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## Medicinal plants traded in Arusha city, Tanzania

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### Abstract

**Background:** Article presents harvest sites and taxonomic diversity of plant species traded in fast growing Arusha city to facilitate traceability and sustainable conservation.

**Methods:** Ethno-botanical information was collected through semi-structured interviews while confirmatory field surveys covered reported harvest forests. Ethnobotanical information was analyzed using Use-Value (UV) and Relative Frequency of Citation (RFC) indices.

**Results:** A total of 147 plant species in 116 genera and 54 families were recorded. The most represented families were Fabaceae with 21 (14%) species, Asteraceae 10 (6.8%) and Euphorbiaceae 8 (5.2%). Highest UV were for *Warburgia ugandensis* (0.26), *Prunus africana* (0.22) and *Rauvolfia caffra* (0.2). *Aloe secundiflora* and *Lannea schweinfurthii* recorded highest RFC (0.92 each). Though village forests supplied most of herbals in Arusha markets, state forests were encroached for rare plants.

**Conclusion:** Village forests though degraded are major sources of herbal materials in Arusha markets. Sustainable utilization is recommended for economic and ecological resilience.

**Keywords:** Medicinal plants, trade, sustainable conservation

### Introduction

Growing demand for herbal medicine in the recent past has increased volumes of plant material traded globally [1]. It is estimated that about 30000 plant species are known to have use values of which half of these are known to be used as drugs worldwide [2, 3]. In some African countries up to 90 percent of the population relies on medicinal plants as a source of drugs [4]. In Tanzania for instance 60% of the population depends on traditional medicine for primary health care [5]. Moreover, medicinal plants have been useful as a trade commodity as supplementary source of income for wealth creation while meeting the demand of the market [6, 7]. In India for instance, medicinal plants provide for livelihood to a greater population segment whereas 960 species are estimated to be in trade [7]. The pharmaceutical industries all over the world are producing drugs from plant species with revenue of more than US\$ 3000 million [3]. In Europe approximately 25% (132,000 tonnes) of the medicinal plants traded internationally are imported, of which 20% is estimated to originate from Africa. In South Africa for instance up to 80% of African people use plants for medicines which created trade worth R270 million a year [1]. Extensive use and trade of medicinal plants and the shrinking habitats due to land use systems gives a reflection that many species might face local extinction in the wild whereby 4,000 – 10,000 species may now be endangered [8, 9]. Thus understanding the diversity of species traded will improve the needed efforts for both in-situ and ex-situ conservation.

Arusha region is one of the most unique regions of Tanzania whereby its highlands have the greatest potential for agriculture production, but its lowlands are some of the hottest and dustiest areas to live [10]. The region as a whole has one of the fastest growing population whereby in 2002 the population was 1.3 million and in 2012 it was 1.7 million [11]. Population increase is subsequently perpetuating the demand among others is the need for medicinal plants for health and income security. Thus the growing number of informal street vendors, formal store owners and open air market traders of medicinal plants in Arusha city necessitates asking the species diversity and their collection localities. The knowledge on plant species trade in the cities will broaden our understanding on the status of the particular species in the field in order to propose conservation priorities for those found to be of higher demand. The aim of this study was to understand the taxonomic diversity of plant species traded in Arusha city markets and know their localities to facilitate traceability and sustainable conservation.

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## Methods

### Study Area and the people

Arusha region is located in the north-eastern corner of Tanzania. It lies below the equator between the latitudes 2° and 4°S; longitudes 35° and 38° E of Greenwich. The region has four distinctive agro-ecological zones basing mainly on topographic and geographic features as well as climatic conditions. These are: woodlands, bush lands, wooded grasslands, bushed grasslands and open grasslands all of which cover 80 percent of the region [10]. The main ethnic groups in Arusha are the Iraqw, Maasai, Waarusha and Meru. Other significant minorities are Chagga, Sonjo, Pare, Rangi and Hadzabe. The majority of Iraqws are settled in Karatu district while Wameru and Waarusha are dominant in Arumeru and Arusha districts. The Maasai are the major ethnic group in Monduli, Ngorongoro and Longido districts. The Hadzabe are mostly found in the bushlands of Karatu district; an interesting group as it is still dependent for its food on hunting and collection of wild plants parts and honey. However, each ethnic group is known to have a history of using plants around their close environment for nutrition, ceremonial, ritual and medicinal purposes, for both human and livestock [10]. For this study Maasai and Waarusha were the only ethnic groups interviewed because they are the majority in the trade of medicinal plants in the city.

### Data collection

Different market places in Arusha city were visited in 2015 whereby 50 traditional medicine vendors were interviewed after oral consent. Ten men interviewed had permanent licensed store for medicinal plants business; 15 men and 5 women were found randomly in weekly open air markets with parts of plants for sell for medicinal use; 16 men and 4 women were also found randomly walking in streets within the city with concoctions and crushed or powdered parts of medicinal plants in plastic containers searching for customers. The language used during the interview was Maa (Maasai and Waarusha language) which was later translated into English. For every single plant named they were asked to mention the number of diseases that particular plant could be used to treat. They were also asked to name the collection locality of the plants material. Of 50 medicinal plants sellers, 8 were purposively selected to walk with the researchers into those localities mentioned as the main sources of medicinal plants sold in Arusha city. The selection was based on the knowledge of individual as regard to their main collection localities of medicinal plants and quality of explanation that particular seller gave during the interview and also their willingness to participate in field trips.

### Field expeditions

From the interview, three main collection localities were identified as the sources of medicinal plants traded. These are village forests adjacent to floral diverse forest reserves in Arumeru, Longido and Monduli districts of Arusha region. In approaching each plant corresponding to the vernacular name given during the interview in the city, the respondents were asked to explain which part of the plant is used for medicine.

Plant specimens that would be identifiable and preserved at the herbarium were collected. A branch of the plant that would show leaf arrangements, flowers and/or fruits was collected from a particular plant. Voucher specimens were brought at National Herbarium of Tanzania for identification and preservation. The identification of collected specimens at the herbarium was based on visual identification of the plant, comparison with the reference specimens in the herbarium and use of taxonomic keys from various volumes of the Flora of Tropical East Africa [12].

### Data analysis

The data was entered in Excel spreadsheet 2010. A descriptive statistical procedure such as frequencies and percentages were employed to analyze ethno-botanical data regarding plant growth forms, plant parts used and taxonomic diversity of species used. Relative frequency of citation (RFC) was calculated by dividing the number of informants mentioning a useful species (Frequency of citation - FC) by the total number of informants in the study [13]. To understand the importance of particular species in relation to the number of uses mentioned by informants the use value was calculated using a formula-  $UV = \sum U_i / N$ . Whereas UV is the use value of each species.  $U_i$  equals the number of uses mentioned by informants in each event and N is the number of informants interviewed in the survey [13].

## Results

### Collection localities of medicinal plants traded in Arusha city

Twelve (12) villages bordering the forest reserves in Arumeru, Longido and Monduli districts in Arusha region were mentioned as the main sources of medicinal plants traded in Arusha city (Table 1). These villages were visited for collection of identifiable specimens as confirmatory to cryptic medicinal samples in markets always traded as fragmented materials, infusions, mixtures or extracts.

**Table 1:** Source of medicinal plants traded in Arusha city

District	Villages
Arumeru	Momela, Ngongongare, Nkoanekali, Kilinga, Ngarenanyuki and Ngurdoto
Longido	Gelai, Ketumbeine and Longido
Monduli	Losimingori, Makuyuni and Monduli juu

### Diversity of medicinal plants

#### Traded plant species in Arusha city

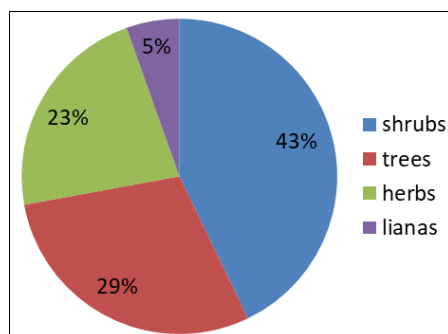
Total of 147 plant species in 116 genera and 54 families were identified to be traded in Arusha city for treatment of various human ailments. The most represented families were Fabaceae with 21 (14%) species followed by Asteraceae 10 (6.8%), Euphorbiaceae 8 (5.4%), Lamiaceae 7 (4.7%), Amaranthaceae and Rhamnaceae had 6 (4%) each, Rutaceae 5 (3.4%), four families represented by 4 species (2.7%) each, 7 families were represented by 3 species (2.7%) each; 12 families had 2 species (1.36%) each and other 23 families were represented by only one species equals 15.6% all together (Table 2).

**Table 2:** Taxonomic diversity of medicinal plants species. F = Frequency; N = 147

Family	Species F	Species %
Fabaceae	21	14.2857
Asteraceae	10	6.80272
Euphorbiaceae	8	5.44218
Lamiaceae	7	4.7619
Amaranthaceae	6	4.08163
Rhamnaceae	6	4.08163
Rutaceae	5	3.40136
Apocynaceae	4	2.72109
Boraginaceae	4	2.72109
Tiliaceae	4	2.72109
Solanaceae	4	2.72109
Acanthaceae	3	2.04082
Capparidaceae	3	2.04082
Verbenaceae	3	2.04082
Myrsinaceae	3	2.04082
Malvaceae	3	2.04082
Anacardiaceae	3	2.04082
Celastraceae	3	2.04082
Asparagaceae	2	1.36054
Simaroubaceae	2	1.36054
Combretaceae	2	1.36054
Burseraceae	2	1.36054
Sapindaceae	2	1.36054
Ebenaceae	2	1.36054
Cucurbitaceae	2	1.36054
Asclepiadaceae	2	1.36054
Loranthaceae	2	1.36054
Rubiaceae	2	1.36054
Flacourtiaceae	2	1.36054
Meliaceae	2	1.36054
Other families	23	15.64626

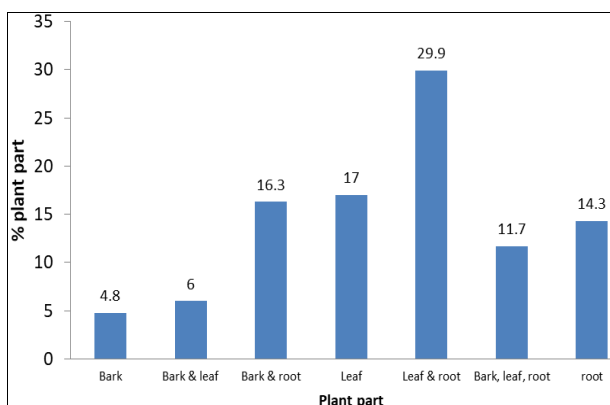
The growth forms of plant species traded in Arusha city showed that shrubs constituted 63 of all the species which is the highest proportion, tree species were 44, herbs species 34

while climbers (including lianas) constituted 6 species (Percentage proportions summarized in in Fig.1).



**Fig 1:** Percentage of habits

Plant parts harvested were leaves and roots 30%, bark and roots 16%, leaves 15% while the whole plant constituted 12% (Fig.2).



**Fig 2:** Percent plant part of medicinal plants harvested for trade in Arusha city

### Use value and frequency of citation

Species with highest use value (UV) were *Warburgia ugandensis* (UV = 0.26) followed by *Prunus africana* (0.22), *Rauvolfia caffra* and *Helitropium steudneri* had UV of 0.2 each while *Aloe secundiflora*, *Acacia nilotica*, *Albizia anthelmintica* had UV of 0.18 each (Table 3).

Species with highest relative frequent of citation (RFC) were *Aloe secundiflora* and *Lannea schweinfurthii* (RFC = 0.92 each), *Acacia nilotica*, *Embelia schimperi*, *Maerua triphylla*, *Maesa lanceolata* and *Rauvolfia caffra* scored 0.9 RFC each. *Tabernaemontana ventricosa* had the RFC of 0.88. *Kigelia africana*, *Ocimum kilimandscharicum*, *Piper capense*, *Prunus africana*, *Senna didymobotrya* and *Warburgia ugandensis* had 0.86 RFC each (Annex 1).

### Discussion

#### Collection localities of medicinal plant material traded

In Tanzania, knowledge of the trade chain of medicinal plants from the collection site to the final market is crucial for implementation of the traceability and survivalance. The Forestry legislations provides for free access and exploitation in village and public lands. Whereas, forest reserves are literally under the state monitoring and consequently are partly waived from free exploitation. Nevertheless, some important medicinal plants not available in the village and public forests are illegally drained from the state forests. In this study, plants sold in the Arusha city were mainly harvested from the village areas bordering the forest reserves in Arumeru, Longido and Monduli districts in Arusha region (Table 1).

Arumeru district has two prominent climatic zones - the sub-humid zone on slopes of Mount Meru and the semi-arid zone beyond it. The sub-humid zone is composed of montane forests on the eastern and western slopes of Mount Meru between 1500 and 2400 m asl. Larger part of the montane forest is within Arusha National Park and smaller part of it is owned by villages bordering the Park. Informants in this part mentioned to obtain medicinal plant material in the villages 'forests at the southern and eastern slopes of Mount Meru bordering the Park.

Longido district located on the north east of Arusha region is characterized by *Acacia-commiphora* woodlands vegetation containing the drier spots on mainland Tanzania [10]. In the middle of dry *Acacia-Commiphora* vegetation are three isolated peaks Gelai (2,942 m asl), Longido (2,637m asl) and Ketumbeine (2,860m asl) which act as condensers of moisture and form the dry montane forest. Field walks were carried out in 3 villages bordering Gelai, Longido and Ketumbeine hills (Table 1).

Other prominent localities are the villages bordering the three hills in Monduli district - Purko (2136 m.asl), Essimngor (2154 m asl) and Monduli (2198 m asl.) with dry montane forests Reserves. Field walks were carried out in a village neighboring each hill (Table 1).

Based on the increased preference of medicinal plants for health and livelihood care [14, 15] coupled with increasing population in Arusha city and in the surroundings [11], it is predicted medicinal plants occurring in free access areas other than forest reserves will be highly vulnerable.

#### Diversity of medicinal plants traded in Arusha city

This study identified 147 plant species in 114 genera and 55 different families traded in the city (Table 3) for treating various human diseases in the form of decoction, powder and concoctions. Study by Verma [16] and Parthiban [17] on

medicinal plants used to treat livestock in India found that Fabaceae was the most represented family in the list. A survey of medicinal plants used in Khulna district, Bangladesh by Rahmatullah [18] and Megersa [19] in Ethiopia found Fabaceae as a leading family with more species used for medicines. Fabaceae was the most represented family having 21 (14%) species in the list (Table 2). The finding is also in agreement with a study by Hilonga *et al.* 2019 on traded medicinal plants of Tanzania whereas Fabaceae was the dominant family in trade accounting for 38(23.5%) of all 162 species [20]. Higher representation of Fabaceae can be supported by the fact that it is one of the largest families in the world with greatest number of species with more than 1900 species which generate a high diversity of secondary metabolites [21].

The result on growth form showed that, out of 147 species traded in the city, 63(43%) were shrubs, followed by trees 43(29%), herbs 33(23%) and climbers 8 (5%); (Fig.1). These results are in line with a study by Mesfin [22] in Ethiopia who found that shrubs had the highest proportion of species used for medicine, however in contrast with a study by Parthiban [17] who found that herbs are commonly used for medicines due to their availability in nature. More plant species were harvested for their leaves and roots (44; 30% altogether) followed by leaves alone (25; 17%), bark and roots (24; 16%), roots alone (21; 14%) while the use of almost the whole plant (bark, leaves, roots) was 17; 12% (Fig. 2). These results are in line with another study on medicinal plants in Ethiopia which found that 70% of medicinal plants were harvested for their leaves and roots [23]. Generally there is no stereotype use-patterns associated with certain part of plant used for medicine. Rather preference is dependent on the kind of disease, knowledge and the reliability at a time of need or at a particular season of the year. While leaves constitutes the greater portion of herbal material in Arusha market, a study by Hilonga [20] on traded medicinal plants of Tanzania recorded roots (55.3%) on the lead followed by bark (23.7%), leaves (15.8%), seeds (1.6%), fruits (2.0%), corms (1.0%). Harvesting leaves for herbal medicine provides sustainable market material due to their short annual rotational yields. Nevertheless overriding use of roots and barks as sources of traded material is destructive to the ecosystems. In this study, all recorded tree species (Annex 1) are mainly extracted for bark or/and roots and the same for all 20 top ranked medicinal plants according to RFC and UV matrices. Species with high UV are considered very important with multiple uses. *Warburgia ugandensis* with highest use value (UV- 0.26; Table 2) is also reported by Njoroge [24], Lusweti [25] and Orodho [26] as one of the priority medicinal plants in whole of East African region. Study of traded medicinal plants in Tanzania reports substitution of *Warburgia stuhulmanii* for *Warburgia ugandensis* in the Tanzania cities as the later is relatively rare and more confined in humid forests [20]. While *Prunus africana* (UV- 0.22) is a CITES listed tree, its bark is exploited for medicine worldwide. The plant species is recorded as one of important plants in Arusha markets, elsewhere records of traded medicinal plants of Tanzania [20] reports *P. africana* as one of leading species for export to Europe markets and at the same time one source of precious timber for furnitures in Morogoro and Kyela in Tanzania. The bark has been exported from Cameroon, Madagascar, Equatorial Guinea and Kenya to France and Italy which produced 86% of the world's bark extract [27]. Respondents reported that *Prunus africana* and *Warburgia ugandensis* have both become rare such that the supply in the market had

declined in the previous two decades while the demand remains high. *Rauvolfia caffra* (0.2 UV) and *Aloe secundiflora* (0.18 UV) were also mentioned by Njoroge [28] as one of the important medicinal plants in Kenya.

*Aloe secundiflora*, *Launea schweinfurthii*, *Acacia nilotica*, *Embelia schimperi*, *Maerua triphylla*, *Maesa lanceolata* and *Rauvolfia caffra* had highest RFC scores from 0.92 to 0.9 (Table 2). Likewise, a study of medicinal plants traded in urban Kenya found that *Aloe secundiflora* had the highest relative frequency of citation [24]. Medicinal plants viz. *Zanthoxylum chalybeum*, *Albizia anthelmintica*, *Ximenia caffra*, *Kigelia africana*, *sclerocarya birrea* and *Cassia abbreviata* and *Acacia nilotica* are most common commodities in the East Africa city markets [25] Kenya, [26] Kenya and Uganda. These species with the highest UV and RFC are considered as important species in medicinal plants trade. Moreover, diversity assessment of the same species in the same region demonstrated lowest Shannon Diversity Indices ( $H^1$ ) ranging from 0 to 0.0005 out of 1.0 [29], thus giving a reflection of their vulnerability.

Pooled impact of bark/root harvesting and the rising demand is a matter of immediate conservation concern. It is noted that major harvesting sources are of free access category in village and public forests without requisite legislations restricting unlawful exploitation. Meanwhile, no replacement planting was recorded indicating systematic drain without refilling. Nevertheless, medicinal plants still hold potentials for economic growth in the light of uprising herbal medicine industry. Farmers have opportunity to plant commercially important species in their farms as one of the sources of income in later years. *Ex-situ* planting in the farms within the same ecological ranges is a possible venture as these native plants are adaptable to the local climate and physiographic conditions.

### Conclusions

Medicinal plant materials sold in the Arusha city are mainly freely collected from the villages' forests and the public lands. Although the harvesting in the neighbouring forest reserves is restricted, there is ongoing encroachment especially for medicinal plants material not available in the free access forests.

Among the species traded, some are very important in treating human ailments and already threatened locally due to over-exploitation, for instance *Prunus Africana* and *Warburgia ugandensis*. Conservation programs which will improve sustainable supply for instance community involvement in domestication of the most useful species in home gardens and botanical gardens are suggested. Enrichment planting *in-situ* within the species specific ecological range state by the Forestry authority is recommended.

### Declarations

**Ethical approval and consent to participate:** Informal oral consent was accepted by the informants.

**Consent for publication:** Informal oral consent was accepted by the informants.

**Availability of data and material:** Plant specimens collected are deposited at the National Herbarium of Tanzania.

**Competing interest:** Authors declare that they have no competing interests.

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**Annex 1:** List of Medicinal Plants recorded during ethnobotanical study in this study

Family	Species name	Venacular name	habit	Uses	Part used	RFC	UV
Aloeaceae	<i>Aloe secundiflora</i> Engl.	Osukuroi	shrub	stomach complains	rt, lv	0.92	0.18
Anacardiaceae	<i>Lannea schweinfurthii</i>	Orupande	tree	Stomach	rt, bk	0.92	0.08
Fabaceae	<i>Acacia nilotica</i> (L.L Delile	Olkiloriti	tree	body strength, facilitate digestion, wounds	rt, bk	0.9	0.18
Myrsinaceae	<i>Embelia schimperi</i> Vatke	Olchanionyokie	shrub	Anthelmintic, malaria	rt, lv	0.9	0.06
Capparidaceae	<i>Maerua triphylla</i> var. <i>caliophylla</i>	Oloiseroi	shrub	swollen testicles	bk	0.9	0.1
Myrsinaceae	<i>Maesa lanceolata</i> Forssk.	Emataangulu	shrub	syphilis, anthelmintic, flue, colds,	rt, bk	0.9	0.06
Apocynaceae	<i>Rauvolfia caffra</i> Sond.	Olchavukalian	tree	Pniumonia, fever, rheumatism, cough, stomach ache	rt, bk, lv	0.9	0.2
Apocynaceae	<i>Tabernaemontana ventricosa</i> Hochst. ex A.DC.	Emurasha	tree	Wounds, fever	rt, lv	0.88	0.06
Bignoniaceae	<i>Kigelia africana</i> (Lam.) Benth.	Oldarpoi	tree	Kidney diseases	rt, bk, lv	0.86	0.16
Labiatae	<i>Ocimum kilimandscharicum</i> Gürke	Esindi	herb	Fever, cough, respiratory track diseases	lv	0.86	0.04
Piperaceae	<i>Piper capense</i> L.f.	Olerubat	shrub	Aphrodisiac, venereal diseases, wounds, fever, epileptic attack	rt, lv	0.86	0.12
Rosaceae	<i>Prunus africana</i> (Hook.f.) Kalkman	Oledet	tree	Stomach ache, snake bite, fever, increase appetite	rt, bk, lv	0.86	0.22
Fabaceae	<i>Senna didymobotrya</i> (Fresen.) H.S.Irwin & Barneby	Olmapinu	shrub	Anthelmintic, fever, stomach complains, venereal diseases	lv	0.86	0.06
Canellaceae	<i>Warburgia ugandensis</i> Sprague	Osokonoi	tree	Toothache, cough, fever, general body pains and anthelmintic, Malaria	rt, bk	0.86	0.26
Sapindaceae	<i>Pappea capensis</i> Eckl. & Zeyh.	Oltimigomi	tree	Stomach ache, facilitate digestion	rt, lv	0.84	0.06
Euphorbiaceae	<i>Phyllanthus sepialis</i> Müll. Arg.	Emuchukuchuku	shrub	Back pain, muscle pain, sore throat, improve sight,	rt, lv	0.82	0.04
Plumbaginaceae	<i>Plumbago dawei</i> Rolfe	Orngerianodus	herb	stomach diseases, dysentery.	rt, lv	0.82	0.1
Solanaceae	<i>Solanum incanum</i> L.	Endulele	shrub	Ring worms, evil eyes	rt, lv	0.82	0.14
Solanaceae	<i>Withania somnifera</i> (L.) Dunal	Olesayiet	shrub	Anaemie, ulcers, asthma, arthritis	rt, lv	0.82	0.14
Oleaceae	<i>Ximenia caffra</i> Sond	Olamai	shrub	venereal diseases and general body weakness	rt, lv	0.82	0.12
Asclepiadaceae	<i>Mondia whitei</i> (Hook.f.) Skeels	Emukongora	shrub	Aphrodisiac, urinary tract infection, diarrhea. Headache	rt, bk, lv	0.8	0.08
Fabaceae	<i>Albizia anthelmintica</i> Brongn.	Olmukutani	tree	cancerous wounds, anthelmintic	rt, bk	0.78	0.18
Meliaceae	<i>Trichilia emetica</i>	Olmukuna	tree	Abdominal pains, dermatitis, quick child birth	rt, bk	0.78	0.14
Amaranthaceae	<i>Achyranthes aspera</i> L.	Olerubat	herb	constipation, constipation and colds	lv	0.76	0.12
Rutaceae	<i>Zanthoxylum chalybeum</i> Engl.	Oloisuki	shrub	Fever, colds, sore throat, venereal diseases	rt, bk	0.76	0.04
Fabaceae	<i>Indigofera arrecta</i>	Emuchukuchuku	shrub	diarrhoe, epilepsy and nervous disorders, ulcers	rt, lv	0.74	0.1
Oleaceae	<i>Olea europaea</i> ssp. <i>Africana</i>	Olorien	tree	Back pain, muscle pain, sore throat, heart diseases, diabetes.	rt, bk	0.74	0.06
Anacardiaceae	<i>Rhus natalensis</i> Krauss	Olmusigiyoiy	shrub	Arthritis	rt, lv	0.74	0.1
Verbenaceae	<i>Clerodendrum myricoides</i> (Hochst.) Vatke	Orkibasirkon	shrub	prevent miscarriage	rt, lv	0.72	0.08
Ebenaceae	<i>Euclea divinorum</i> Hiern	Osodjo	shrub	Cancerous wounds, arthritis, stomach pain	rt, bk, lv	0.68	0.04

Salvadoraceae	<i>Salvadora persica</i> L.	Oremit	shrub	Malaria, flue, colds, induce vomiting	rt, bk	0.68	0.16
Apocynaceae	<i>Acokanthera schimperi</i> (A.DC.) Schweinf.	Olmorjoi	shrub	tonsillitis, skin diseases, fertility for women	rt, bk, lv	0.66	0.06
Combretaceae	<i>Terminalia brownii</i> Fresen.	Orbukoi	tree	fever, colds, chest pain, pneumonia	bk	0.64	0.06
Fabaceae	<i>Acacia oerfota</i> (Forssk.) Schweinf.	Kiiti	tree	body strength and stomach discomfort	rt, bk	0.62	0.08
Verbenaceae	<i>Clerodendrum johnstonii</i> Oliv.	Oloholo	shrub	Anthelmintic	rt, lv	0.58	0.04
Asclepiadaceae	<i>Pentarrhinum abyssinicum</i> Decne.	orkorirr	climber	Stomach ache.	rt, lv	0.58	0.04
Fabaceae	<i>Acacia thomasii</i> Harms.	Olderkesi	tree	leprocy	bk	0.54	0.12
Zygophyllaceae	<i>Balanites glabra</i> Mildbr. & Schltr.	Erg'oswa	shrub	malaria	rt, bk	0.54	0.06
Simaroubaceae	<i>Harrisonia abyssinica</i> Oliv.	Olesupen	shrub	sleeping sickness	rt, lv	0.54	0.04
Fabaceae	<i>Acacia senegal</i> Willd.	Olderkesi	tree	Facilitate placenta removal after birth	rt, bk	0.52	0.1
Fabaceae	<i>Acacia ancistroclada</i> Brenan	Orperrolong'o	tree	stomach discomfort, appetizer, body strength	rt, bk	0.5	0.12
Fabaceae	<i>Acacia tortilis</i> (Hochst. ex A. Rich.) Brenan	Olmorjoi	tree	venereal diseases and general body weakness	rt, bk, lv	0.5	0.08
Asteraceae	<i>Artemisia afra</i> Jacq. ex Willd.	Enjanipus	shrub	malaria	rt, lv	0.5	0.08
Ebenaceae	<i>Euclea racemosa</i> L.	Orkinyei	shrub	purgative & live fence	bk, lv	0.5	0.04
Ulmaceae	<i>Trema orientalis</i> (L.) Blume	Olmataata	tree	Malaria, sore throat, asthma, venereal diseases	rt, bk, lv	0.5	0.04
Ranunculaceae	<i>Clematis simensis</i> Fresen.	Enaiborlukuny	herb	chest & stomach	lv	0.48	0.06
Fabaceae	<i>Acacia abyssinica</i> Hochst. ex Benth.	Olmamasbiro	tree	Aphrodiastic, body strength.	rt	0.46	0.1
Euphorbiaceae	<i>Croton megalocarpus</i> Hutch.	Ormarbait	tree	Pneumonia, stomach ache, malaria.	rt, bk	0.46	0.08
Euphorbiaceae	<i>Croton scheffleri</i> Pax	Enjanimpurkel	climber	Leprosy, malaria, stomach ache	rt, lv	0.46	0.08
Sapindaceae	<i>Deinbollia borbonica</i> Scheff.	Engillelekuru	tree	Stomach diseases, boils, arthritis	rt	0.46	0.06
Fabaceae	<i>Erythrina abyssinica</i> Lam. ex DC.	Olng'osoroti	tree	Ear ache, anthelmintic, malaria	bk	0.46	0.06
Celastraceae	<i>Maytenus undata</i> (Thunb.) Blakelock	Olaiturunyai	tree	Diseases of the uretha, syphilis, diarrhea.	rt, bk	0.46	0.04
Myricaceae	<i>Morella salicifolia</i> (Hochst. ex A. Rich.) Verdc. & Polhill	Olkitalaswa	shrub	Heart diseases, ulcers, diabetes	lv	0.46	0.04
Asteraceae	<i>Psidia punctulata</i> (DC.)Vatke	Endimii	herb	Cough, asthma, fever, wounds due to burns	lv	0.46	0.06
Rhamnaceae	<i>Rhamnus staddo</i>	Olkokola	shrub	Venereal diseases	rt	0.46	0.06
Rhamnaceae	<i>Scutia myrtina</i> (Burm.f.) Kurz	Osikaredi	shrub	Stomach problems	rt	0.46	0.08
Flacourtiaceae	<i>Trimeria grandiflora</i> (Hochst.) Warb.	Olesarie	tree	General body strength	rt, bk	0.46	0.06
Fabaceae	<i>Acacia schweinfurthii</i> Brenan & Exell	Eirii	tree	body strength and stomach discomfort	rt, bk	0.44	0.1
Meliastaceae	<i>Bersama abyssinica</i> Fresen.	Ormobaletare	tree	wounds	rt, bk, lv	0.44	0.08
Combretaceae	<i>Combretum molle</i> G. Don	Olmororoi-orok	shrub	leprosy, fever, hookworm, stomach pains and gonorrhea	rt, lv	0.44	0.04
Euphorbiaceae	<i>Croton macrostachyus</i> Delile	Oloiypiyap	tree	Anthelmintic, cough, oedema	bk, lv	0.44	0.08
Celastraceae	<i>Maytenus senegalensis</i> (Lam.) Exell	Osupukiai	shrub	Malaria, arthritis, anthelmintic, rheumatism.	lv	0.44	0.04
Euphorbiaceae	<i>Euphorbia umbellata</i> (Pax) Bruyns	Oloile	tree	Sore throat, back ache, malaria	bk, lv	0.44	0.08
Rubiaceae	<i>Vangueria apiculata</i> K. Schum.	Orgumiy	shrub	Rheumatism & paralysis	rt, lv	0.44	0.08
Labiatae	<i>Leonotis nepetifolia</i> (L.) R. Br.	Orbibiyai	shrub	headache and flue	rt, lv	0.42	0.02
Fabaceae	<i>Acacia drepanolobium</i> Harms ex Sij'stedt	Eluwayi	tree	hasten placental removal	rt	0.38	0.14
Rutaceae	<i>Clausena anisata</i> (Willd.) Benth.	Ematasiay	shrub	abdominal pains	rt	0.38	0.06
Meliaceae	<i>Turraea fischeri</i> Gürke	Enginaisho	tree	Stomach ache, infertility in women	rt, bk	0.38	0.12
Rutaceae	<i>Vepris simplicifolia</i> (Engl.) Mziray	Orgilayi	shrub	stomach ache, backache, leprosy, gonorrhoea and brucellosis	rt	0.38	0.06
Rutaceae	<i>Vepris uguenensis</i> Engl.	Eng'ang'olo	shrub	Malaria, kidney complains, colds and head ache	rt	0.38	0.06
Burseraceae	<i>Commiphora africana</i> (A.Rich.) Endl.	Olailupai	herb	dermatitis	lv	0.36	0.04
Loganiaceae	<i>Strychnos henningii</i> Gilg	Olduyesi	tree	Malaria, fever, stomach ache, colic in children	bk	0.36	0.12
	<i>Cissampelos mucronata</i> A.Rich.	Olejisirkon	climber	headache and flue	lv	0.34	0.06
Santalaceae	<i>Osyris lanceolata</i> Hochst. & Steud.	Ololesiyai	shrub	Stomach ache, aphrodisiac, skin rashes, malaria	rt, bk, lv	0.34	0.06
Fabaceae	<i>Acacia mellifera</i> (Vahl) Benth.	Oitii	tree	arthritis, joint pain, internal wounds	rt, bk	0.32	0.08
Asteraceae	<i>Bidens pilosa</i> L.	Enterepeni	herb	wounds	lv	0.32	0.04
Dioscoreaceae	<i>Dioscorea praehensilis</i> Benth.	Engikwa	climber	Rheumatism, hasten child birth	rt	0.32	0.04
Lamiaceae	<i>Hoslundia opposita</i> Vahl	Olandanu	shrub	Kidney, malaria	lv	0.3	0.06
Primulaceae	<i>Rapanea melanophloeos</i> (L.) Mez	Olangaburra	tree	Respiratory complains, muscles pains	rt, bk, lv	0.3	0.04
Tiliaceae	<i>Triumfetta annua</i> L.	En-dadaikinyi	shrub	Wounds	rt	0.3	0.1
Tiliaceae	<i>Triumfetta rhomboidea</i> Jacq.	Odadai	herb	Wounds	rt	0.3	0.1
Rutaceae	<i>Calodendrum capense</i> (L.f.) Thunb.	Olarashi	tree	chest pain and stomach complain	rt, lv	0.28	0.04
Cucurbitaceae	<i>Momordica foetida</i> Schumach.	Olaimurunyai	climber	Aphrodisiac, stomach ache, hasten child birth	lv	0.28	0.06
Fabaceae	<i>Acacia brevispica</i> Harms	Orgirgir	tree	facilitate digestion, appetizer, body strength	rt	0.26	0.1
Sterculiaceae	<i>Dombeya burgessiae</i> Gerrard ex Harv.	Olporokwai	shrub	Aphrodisiac, stomach ache, sores	rt, bk	0.26	0.04
Verbenaceae	<i>Lantana trifolia</i>	Ormagirigiriani	shrub	Stomach pains, appetizer, promote digestion	lv	0.26	0.04
Anacardiaceae	<i>Ozoroa insignis</i> Delile	Olokinonoi	shrub	stomach, kidney, liver complain, chest pain, dysentery	rt, bk	0.26	0.06
Rhamnaceae	<i>Ziziphus abyssinica</i> A.Rich.	Oloilaleyi	shrub	Swollen cervix, diabetes, general body pains	rt, bk	0.26	0.1
Rhamnaceae	<i>Ziziphus mucronata</i> Willd.	Olperetini	tree	Measles, dysentery, lumbago and chest complains	rt, bk, lv	0.26	0.1
Lamiaceae	<i>Ajuga remota</i> Benth.	Emenang'i	herb	malaria	rt, bk, lv	0.24	0.08
Boraginaceae	<i>Cordia monoica</i> Roxb.	Osiyeki	shrub	chest pain, leprosy, body wash	rt, bk	0.24	0.04
Boraginaceae	<i>Cordia sinensis</i> Lam.	Oldorko	shrub	hasten delivery for women, malaria and fever	rt, bk, lv	0.24	0.02
Labiatae	<i>Leucas grandis</i> Vatke	Orbibiyai	herb	headache and flue	lv	0.24	0.08
Asclepiadaceae	<i>Periploca linearifolia</i> Quart.-Dill. & A.Rich.	osinandei	climber	Typhoid	rt	0.24	0.04
Lamiaceae	<i>Tetradenia riparia</i> (Hochst.) Codd	Ngoja sana	shrub	Stomach ache, fever, cough,	rt, lv	0.24	0.06
Berberidaceae	<i>Berberis holstii</i> Engl.	Eng'arengupe	tree	malaria	rt, lv	0.22	0.02
Boraginaceae	<i>Cynoglossum coeruleum</i> Hochst. ex A.DC	Oseyai	herb	Promote quick removal of the placenta, fever and influenza	rt, lv	0.22	0.06
Euphorbiaceae	<i>Euphorbia cuneata</i> Vahl.	Ormemit	shrub	eyes diseases, wounds and warts	bk, lv	0.22	0.02

Fabaceae	<i>Rhynchosia hirta</i> (Andr.) Meikle & Verdc.	Nsango	herb	milk production in women	lv	0.22	0.06
Cucurbitaceae	<i>Zehneria scabra</i> (L.f.) Sond.	Endukushi	climber	Fever, diarrhoea	rt, lv	0.22	0.04
Rubiaceae	<i>Pentas lanceolata</i> (Forssk.) Deflers	Engilokenger	shrub	Wounds	rt	0.2	0.04
Amaranthaceae	<i>Aerva lanata</i> (L.) Schult.	Eleturot	herb	Snake bite	rt, lv	0.18	0.06
Asparagaceae	<i>Asparagus racemosus</i> Willd.	Emperepapai	herb	aphrodisias and fertility for women	rt, lv	0.18	0.06
Acanthaceae	<i>Barleria eranthemoides</i> R.Br.	Enkurishashi	herb	swollen testicles	lv	0.18	0.02
Acanthaceae	<i>Barleria prionitis</i> L.	Enkurishashi	herb	abortive	rt, lv	0.18	0.02
Fabaceae	<i>Crotalaria incana</i> (Lam.) Milne-Redh.	Olootwalan	shrub	wounds, venereal diseases	lv	0.18	0.02
Araliaceae	<i>Cussonia spicata</i> Thunb.	orng'anayoi - loondare	climber	Malaria, snake bite	lv	0.18	0.04
Amaranthaceae	<i>Cyathula uncinulata</i> (Schrud.) Schinz	Olekidong'o	herb	Fertility for women	rt, lv	0.18	0.04
Euphorbiaceae	<i>Euphorbia grantii</i> Oliv.	Orkorbobi	shrub	Stomach pains, epilepsy, wounds, snake bites	lv	0.18	0.02
Rhamnaceae	<i>Gouania longispicata</i> Engl.	Olesupeni	shrub	Hasten child birth, stomach ache, Malaria	rt	0.18	0.02
Tiliaceae	<i>Grewia bicolor</i> Juss.	Ormangulai	tree	purgative & burns cure	rt, lv	0.18	0.06
Asteraceae	<i>Helichrysum odoratissimum</i> (L.) Sweet	Emukutiayi	herb	Wounds, cough, chest pain	rt, lv	0.18	0.02
Rhamnaceae	<i>Helinus integrifolius</i> (Lam.) Kuntze	Enkurishashi	shrub	Breast pain	rt, lv	0.18	0.04
Solanaceae	<i>Lycium europaeum</i> L.	Engokii	shrub	Syphilis, cancer	bk	0.18	0.02
Celastraceae	<i>Maytenus obscura</i> (A. Rich.) Cufod.	Olaimurunyi	shrub	wounds	bk, lv	0.18	0.02
Loranthaceae	<i>Oncocalyx fischeri</i> (Engl.) M.G. Gilbert	Olkitalaswa	shrub	Evil eye, stomach problems	bk, lv	0.18	0.06
Malvaceae	<i>Sida massaica</i> Voll.	Emporokwai ekop	herb	stomach worms	rt	0.18	0.06
Malvaceae	<i>Sida ovata</i> Forssk	Engonini	herb	stomach worms	rt	0.18	0.06
Solanaceae	<i>Solanum setaceum</i> Dammer	Endemelwa	shrub	Stomach complains, evil eye	rt, lv	0.18	0.06
Asparagaceae	<i>Asparagus setaceus</i>	Emperepapai	herb	aphrodisias and fertility for women	rt, lv	0.16	0.02
Salvadoraceae	<i>Azima tetracantha</i> Lam.	Enkosida	herb	food poison	lv	0.16	0.02
Bursaceae	<i>Commiphora swynnertonii</i> Burtt.	Oldemwai	tree	Skin disesas in human and livestock, body pain.	rt, bk	0.16	0.08
Tiliaceae	<i>Grewia villosa</i> Willd.	Ositetii	shrub	stomach	rt	0.16	0.06
Asteraceae	<i>Sphaeranthus steetzii</i> Oliv. & Hiern	Orkipirelekima	herb	Menstral period pains, joints pain	rt, lv	0.16	0.05
Acanthaceae	<i>Asystasia gangetica</i> (L.) T. Anderson	Oloyapasei	shrub	Malaria fever flue and general body ailment	rt, lv	0.14	0.02
Capparidaceae	<i>Boscia mossambicensis</i> Klotzsch	Oloireroi	tree	chronic wound	bk	0.14	0.02
Capparidaceae	<i>Cadaba farinosa</i> Forssk.	Alaitujai	tree	rheumatism	rt	0.14	0.02
Commelinaceae	<i>Commelina benghalensis</i> Wall.	Engaiteteyai	herb	for blessings and fever	rt, lv	0.14	0.04
Fabaceae	<i>Crotalaria recta</i> Steud. ex A. Rich.	Oltwala	shrub	wounds, fever	lv	0.14	0.02
Asteraceae	<i>Galinsoga parviflora</i> Cav.	Esirwa	herb	wounds and body wash	lv	0.14	0.02
Acanthaceae	<i>Hypoestes aristata</i> (Vahl) Roem. & Schult.	Olosida	herb	sore eyes	lv	0.14	0.02
Asteraceae	<i>Tarchonanthus camphoratus</i> L.	Oleleshwa	shrub	Bedsore, skin irritations, toothache, cough.	rt, bk, lv	0.13	0.03
Asteraceae	<i>Bothriocline longipes</i> (Oliv. & Hiern) N.E.Br.	Endishai	herb	venereal diseases, colic, body pains	rt	0.12	0.02
Fabaceae	<i>Crotalaria natalitia</i> De Wild.	Oltwala	shrub	treatment of wounds due to boils	lv	0.12	0.02
Amaranthaceae	<i>Cyathula cylindrica</i> Moq.	Olekidong'o	herb	Leprosy, facilitate fertility for women	rt, lv	0.12	0.06
Boraginaceae	<i>Heliotropium steudneri</i> Vatke	Olesikira	herb	Wounds, cattle eyes diseases	rt, lv	0.12	0.2
Loranthaceae	<i>Plicosepalus curviflorus</i> (Benth. ex Oliv.) Tiegh	Engilalangua	herb	Tonsilitis, cancer, fever	bk, lv	0.12	0.02
Fabaceae	<i>Albizia harvey</i> E. Fourn.	Orperelong'o	tree	aphrodisias, malaria, anthelmintic	rt, bk, lv	0.1	0.02
Simaroubaceae	<i>Brucea antidysenterica</i> J. F. Mill.	Orkodila	tree	anthelmintic, malaria	rt, lv	0.1	0.02
Amaranthaceae	<i>Celosia schweinfurthiana</i> Schinz	Olekidong'o	herb	stomach pain, bilhazia,	rt	0.1	0.01
Fabaceae	<i>Crotalaria uguenensis</i> Taub.	Nootwalan	shrub	stomach & purgative	rt, lv	0.1	0.02
Euphorbiaceae	<i>Croton dichogamus</i> Pax	oloiborbenek	shrub	colds, syphilis, cough.	rt, bk, lv	0.1	0.08
Amaranthaceae	<i>Cyathula polycephala</i>	Olekidong'o	herb	Fertility for women	rt, lv	0.1	0.02
Orobanchaceae	<i>Cynium ajugiflorum</i> Engl.	Enjaninaibor	herb	Anthelmintic, colic, wounds	rt, lv	0.1	0.02
Lamiaceae	<i>Fuerstia africana</i> T.C.E.Fr.	Olosaji	shrub	women complains, eyes problem	bk, lv	0.1	0.02
Malvaceae	<i>Hibiscus surattensis</i> L.	Isendeeri	shrub	Cervix problems, aphorodiastic, stomach ache	lv	0.1	0.02