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Ethnobotanical survey of food and medicinal plants of the Ilkisonko Maasai community in Kenya

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ABSTRACT

Aim of the study: Pastoralist communities such as the Maasai are heavily reliant on traditional foods and medicines. This survey sought to identify traditional foods and/or medicinal plants of the Ilkisonko Maasai community living in Kenya.

Materials and methods: Ethnobotanical knowledge of traditional plants used as food and human/veterinary medicine was obtained using structured and semi-structured questionnaires administered through face to face interviews of key informants.

Results: A total of 30 species from 21 families and 25 genera were reportedly used as food and/or medicine by 48 respondents. The most commonly encountered genus was the *Fabaceae*. The growth forms encountered were tree (47%), shrub (33%) and herb (20%). Plants that were commonly mentioned by respondents were *Salvadora persica* (85%), *Grewia villosa* (52%), *Ximenia americana* (52%), *Albizia anthelmintica* (50%), *Acacia robusta* (46%) and *Acacia nilotica* (42%). The root/root bark was the most commonly used plant part (35%), followed by the stem/stem bark (30%), fruit (15%), leaves (11%) and whole plant (9%). Common ailments treated were stomach aches, constipation, back aches, joint aches, body pains and sexually transmitted infections. The plants were also used as tonics, digestives, and restoratives.

Conclusion: It was evident that traditional medicine was the preferred health care system for the Ilkisonko Maasai community. It is important to document and use this knowledge in producing novel products that could improve nutrition and healthcare in rural communities.

1. Introduction

The Ilkisonko Maasai, part of the eight Maasai clusters of Kenya, are a pastoralist community living near or around Loitokitok, neighboring Mt. Kilimanjaro (Fig. 1). The Maasai have set traditions carried out through the ages which have attracted considerable interest globally. They depend heavily on the environment for food and medicine and have been known to practice African traditional medicine through folklore (Kiringe and Okello, 2005; Ole-Miaron, 2003). The Maasai have been known to use certain medicinal plants as dietary additives for preventive or curative care for the community (Johns et al., 1999). This traditional medicine practice is under threat from formal educational systems and urbanization where the Maasai are educating more of their children who move to the towns looking for work, leaving few to harness this important knowledge. The diverse number of plants used in traditional medicine practice are also reducing due to subdivision of communal land for use in small scale irrigation farming (Johns et al., 1994).

Research into plant foods and medicine used by the Maasai is important in obtaining and documenting their rich knowledge. By identifying these indigenous plants it may be possible to deter their extinction and even encourage their propagation and cultivation to obtain the medicinal compounds.

2. Methods

2.1. Study area

The Ilkisonko Maasai are found in and around Loitokitok sub-county which is located in Kajiado County that lies in the southern part of Kenya. Although Loitokitok is in close contact with Mt.

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Fig. 1. A map of the study area.

Kilimanjaro and the lush forest surrounding it, heavy rains are only experienced in the mountainous zones and much less around Loitokitok. Rainfall patterns in Loitokitok are bimodal with the long rains falling between March and May and the short rains between October and December. The soils are fine, inherently fertile volcanic clays, very prone to erosion. These soils support bushland vegetation and open grassland suitable for agropastoralism and wildlife. The main economic activities are tourism in the neighboring national parks, commercial farming, and peasant livestock farming. Commercial farming has made the sub-county considerably wealthier than before but this investment is localized and many areas of Loitokitok remain poor. Loitokitok is a semi-arid region with great plant biodiversity, which is slowly disappearing due to intermittent drought, overgrazing and population increase.

Interviews were conducted in three locations in Loitokitok sub-county namely Rombo, Kimana and Entonet. Rombo and Kimana were chosen as they are under the Endangered Ecosystems list of Kenya, while Entonet was included as it is in the nearby area (Reid et al., 2004).

2.2. Study approval

Ethical approval for this study was obtained from Kenyatta National Hospital-University of Nairobi Research Ethics Review Committee (Reference number: KNH-ERC/A/173). Permission to conduct the study in Loitokitok was obtained from the respective sub-county administrators in Rombo, Kimana and Entonet. Written consent was sought from the study participants after information was provided to them on the purpose, benefits and risks associated with the study.

2.3. Data collection

The interviews were carried out on plants used as food and medicine among the Ilkisonko Maasai community. Individuals who were locally recognized as knowledgeable on plant use were identified with the assistance of the village elders. The selection in the questionnaire was described as random but guided sampling was done to obtain more useful information. A total of 48 respondents were interviewed using a semi-structured questionnaire consisting of open and close-ended questions. Pretesting of the semi-structured questionnaire had been conducted with seven key informants not involved in the study.

There were 14 questions in the questionnaire which were conducted in the local dialect of the Maasai language, Maa, or the national language, Swahili, depending on the respondent's preference.

Due to the dynamic nature of ethnobotanical information, this study included plants mentioned by three or more informants to increase the reliability of the obtained data (Johns et al., 1990). The medicinal plants chosen to undergo further analysis were identified by a botanist using the Flora of Tropical East Africa and voucher specimens were deposited at the University of Nairobi Herbarium (NAI).

3. Results and discussion

All 48 respondents interviewed were males aged 35–75 years of age (Fig. 2). Although our initial intent was to obtain information from both gender, only men participated in the study. This could be due to the patriarchal nature of the Maasai where the male elders speak on behalf of the community (Gneezy et al., 2009). A majority of the interviewees (90%) were pastoralists while 77% of the respondents had no formal education (Fig. 3).

The study showed that the respondents preferred traditional medicine to conventional medicine, in agreement with previous observation (Kiringe, 2006). The traditional medicine was frequently taken together with conventional medicine which was thought to be superior. This is different from what Kiringe observed that the Maasai at that time thought traditional medicine to be superior (Kiringe, 2006). Traditional foods or medicine were first ingested in the early stages of the disease but when ineffective the locals resorted to conventional medicine (Fig. 4).

At least 54% of the respondents use indigenous foods and medicinal plants once a month or less frequently (Fig. 5). Use of indigenous plants as food or food additives may depend on the availability of meat, in which the soup is used to flavor the decoction. The Maasai usually boil the traditional plants and mix the decoction with either bone soup or milk before drinking. This would point towards the presence of heat stable hydrophilic and lipophilic compounds that act as adaptogens and medicines. The decoction was taken as an adaptogen when the herder has a long distance trek in search of pasture, which is infrequent. Traditional

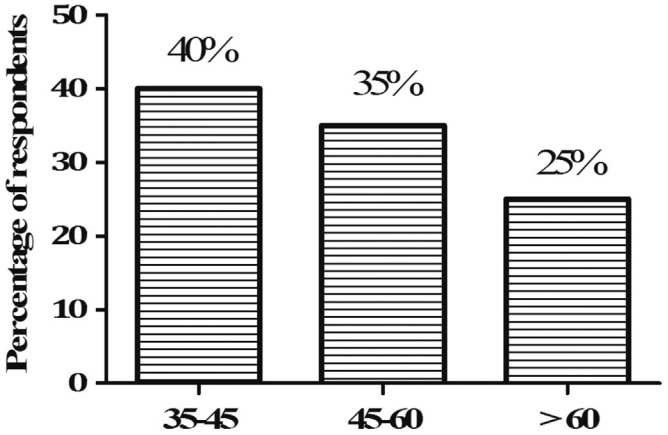

Fig. 2. Age of respondents.

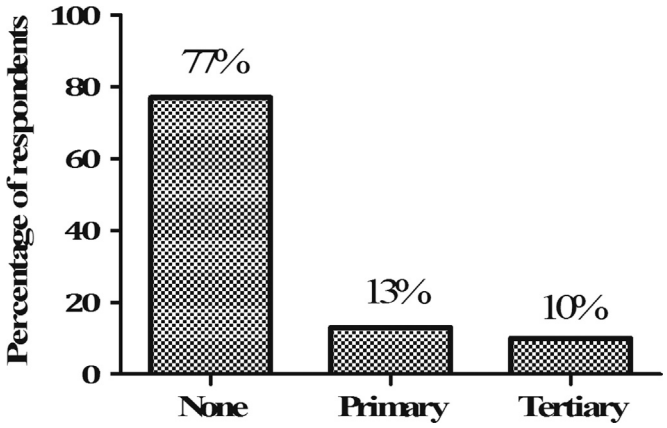

Fig. 3. Education level of the respondents.

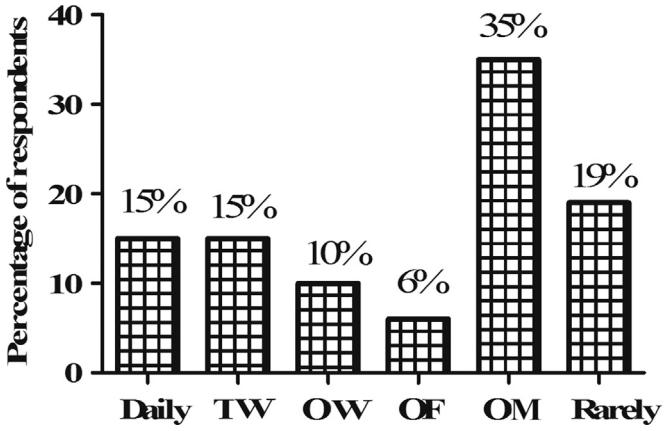

Fig. 4. The preference with which the respondents take the medicinal plants. TM – traditional medicine and CM – conventional medicine.

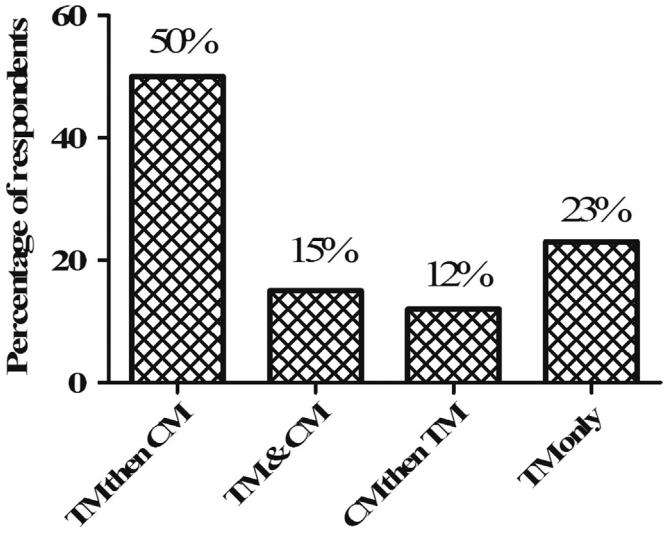

Fig. 5. Frequency of plant use where TW – thrice weekly, OW – once weekly, OF – once a fortnight and OM – once a month.

plants used as medicine are taken even less frequently because most persons fall ill once a month or less. The most common route of administration was oral (78%) while 19% of the plants where used as topical preparations and only *Ocimum gratissimum* (3%) was used as an inhalation.

A total of 30 species from 21 families and 25 genera were reportedly used as food and/or medicine. A study by Bussmann et al. (2006) in Kajiado County, Sekenani valley shows a great number of plants (155 plant species) as they sought to check on the complete flora of the area, while this study looked at the useful species in Loitokitok sub-county. Muthee et al. (2011) has cited a total of 80 medicinal plants from Loitokitok sub-county, some of which were mentioned by only one respondent while this study identified only those which had been mentioned three or more times. All the respondents mentioned the plant names in the local dialect, Maa. The most commonly encountered family was the Fabaceae with a total of eight plants, followed by Anacardiaceae and Solanaceae with two plants each (Table 1).

Salvadora persica was mentioned by 85% of the respondents due to its importance in dental hygiene and also as a medicine (Halawany, 2012). Other plants that were commonly mentioned by respondents were *Grewia villosa* (52%), *Ximenia americana* (52%), *Albizia anthelmintica* (50%), *Acacia robusta* (46%) and *Acacia nilotica* (42%) as seen in Table 1. The commonly mentioned plants were all used as tonics except for *A. robusta*. As shown in Fig. 6, the growth forms encountered were the tree (47%), shrub (33%) and herb (20%).

Fig. 7 shows that the root/root bark was the most commonly used plant part (35%), followed by the stem/stem bark (30%), fruit (15%), leaves (11%) and whole plant (9%). Harvesting of roots is an important factor in sustainable land use as good harvesting practices are normally not adhered to leading to loss of plant life. Leaves are the least used plant part possibly because the Maasai are known to consume very little vegetable in their diet (Nestel, 1989).

In this study the common ailments treated were stomach aches, constipation, back aches, joint aches, body pains and sexually transmitted infections (Table 1). The plants were also used as tonics, digestives, and restoratives. Most of these uses were supported by similar studies as illustrated in Table 1. Sixteen families (53%) from each of the studies by Bussmann et al. (2006) and Muthee et al. (2011) are similar to those cited in our study. At least 33% of the plants identified were used as both food and medicine in which plants such as *Ximenia* sp., *Carissa* sp., *Cyphostemma* sp., and *Grewia* sp. have also been cited as sources of food (Bussmann et al., 2006), while the remaining 67% were used as medicine. Amongst the thirty plants included in Table 1, nine species (30%) find use in management of livestock conditions such as retained placenta, East Coast fever and sometimes used as a tonic.

It was evident that traditional medicine was the preferred health care system for the Ilkisonko Maasai community and some preferred it to conventional medicine. Despite this, there is an emerging threat to local medicinal plants due to charcoal burning, increased consumption emanating from increase in human population and land use changes particularly expansion of agriculture (Kiringe and Okello, 2005). Traditional plants with potential to produce both food and medicine can be an attractive resource in poverty alleviation. Documentation of the medicinal plants and their uses is important in preserving the indigenous knowledge. Further research in these plants could provide novel compounds that could be used as leads in drug discovery.

Author contributions

Jacob Miaron directed and planned the ethnobotanical survey. All authors contributed in designing, collecting and analysis of data. Julia Kimondo wrote the first draft and all authors were involved in the revision of the draft manuscript and agreed to the final content.

Conflict of interest

The authors declare that there is no conflict of interest.

Table 1
Plants used as food and/or medicine by the Ilkisonko Maasai community with their corresponding traditional use and pharmacological activity.

Voucher number	Family and scientific name	Local Maasai name (Maa)	Uses	Reported traditional uses	Reported pharmacological/ chemical activity	Part used	Number of mentions	Habit
JW2014/01	Amaranthaceae *Achyranthes aspera* L. Anacardiaceae	Olerubat	Teeth and new wounds, back and knee aches, conjunctivitis	Used to treat malaria and toothache (Bussmann et al., 2006; Kareru et al., 2007b)	Anti-inflammatory effect (Vetrichelvan and Jegadeesan, 2003)	Whole plant	3	Herb
JW2014/02	*Rhus natalensis* Krauss	Olmusigiyoi	Strengthener, respiratory disorders, stomachic, malaria	Used as food (Orwa et al., 2009). Roots used for digestive disorders and gonorrhea (Arbonnier, 2004)	Water and methanol extracts showed antiplasmodial activity (Gathirwa et al., 2008)	Root, fruit, stem	3	Tree
JW2014/03	*Sclerocarya birrea* (A. Rich.) Hochst.	Oloisuki	Cold and flu in children, edema of limbs, respiratory disorders, joint pains, tonic in cows, food	Used in inflammatory disorders, malaria, nausea, tonic for man and cattle food, timber, dye (Arbonnier, 2004)	The methanol extract exhibited antifungal activity (Hamza et al., 2006)	Root/ stem bark	8	Tree
JW2014/04	Apocynaceae *Carissa spinarum* L.	Olamuriaki	Food, colds	Have edible fruits (Maundu et al., 2001)	Isolated compounds were found to have antioxidant effects, while the extract had antibacterial effect (Sanwal and Chaudhary, 2011; Wangteeraprasert et al., 2012).	Fruit	5	Shrub
JW2014/05	Asphodelaceae *Aloe secundiflora* Engl.	Osukuroi	Tonic, respiratory problems, East Coast fever, wounds, headache	Used for chest pain, headaches, malaria, rheumatism and topically on wounds (Kokwaro, 2009; Muthee et al., 2011)	The leaf exudate has antibacterial property which may be due to the presence of aloenin (Rebecca et al., 2003; Wagate et al., 2010).	Leaf sap	13	Herb
JW2014/06	Canellaceae *Warburgia ugandensis* (Sprague) subsp. *ugandensis*	Osokonoi	Diarrhea, respiratory problems, stomach ache, malaria	Used by the Maasai to treat respiratory disorders (Muthee et al., 2011), as a tonic and aphrodisiac (Kiringe, 2006)	The crude extract showed antibacterial, antifungal effect and antioxidant molecules were obtained (Olila et al., 2001; Manguro et al., 2003)	Root/ stem bark	14	Tree
JW2014/07	Capparaceae *Maerua triphylla* A. Rich.	Olamalogi	Food, cleaning wounds, aphrodisiac, headache, tonic	Leaf paste is used to clean boils (Hassan-Abdallah et al., 2013)	No reported pharmacological activity	Stem bark, leaf	3	Tree
JW2014/08	Combretaceae *Combretum molle* R. Br. ex G. Don. Fabaceae	Olmaroroi	Sexually transmitted infections, backache	Used to treat respiratory disorders and backache (Muthee et al., 2011)	Anti-inflammatory triterpenoids are present (Ponou et al., 2008)	Root	3	Tree
JW2014/09	*Acacia drepanolobium* Harms ex Sjöstedt	Eluai	Retained placenta in cows, postpartum pain in humans, fertility, tonic	Used to expel retained placenta (Kiringe, 2006; Maundu et al., 2001)	Presence of tannins and proanthocyanidins (Kusano et al., 2011)	Stem bark	15	Shrub
JW2014/10	*Acacia nilotica* (L.) Willd.	Enkiloriti	Strengthener/ tonic, appetizer, body aches, stomachic, stamina, stimulant/excitant	Antioxidant (Sultana et al., 2007)	Umbelliferone has antioxidant activity (Singh et al., 2010), niloticane has anti-inflammatory and antibacterial effect (Eldeen et al., 2010)	Stem/root bark	20	Tree
JW2014/11	*Acacia mellifera* (M. Vahl) Benth.	Oiti	Postpartum tonic, appetizer, sore throat, East Coast fever	Stomachache (Johns et al., 1999), appetizer (Kiringe, 2006)	Lupanes isolated have cytotoxic activity while its triterpenoids have antibacterial activity (Mutai et al., 2009)	Stem bark	4	Tree
JW2014/12	*Acacia reficiens* subsp. *misera* (Vatke) Brenan	Olchurrai	Strengthener, appetizer, tonic/ adaptogen, laxative	Spice and condiment, fodder, aphrodisiac (Kokwaro, 2009)	No reported activity	Root/ stem bark	16	Tree
JW2014/13	*Acacia nubica* Benth.	Oldepe	Sexually transmitted infections, postpartum tonic, facilitate lactation, rejuvenation	Tonic and joint pains (Johns et al., 1994), postpartum (Kiringe, 2006)	Root bark contains triterpenes with antifungal activity (Elfadil et al., 2015)	Root bark	5	Tree
JW2014/14	*Albizia anthelmintica* Brongn.	Olmukutan	Purgative, dewormer, antimalarial, tonic, food for goats	To induce vomiting in malaria (Kiringe, 2006) and treat fevers (Johns et al., 1999)	Contains triterpenes with potent analgesic and antioxidant activity (Mohamed et al., 2013)	Root/ stem bark	24	Tree
JW2014/15	*Acacia robusta* Burch.	Olmumunyi	Retained placenta in cows and humans	To remove placenta after birth (Kiringe, 2006)	The methanol extract exhibited antifungal activity (Hamza et al., 2006)	Root bark	22	Tree
JW2014/16	*Ormocarpum kirkii* S. Moore	Enkokirisianjoi	Stops postpartum bleeding, prevents abortion	Cuts and wounds (Muthee et al., 2011)	Presence of biflavonoids with antimicrobial activity (Dhooghe et al., 2010)	Root, fruit	3	Shrub
JW2014/17	Labiatae *Ocimum gratissimum* L.	Olemoran	Treatment of colds, headache, fragrant	Used for bronchitis and malaria (Kareru et al., 2007b)	Extracts were found to have anti-inflammatory effects (Chiu et al., 2012)	Leaf	5	Herb

JW2014/18	Malvaceae *Grewia villosa* Willd.	Olmankulai	Food, galactagogue, strength/ tonic, stomachache in kids	Used as an anticancer (Kareru et al., 2007b), for oral hygiene (Bussmann et al., 2006)	The fruits and leaves are highly nutritive and the root contains harman alkaloids (Goyal, 2012; Saleem et al., 2012)	Root, stem, fruit	25	Shrub
JW2014/19	Olacaceae *Ximenia americana* L.	Enkamai	Stomachache in kids, food, tonic, constipation	Stomachaches (Muthee et al., 2011) used in Mali as a tonic (Le et al., 2012) and to manage HIV related symptoms in Kenya (Nagata et al., 2011)	Leaves contain sambunigrin which is toxic to parasites (Orwa et al., 2009). Presence of gallic acid, gallotannins and flavanols in the leaves (Le et al., 2012)	Root, fruit	25	Tree
JW2014/20	Oleaceae *Olea capensis* L.	Oloiren	Preserve milk, tonic, cold and fever, East Coast fever	For respiratory ailments (Muthee et al., 2011)	The plant extract contains triterpenoids with antibacterial activity (Bamuamba et al., 2008)	Stem	5	Tree
JW2014/21	Polygonaceae *Oxygonum sinuatum* (Hochst. & Steud ex Meisn.) Dammer	Enkaisijoi	Tonsillitis, food, conjunctivitis	Used to treat gonorrhea (Kareru et al., 2007a)	Antibacterial and anti-inflammatory activity (Matu and Van Staden, 2003)	Whole plant	4	Herb
JW2014/22	Rhamnaceae *Rhamnus prinoides* L.	Olkonyil	Sexually transmitted infections, back and joint aches, arthritis, aids in digestion, tonic	The plant was observed by Muthee et al. (2011) to treat sexually transmitted infections and some parasitic infections	Extract contain laxative anthraquinones and has antiplasmodial activity (Berhanu, 2014; Muregi et al., 2007)	Root	16	Shrub
JW2014/23	Salvadoraceae *Salvadora persica* L.	Oremit	Eye infections, worms, malaria, stomachache, constipation, tonic, cold, teeth hygiene, respiratory infections	Used for abdominal disturbances (Kokwaro, 2009)	Antimicrobial properties and contains flavonoids with known antioxidant effect (Halawany, 2012)	Root, stem	41	Shrub
JW2014/24	Sapindaceae *Pappea capensis* Eckl. & Zeyh.	Oltimigomi	Strengthens, food, fertility, stomach ache, stamina	Used for stomach aches, as an aphrodisiac and an adaptogen (Kokwaro, 2009; Muthee et al., 2011; Johns et al., 1999)	Leaf and stem bark extracts have antioxidant activity (Karau et al., 2012)	Stem bark	17	Tree
JW2014/25	Simaroubaceae *Harrisonia abyssinica* Oliv. Solanaceae	Enkisarang'atuny	Arthritis, sexually transmitted infections	Arthritis (Johns et al., 1999; Kareru et al., 2007a)	Bark and root produced compounds with potent anti-microbial activity (Balde et al., 1995; Lee et al., 2014)	Root, fruit, leaf	7	Shrub
JW2014/26	*Solanum incanum* L.	Entulelei	Oral hygiene, strength, stomachache, sore throat	Used for throat infections (Muthee et al., 2011), also for symptoms of diabetes (Moshi and Mbwambo, 2002)	Anti-tumor glycoalkaloids (Lin et al., 2000)	Fruit, stem	4	Shrub
JW2014/27	*Withania somnifera* (L.) Dunal.	Olesayiet	Blood tonic and rejuvenator, back and joint aches, galactagogue, appetite and tonic for calves	Treats symptoms related to diabetes and also used as a tonic (Keter and Mutiso, 2012; Kokwaro, 2009)	Antioxidant and anti-inflammatory effect of the withanolides (Yang et al., 2013)	Root bark	10	Shrub
JW2014/28	Urticaceae *Urtica massaica* Mildbr.	Enjamejoi	Food, stomachache	Stomachache (Kokwaro, 2009)	Contains acetylcholine and histamine which affect smooth muscle (Maitai et al., 1980)	Whole plant	4	Herb
JW2014/29	Verbenaceae *Lippia kituiensis* Vatke	Osinoni	Respiratory problems, measles, protects cattle from ectoparasites	Management of chronic pain (Wambugu et al., 2011)	Contains essential oil which has acaricidal activity (Kosgei et al., 2014)	Leaf	5	Shrub
JW2014/30	Vitaceae *Cyphostemma nodiglandulosum* (Th. Fr. Jr)	Enkilenya	Sexually transmitted infections, tonic, galactagogue, stomachache	No reports	No reported pharmacological activity	Whole plant	3	Herb

*Plants outlined in Table 1 were only those mentioned three or more times by the respondents.

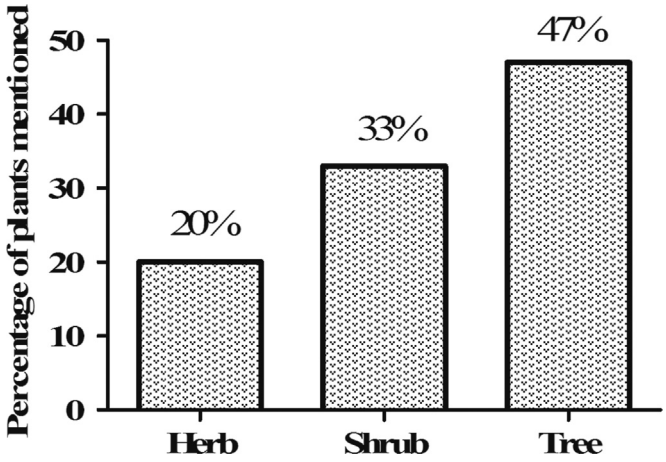

Fig. 6. The predominant growth forms in the area.

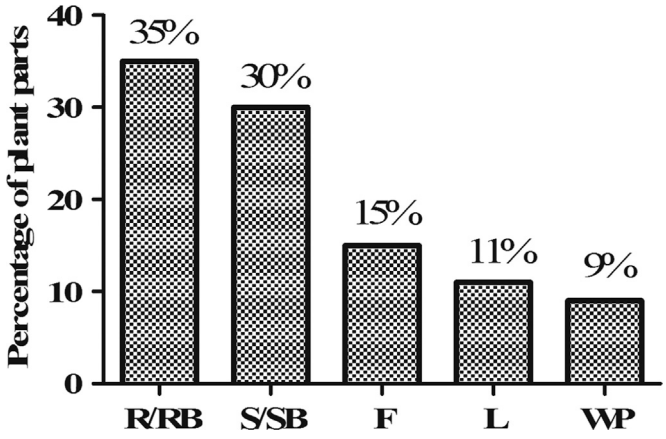

Fig. 7. The plant parts used as food and medicine. R/RB – root/root bark, S/SB – stem/stem bark, F – fruit, L – leaves, WP – whole plant.

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Appendix A. Suplementary information

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.jep.2015.10.013.

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