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Original Article

Ethnobotanical survey and threats to medicinal plants traditionally used for the management of human diseases in Nyeri County, Kenya

Loice Njeri Kamau[1,*], Peter Mathiu Mbaabu[1], James Mucunu Mbaria[2], Peter Karuri Gathumbi[3], Stephen Gitahi Kiama[1]

[1]Department of Veterinary Anatomy and Physiology, University of Nairobi, P.O Box 30197-00100, Nairobi, Kenya; [2]Department of Public Health, Pharmacology and Toxicology, University of Nairobi, P.O Box 30197- 00100, Nairobi, Kenya; [3]Department of Veterinary Pathology, Microbiology and Parasitology, University of Nairobi, P.O. Box 29053-00625 Nairobi, Kenya

ABSTRACT

In Kenya, traditional knowledge on herbal medicine has remained a mainstream source of maintaining wellbeing for generations in many communities. However, the knowledge has been eroded in the course of time due to sociocultural dynamics virtually advanced by Christianity and formal education especially in the Kikuyu community. The study documented current ethnobotanical knowledge and threat to the traditional knowledge on medicinal plants among the Kikuyu community. A survey was carried out in Mathira, Tetu, Kieni, Othaya, Mukurweini, and Nyeri Town constituencies. Thirty practicing herbalists were purposively sampled; 5 per constituency. Data was obtained through semi - structured questionnaires and analyzed both qualitatively and quantitatively. A total of 80 ailments treated using 111 medicinal plant species distributed within 98 genera and 56 families were documented. Prevalent communicable diseases treated using herbal medicine included; gonorrhea (17.5%), malaria (15%), respiratory infections (12%), colds (10%) and amoebiasis (10%). Non-communicable diseases were; joint pains (11.1%), ulcers/hyperacidity (8.7%), high blood pressure (8.7%), intestinal worms (11.1%) and arthritis/gout (10%). Frequently harvested plant materials were; roots, barks and leaves. The study concluded that, traditional medicine practitioners in Nyeri County possessed wide knowledge of herbal medicine but this knowledge was on the verge of disappearing as it was largely a preserve of the aged generation. The study recommended massive campaign about the benefits of using herbal medicine in the study area. Further pharmacological studies are recommended on the mentioned plant species aimed at establishing their efficacy and safety as well as standardization as potential drugs.

Keywords traditional medicine, Kikuyu comunity, Nyeri County, Kenya

INTRODUCTION

Traditional knowledge on herbal medicine has remained a mainstream source of maintaining wellbeing for generations in many communities (Kamboj, 2000). However, while many communities in Africa are custodian of sophisticated plant knowledge (Barrow, 1996), adoption of western culture has caused rapid erosion of indigenous knowledge (Fratkin, 1996). The Kikuyu community which largely occupies central Kenya had most of its culture eroded by western influence as a result of Christianity, colonialism and formal education (Sindiga et al., 1995). During the colonial period, Nyeri County witnessed unprecedented early missionary establishment notably, Tumutumu Mission in 1908. This was followed by establishment of a hospital, school and a church by the Scottish Mission. The mission was a spring board and focal point of Christianity and education establishment in other parts of Nyeri region (Presbyterian Church of East Africa, 2011). Similarly, the Catholic missions particularly, Consolata fathers established a mission in Nyeri in 1910. The mission established a primary school in 1924 which is today's Nyeri High School and, several other schools. Consolata hospital was established in the same place in 1937 (Njoroge, 1999). To date, Nyeri County enjoys one of the highest literacy levels in Kenya (Kenya National Bureau of Statistics, 2013). The spread of Christianity and introduction of formal education brought about unprecedented changes (Sindiga et al., 1995). It came with a cost especially on the loss of traditions which the missionaries considered barbaric. Missionaries were disdainful of African traditional beliefs, attitudes and practices. They were guided by "counter cultural" model of Christian-culture interaction based on the assumption that Christianity and indigenous practices were diametrically opposed and the latter would have to give the way (Bevans, 1992). Particularly, use of traditional medicine faced a major setback due to alleged association with witchcraft and perceived potent of western medication. Consequently, use of traditional medicine among other cultural practices was condemned and prohibited among converts (Muraya, 2013). The effort of missionaries was boosted by colonial government which introduced the "Witchcraft Act" of 1925" outlawing traditional medicine in Kenya (Sleap, 2011). Moreover, establishment of hospitals alongside schools provided an alternative source of healthcare provision (Njoroge, 1999). From the foregoing, the Kikuyu culture within which knowledge on traditional medicine is engrained was rendered amorphous. Nonetheless, the post-independence era witnessed

*Correspondence: Loice Njeri Kamau
E-mail: loicekam66@yahoo.com
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Kikuyu community from Nyeri County grapple with high prevalence of non-communicable diseases (http://integratepc.org/hospitals/kenya-only/) that defied conventional treatment approaches (Lucado et al., 2011). Further, high incidences of ailments which were resistant to antibiotics (Laxminarayan and Heymann (2012) continued to challenge allopathic mode of treatment. This may have driven the community to seek alternative treatment methods, notably, several herbal clinics were opened especially in urban centers in Nyeri, an indication that traditional medicine was gaining acceptance in Central Kenya. However, future ethno therapeutic studies of traditional medicine used by the Kikuyu community from Nyeri County relied on the preservation and protection from extinction, of traditional medicinal knowledge engrained in the pre-colonial Kikuyu cultural heritage. World Health Assembly (1987) expressed the need for member countries to develop programmes for conserving cultural medicinal knowledge (Eloff, 1998). This endeavor could only be achieved through detailed documentation of ethnobotanical knowledge of different communities. Njoroge and Bussmann (2006) and Bussmann and Njoroge (2007), documented herbal medicine for skin and, eye, ear and throat (ENT) around Mt. Kenya and commonly sold herbs around urban centers in central region of Kenya. Despite the reported rise in use of herbal health services in Kenya, little published data was available on traditional knowledge on herbal medicine used in Nyeri County. The purpose of the current survey was to investigate and document comprehensively, traditional medicinal plants used in the treatment and management of ailments in Nyeri County.

MATERIALS AND METHODS

Study area and ethnographic background

Nyeri County occurs in Central Kenya and it borders; Laikipia County to the North, Nyandarua to the West, Murang'a to the South, Kirinyaga to the East, and Meru to the North East (Fig. 1). It is located between latitude 0.4167° S, 36.9500° E. At the time of the study, it had a population of 693,558 (Male – 49%, Female – 51%) occupying an area of about 3,337 km^2. It is divided into six constituencies; Tetu, Othaya, Kieni, Mukurwe-ini, Mathira and Nyeri town. The temperature ranges from an average annual minimum of 12℃ to a maximum of 27℃ and receives rainfall amounts from 550 mm to 1,500 mm per annum. The long rains starts on March and ends on May while the short rains sets in from October to December. Nyeri County leads nationally with a forest cover of 38.5% as compared to a national cover of 6.99%. The major geographical landscapes of the County are Mount Kenya (5,199 m) and the Aberdare ranges (3,999 m) to the east and west, respectively; both are densely forested with rich plant species diversity. Agricultural activities are a source of livelihood and the most predominant economic activities include; tea and coffee which are grown for exports, large scale horticultural flower farming, greenhouse farming by small scale vegetable farmers and dairy farming. The most predominant tribe is the Kikuyu community; others included the Kamba, Luo, Meru, Embu, Somali, and Borana. Most of the people living in Nyeri County are of Christian faith. Nyeri County has one level 5 hospital, three level 4, 18 level 3 and 75 level two health facilities. It has three mission and three private hospitals, one hospice, one nursing home and 228 private clinics which are spread across the County. The doctor/population ratio is about 1:6459 and a nurse/population ratio is 1:143.

Study design and data collection

The study was a cross sectional survey, 30 practicing traditional medicine practitioners (TMPs) that willingly consented to participate were purposively sampled (5 per constituency), through the guidance of officers from Ministry of Culture and Social Services. The criteria for selecting the target population were guided by Cohen et al. (2000). According to the authors, a sample of 30 respondents is the minimum sample size that can reveal the full range or nearly full range of potentially important opinions when seeking qualitative data as well as in working out statistical analysis in quantitative data. Inclusion criteria were based on those TMPs that were born and practiced in the study area. Data collection involved interviews, administration of pilot tested semi-structured questionnaire to the TMPs, and transect walk. Interviews were conducted in the native language (Kikuyu) and translated to English by a team of trained research assistants. The respondents were assured of confidentiality and that, any information volunteered would be used for research purpose. Information collected from the TMPs included; demographic information, traditional knowledge on herbal medicine (harvesting, processing, dosage, preparation, route of administration and toxicity) and challenges in herbal medicine practice.

Sample collection and identification

Medicinal plants used to treat diseases that were mentioned by the TMPs during the interview were collected by a team of researchers from the University of Nairobi, research assistants and TMPs. The plants were identified by a botanist and voucher specimens were deposited at the University of Nairobi Herbarium. Information about; habit, habitat, plant part harvested and scientific name was recorded.

Data analysis

Both qualitative and quantitative data were collected during the study. Qualitative responses were organized into themes while others were presented verbatim. Quantitative data from demographic information as well as quantified qualitative data were presented as proportions, percentages, pie charts and bar graphs as well as analyzed using SPSS Version 20. The relevance of medicinal plant species among traditional medicine practitioners was calculated using the formulae; UVs (total Use Value of the species for all informants) = (ΣUV_{is}) / (n_i); UV_{is} is the Use Value of the species for a single informant and n_{is} is the number of interviews by the informant (Hoffman, 2007; Phillips and Gentry, 1993).

RESULTS

Majority of the Traditional Medicine Practitioners (TMPs) were over 57 years (87%) and were of Christian faith (89%). Seventy seven percent (77%) had formal education out of which 55.6% had undergone professional training and worked in the formal sector; however, 20% had since retired. Sixty seven percent (67%) combined herbal practice with other income generating activities such as; business, farming, masonry and formal employment, the other 33% of the practitioners earned their living from herbalism. The TMPs had long standing experience; 89% had practiced for over 20 years, the other 11% between 6-10 years. They mainly practiced from their homes (78%); the other 22% had established a clinic at either Karatina, Mweiga and Nyeri town. Additionally, they had acquired their skills in herbal medicine through inheritance from parents and long-standing experience. Notably, there was no evidence of apprenticeship or organized structures of passing down

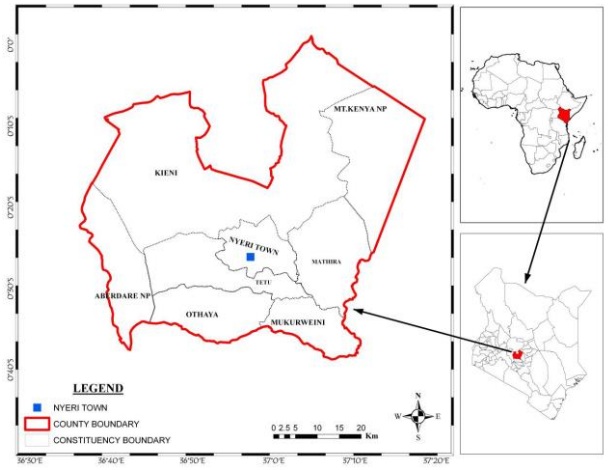

Fig. 1. Map of Africa showing the location of Kenya and Nyeri County.

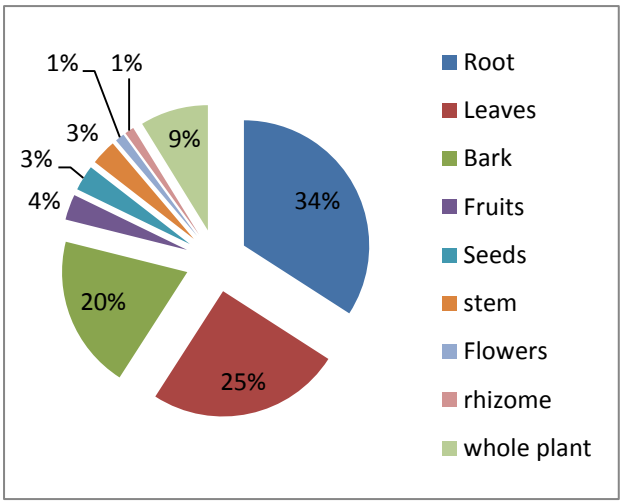

Fig. 2. Commonly used plant parts of the medicinal plants.

knowledge which they possessed. However, 67% had acquired additional information from books, media and internet. Fifty six percent (56%) had no formal training on herbal medicine while 44% had attended a government and World Bank sponsored seminar. The attendees displayed a deep mastery of appropriate herbal medicine practices during plant harvesting, preparation, storage, and dosage administration. They were aware of the group of patients that should be referred to medical practitioners for specialized treatment based on, age, sex and magnitude of sickness. Additionally, they learned management skills which included record keeping and financial management. Besides uplifting their confidence and self-esteem in the profession, the seminar had driven out fear among them. Eighty percent (80%) had registered as members of the Nyeri Herbalists Association (NYETIPA) under the Ministry of Culture and Social Services. A total of 80 ailments treated by TMPs were recorded, common communicable (infectious) diseases included; colds (53.3%), (50%), gonorrhea (40%), respiratory infections (33.3%), intestinal worms (33.3%), and amoebiasis (10.0%) while non-communicable diseases were; high blood pressure (43%), arthritis/gout (40%), wounds (40%), joint pain (33.3%), malaria ulcers/hyperacidity (33.3%), stomachache (33.3%), male sexual dysfunction (33.3%) and constipation/indigestion (33.3%). Some diseases

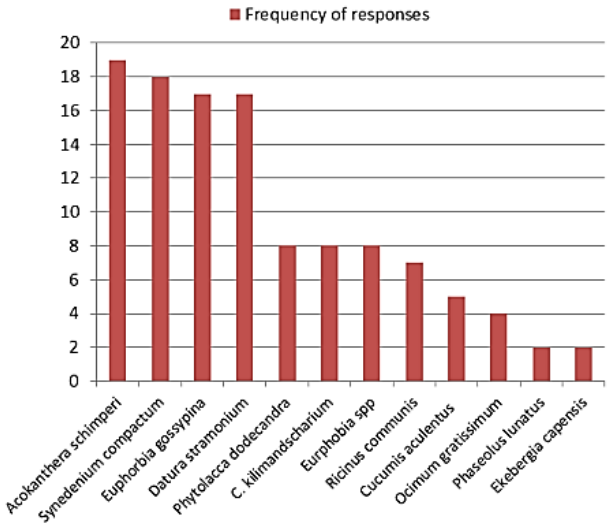

Fig. 3. Most common poisonous plant species among the Kikuyu community, Nyeri County.

were treated as one, like arthritis and gout and, ulcers and hyperacidity (Table 1). For the TMPs to achieve a wholesome effect they used a holistic treatment approach which included several herbs like; blood purifiers, appetizers, digestives and revitalizers and, nutritional vegetables such as stinging nettle and Macdonald's eye. They combined 4-5 herbs in the treatment of one disease; some acknowledged using a cocktail of up to 20 herbs, thus the saying "*gũtirĩ mũtĩ wa mũmwe*", which means "plant species never grow in isolation".

The plants occurred in diverse habitats, 23.8% of the herbs were harvested either from the; bush, crop farms, compound or boundary. The highest proportion of species growth form was trees (36%) followed by shrubs (32%), herbs (24%), liana (7%) and fungi (1%). Regularly harvested plant parts were the roots (34.1%), leaves (25%), bark (20%) and whole plant (9%) (Fig. 2). In order to conserve medicinal plants, the TMPs obtained the bark by cutting longitudinal strips or a third of the roots per plant; others had developed botanical gardens in their farms where they grew trees like *Prunus africana* and *Azadirachta indica*.

Plant materials were washed and dried before grinding and stored in water proof containers. Plant medicine was prepared by boiling (80%), as an infusion (15%), inhalant or through dermal or nasal application (5%). Frequently used measurement unit was a glass/cup (equivalent to 250 ml) of herbal decoction or infusion taken twice or thrice daily, children took half the adult dose. Preparation was done by the TMP and therefore cases of over dosage were rarely reported, but when they did, the effects included; constipation/indigestion and vomiting which were treated by administering a laxative and anti-vomiting herb respectively. Notably, TMPs did not treat infants, pregnant women, very old people and emergency cases but referred them to hospital for specialized treatment.

Plant toxicity was reportedly rare, however, 11% of TMPs acknowledged that, some herbs like; *Annona cherimola*. *Warbugia ugandensis*, *Aloe* spp. and *Senna didymobotrya* caused toxic effects such as diarrhea, mild headache, stomachache and general body weakness. In particular, *Neoboutonia macrocalyx* caused kidney problems, *Caesalpina volkensii* and *Acacia nilotica* (L. Willd) reportedly caused blood thinning effect while *Rhamnus prinoides* and *Prunus africana* demonstrated diuretic effect. The TMPs neutralized plant toxicity by adding milk, fats, and bone soup and, by combining with other plants such as, *Rhamnus prinoides*, *Periploca linearifolia*, *Carissa edulis*, *Rotheca myricoides*,

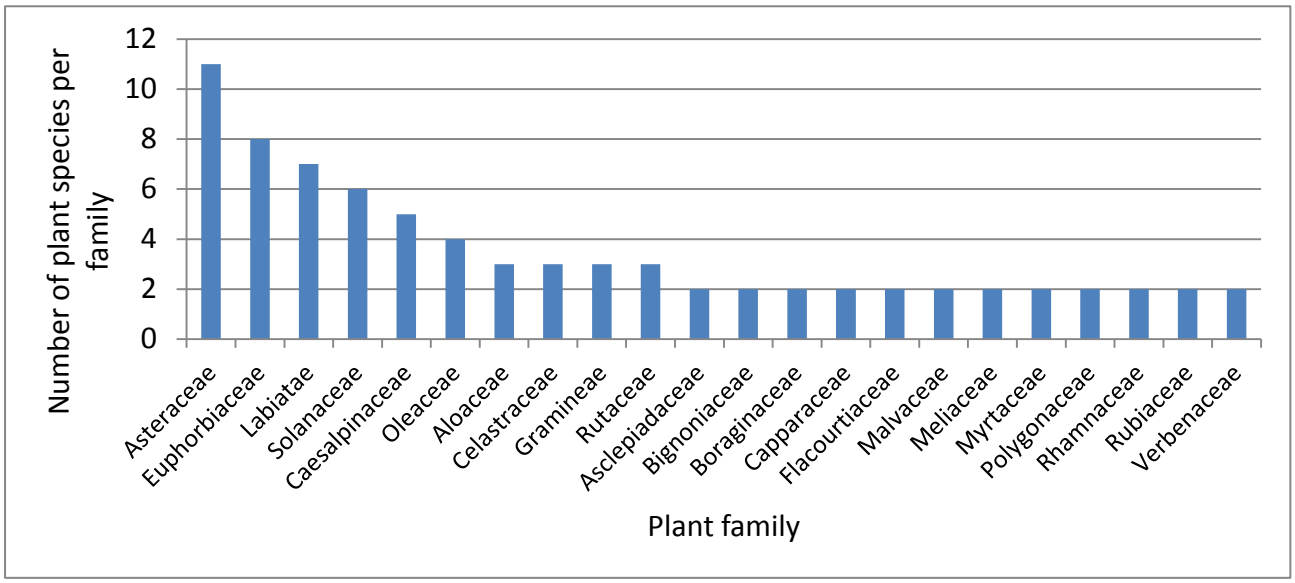

Fig. 4. Plant families with high proportion of medicinal plant species used in Nyeri County.

prunus africana, *Acasia nilotica* or *Tremma orientalis* depending on the plant type. Also, ½ a glass of *Achyranthes aspera* leaves and *Ficus natalensis* (roots or bark) was added to the root preparation of *Euclea divinorum*, *Senna didymobotrya* and *Cyathula polycephala* leaves, to counteract their laxative effect.

Notably, high level of knowledge in plants that are toxic to both man and animals was observed among the TMPs. Plant(s) that were not eaten by goats or those that produced a milky sap were considered to be poisonous to humans or animals. At least each TMP mentioned 3-5 toxic plants, this finding explained why plant toxicity due to adulteration was reportedly rare; a total of 12 plants were identified and documented (Fig. 3).

The TMPs displayed an in-depth knowledge on herbal medicine used to manage diseases in the Kikuyu community; majority (67%) mentioned over 20 medicinal plants without reference to their records. However, there was no significant relationship between level of education (p = 0.070) or age (p = 0.889) and traditional knowledge of herbal medicine. A total of 111 medicinal plant species distributed within 98 genera and 56 families were documented (Table 1). Plant families with high numbers of medicinal plants were; Asteraceae (9.5%), Euphorbiaceae (7.2%), Labiatae (6.3%), Solanaceae (5.4%) and Caesalpinaceae (4.5%) (Fig. 4). Plants that showed a high "User Value" among the TMPs included; *Prunus africana*, *Rotheca myricoides*, *Kigelia africana*, *Warbugia ugandensis*, *Croton megalocarpus* and *Cordia abyssinica* (Table 1). The TMPs from drier parts of the County in particular Kieni sub-county, possessed more information on traditional herbal medicine and relied more on knowledge inherited from their parents.

Despite their deep knowledge in traditional medicine, the practice faced several challenges, 70% of the TMPs acknowledged that, there was a general belief among members of the community that taking herbal medicine causes resistance to modern drugs. Failure to complete prescribed dose was also reported, especially when a large quantity of herb decoction was administered mainly because the patient presumed that it was an overdose. Other challenges included poor payment for services rendered by the TMPs and very high expectation from the patients for immediate healing.

DISCUSSION

Majority of the herbalist were old, an indication that the practice was not being passed on to the young generation. This is similar to what was reported in other studies in Kenya (Muthee et al., 2011; Wambugu et al., 2011). Most herbalists were of Christian faith; similar observation was made by Muthee et al. (2011) in Loitoktok District. High level of education among the TMPs was attributed to early introduction of education and Christianity by the missionaries (Sindiga et al., 1995). Lack of laid down structures to pass down knowledge contradicted Kamenju (2013), report which showed that, Kikuyu traditional herbalists undertook the practice as a profession and a means of livelihood and, they routinely passed the knowledge to the young generation. Besides uplifting their confidence and self-esteem in the profession, information acquired from organized seminar had driven out fear among those that had it instilled in them during the colonial period (Sindiga et al., 1995). Additionally, high rate of registration with herbalists' association was observed in other parts of Kenya, as reported by Muthee et al. (2011) among the Maasai herbalists which were practicing in Loitoktok District.

As observed in the present study, respiratory infections and arthritis have been cited in Tana River County (Kaluwa et al., 2014). Similarly, a study carried out by Bussman et al. (2006) cited a high prevalence of sexually transmitted diseases, malaria, gastro-intestinal disorders, parasitic ailments and wounds among the Maasai of Sekenani. Use of polyherbals in the treatment of diseases is in agreement with Kamenju (2013) view that, Kikuyu traditional herbalists' treatment approach aims at addressing the root cause of the disease. High usage of shrub and herbs as reported in this study was in agreement with

The present study revealed increased use of roots, similarly, a high prevalence in harvesting of roots and bark was reported among the Ilkisonko Maasai community (Kimondo et al., 2015). But in a study carried out in India by Kumar and Bharati (2014), it was observed that, leaves (33 instances) were the most frequently used plant part. Although root harvesting threatens plants species, conservation measures undertaken by the TMP in the present study area were significant towards protection of the ecosystem. Measurement of the plant medicine using a cup /glass was also observed by Muthee et al. (2011). TMPs in the

Table 1. Plants traditionally used in the management of human diseases in Kenya

Plant Family	Botanical name and Voucher number	Therapeutic uses	Kikuyu name	Ppu[a]	Preparation	Growth forms	Habitat	Ncs[b]	Use Value (UVs)
Acanthaceae	*Thunbergia alata* Bojer ex Sims LNM14/103	Tonsils, hemorrhagia and postpartum bleeding	Kanyanja	Leaves	Decoction	Vine /Herb	Bu	2	0.06
Acanthaceae	*Justicia diclipteroides* Lindau LNM14/76	Pain	Numa	Leaves	decoction	Herb	Bu, Cp	1	0.03
Aloaceae	*Aloe kedongensis* Reynolds LNM14/84	Clear pimples, acne	Mũgwanũgũ	Leaves	Sap	Herb	Cp, Bu	3	0.1
Aloaceae	*Aloe lateritia* Engl. LNM14/32	Muscle inflammation or elephantiasis	Kĩĩruma	Leaves	Sap	Herb	Cp, Bm, Bu	1	0.03
Amaranthaceae	*Achyranthes aspera* L. LNM14/117	Wounds (blood coagulation) / used to clean wounds	Mũtegenye /Kamũtegenye	Leaf	Use sap or pound to obtain the juice	Shrub	Bu	1	0.03
Anacardiaceae	*Rhus natalensis* Bernh. ex Kraus LNM14/96	STDs, fibroids and colds	Mũthigiũ	Stems Roots Leaves Bark	Infusion	Tree	Bu, Cp,	2	0.06
Annonaceae	*Annona cherimola* Mill. LNM14/53	Cancer	Mũtomoko	Bark	Decoction	Tree	Cf	1	0.03
Apocynaceae	*Carissa edulis* (Forssk.)Vahl LNM14/24	STD polio arthritis/gouts, energizer, stomach ache, malaria, coughing / cold, Male sexual stimulant	Mũkawa	Leaves Bark	Decoction	Shrub	Bu, Cp	8	0.27
Araliaceae	*Cussonia holostii Engl.* LNM14/45	Wounds, high blood pressure, irregular menstrual cycle, uterine cleansing, fibroids,	Mũroha	Bark	Decoction	Tree	Bu, Cf, Cp, Bm	6	0.2
Asclepiadaceae	*Mondia whitei* (Hook f.) Skeels LNM14/44	Appetizer, stomach problems, deworming, hyperacidity/ulcers, male sexual stimulant, kidney cleansing, malaria.	Mũhukũra	Roots Bark	Decoction added to soup	Liana	Bu, Cf, Cp,	6	0.2
Asclepiadaceae	*Periploca linearifolia* Dill. & A. Rich. LNM14/06	Colds and STDs	Mwemba-igũrũ	Roots	Sap	Liana	Bu, Bm	2	0.06
Asteraceae	*Sonchus oleraceus* L. LNM14/02	Constipation, stimulate digestive system, cancer	Mũthũnga	Roots Leaves	Decoction	Herb	Cf	3	0.1
Asteraceae	*Tagetes minuta* L. LNM14/48	Wounds, toothe ache, insect bite	Mũbangi	Root Stem Leaves	Crushed, Chew	Herb	Cf	5	0.17
Asteraceae	*Bidens pilosa* L. LNM14/49	Conjunctivitis, malaria, kidney cleansing	Mũhehenje /Mũcheege	Root	decoction	Herb	Cf	5	0.17
Asteraceae	*Vernonia auriculifera* LNM14/40	Stomach ailments, insect repellant, intestinal worms, dysentery	Mũthakwa	Roots Leaves	Decoction, whole leaves	Shrub	Bu, Cf, Cp,	5	0.17
Asteraceae	*Galinsonga parviflora Cav*. LNM14/08	Measles, tonsils, colds, asthma	Mũng'ei	Whole plant	Chew leaves Decoction	Herb	Cf	4	0.13

Asteraceae	*Launaea cornuta* (Hochst. ex Oliv. & Hiern) C. Jeffrey LNM14/03	Constipation and cancer	Mũthũnga	Roots Leaves	Decoction	Herb	Cf	3	0.1
Asteraceae	*Vernonia lasiopus* O.Hoffm. LNM14/23	Malaria, deworming, male stimulant, restore periods in women	Mũchatha	Roots	decoction	Shrub	Bu	3	0.1
Asteraceae	*Psiadia punctulata* (DC.) Oliv. & Hiern LNM14/90	Male sexual stimulant	Mũbai or mũenda ngueko	Roots	Decoction	Shrub	Bu, Cf,	5	0.06
Asteraceae	*Bersama abyssinica* Fresen. LNM14/95	Epilepsy and male sexual stimulant	Mũrumandũ	Leaves Root	Chew Decoction	Tree	Bu, Cp	2	0.06
Asteraceae	*Aspilia pluriseta* Schweinf. ex Engl. LNM14/110	Diarrhea	Mũũtĩ	Roots	Decoction	Herb	Bu	1	0.03
Asteraceae	*Vernonia brachycalyx* O. Hoffm. LNM14/111	Stomach evacuation	Kagutu	Leaf	decoction			1	0.03
Asteraceae	*Spilanthes mauritiana* (A.Rich. ex Pers.) DC. LNM14/30	Toothache	Gatharia ita	Flowers Roots	Chew	Herb	Bu	1	0.03
Bignoniaceae	*Kigelia africana* (Lam.) Benth. LNM14/33	Gonorrhea, sphyllis, drugs / bhang addiction, jaundice, madness, cataract, blood cleanser, high blood pressure, hydrocephalus, measles, hemorrhagia and postpartum bleeding	Mũratina	Leaves Bark Fruit	Decoction	Tree	Bu, Cf, Cp, Bm	15	0.5
Bignoniaceae	*Markhamia lutea* (Benth.) K. Schum. LNM14/120	Toothe ache (mouth wash before bed)	Mũũ	Bark	Chew	Tree	BM, Bu, Cp, Cf	1	0.03
Boraginaceae	*Cordia africana Lam.* LNM14/123	Joints, typhoid, high blood pressure, antitumor, chest infection, and cardiac stimulant.	Mũringa	Bark	Decoction	Tree	Bu, Cf, Cp, Bm	12	0.4
Boraginaceae	*Ehretia cymosa* Thonn. LNM14/94	Wounds and male sexual stimulant.	Mũrembu	Bark	Decoction Sap	Tree	Bu, Cf, Cp,	2	0.06
Burseraceae	*Commiphora eminii* Engl. LNM14/74	Clean teeth, snake bite	Mũkũngũgũ	Bark Stem Root	Decoction	Tree	Cf, Cp,	3	0.1
Caesalpinaceae	*Senna didymobotrya* (Fresen.) Irwin & Barneby LNM14/39	Intestinal worms, antifungal, burns, bleeding gums, tooth ache, typhoid, amoebiasis and stomache evacuation.	Mwĩnũ / Mũĩnũ	Leaves	Decoction	Shrub	Cp, Bu	9	0.3
Caesalpiniaceae	*Caesalpinia volkensii* Harms LNM14/43	Headache / migraine energizer, malaria, joints	Mũchũthĩ (Njũthĩ)/ mũbũthĩ	Seeds Roots	crush to form a paste	Liana	Bu, Cf, Cp,	6	0.2
Caesalpiniaceae	*Senna septemtrionalis*	Gonorrhea, syphilis, intestinal	Mũchingiri	Root	Decoction	shrub	Bu	3	0.1

	(Viv.) H. Irwin & Barneby LNM14/70	worms							
Caesalpiniaceae	*Caesalpinia decapetala* (Roth) Alston LNM14/112	Clean teeth	Mũbaage	Stem	Stem cutting	Shrub	Bu	1	0.03
Canellaceae	*Warburgia ugandensis* Sprague LNM14/34	Arthritis / gouts, tooth ache, stomach 7 problems, malaria, respiratory diseases e.g. colds, asthma, chest pain, AIDs, cancer, anthrax	Mũthĩga	Bark Root Leaves	Decoction	Tree	Bu, Cf, Cp, Bm	14	0.47
Capparaceae	*Maerua triphylla* LNM14/81	Headache and migraine	Mũkũri-ũndũ	Root	Decoction	Shrub	Bu	3	0.1
Capparaceae	*Capparis tomentosa* Lam. LNM14/71	Arthritis, inflammation / elephantiasis, joint pain	Mũri ũmwe	Bark	Decoction or cover the inflamed tissue with bark for 15 minutes).	Tree	Bu	1	0.03
Caricaceae	*Carica papaya* L. LNM14/46	Skin fungal infection	Mũbabae	Unripe fruit	Juice	Tree	Cf	1	0.03
Celastraceae	*Hippocratea africana* Loes. ex Engl. LNM14/93	Sexual stimulant in men, drying of wounds and STDs	Mũng'aang'a	Bark Roots	Decoction	Liana	Bu	2	0.06
Celastraceae	*Maytenus heterophylla* (Eckl. & Zeyh.) LNM14/104	Diarrhea	Mũthuthi	Roots	Decoction	Tree	Bu	2	0.06
Celastraceae	*Elaeodendron buchananii* Loes. LNM14/116	Wounds	Mũtanga	Roots	Grinded	Tree	Bu	1	0.03
Chenopodiaceae	*Chenopodium opulifolium* Schrad. ex W.D.J. Koch & Ziz LNM14/109	Gonorrhea	Mũiganjo	Bark Root	Decoction	Herb	Bu, Cp	1	0.03
Crassulaceae	*Kalanchoe marmorata* Baker *or K. densiflora* Rolfe. LNM14/31	Tooth ache	Mahũitia / Mũkondori	Leaves	Heat over the fire and place on the inflamed or swollen muscle	Shrub	Bu	1	0.03
Cucurbitaceae	*Coccinia trilobata* (Cogn.) C. Jeffrey LNM14/108	Syphilis	Kagerema	Leaves	Decoction	Vine	Bu	1	0.03
Dracaenaceae	*Dracaena steudneri* Schweinf. ex Engl. LNM14/11	High blood pressure	Ithare	Bark Root	Decoction	Tree	Bu, Cp	2	0.06
Ebenaceae	*Euclea divinorum Hiern* LNM14/73	Diarrhea, typhoid and stroke	Mũkinyai	Root	Infusion Decoction	Tree	Bu, Cf, Cp,	3	0.1
Euphorbiaceae	*Croton megalocarpus* Del. LNM14/35	Influenza, pneumonia, wounds, family planning amoeba / protozoa, typhoid, over-bleeding during menstruation cycle and birth	Mũkindũri	Bark Leaves	Decoction	Tree	Bu, Cf, Cp, Bm	12	0.4
Euphorbiaceae	*Neoboutonia macrocalyx Pax* LNM14/38	Coughing / cold, chest, wounds, family planning,	Mũtũndũ	Bark Roots	Decoction	Tree	Bu, Cf, Cp, Bm	9	0.3

		high blood pressure, cardiac problem / hypertrophy, cholesterol, chicken pox							
Euphorbiaceae	*Synedenium compactum* N. E. Br. LNM14/77	AIDs, warts and joints	Watha	Leaves	Decoctionor Milky sap, Ash from the bark	Shrub	Bu, Bm	3	0.1
Euphorbiaceae	*Ricinus communis* L. LNM14/98	Gouts and family planning	Mwarĩki /Mbarĩki	Root Seeds	Root decoction 3 drops of oil	Shrub	Cf	2	0.06
Euphorbiaceae	*Tragia brevipes* Pax. LNM14/100	Male sexual stimulant and parturition	Njegeni	Roots	Roots sap applied on penis Decoction	Herb	Bu,	2	0.06
Euphorbiaceae	*Bridelia micrantha* (Hochst.) Baill. LNM14/106	Gastrointestinal worms	Mũkoigo	Bark	Decoction	Tree	Bu	2	0.06
Euphorbiaceae	*Acalypha Volkensii* Pax LNM14/115	Wounds	Mũng'aria	Roots	Sap	Shrub	Bu	1	0.03
Euphorbiceae	*Euphorbia gossypina* (Pax) LNM14/86	Respiratory diseases, leukemia and energizer	Kariaria	Roots Stem Leaves	Decoction	Shrub	Bu, Cp, Bm	2	0.06
Flacourtiaceae	*Trimeria grandifolia* (Hochst.) Warb. LNM14/56	Arthritis / gouts, hyperacidity / ulcers, joints	Mũhĩndahĩn di	Roots	Decoction	Shrub	Bu, Cp	4	0.13
Flacourtiaceae	*Dovyalis abyssinica* A. Rich LNM14/58	Gonorrhea syphilis, constipation / indigestion, fibroids	Mũkambura	Bark Leaves Roots	Decoction	Shrub	Bu, Cf, Cp,	4	0.13
Gramineae	*Digitaria scalarum* Chiov. LNM14/102	Gonorrhea, candidiasis	Thangari	Root	Decoction	Herb	Cf, Cp, Bu	2	0.06
Gramineae	*Saccharum officinarum* L.	Fibroids	Kĩgwa	Stem	Juice	Herb	Cf	1	0.03
Gramineae	*Pennisetum clandestinum* Hochst. ex Chiov. LNM14/78	Kidney cleansing	Wĩtima	Roots	Decoction	Herb	Cp, Bu,	1	0.03
Guttiferae	*Hypericum revolutum* Vahl. LNM14/40	AIDs	Mũthathum wa	Leaves	Decoction	Tree	Bu	1	0.03
Hydnoraceae	*Hydnora abyssinica* Schweinf. LNM14/17	High blood pressure, diarrhea, expel after birth, hemorrhagia and postpartum bleeding	Mũthigira	Roots Rhizo me	Decoction	Herb	Bu, Cf, Cp,	4	0.13
Hypericaceae	*Harungana madagascariensis* Lam. ex Poir. LNM14/92	Malaria and stimulate growth of mammary glands	Mũitathũa	Roots	Decoction	Shrub	Bu,	2	0.06
Hypocreaceae	*Engleromyces goetzei* P.Henn. LNM14/87	Colds and pneumonia	Kĩeha kia mũrangi	Whole plant	Decoction	Fungi	Bu, Bm	2	0.06
Labiatae	*Ajuga remota*. Benth LNM14/42	Colds, malaria AIDs tooth ache, high blood pressure amoeba / protozoa	Wanjirũ wa kieni	Leaves Roots	Decoction	Herb	Bu, Cp	7	0.23
Labiatae	*Leonotis nepetifolia* (L.) R. Br. LNM14/63	Goiter, intestinal worms, conjunctivitis, irregular menstrual cycle	Mũchii	Leaves	Decoction	Shrub	Bu	4	0.13
Labiatae	*Plectranthus*	Stomach problem,	Maigũya	Leaves	Decoction	Shrub	Bu, Cf,	3	0.1

	barbatus Andrews forskohlii LNM14/67	tooth ache, constipation					Cp, Bm		
Labiatae	*Ocimum kilimandscharicum* Guaerke LNM14/68	Respiratory diseases insect repellant	Makũri	Leaves	Decoction	Shrub	Bu, Cf, Cp,	3	0.1
Labiatae	*Ocimum gratissimum L.* LNM14/80	Headache / migraine, Gonorrhea, colds	Mũkandu	Bark Leaves	Decoction, Infusion	Shrub	Bu	3	0.1
Labiatae	*Fuerstia africana* T.C.E.Fr. LNM14/105	Gonorrhea	Gathĩrĩga	Leaves	Decoction	Herb	Bu	1	0.03
Lauraceae	*Persea Americana* Mill. LNM14/19	Bleeding gums, diarrhea, high blood pressure, diuretic, typhoid	Mũkorobia	Seed Leaves Fruit peels	Seed (infusion, Leaf decoction Peel decoction	Tree	Cp Cf	4	0.13
Liliaceae	*Aloe secundiflora Engl.* LNM14/36	Pneumonia, constipation, malaria, fibroids, AIDs, wounds (apply sap)	Thukũrũi	Leaves	3 drops per glass	Herb	Bu, Cp	10	0.33
Loganiaceae	*Strychnos henningsii* Gilg LNM14/47	Arthritis / gouts, back or joint pain, pain / fatigue, malaria, respiratory diseases	Mũteta	Root Bark	decoction	Shrub	BuCf, CpBm	6	0.2
Malvaceae	*Sida tenuicarpa Vollesen* LNM14/57	Gonorrhea, diarrhea and toothache.	Kahĩnga	Roots	Decoction	Shrub	Bu, Cf, Cp,	4	0.13
Malvaceae	*Pavonia urens* Cav. LNM14/89	Hyperacidity and tooth ache	Machũna	Leaves	Decoction	Shrub	Bu, Cp,	2	0.06
Malvaceae	*Hibiscus fuscus* Garcke	Stomach evacuation due to food poisoning / afflatoxins	Mũgere	Roots	Decoction	Shrub	Bu	1	
Meliaceae	*Ekebergia capensis Sparrm.* LNM14/75	Pneumonia, induce aggressive actions, colds and coughing	Mũnunga	Bark Leaves	Decoction	Tree	Bu, Cf,	3	0.1
Meliaceae	*Melia volkensii* Gürke LNM14/59	Malaria	Mwarubainĩ	Bark Leaves	Decoction	Tree	Bu, Cp,	1	0.03
Mimosaceae	*Mimosa pudica* L. LNM14/113	Asthma	Mũkua-tũhũ / Mwĩkuithia	Root	decoction	Herb	Cf, Cp, Bu	1	0.03
Moraceae	*Ficus thonningii Blume* LNM14/55	Intestinal worms, colds, dysentery	Mũgumo	Bark Leaves	decoction	Tree	Cf	4	0.13
Moraceae	*Ficus lutea* Vahl LNM14/83	Skin fungal infection	Mũmbũ	Leaves	Milky sap	Tree	Bu	1	0.03
Moringaceae	*Moringa oleifera Lam.* LNM 14/28	Arthritis / gouts, loss of memory, prostate cancer, high blood pressure	Moringa	Seeds Leaves	Chew seed, Leaf decoction	Tree	Cf, Cp	4	0.13
Musaceae	*Musa sapientum* L. LNM14/107	Gonorrhea	Ngoro ya irigũ	Inflore scence (flower)	Decoction	Tree	Cf	1	0.03
Myricaceae	*Myrica salicifolia* Boj. ex Baker LNM14/99	AIDs	Mũthongoya	Bark Roots	decoction	Shrub	Bu	1	0.03
Myrsinaceae	*Myrsine africanum L.* LNM14/26	Intestinal worms, Cancer	Mũgaita	Fruits Bark	Decoction	Shrub	Bu,	4	0.13

Myrtaceae	*Eucalyptus globilus* Labil. LNM14/82	Asthma, pneumonia, cold, sinuses, epilepsy, high blood pressure (bark)	Mubao wa white	Bark Leaves	Decoction, Infusion	Tree	BuCpBM	3	0.1
Myrtaceae	*Callistemon viminalis* (Gaertn.) G.Don ex Loudon LNM14/119	Tooth ache	Bottle brush	Leaves	Boil	Tree	Cp	1	0.03
Oleaceae	*Olea africana* L. LNM14/27	Intestinal worms, high blood pressure, amoeba / protozoa, joints	Mũtero / Mũtamaiyo	Stem Root Bark	Decoction	Tree	Bu, Cf, Cp, Bm	6	0.2
Oleaceae	*Olea hochstetteri Bak.* LNM14/69	Gonorrhea, syphilis, colds, intestinal worms	Mũcharage	Bark Stem	Decoction	Tree	Bu	3	0.1
Oleaceae	*Schrebera alata* (Hochst.) Welw. LNM14/41	Tooth ache	Muga nyoni	Bark Twig	Chew	Tree	Bu, Cp	1	0.03
Papilionaceae	*Erythrina abyssinia* DC LNM14/72	Gonorrhea, sphyllis, arthritis / gouts	Mũhũtĩ	Roots Bark	Decoction	Tree	Bu, Cf, Cp,	3	0.1
Phytolacaceae	*Phytolacca dodecandra* L Hér. LNM14/91	Hyperacidity, jigger repellant	Mũhoko	Leaves	Powder Decocotion	Liana	Bu,	2	0.06
Polygonaceae	*Oxinum sinuatum* LNM14/52	STDs, candidiasis	Cong'e	Roots	Decoction	Herb	Cf, Cp	4	0.13
Polygonaceae	*Rumex abyssinicus* Jacq. LNM14/114	Pneumonia	Mũgũagũa /Mũgagatiu	Stem	Crushed/chew	Herb	Bu, Cf	1	0.03
Ranunculaceae	*Clematis hirsuta Guill. & Perr.* LNM14/10	Colds, kidney cleanser	Mũgaya-ng'ũndũ	Leaves Roots	Inhale crushed leaves or roots	Shrub	Bu	3	0.1
Rhamnaceae	*Rhamnus prinoides* L. He'rit LNM14/18	Arthritis / gouts, appetizer, constipation / digestive system, hyperacidity / ulcers, high blood pressure, male sexual stimulant, anthrax	Mũkaraking a	Leaves Roots Bark	Decoction	Shrub	Bu, Cp	7	0.23
Rhamnaceae	*Rhamnus staddo* A. Rich LNM14/101	Kidney cleansing, malaria	Ngukura	Roots	Decoction added to soup	Shrub	Bu	2	0.06
Rosaceae	*Prunus africana* (Hook .F.) Kalkm. LNM14/20	Animal protein allergy, STD, arthritis / gouts, blood purifier / cleanse, appetizer, prostate, arthritis, stomach 10 problems, constipation, malaria hyperacidity / ulcers, fibroids, joints, renew memory	Mũiri	Bark Leaves	Decoction	Tree	Bu Cf Cp Bm	17	0.57
Rubiaceae	*Galium aparine* L. LNM14/85	STDs and kidney cleansing	Gakarakũ	Leaves	Decoction	Herb	Cf, Bu	2	0.06
Rubiaceae	*Vangueria madagascariensis* J. F. Gmel. LNM14/61	Stimulate digestion	Mũbirũ	Roots	Decoction	Tree	Bu	1	0.03
Rutaceae	*Zanthoxylum usambarense*	Toothache and cleaning teeth,	Mũheheti	Bark, Stem	Decoction, Chew	Tree	Bu, Cf, Cp, Bm	9	0.3

	(Engl.) LNM14/37	malaria, chest 11 problems: colds, coughing, asthma							
Rutaceae	*Toddalia asiatica* (L.) Lam. LNM14/60	Colds, respiratory diseases, e.g. cold, asthma or chest pain, tooth ache	Mũrũrũe	Leaves	Decoction	Tree	Bu, Cf, Cp, Bm	4	0.13
Rutaceae	*Clausena anisata* Hook.f., De Wild. & Staner LNM14/121	Toothe ache (mouth wash before bed)	Mũtathi	Leaf Root	Decoction	Tree	Bu	1	0.03
Solanaceae	*Solanum aculeastrum* Dunal LNM14/51	Whooping cough, wounds and male sexual stimulant	Mũtũra (mũgandũra anake) (Ndura/fruit)	Roots Fruits	Decoction	Shrub	Bu, Cf, Cp, Bm	5	0.17
Solanaceae	*Solanum incanum L.* LNM14/62	Anti-vomiting, stomach 11 problems, hyperacidity, dyspepsia	Mũtongu	Roots	Decoction	Shrub	Bu, Cf, Cp,	4	0.13
Solanaceae	*Solanum nigrum* L. LNM14/29	Nausea, high blood pressure, arthritis/gouts	Managu	Leaves	Decoction	Herb	Cf	3	0.1
Solanaceae	*Withania somnifera* (L.) Dunal LNM14/97	Hyperacidity/ulcers	Mũrumbae	Flowers	Decoction	Shrub	Bu, Cf, Cp,	2	0.06
Solanaceae	*Physalis peruviana* L. LNM14/65	Hyperacidity	Mũnathi	Whole plant	Decoction	Herb	Bu	1	0.03
Sterculiaceae	*Dombeya burgessiae* Gerr. ex Harv. LNM14/118	Stops bleeding (clotting effect)	Mũkeũ	Leaves Stem	Sap	Shrub	Bu	1	0.03
Ulmaceae	*Trema orientalis* (L.) Blume. LNM14/64	Asthma	Mũhethũ	Roots	Decoction	Tree	Bu	1	0.03
Urticaceae	*Urtica masaica Mildbr.* LNM14/12	Arthritis / gouts, high blood pressure, sexual stimulant, joint pain,	Hatha /Thabai	Roots, Leaves	Decoction	Herb	Cf, Bu	3	0.1
Verbenaceae	*Rotheca myricoides* (Hochst.) Vatke LNM14/09	Kidney cleansing, gonorrhea, syphilis, STD, headache / migraine, pneumonia, prostate cancer, constipation / indigestion, malaria, hyperacidity / ulcers, amoeba, typhoid, joints, brucellosis	Munjuga-iria	Roots	Decoction (Boil)	Shrub	Bu, Cf, Cp, Bm	15	0.5
Verbenaceae	*Lantana camara* L. LNM14/66	Headache / migraine, athletes foot, sun burn	Karendi / Mũkigĩ	Leaves	Crush sniff decoction	Shrub	Bu Cf, Cp Bm	3	0.1
Vitaceae	*Rhoicissus 11 tridentata* (L.f.) Wild & Drummond LNM14/54	Remove after birth	Ndurutua	Roots	Decoction	Liana	Bu	1	0.03

Bu-bush, Cf- Crop field, Cp-Compound and Bm-Boundary marker Ppu[a]- Part of plant used, Ncs[b]- Number of citation

present study did not treat some groups of patients, the findings contradicted the perception and attitude by pregnant women in Nigeria who believed that, herbal medicine was safe (Fakeye et al. (2009) however, it was in agreement with the report by Muthee et al. (2011).

The present study revealed that, the TMPs possessed in-depth knowledge on herbal medicine; similar findings were reported from Samburu County and Sekenani valley in Maasai Mara (Bussman, et al., 2006; Nanyingi et al., 2008). In the present study, family Asteraceae had the highest citations of medicinal plants, this finding concurred with that of Malik et al. (2015) in a study carried out in Northern Punjab. As indicated

Table 2. Cross-reference of most cited medicinal plants using existing literature

Botanical name and plant family	Ncs[b]	Therapeutic uses	Chemical constituents
Prunus africana (Hook .F.) (Rosaceae)	17	It has antimicrobial activity (Mwitari et al., 2013) against *Salmonella typhi*, *Proteus vulgaris*, *Serratia marscecens*, *Escherichia coli* and *Bacillus cereus* (Mutuku et al., 2014).	It contains tannins, saponins, flavonoids, terpenoids, glycosides, alkaloids and phenols (Mutuku et al., 2014)
Kigelia africana (Lam.) Benth. (Bignoniaceae)	15	It has antiplasmodial (Zofou et al., 2012) and hepatoprotective activity (Olaleye and Rocha, 2008).	It contains glycosides, phenolics, alkaloids, flavonoid and cardiac glycosides (Abdulkadir et al., 2015)
Rotheca myricoides (Hochst.) Vatke (Verbenaceae)	15	It has antiplasmodial activity (Muthaura et al., 2015)	It contains alkaloids, terpernoids and flavonoids (Jeruto et al., 2010)
Warburgia ugandensis Sprague (Canellaceae)	14	It has antimicrobial (Mwitari et al., 2013) and antiplasmodial activity against *Plasmodium knowlesi* and *Plasmodium berghei* (Were et al., 2010).	It contains alkaloids, terpenoids, flavonoids and terpenes (Were et al., 2015).
Cordia africana Lam. (Boraginaceae)	12	It has antibacterial activity against *Bacillus subtilis* and *Staphylococcus aureus* and, antifungal activity against *Apergillus niger* and *Candida albicans* (Emtinan et al., 2015).	It contains coumarins, saponins, sterols, flavonoids and triterpenes (Emtinan et al., 2015).
Croton megalocarpus Del. (Euphorbiaceae)	12		It contains alkaloids, glycosides, saponins, steroids, flavones and catecholics (Waiganjo et al., 2013)
Aloe secundiflora Engl. (Liliaceae)	10	It contains aloenin which has antiviral (Waihenya et al., 2005) and nematicidal activity against *Ascaridia galli* (Kaingu et al., 2013)	It contains anthrones (aloenin, isobarbaloin, aloenin B and barbaloin), chromones and phenylpyrones (Rebecca et al., 2003).
Senna didymobotrya (Fresen.) Irwin & Barneby (Caesalpinaceae)	9	It has antimicrobial activity against *Streptococcus pyogenes*, *Escherichia coli* and *Proteus vulgaris* (Ngule et al., 2013).	It contains steroids, saponins, flavonoids, tannins, phenols, steroids, cardiac glycosides (Ngule et al., 2013), terpenoids, anthraquinones, tannins and alkaloids (Nyamwamu et al., 2015).
Neoboutonia macrocalyx Pax (Euphorbiaceae)	9	It has antiplasmodial activity (Fabrice et al., 2009).	It contains cycloartane triterpenes and phenanthrene (Namukobe et al., Namukobe), steroids and diterpenoids (Kirira et al., 2007).
Zanthoxylum usambarense (Engl.) (Rutaceae)	9	It has anti-inflammatory, antibacterial (Matu and van Staden, 2003) and antiplasmodial activity against *Plasmodium knowlesi* and *Plasmodium berghei* (Were et al., 2010).	It contains alkaloids (Atsushi et al., 1995).
Carissa edulis (Forssk.)Vahl (Apocynaceae)	8	It has anti-inflammatory, diuretics, hypotensive (Hanan and Wafaa, 2012) and antibacterial activity against *Salmonella typhi*, *Shigella dysenteriae* and *Streptococcus pyogenes* (Ngulde et al., 2013).	It contains saponins, cardiac glycosides and terpenoids (Ngulde et al., 2013).

Ncs[b] - Number of citations

in the present study, Njoroge (2012) had reported Prunus africana and Strychnos henningsii as frequently used herbs in Central Kenya. TMPs from drier parts of Nyeri County demonstrated deeper knowledge in medicinal plants and reported increased use of herbal medicine by the TMPs. Over reliance on medicinal plants was reported in other drier regions like Samburu and Tana River Counties which had fewer medical facilities (Nanyingi et al., 2008, Kaluwa et al., 2014). The most cited medicinal plants demonstrated various pharmacological activities as well as phytochemicals (Table 2).

Major challenges facing demand for the services from TMPs in Nyeri County was attributed to poor perception towards herbal medicine. A study carried out in Thika and Nairobi by Njoroge (2012), showed that, "part of the local populations still holds TMPs with suspicion, erroneously perceiving them as "witchdoctors". In a study carried out in Murang'a, 20 % of patients didn't believe that herbal medicine work while 16% said they didn't like it (Mwangi and Gitonga, 2014). This was in contradiction with the upward trend in the use of traditional herbal medicines observed in other parts of Kenya (Mboya, 2003).

CONCLUSION

The study concluded that; the current cohort of traditional medicine practitioners from Nyeri County possess vast information about treatment various ailments affecting its community; despite lack of clientele. The documented plants had medicinal potential; the most cited herbal medicines contained common phytochemical compounds such as; terpenoids, flavonoids and saponins and demonstrated pharmacological activities such as antimalarial, antibacterial and antifungal activities. Therefore the study recommended massive campaign about the benefits of herbal medicine in order to promote their use. Further research on efficacy and safety of the documented herbs was encouraged with the aim of developing drugs that can be used to treat and manage various diseases.

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CONFLICT OF INTEREST

The authors declares that there is no conflict of interest

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