN-16	Anthrax <sup>28</sup>
<i>Albizia schimperiana</i> Oliv.	Fabaceae	Sisaa	T	L/R	Liver disorder	Hu	Crush leaves and roots and mix them with water	Oral	21	GN-43	Trypanosomiasis, <sup>43</sup> helminthic infection, <sup>44</sup> microbial infection, <sup>45</sup> microbial infection <sup>46</sup>
<i>Aloe</i> sp.	Aloaceae	Hargisa	H	La	Hemorrhoids	Hu	Decoction	Topical	16	GN-127	Wounds and skin complaints, malaria, microbial infections, and complaints of the digestive system, <sup>47</sup> malaria <sup>48</sup>
					Hepatitis	Hu	Crushing the latex	Oral	18		
					Hemorrhoids	Hu	Crushing and squeezing	Anal	260		
					Abdominal pain	Hu	Crushing and squeezing	Oral	80		
					Dermatophilosis, hair loss	Hu	Creaming	Topical	78		
					Blood pressure	Hu	Crushing	Oral	103		
<i>Amaranthus dubius</i> Mart ex Thell.	Amaranthaceae	Raafu qinx	H	L	Eye ache	LS	Squeezing	Topical	4	GN-33	Diarrhea <sup>49</sup>
					Anorexia	Hu	Fresh leaves are boiled	Oral	8		
					Cancer	H	Crushed & squeezed	Oral	52		
					HIV-AIDS	H	Crush & mix juice produced with honey	Oral	1		
<i>Anethum graveolens</i> L.	Apiaceae	Goomana	H	L	Constipation	Hu/ LS	Fresh leaves are crushed and boiled	Oral	23	GN-171	Stomachache <sup>50</sup>
<i>Apodytes dimidiata</i> E. Mey. ex Arn.	Icacinaceae	Odda badaa	T	Ba	Stomachache	Hu	Decoction	Oral	23	GN-66	Stomachache, cough, <sup>28</sup> child diarrheal disease, cholera, general health problem (low weight and compromised immunity of infants <sup>24</sup>
					Internal parasite infection	LS	Crushed & mixed with water	Oral	9		

<i>Arundinaria alpina</i> K. Schum	Poaceae	Leman	Sh	Sh	Hemorrhoid, diarrhea	Hu	Leaves are pounded and squeezed and mixed with water	Oral	12	GN-48	Neck tumour <sup>23</sup>
<i>Asparagus africanus</i> Lam.	Asparagaceae	Sariiti	H	L	Breast cancer	Hu	Crush leaves and add honey	Oral	59	GN-2	Malaria, <sup>51</sup> erectile dysfunction, <sup>52</sup> malaria <sup>53</sup>
				R	Anthrax	Ls	Crush fresh root and mix it with water	Oral	6		
<i>Bersama abyssinica</i> Fresen.	Melianthaceae	Koraqa	Sh	L	Blackleg	Hu	Crush pounded and mix it with water	Oral	5	GN-1	HIV-AIDS, <sup>54</sup> diabetics, <sup>55,56</sup> diarrhea <sup>57</sup>
				L	Intestinal parasite	Hu	Crush pounded and mix it with water	Oral	90		
				L	Stomach ache, diarrhea	Hu	Crush pounded and mix it with water	Oral	44		
				L	Equine glanders	Ls	Crush pounded and mix it with water	Dermal	115		
<i>Brucea antidysenterica</i> J.F. Mill	Simaroubaceae	Ciironta	Sh	L	Elephantiasis, itching	Hu	Pounded and boiled			GN-6	Diarrhea, <sup>58</sup> leishmaniasis <sup>59</sup>
				Sd	Eczema	Hu	Crush pounded and mix it with water	Oral	69		
<i>Caesalpinia decapetala</i> (Roth) Alston		Gorxa	La	L	Amoeba/diarrhea	Hu	Dry, grind and mix it with water	Oral	53	GN-35	Spiritual use, <sup>59</sup> Tonsillitis <sup>60</sup>
				L	Dermatophilosis	Hu	Fresh leaves are smashed, pounded and mixed with water	Oral	3		
<i>Calpurnia aurea</i> (Aiton) Benth	Fabaceae	Ceekata	Sh	L	Tick infestation	Ls	Pounding and squeezing	Dermal	87	GN-143	Malaria, <sup>61</sup> snake poisoning, <sup>62</sup> livestock external parasites <sup>63</sup>
				L	Rabies	Hu/ Ls	Fresh leaves are crushed and squeezed	Oral	21		
				L	Liver disorders	Hu	Dried & ground and mix it with water	Oral	76		
<i>Carica papaya</i> L.	Caricaceae	Papaya	Sh	Fr	Anemia	Hu	Crushed & squeezed	Oral	7	GN-174	Malaria, <sup>64</sup>
<i>Carissa spinarum</i> L.	Apocynaceae	Agamsa	Sh	Ba	Tumour	Hu	Fresh bark is crushed and squeezed	Oral	17	GN-23	Evil eye, <sup>65,66</sup> gonorrhoea, <sup>67</sup> bacterial infection, <sup>68</sup> spiritual illness, <sup>59</sup> accumulation of fluid in the body <sup>69</sup>
				R	Cancer	Hu	Root is crushed together with root of <i>Euclea schimperi</i> , pounded and boiled	Oral & dermal	77		
				R	Wound	Hu	Fresh bark is crushed and mixed with butter	Topical	22		

(Continued)

Table 3 (Continued).

Species Name	Family Name	Local Name	Habit	Part used	Disease Name Treated	Use	Mode of Preparation	Administration Route	Use citation	Voucher Number	Ailment Managed Elsewhere in Ethiopia
<i>Casimiroa edulis</i> La Llave	Solanaceae	Koshimi	SH	R	Evil eye	Hu	Pounded & decocted for steam bath	Topical	3	GN-107	Cancer <sup>70</sup>
<i>Catha edulis</i> (Vahl) Forssk. Ex Endl.	Celastraceae	Caatii	H	L	Stomachache	Hu	Chewed	Oral	4	GN-108	Jaundice, <sup>71</sup> stomachache <sup>72</sup>
<i>Clematis hirsuta</i> Perr. and Guill.	Ranunculaceae	Fiitii	La	L	Bone cancer Wound	Hu Hu	Pounded	Politice	43 32	GN-76	Blackleg, <sup>73</sup> respiratory tract problem and cataract <sup>74</sup>
<i>Clerodendrum myricoides</i> (Hochst.) R. Br. ex Vatke	Verbenaceae	Marachisa	T	Fr L	Oedema Wound	Hu Hu/ Ls	Dried & ground Fresh leaves are crushed and mixed with water	Oral Dermal	18 16	GN-4	Rheumatism, evil eye <sup>71</sup>
<i>Coffea arabica</i> L.	Rubiaceae	Buna	Sh	Fr	Diarrhea	Hu	Dried, ground and mixed with water	Oral	13	GN-178	Diarrhea <sup>75</sup>
<i>Cordia africana</i> Lam.	Boraginaceae	Wodeessa	T	Ba	Cancer	Hu	Crushed while fresh and mixed with water	Oral	13	GN-	Pain, inflammation, microbial and viral infections, and fertility problem <sup>76</sup>
<i>Croton macrostachyus</i> Hochst. ex Delile	Euphorbiaceae	Makanisa	T	Ba	Tumour	Hu	Bark is dried and ground	Topical	55	GN-25	Malaria, abdominal pain, gonorrhoea, wounds, ringworm infestation, hemorrhoids, ascariasis, venereal diseases, cough and rheumatism, <sup>77</sup> malaria <sup>65</sup>
<i>Cynoglossum lanceolatum</i> Forssk.	Boraginaceae	Maxxanne	H	Wh	Febrile illnesses	Hu	Crushed & boiled	Oral	2	GN-98	Fever, <sup>78</sup> hemorrhoids <sup>79</sup>
<i>Datura stramonium</i> L.	Solanaceae	Banji	H	Sd	Rabies	Hu	Seeds are roasted, ground and mixed with water	Oral	76	GN-9	Bacterial infection, <sup>80</sup> skin infections, <sup>81</sup> head fungal infection, <sup>82</sup> toothache, <sup>41</sup> dermatological diseases <sup>61</sup>
<i>Discopodium penninervum</i> Hochst.	Solanaceae	Maraaro	Sh	Sd L	Head ache Pasteurolosis	Hu Ls	Seeds are roasted Its leaves are crushed with leaves of <i>Kalanchoe petitiata</i> and mixed with water	Nostril Oral	13 7	GN-29	Malaria, hemorrhoids, and anthrax in livestock <sup>28</sup>
<i>Dodonaea viscosa</i> subsp. <i>angustifolia</i> (L.f.) J.G. West	Sapindaceae	Ittacha	Sh	L	Herpes zoster Dermatochalasis	Hu Hu	Crushed & squeezed Crushing, pounding and powdering	Dermal Dermal	16 27	GN-15	Malaria, <sup>83</sup> diarrhea, ulcer, microbial infection, diabetics, HIV-AIDS <sup>54</sup>
<i>Dovalis abyssinica</i> (A.Rich.) Warb.	Flacourtiaceae	Dhangago	Sh	Fr	Wound Jaundice	Hu Hu	Decoction Its fruits are mixed with root of <i>Stephania abyssinica</i> , crushed and mixed with water	Body shower Oral	42 22	GN-44	Ascariasis <sup>84</sup>



<i>Drynaria volkensii</i> Hieron.	Polypodiaceae	Kokoso	Sh	L	Tumour	Hu	Chewed & swallowed	Oral	2	GN-71	Tooth ache <sup>41</sup>
<i>Echinops angustilobus</i> S. Moore	Asteraceae	Anshokala	H	R	Evil eye	Hu	Dried, and ground	Nostrils	5	GN-153	Bloating <sup>28</sup>
<i>Ekebergia capensis</i> Sparrm	Miliaceae	Onoonuu	T	Ba	Babesiosis	Ls	Fresh bark is crushed and mixed with water	Oral	73	GN-55	TB, <sup>28</sup> weight loss in children, stabbing pain, bovine TB <sup>85</sup>
<i>Embelia schimperi</i> Vatke	Myrsinaceae	Qaanqu	Sh	Fr	Tapeworm	Hu	Grind the dried fruit by mixing with <i>Hagenia abyssinica</i> dried flower	Oral	197	GN-73	Helminthic infection, <sup>86</sup> gastro-intestinal diseases in animals, <sup>87</sup> helminthic infection <sup>88</sup>
<i>Englerina woodfordioides</i> (Schweinf.) M Gilbert	Loranthaceae	Mukure	Epi	Wh	Liver disorders	Hu	Crushed & boiled	Oral	19	GN-36	Earaches <sup>71</sup>
<i>Ensete ventricosum</i> (Welw.) Cheesman	Musaceae	Worqe	Sh	L	Stomachache	Hu	Leaf petiole is crushed and fermented for weeks	Oral	3	GN-177	Abdominal pain <sup>89</sup>
<i>Entada abyssinica</i> Steud. Ex A. Rich	Fabaceae	Bobanqa	T	L	Skin diseases	Hu	Crushed, pounded and mixed with water	Dermal	62	GN-86	Convulsion <sup>90</sup>
<i>Erica</i> sp.	Ericaceae	Sato	Sh	L	Stomachache	LS	Fresh leaf is crushed and mixed with water	Oral	11	GN- 60	Indigestion and bloating <sup>24</sup>
<i>Erythrina abyssinica</i> Lam. ex DC.	Fabaceae	Woleena	Sh	Sh	Pasteurolosis	Ls	Fresh shoot is crushed and squeezed	Oral	14	GN-5	Snakebites, malaria, sexual transmittable diseases such as syphilis and gonorrhoea, amoebiasis, cough, liver inflammation, stomachache, colic, measles, burns, ulcers and swellings, <sup>91</sup> evil eye <sup>92</sup>
<i>Eucalyptus camaldulensis</i> Dehnh.	Myrtaceae	Bergamo diima	Sh	Ba	Febrile illness	Hu	Fresh part is crushed and squeezed	Topical	8	GN-169	Bacterial infection <sup>93</sup>
<i>Eucalyptus globulus</i> Labill.	Myrtaceae	Bargamo adii	T	L	Stomachache	Hu	Crushed & chewed	Oral		GN-162	Stomachache, <sup>94</sup> influenza, <sup>95</sup> bacterial infection, <sup>96</sup> respiratory tract infections, <sup>97</sup> malaria <sup>57</sup>

(Continued)

Table 3 (Continued).

Species Name	Family Name	Local Name	Habit	Part used	Disease Name Treated	Use	Mode of Preparation	Administration Route	Use citation	Voucher Number	Ailment Managed Elsewhere in Ethiopia
<i>Euclea schimperi</i> (A.DC) Dandy	Ebenaceae	Mi'eesa	T	RB	Hemorrhoids	Hu	Its root bark and seeds of <i>Solanum anguivi</i> are dried, ground and mixed with butter	Topical	15	GN-87	Wound, teeth infections, eye disorders, head ache, pain, spasm <sup>98</sup>
					Dermatophilosis	Hu	Dried, pounded and mixed with butter	Topical	131		
<i>Euphorbia schimperiana</i> Scheele	Euphorbiaceae	Guurii	H	L Sp	Stomach ache	Hu		Oral	50	GN-6	Proliferative activity, <sup>99</sup> cancer, <sup>39</sup> anthrax in livestock <sup>73</sup>
					Gonorrhea	Hu	Crushed & decocted	Dermal	73		
<i>Euphorbia tirucalli</i> L.	Euphorbiaceae	Aananoo	Sh	La	Hemorrhoid	HU	Crushing & pounding	Anal	95	GN-100	Bacterial infection of urinary tract, <sup>100</sup> urogenital disease, <sup>101</sup> Stomachache <sup>28</sup>
<i>Ficus sycomorus</i> L.	Moraceae	Qiltu	T	Ba	Diarrhea	Hu	Body swelling, gonorrhea	Dermal	89	GN-104	Nausea and vomiting, <sup>49</sup> ascariasis <sup>102</sup>
<i>Galiniera saxifraga</i> (Hochst.) Bridson	Rubiaceae	Koralla	Sh	Ba Ba Ba Ba	Babesiosis	LS	Fresh bark is crushed and squeezed	Oral	19	GN-15	Anthrax <sup>28</sup>
							Crushed and squeezed	Oral	14		
							Crushed squeezed and mixed with water	Oral	73		
								Oral	31		
				Liver disorders	Hu	Fresh leaf is crushed and swallowed	Oral	63			
				Jaundice	Hu	Fresh root is chewed and swallowed					
<i>Hagenia abyssinica</i> (Bruce) J.F. Gmel.	Rosaceae	Heexo	T	Fr	Stomach ache	Hu	Decoction	Oral		GN-91	Helminthic infections <sup>82</sup>
					Tapeworm	Hu	Crush its dried flower with bark of <i>Croton macrostachyus</i> and fruit of <i>Embelia schimperi</i>	Oral	76		
<i>Halleria lucida</i> L.	Scrophulariaceae	Muka dadhi	T	L	Body swelling	Hu	Decoction	Topical	16	GN-54	Evil eye and kidney problem <sup>103</sup>
<i>Hypericum quartinianum</i> A.Rich.	Hypericaceae	Garamba	Sh	L	Hepatitis	Hu	Its leaves and that of <i>Junipers procera</i> are crushed together and boiled	Oral	85	GN-	Stomachache for livestock <sup>104</sup>

<i>Ilex mitis</i> (L.) Radlk	Rubiaceae	Amshiq	T	Ba	Hemorrhoids	Hu	Fresh bark is crushed and boiled in water	Oral	98	GN-161	Rheumatism <sup>71</sup>
<i>Juniperus procera</i> Hochst.ex. Endl.	Cuperssaceae	Hidhesa ummama	T	Ba	Diarrhea	Hu	Fresh bark is crushed and squeezed and mixed with water	Oral	35	GN-14	Stomachache <sup>105</sup>
<i>Justicia schimperiana</i> (Hochst. ex Nees) T. Anderson	Acanthaceae	Dhumuuga	Sh	Sh	Hepatitis	Hu	Fresh shoot is pounded to make juice	Oral	235	GN-7	Diabetes mellitus <sup>106</sup>
<i>Kalanchoe petitiiana</i> A. Rich	Rassulaceae	Hancuura	H	L	Tonsillitis	Hu	Crushed while fresh and squeezed	Oral Dressing	15	GN-18	Evil eye, fractured bones and skin disorders, <sup>107</sup> tissue proliferation, <sup>39</sup> metacarpal bone fracture in livestock, <sup>91,108</sup> anthrax <sup>28</sup>
					Bone fracture	Hu	Boiled while fresh	Oral	71		
					GIT disorders	Hu	Fresh leaf is chewed	Oral	13		
					Pasteurellosis	Ls	Crushed together with leaf of <i>Disco podium penninervum</i>	Oral	11		
				L	Anthrax	Hu	Crushed together with leaf of <i>Disco podium penninervum</i>	Oral	5		
<i>Lagneria</i> sp.	Cucurbitaceae	Buqe arba	Sh	St	Hepatitis	Hu	Crushed & sap produced is collected	Oral	87	GN-66	Gonorrhoea, <sup>16</sup> cancer <sup>109</sup>
<i>Lippia adoensis</i> Hochst.	Verbenaceae	Sukayi	H	L	Stomachache	HU	Crushed & chewed	Oral	22	GN-37	Severe headache, <sup>25</sup> pain, <sup>110</sup> harm on body by free radicals, <sup>111</sup> fungal infection, <sup>112</sup> repelling <i>Anopheles arabiensis</i> and <i>Aedes aegypti</i> , <sup>113</sup> bacterial and fungal infection, <sup>114</sup> stomach pain <sup>71</sup>
<i>Maesa Lanceolata</i> Forssk.	Myrsinaceae	Abbayii	T	Ba	Liver disorders	Hu	Its bark is mixed with leaves of <i>Discopodium penninervum</i> and boiled	Oral	97	GN-142	Mastitis, <sup>28</sup> malaria, <sup>115</sup> ovicidal and larvicidal activity, <sup>116</sup> Snakebites <sup>81</sup>
					Dermatophilosis	Hu/Ls	Dried & boiled	Dermal	62		
<i>Mangifera indica</i> L.	Anacardiaceae	Mango	Sh	Fr	Blood pressure	Hu	Squeezed	Oral	4	GN-110	Harm on body by free radicals <sup>117</sup>
<i>Maytenus addat</i> (Looes.) Sebsebe	Celastraceae	Kombolcha	Sh	Ba	Diarrhea	Hu	Fresh bark is crushed and mixed with water	Oral	10	GN-53	Parasites infections <sup>28</sup>
<i>Millettia ferruginea</i> (Hochst.) Bak.	Fabaceae	Dhadhatu	T	Fr	Leech infestation	Ls	Crushed & pounded	Nostril	72	GN-90	'Mujele' (infection caused by an insect present in the soil) <sup>118</sup>
<i>Moringa stenopetala</i> (Bak.f.) Cuf.	Moringaceae	Shifera	Sh	L	Blood pressure	Hu	Crushed, dried and ground	Oral	44	GN-126	Anthrax <sup>28</sup>
<i>Myrsine melanophlous</i> (L.) R.Br.	Myrsinaceae	Tuula	Sh	L	Child emaciation	Hu	Fresh leaf is	Oral & body shower	57	GN-41	Stomach problem <sup>28</sup>
					Stomachache	Hu	pounded and boiled	Oral	69		

(Continued)

Table 3 (Continued).

Species Name	Family Name	Local Name	Habit	Part used	Disease Name Treated	Use	Mode of Preparation	Administration Route	Use citation	Voucher Number	Ailment Managed Elsewhere in Ethiopia
<i>Nicotiana tabacum</i> L.	Solanaceae	Tambo	H	R	Leech infestation	Hu/ Ls	Chewed & spit into the mouth of the sick animal	Oral	48	GN-176	Leech repulsion <sup>78</sup>
<i>Nuxia congesta</i> R. Br. ex Fresen.	Loganiaceae	Bixana		L	Tooth ache Anthrax	HU Ls	Dried & powdered Crushed, squeezed and mixed with water	Topical Oral	14 11	GN-47	Malaria, <sup>119</sup> calf pneumonia, <sup>120</sup> anthrax <sup>28</sup>
<i>Ocimum gratissimum</i> L.	Lamiaceae	Cabbicha	H	L	Rheumatism, headache, eye disease, allergic reaction	Hu	Crushed & squeezed	Oral & nostril	31	GN-80	Skin infections <sup>121</sup>
<i>Oenanthe palustris</i> (Chiov.) Norman	Apiaceae	Goonde	H	L	Bone cancer	Hu/ Ls	Fresh leaves are crushed	Topical	13	GN-42	Tooth ache <sup>41</sup>
<i>Olinia rochetiana</i> A. Juss.	Oliniaceae	Gunaa	T	L	Bone TB	Hu	Fresh leaf is crushed and macerated with water	Dermal	79	GN-17	Stabbing pain, <sup>73</sup> colds and chest related condition <sup>122</sup>
<i>Physalis peruviana</i> L.	Solanaceae	Mujulo	H	Wh	Indigestion	Hu	Crushed & boiled in water	Oral	3	GN-111	Medicinal value <sup>95</sup>
<i>Phytolacca dodecandra</i> L'Her.	Phytolaccaceae	Handoode	H	L	Jaundice	Hu	Fresh leaves are crushed and juice diluted in water	Oral	8	GN-93	Molluscicidal properties, <sup>123</sup> used for abortion <sup>118</sup>
				L R	External parasite, dermatophilosis Rabies	LS Hu/ LS	Fresh leaf is crushed Fresh root is crushed and mixed with water	Dermal Oral	64 92		
<i>Pittosporum abyssinicum</i> Del.	Pittosporaceae	Aaraa	T	L	Cancer	Hu	Fresh leaves are crushed and mixed with water	Oral	22	GN-50	Coughing, Pneumonia, TB, and Abdominal pain, <sup>24</sup> cancer, <sup>124</sup> intestinal problems, internal parasites, urine problems, diarrhea, swelling of gland, ascariasis, diarrhea, and vomiting <sup>125</sup>
				Ba	Blackleg		Crushed & mixed with water	Oral	6		
<i>Podocarpus falcatus</i> (Thunb.) R.B. ex Mirb.	Podocarpaceae	Birbirsa	T	L	Epilepsy	Hu	Its leaves together with leaves of <i>Carissa spinarum</i> are crushed and boiled	Oral	50	GN-8	Wound of both human and livestock <sup>126</sup>
					Cancer	Hu	Fresh leaves are crushed and boiled in water	Oral	17		

<i>Polycarpon tetraphyllum</i> (L.) L.	Caryophyllaceae	Laalessa	CL	R	Toothache	Hu	Crushed & kept between teeth	Topical	4	GN-172	Lung diseases and menstrual problem <sup>71</sup>
<i>Prunus africana</i> (Hook.f.) Kalkman	Rosaceae	Sukee	T	L Sh Ba	GIT cancer Stomachache Skin diseases, wound	Hu Hu/ Ls	Fresh leaves are boiled in water Crushed & squeezed	Oral Dermal	21 73 76	GN-27	Cancer, respiratory disorders, bad breath, diarrhea, gonorrhoea, tuberculosis, and ear problems <sup>28</sup>
<i>Psidium guajava</i> L.	Myrtaceae	Zeeytuna	Sh	Sd	Hepatitis	Hu	Dried, powdered and mixed with water	Oral	7	GN-175	Damage on body by free radicals and bacterial infection <sup>127,128</sup>
<i>Ranunculus multifidus</i> Forssk.	Ranunculaceae	Siifa	H	L	Cancer	Hu	Fresh leaf is crushed and mixed with water	Oral	12	GN-51	Oedema <sup>129</sup>
<i>Rhamnus prinoides</i> L'Hér	Rhamnaceae	Geesho	H	Wh	Stomach ache	Ls	Pounded & mixed with water	Oral	6	GN-170	Tonsillitis <sup>71</sup>
<i>Rhus tenuinervis</i> Engl.	Anacardiaceae	Kolaassa	Sh	L	Cough	Hu/ Ls	Dried, ground and boiled in water	Oral	3	GN-22	Stomach bloating in livestock <sup>28</sup>
<i>Ricinus communis</i> L.	Euphorbiaceae	Qoboo	Sh	Sd	Infertility	Hu/ LS	Seeds are dried, powdered and boiled	Oral	44	GN-92	Erectile dysfunction, <sup>52</sup> antimicrobial infection, <sup>130</sup> coughing, constipation and swelling and anthrax <sup>94</sup>
<i>Rosmarinus officinalis</i> L.	Lamiaceae	Wodi fooni	H	L	Diabetes	Hu	Crushed & boiled	Oral	31	GN-99	Bacterial infection, <sup>110,131,132</sup>
<i>Rubus steudneri</i> Schweinf.	Rosaceae	Gora	La	L	Wound	Hu/ LS	Dried & ground	Dermal	5	GN-40	Bacterial infection, <sup>87</sup> damage on body by free radicals <sup>116</sup>
<i>Rumex abyssinica</i> Jacq.	Polygonaceae	Shoshira	Sh	L	Gonorrhoea, diarrhea	Hu	Crushed, pounded and boiled	Oral	10	GN-74	Damage on body by free radicals and inflammation, <sup>133</sup> diabetes mellitus <sup>134</sup>
<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Shaabee	H	R L	Hemorrhoids Goiter	Hu Hu	Dried, ground and mixed with sugar Crushed & mixed with water	Oral Oral	78 10	GN-9	Gastrointestinal infection, <sup>74</sup> diarrhoea <sup>73</sup>
<i>Ruta chalepensis</i> L.	Rutaceae	Caarota	H	L	Stomachache, abdominal pain, gastritis	Hu	Crushed and chewed	Oral	6	GN-97	Stomachache <sup>28</sup>
<i>Rytigynia neglecta</i> (Hiem) Robyns	Rubiaceae	Gaaloo	Sh	R	Pneumonia	Hu	Fresh root is crushed and boiled in water	Oral	13	GN-20	TB <sup>135</sup>
<i>Salvia nilotica</i> Juss. ex Jacq.	Lamiaceae	Hulageb	H	L	Snakebites	Hu	Crushed, dried and mixed with butter	Dermal	27	GN-173	Skin diseases <sup>28</sup>

(Continued)

Table 3 (Continued).

Species Name	Family Name	Local Name	Habit	Part used	Disease Name Treated	Use	Mode of Preparation	Administration Route	Use citation	Voucher Number	Ailment Managed Elsewhere in Ethiopia
<i>Schefflera abyssinica</i> Hochst. ex A. Rich.) Harms	Araliaceae	Gatame	T	Ba	Tonsillitis	Hu	Inner part of the bark is chewed	Oral	13	GN-151	Anthrax <sup>28</sup>
<i>Schefflera volkensii</i> (Engl). Harms	Araliaceae	Anshaa	T	L	Anthrax	Ls	Its leaves are crushed with leaves of <i>Hypericum quartinianum</i> and mixed with water	Oral	28	GN-161	Head ache <sup>73</sup>
<i>Sedum baleensis</i> M. Gilbert	Crassulaceae	Buri	H	R	Eczema	Hu/ LS	Fresh leaves are crushed	Dermal	4	GN-68	Eczema <sup>71</sup>
<i>Senecio myriocephalus</i> Sch. Bip. ex A. Rich.	Asteraceae	Agadana	T	R	Stomachache		Fresh root is crushed, squeezed and mixed with water	Oral	24	GN-163	Evil eye, <sup>118</sup> herpes Zoster <sup>71</sup>
<i>Sida schimperiana</i> Hochst. ex A. Rich	Malvaceae	Kotte jabeesa	H	L	Evil eye	Hu	Leaf is dried and ground	Tie on the neck	12	GN-152	Prenatal abortion, <sup>67</sup> microbial infection <sup>136</sup>
<i>Solanecio gigas</i> (Vatke) C. Jeffrey	Asteraceae	Taruura	Sh	Ba	Babesiosis	Hu/ LS	Crushed & mixed with water	Oral	4	GN-172	Bacterial infection <sup>137</sup>
<i>Solanum adoense</i> Hochst ex. A.Rich.	Solanaceae	Hiddi oromoo	Sh	L	Nose bleed	Hu	Fresh leaves are smashed	Nostril	11	GN-10	Malaria <sup>138</sup>
<i>Solanum anguivi</i> Lam	Solanaceae	Xoshine	H	L	Blood pressure	Hu	Dried, ground and boiled	Oral	51	GN-65	Trypanosomiasis, <sup>139</sup> diabetes and atherosclerosis <sup>140</sup>
<i>Solanum benderianum</i> Schimp. ex Engl.	Solanaceae	Galimo	T	R	Stomachache	Hu	Root is crushed, dried and boiled	Oral	3	GN-69	Hypertension <sup>141</sup>
<i>Solanum benderianum</i> Shimper ex Damme	Solanaceae	Galimo	CL	Ba	Stomachache	Hu	Dried, ground and boiled	Oral	3	GN- 69	Calf diarrhea <sup>142</sup>
<i>Stephania abyssinica</i> (Dillon & A. Rich.) Walp.	Menispermaceae	Kalaala	Cl	L	Jaundice	Hu	Leaf dried, ground and boiled in water	Oral	31	GN-11	Malaria, <sup>143</sup> gastrointestinal diseases, <sup>144</sup> external cancer <sup>91</sup>
<i>Syzygium guineense</i> (Willd.) DC.	Myrtaceae	Baddeesa	T	Ba	Kidney infection	Hu	Fresh leaf is crushed, squeezed and mixed with water	Oral	20	GN-62	Stomachache, diarrhea, <sup>28</sup> hypertension, <sup>145</sup> Malaria, <sup>100</sup> cancer. <sup>146</sup>
<i>Teclea nobilis</i> Del.	Rutaceae	Hadhesa	Sh	L	Diarrhea Tonsillitis Blackleg	Hu Ls	Fresh leaf is chewed and ingested Leaves are pounded and mixed with water	Oral Oral	133 13 10	GN-30	Blackleg <sup>89</sup>

<i>Toddalia asiatica</i> (L) Lam.	Rutaceae	Gaawo	Sh	Fr	Stomach ache, wound	Hu/ Ls	Fruit is crushed, pounded and mixed with water	Oral	7	GN-28	External body swelling <sup>147</sup>
<i>Urera hypselodendron</i> (Hochst. ex A. Rich.) Wedd.	Urticaceae	Haliila	CL	Ba	Internal parasite		Leaves are crushed and mixed with water	Oral	66	GN-31	Anthrax <sup>17</sup>
<i>Urtica simensis</i> Steudel.	Urticaceae	Doobii	H	L	Constipation & gastritis	Hu	Leaves are washed and boiled in water	Oral	35	GN-95	Damage on body by free radicals, <sup>92</sup> stomach ulcer, <sup>144</sup> wound, <sup>148</sup> malaria <sup>149</sup>
						Ls	Leaves are washed and boiled in water		16		
<i>Verbascum sinaiticum</i> Benth.	Scrophulariaceae	Gurra harree	Sh	L	Hepatitis	Hu	Fresh/dry leaves are crushed and mixed in water	Oral	8	GN-	Hepatitis, <sup>150</sup> blood pressure <sup>151</sup>
<i>Vernonia amygdalina</i> Del.	Asteraceae	Ebicha	Sh	Ba	Bone TB	Hu	Fresh root is crushed and mixed with honey	Oral	7	GN-12	Malaria <sup>152</sup>
						Hu	Decoction	Dermal	81		
						Hu/ Ls	Decoction	Oral	84		
						Hu	Fresh leaf is crushed and squeezed	Oral	15		
<i>Vernonia auriculifera</i> Hiern	Asteraceae	Reejii	Sh	L	Bloat	Ls	Leaves are crushed and macerated in water	Oral	16	GN-13	Wound, <sup>153</sup> bacterial infection, <sup>154</sup> pain and inflammation, wound <sup>155</sup>
<i>Vernonia</i> sp.	Asteraceae	Kalaqicha	Sh	L	Diarrhea	Hu	Crushed & squeezed	Oral	7	GN-70	Malaria <sup>64</sup>
<i>Withania somnifera</i> (L.) Dunal	Solanaceae	Baala ajo	Sh	St	Ringworm	Hu	Stem is crushed	Dermal	12	GN-84	Trypanosomiasis, <sup>156</sup> evil eye, <sup>157</sup> enteric bacteria infection <sup>83</sup>
				L/R	Evil eye	Hu	Dried, ground and mixed with water	Oral & nostril	78		
				L	Diarrhea		Leaf is crushed and squeezed	Oral	65		

**Abbreviations:** T, tree, Sh, shrub, H, herb, Fr, fruit, Sa, sap, La, liana, Cl, climbers, ep, epiphyte, Hu, human, Ls, livestock, Hu/Ls, human and livestock, L, leaf, Ba, bark, R, root, Se, seed, St, stem, Wh, whole plant, Sh, shoot, Lt, latex, L/R, leaf and root, GIT, gastro-intestinal tract, TB, tuberculosis.

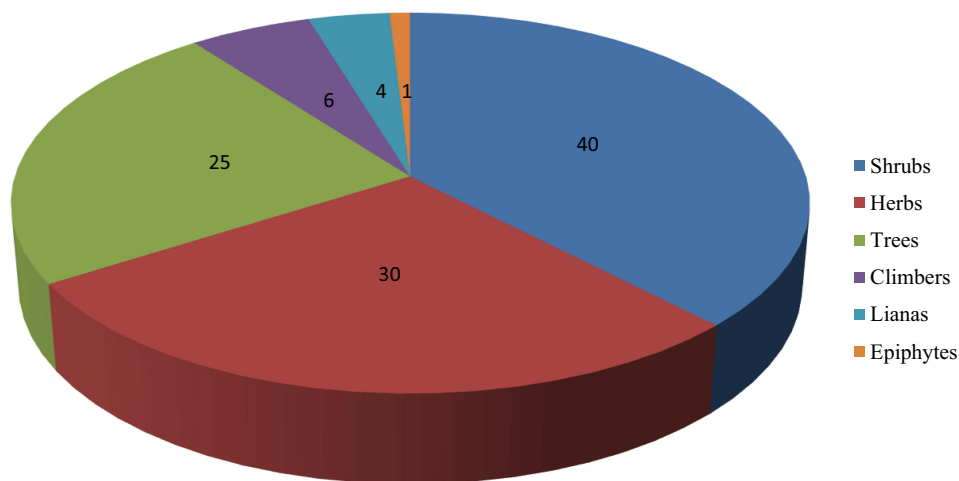


Figure 2 Proportions of medicinal plants growth forms in percent.

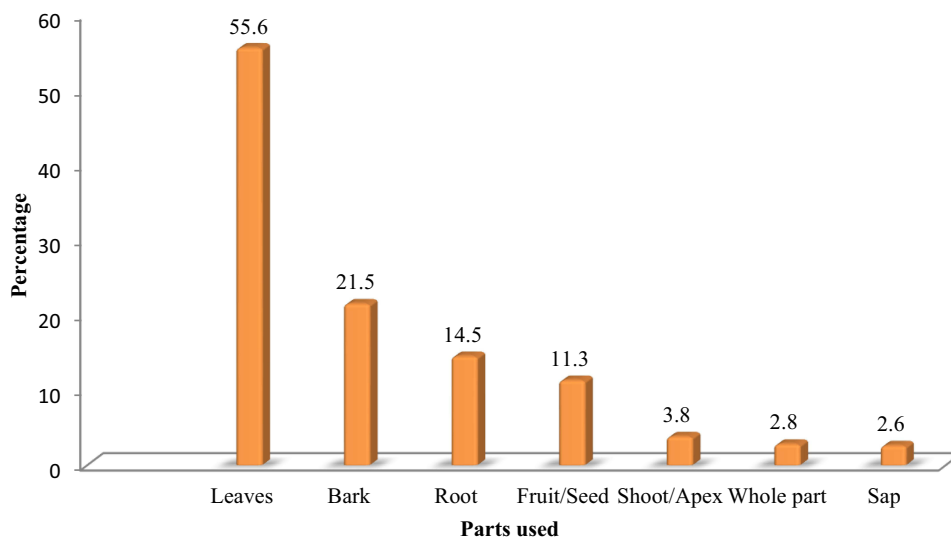


Figure 3 Proportions in percent of plant parts used for the treatment of human and livestock diseases in Kofale District, Oromia Regional State, Ethiopia.

dermatophilosis, equine glanders, anthrax, blackleg and pasteurellosis were the most reported ones with frequency of citation 26%, 22.4%, 19%, 16%, 11.3%, 7.2% and 3.3%, respectively.

### Preference Ranking of Selected Medicinal Plants Used Against Human Gastrointestinal and Skin Diseases in the District

According to preference ranking exercise conducted on seven medicinal plants of the highest informant citations for their uses to treat human gastrointestinal complaints, a health problem of the second highest prevalence in the study district, *Olinia rochetiana* was the most preferred medicinal plant, followed by *Bersama abyssinica* and *Vernonia amygdalina* (Table 5).

A preference ranking exercise conducted on seven medicinal plants with the highest informant citations for their use in managing skin disorders, a health problem with the highest prevalence in the study district revealed that *Euclea schimperi* was the most preferred medicinal plant, followed by *Maesa lanceolata* and *Vernonia amygdalina* (Table 6).



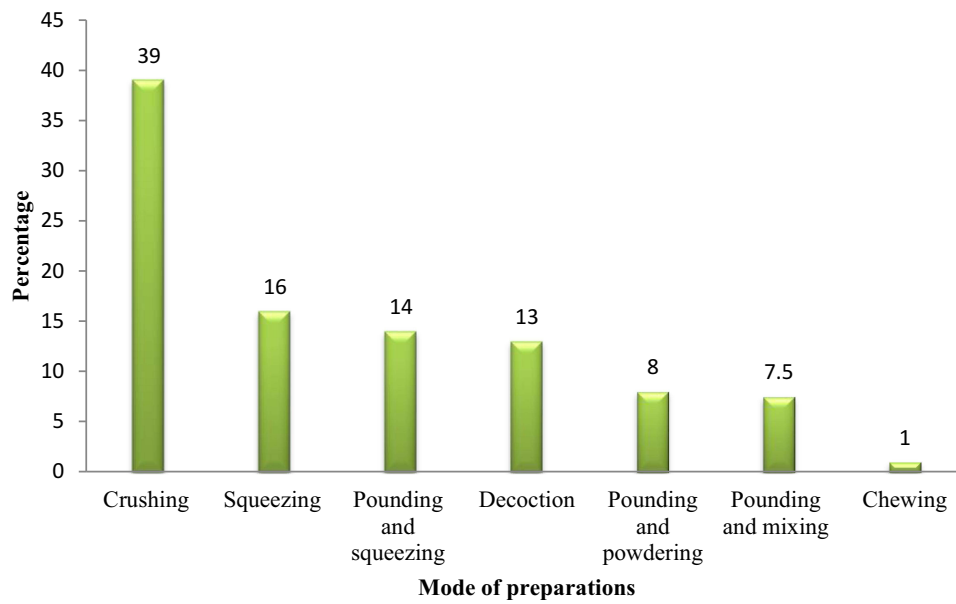


Figure 4 Percentages of different methods of remedy preparations.

### Medicinal Plants Scoring the Highest Fidelity Level and Rank Order Priority Values

Of the medicinal plants used to manage human ailments in the district, *Justicia schimperiana*, *Embelia schimperi*, *Olinia rochetiana* and *Euclea schimperi* which have been used to treat liver disorders, tapeworm infections, general gastrointestinal complaints, and dermatological disorders, respectively, scored the highest fidelity level (FL) (100%) and rank order priority (ROP) (>81%) values (Table 7).

Table 4 Route of plant remedy application

Route of Application	Frequency of Citation	Percentage
Oral	65	61.3
Dermal	27	25.4
Nasal	5	4.7
Ocular	4	3.8
Skin cut	2	1.9
Ears	2	1.9

Table 5 Preference ranking of selected medicinal plants used to treat human gastrointestinal complaints in Kofale District

Medicinal Plants Ranked	Informants Labeled A to J										Total Score	Rank
	A	B	C	D	E	F	G	H	I	J		
<i>Olinia rochetiana</i>	5	4	7	6	7	5	4	6	7	6	57	1
<i>Bersama abyssinica</i>	4	7	6	5	5	6	6	5	5	6	55	2
<i>Vernonia amygdalina</i>	6	5	6	4	6	5	5	5	6	6	54	3
<i>Euclea schimperi</i>	5	6	5	5	3	4	5	3	7	4	47	4
<i>Rumex nepalensis</i>	4	4	6	7	3	2	6	7	5	2	46	5
<i>Prunus africana</i>	5	3	2	5	4	3	5	4	2	6	39	6
<i>Myrsine melanophloeos</i>	4	3	3	3	6	4	3	2	6	2	36	7

**Table 6** Preference ranking of selected medicinal plants used to manage skin diseases in Kofale District

Medicinal Plants Ranked	Informants Labeled A to J										Total Score	Rank
	A	B	C	D	E	F	G	H	I	J		
<i>Euclea schimperi</i>	7	7	4	4	6	7	5	5	6	7	61	1
<i>Maesa lanceolata</i>	7	4	7	5	7	6	6	4	6	6	58	2
<i>Vernonia amygdalina</i>	7	7	4	4	5	5	6	7	5	4	57	3
<i>Aloe sp.</i>	7	6	6	5	5	6	5	5	5	4	55	4
<i>Prunus africana</i>	7	6	5	5	6	7	4	4	4	4	52	5
<i>Bersama abyssinica</i>	4	4	3	5	5	5	5	6	6	6	50	6
<i>Phytolacca dodecandra</i>	5	5	3	6	4	5	4	3	6	6	47	7

**Table 7** Rank order priority values of medicinal plants used to treat human ailments in the Kofale District with fidelity level values of above 80%

Medicinal Plant Spp.	Therapeutic Category	Np	N	FL (%)	RPL	ROP
<i>Justicia schimperiana</i>	Liver disorders	235	235	100.0	1.00	100.0
<i>Embelia schimperi</i>	Tapeworm worm infection	197	197	100.0	1.00	100.0
<i>Olinia rochetiana</i>	General gastrointestinal complaints	133	133	100.0	0.83	83.1
<i>Euclea schimperi</i>	Dermatological diseases	131	131	100.0	0.82	81.9
<i>Aloe sp.</i>	Hemorrhoids	260	320	81.0	1.00	81.0
<i>Phytolacca dodecandra</i>	Rabies	92	98	94.0	0.61	57.6
<i>Withania somnifera</i>	Evil spirit	65	75	87.0	0.47	40.8
<i>Podocarpus falcatus</i>	Epilepsy	50	62	80.6	0.39	31.2
<i>Asparagus africanus</i>	Cancer	44	52	84.6	0.33	27.5

Among the medicinal plants claimed to manage livestock health problems in the study district, *Ekebergia capensis* (for treatment of babesiosis), *Datura stramonium* (for treatment of rabies), and *Millettia ferruginea* (for treatment of leech infestation) had the highest fidelity level (FL) (>97%) and rank order priority (ROP) (97%) values (Table 8).

### Informant Consensus Factor Values

Human and livestock ailments in the study district reported by informants were grouped into 12 major disease categories, and informant consensus factor (ICF) values were calculated. Accordingly, skin-related diseases scored the highest ICF value (0.97), followed by gastrointestinal tract infections (0.95), cancer (0.93), animal bites (0.92), hemorrhoids, and body swelling (0.91). Respiratory tract disorder category had the lowest ICF value (0.62) (Table 9).

**Table 8** Rank order priority values of medicinal plants for livestock diseases in the Kofale District

Medicinal Plant Spp.	Therapeutic Category	Np	N	FL (%)	RPL	ROP
<i>Ekebergia capensis</i>	Babesiosis	73	73	100	1.00	100.0
<i>Datura stramonium</i>	Rabies	76	76	100	1.00	100.0
<i>Millettia ferruginea</i>	Leech infestation	72	74	97.2	1.00	97.2
<i>Prunus africana</i>	Wound	102	121	82.6	1.00	82.6
<i>Maesa lanceolata</i>	Dermatophilosis	62	76	82	1.00	82.0
<i>Calpurnia aurea</i>	Tick infestation	87	107	81.3	1.00	81.3
<i>Bersama abyssinica</i>	Equine glanders	44	46	95.6	0.75	72.1
<i>Schefflera volkensii</i>	Anthrax	28	33	85	0.54	46.0
<i>Kalanchoe petitiara</i>	Pasteurellosis	11	13	85	0.21	18.1

**Table 9** Informant consensus factor values of disease categories in study area

Diseases Category	Specific Ailment Reported	Use Citation (Nur)	Number of Species Used (Nt)	Informant Consensus Factor (ICF)
Skin-related diseases	Eczema, dandruff, lump rashes, skin lesion, ringworm, wound, wart, scabies, tick infestation, epizootic lymphangitis of horse	288	10	0.97
Gastro-intestinal tract infections and parasitic diseases	Abdominal pains, diarrhea, dysentery, typhoid fever, indigestion, stomachache, ulcers, vomiting, nausea, constipation, ascariasis, taeniasis	286	16	0.95
Cancer diseases	Breast cancer, throat cancer, skin cancers, tumor, other cancers	124	9	0.93
Animal bites	Poisoning, rabies, insect bites	76	7	0.92
Hemorrhoid, and body swellings		100	9	0.91
Liver diseases	Hepatitis, diseases of gallbladder, bile duct diseases, jaundice	75	9	0.87
Animal bacterial diseases	Anthrax, blackleg, glanders, Pasteurellosis	92	12	0.87
Endocrine & metabolic diseases	Diabetes, blood pressure, anemia heart diseases, hypertension	31	5	0.86
Musculoskeletal diseases & nervous disorders	Bone fracture, rheumatism, epilepsy	28	5	0.85
Arthritis				
Spiritual complications		29	7	0.78
Urogenital and reproductive disorders	Erectile dysfunction, syphilis, uterine infections, retained placenta, gonorrhea, abnormal menstrual cycle, infertility, breech position in pregnancy, dystocia labor	34	9	0.75
Respiratory tract-related problem	Asthma, chest pain, cough, pneumonia, tonsillitis.	9	4	0.62

## Ways of Acquisition of Traditional Medical Knowledge

Traditional medicinal knowledge in the district was reported to have been acquired in different ways. Among the informants interviewed, 79.8% reported that they acquired knowledge through family lines, while the remaining (20.2%) confirmed that they acquired knowledge through observation (10.8%), mentorship with other traditional medicine practitioners (3.5%), experimentation (3.5%), and friends (2.4%).

## Medicinal Plant Knowledge Comparison Between Different Social Groups

Interview data analyses showed that a significantly ( $p < 0.05$ ) higher mean number of medicinal plants ( $6.52944 \pm 0.1041$ ) was reported by older informants (age  $> 60$  years) compared to youngsters (20–40 years of age) ( $1.833 \pm 0.1931$ ) and those between the ages of 41–60 years ( $2.69603 \pm 0.18031$ ). Similarly, significantly ( $p < 0.05$ ) higher mean numbers of medicinal plants were reported by illiterate ( $5.296 \pm 3.0703$ ) and traditional medicine practitioners ( $8.9058 \pm 3.620$ ) as compared with that of literate ( $3.6234 \pm 3.122$ ) and general informants ( $3.389 \pm 1.661$ ) (Table 10), respectively. But, there was no significant difference ( $p = 0.8789$ ) between the mean numbers of medicinal plants reported by male ( $4.638 \pm 3.252$ ) and female ( $4.0714 \pm 2.355$ ) respondents.

## Threats to Medicinal Plants and Conservation Practices

Agricultural expansion and deforestation are commonly cited threats to medicinal plants as reported by 91% and 80% of the informants, respectively. Other stated threats included drought (8%), timber and firewood production (11%), over-exploitation (4%), and exotic species plantations (3%). The preference ranking exercise conducted by the informants also ranked agricultural expansion and deforestation as the major and leading threats (Table 11).

**Table 10** Comparison of medicinal plant knowledge among different groups of informants

Demographic Features	Categories	No.	No. of Plants Reported (Mean ± SD)	P-value
Gender	male	360	4.638 ± 3.252	0.8789
	female	28	4.0714 ± 2.355	
Age	20–40	86	1.833 ± 0.1931	0.0001
	41–60	210	2.69603± 0.18031	
	61–86	92	6.52944±0.1041	
	Illiterate	226	5.296 ± 3.0703	
Education	Literate	162	3.6234 ± 3.122	0.0001
	Traditional medicine practitioners	84	8.9058 ± 3.620	
Experience	General informants	304	3.389 ± 1.661	0.0001

**Table 11** Ranking of commonly reported threats against medicinal plants in the study area

Major Treats	Informants Labelled K1 to K10										Total Score	Rank
	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10		
Deforestation	4	5	4	4	4	5	5	3	5	4	43	2
Agricultural expansion	5	5	4	5	5	4	5	5	4	5	47	1
Timber & firewood making	4	3	3	4	5	4	5	3	4	5	40	3
Plantation of exotic species	1	2	2	3	4	2	1	2	3	1	20	5
Over exploitation	2	4	3	3	3	2	2	1	2	2	24	4

**Table 12** Ranking of medicinal plants reported as threatened in the study district

Medicinal Plants List	Informants Coded A-J										Total Score	Rank
	A	B	C	D	E	F	G	H	I	J		
<i>Hagenia abyssinica</i>	5	4	5	5	4	5	4	5	5	5	47	1
<i>Juniperus procera</i>	5	5	4	4	5	4	3	5	5	5	45	2
<i>Podocarpus falcatus</i>	5	4	5	4	4	5	3	4	4	5	44	3
<i>Asparagus africanus</i>	4	5	5	5	3	4	3	3	5	2	43	4
<i>Withania somnifera</i>	5	5	2	4	4	5	5	3	3	4	40	5
<i>Cordia africana</i>	4	2	4	5	3	4	2	5	4	4	37	6
<i>Croton macrostachyus</i>	3	2	2	1	3	2	1	3	1	1	19	7

Medicinal plant conservation practices in the study area were poor. Only a few informants (13%) reported the cultivation of medicinal plants, including *Achyranthes aspera*, *Asparagus africanus*, *Ocimum lamiifolium*, *Rumex nepalensis*, *Ruta chalepensis*, *Withania somnifera* and *Aloe sp.* in homestead gardens.

### Ranking of Threatened Medicinal Plants

Preference ranking exercise, carried out on six threatened medicinal plants based on the interview results, revealed *Hagenia abyssinica* as the most threatened medicinal plant, followed by *Juniperus procera* and *Podocarpus falcatus* (Table 12).

### Discussion

The findings of this study showed the high dependence of the people in the Kofale District of West-Arsi Zone on traditional herbal medicine in their day-to-day primary healthcare needs, as demonstrated by the high number of

medicinal plant species reported by informants. In Kofale District, 106 medicinal plant species have been claimed to be used to manage both human and livestock ailments, which is a higher number than that reported for other districts in the country. Studies by Tolossa et al,<sup>20</sup> Ashagre and Molla,<sup>158</sup> Yineger et al,<sup>71</sup> and Gijan and Dalle<sup>28</sup> reported the use of 91, 98, 101, and 102 medicinal plants, respectively. The utilization of a relatively high number of medicinal plants in the study district may be linked to people's restricted access to modern healthcare facilities, cultural acceptability of medicinal plant-based treatments, and better vegetation cover in the area. All medicinal plants reported in the current study were found to have similar or different medicinal uses elsewhere in the country, as shown in Table 3. Of the total claimed medicinal plants, some were claimed to have been used elsewhere in the world for same or similar purpose, which include *Asparagus africanus* for treatment of tumor and cancer in Cote d'Ivoire,<sup>159</sup> *Calpurnia aurea* as antidermatophytic in Kenya,<sup>160</sup> *Carissa spinarum* against wound in India,<sup>161</sup> *Croton macrostachyus* against cancer in India,<sup>162</sup> *Euclea schimperi* against skin sores and rashes in Namibia,<sup>163</sup> *Ocimum gratissimum* as analgesic in Nigeria,<sup>164</sup> *Physalis peruviana* to treat gastro-intestinal tract disorders in Uganda,<sup>165</sup> *Podocarpus falcatus* to treat cancer in China,<sup>166</sup> *Rumex abyssinicus* to relieve stomachache in Africa,<sup>167</sup> *Syzygium guineense* to treat stomachache in Mali<sup>168</sup> and *Verbascum sinaiticum* against hepatitis in Egypt.<sup>169</sup>

The dominance of the families Asteraceae, Fabaceae, and Solanaceae in contributing high number of medicinal plants in the study district could be due linked to their diversity in species and/or richness in medically active constituents. Fabaceae and Asteraceae are among the dominant families in the Flora of Ethiopia and Eritrea in terms of species richness contributing 486<sup>50</sup> and 440<sup>170</sup> species, respectively. Studies conducted in other areas of country have also reported a high contribution of Asteraceae,<sup>74,125,171</sup> Fabaceae<sup>14,161–163</sup> and Solanaceae<sup>14</sup> to the medicinal flora.

The majority of claimed medicinal plants was collected from the wild and semi-wild habitats is in accordance with the results of other studies conducted elsewhere in different parts of the country.<sup>23,38,67,74,81,135</sup> The poor cultivation practice of medicinal plants in the district might be related to their easy accessibility in the wild.

This study also shown that shrubs were the most dominant medicinal flora in the study district, which might be because of their year-round availability, in contrast to trees that were exposed to selective cutting and herbs that blossom seasonally after the rainy season. The dominance of shrubby medicinal plants has been observed in other parts of the country.<sup>20,135,172</sup>

Leaves were the dominant plant parts employed in remedy preparations for the treatment of human and livestock ailments in the study district, which could be attributed to their perceived efficacy, accessibility, ease of harvesting, and simplicity of preparation. The common use of leaves in the preparation of remedies has also been reported in studies conducted elsewhere in the country.<sup>14,20,23,28,125</sup> Harvesting leaves has been reported to have much less damaging effects on the mother plant as compared to other parts such as roots and barks, the gathering of which could seriously affect the existence of individual plants.<sup>24,135</sup>

Different techniques were employed in the preparation of remedies in the district, with the crushing method taking the lead, which is in agreement with the results of previous studies conducted elsewhere in the country.<sup>21,27</sup> Moreover, the finding related to the condition of the plants used for preparation indicated that the majority of remedies were made from fresh plant parts, which is in agreement with the results of studies carried out elsewhere in the country.<sup>173,174</sup> Fresh materials retain volatile bioactive compounds, such as essential oils, which may be lost upon drying.

Oral was the most popular route of remedy administration which could be due to the reason that it creates favorable environmental condition for quick physiological reaction of the preparation against the pathogens and by so doing boosts its healing power.<sup>20</sup> Oral administration has an additional advantage in that it allows the traditional medicine practitioners to reverse complication that might happen on the clients during treatment using antidotes. Other ethnobotanical studies conducted elsewhere in Ethiopia also reported oral administration as a common route of remedy application.<sup>12,14,16,20,27,175</sup>

Skin-related and gastrointestinal tract diseases had the highest ICF values, which might imply better consensus among informants in the study district regarding the selection of plants used to manage such diseases.<sup>176,177</sup>

Of the medicinal plants employed to treat human health problems, *Justicia schimperiana*, *Embelia schimperi*, *Olinia rochetiana* and *Euclea schimperi* which were used to treat liver disorders, tapeworm infection, general gastrointestinal complaints, and skin diseases, respectively, scored the highest FL and ROP values, which are measures of therapeutic potential.<sup>35</sup> *Justicia schimperiana* was reported to have shown antioxidant,<sup>178</sup> lousicidal and acaricidal,<sup>179</sup> anticancer<sup>180</sup> and

antimalarial<sup>181</sup> activities. Crude extracts of *Embelia schimperi* exhibited anthelmintic<sup>182</sup> and antioxidant properties.<sup>183</sup> Investigation reported the antibacterial,<sup>184</sup> antidiarrheal<sup>185</sup> and anti-inflammatory<sup>186</sup> activities of *Olinia rochetiana*. Leaf extracts of *Euclea schimperi* demonstrated antioxidant and antibacterial activities.<sup>187</sup> Generally, there is a higher consensus among informants in the study district regarding the selection of medicinal plants for the treatment of skin infections and gastrointestinal complaints, as revealed by the highest informant consensus factor (ICF) values scored by the two disease categories, which again is a sign of their better healing potential. Similar medicinal uses of these plants have been widely reported in different parts of the country.<sup>14,17,25,54,71,86,88,98,188</sup> Among the medicinal plants claimed to manage livestock health problems, *Ekebergia capensis* and *Datura stramonium* which are used against babesiosis and rabies, respectively, scored the highest FL and ROP values. Previous studies have also reported the anti-infectious properties.<sup>28,81</sup>

Data analysis revealed that older, illiterate, and key informants in the study district reported significantly higher mean numbers of medicinal plants than that reported by the young, literate, and general informants, respectively. The fact that the younger generation had less medicinal plant knowledge compared to the older generation could be due to the reason that the former are more prone to acculturation and modernization and thus are more reluctant to learn and practice traditional medicine. Studies conducted in other areas of the country also reported that older people have better knowledge of medicinal plants than younger people.<sup>21,74,175</sup> The reason that key informants had better knowledge of medicinal plants in the study district compared to general informants is also in agreement with the findings of previous studies conducted elsewhere in the country.<sup>26,189</sup> The fact that literate informants in the district had less knowledge of medicinal plants than illiterate ones could be attributed to the influence of modern education. A study conducted in other areas of the country reported similar results.<sup>118</sup>

Agricultural expansion and deforestation were identified as major threats to the survival of medicinal plants in the district. Research carried out elsewhere in the country also revealed that agricultural expansion and deforestation are main threats to medicinal plants.<sup>28,60,94,190</sup>

## Conclusion

The diversity of reported medicinal plants (106 species) employed to manage human and livestock disorders is indicative of plant-related rich knowledge of traditional medicine practices in the Kofale district. Leaves have been reported to be the most commonly utilized plant part in the preparation of remedies for the treatment of various ailments. Skin and gastrointestinal disorders were the major disease categories, with the highest ICF values. Medicinal plants, including *Euclea schimperi*, *Olinia rochetiana*, *Embelia schimperi*, and *Justicia schimperiana*, were the ones having the highest FL and ROP values for their use in the treatment of skin diseases, general gastrointestinal complaints, tapeworm infections, and liver disorders. Different scientific investigations also revealed the bioactivity of these plants against a number of aetiological agents. Comparative studies conducted on sociodemographic factors in the district revealed that older, illiterate, and key informants had better knowledge of the use of medicinal plants for the treatment of various human and livestock diseases than younger, literate, and general informants, respectively. In future phytochemical and pharmacological investigations, priority needs to be given to medicinal plants that scored the highest FL and ROP values and those plants that were used to treat disease categories with the highest ICF values.

## Data Sharing Statement

Data concerning this study were kept on a desktop computer at the Aklilu Lemma Institute of Pathobiology (ALIPB), Addis Ababa University (AAU). Readers may get access to the data through requests made to ALIPB. Plant voucher specimens were stored at the mini-herbarium of the Endod and Other Medicinal Plants Research Unit (ALIPB, AAU).

## Ethical Consideration

The study proposal was evaluated and approved by the Ethical Review Committee of the Aklilu Lemma Institute of Pathobiology at the Addis Ababa University. Permissions were granted by the zone, district, and kebele administrations to conduct the fieldwork. Verbal consent was obtained from the study participants, which was also approved by the Review Committee. We confirm that our study complies with the Declaration of Helsinki.<sup>191</sup>

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## Disclosure

The authors report no conflicts of interest in this work.

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