

Ethnomedicinal Plants Traditionally Used by the Keiyo Community in Elgeyo Marakwet County, Kenya

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Abstract

Objective: Traditional medicinal plants have long been used to treat various ailments in Keiyo district. However to date there are no records on medicinal plants used by the Keiyo despite threats of rapid disappearance of indigenous knowledge from deforestation, overexploitation among other factors. The purpose of the study was to document medicinal plants used by the Keiyo community in order to preserve traditional medical knowledge for future research and potential development of new drugs.

Methods: The research team comprised of professionals from the fields of medicine and botany. Local leaders, community elders, church leaders and other stakeholders were used to identify herbalists and convince them to provide information. Semi structured interviews, group discussions and observations were used to collect information on traditional knowledge from herbalists. Details of the medical conditions treated, herbal preparations used, treatment methods, local plant names and methods of collection of herbs were recorded.

Results: A total of 73 medicinal plant species belonging to 33 families were identified, used to treat 46 common human and three veterinary diseases. *Leucas calostachys* was the most widely used (17 medicinal uses) followed by *Vachelia xanthophloea* (10), *Carissa edulis* (9), *Trimeria grandifolia* (8), *Terminalia brownii* (7) and *Rhamnus prinoides* (6). Heartburn was treated using the largest number of plants (17) followed by cancer (9). Eight plants were used to either treat infertility in women or arthritis, whereas peptic ulcers, hypertension, headache, chest congestion and colic pains were each treated using seven plants.

Conclusions: The study provides information on medicinal and healing methods used by the Keiyo community. It also revealed that traditional medicines are still widely used in Keiyo district. Some of the identified plants have been demonstrated to possess pharmacological activities related to those mentioned by the herbalists.

Keywords: Keiyo; Traditional medicine; Ethno pharmacology; Research; Medicinal plants; Knowledge; Conservation

Background

Natural products continue to provide an important source of new drugs [1-3]. Random screening of plants has previously been used to provide leads for the development of new drugs, but is quite expensive and has not produced much result [4-6]. Smarter and cheaper screening methods therefore require to be developed for future research, and development of new drugs [7]. Some scientists have recently proposed changes in approach from just random screening of plants to a rather patient focused approach. This method relies on investment in ethnopharmacology and reports on clinical observation studies before embarking on chemical and pharmacological extraction

[8,9]. To do this, data from communities which still practice traditional medicine (TM) are recorded and databases developed. Herbal plants which appear to show evidence of clinical activity are then selected and screened [10]. This kind of approach was applied in the selection and isolation of artemesin from qinghao (*Artemisia annua*); a herb used in Chinese traditional medicine [11,12]. Similarly, the *Pygeum africanum* bark extract, now used in the treatment of benign prostatic hyperplasia, was adopted because European settlers in the 1700s observed that South African tribes used the herb to treat an "old man's disease" [13,14].

Africa provides a new frontier for the discovery of new medicinal products since to date, not much research has been carried out on traditional medicinal plants in many African countries [15,16]. In fact most countries have scant records on TM despite potential risk of complete disappearance of the knowledge on TM. This has been

occasioned by several factors including lack of regulatory frameworks, use of modern medicine, overexploitation and deforestation amongst several other factors. Africa has several tribes, each with unique methods of treatment involving thousands of trees and shrubs which are available in the continent. The documentation of these traditional medicine and healing methods which have been used for thousands of years will therefore provide an important database for future research and potential development of new drugs, just like in Asia [10,17-19].

Despite the advent of modern medicine, herbal medicines are still widely used in Kenya, especially by the rural communities, just like in other parts of sub Saharan-Africa [20,21]. However, most of those herbal plants used by the Kenyan 42 tribes largely remain undocumented [10]. In addition, most of the genuine herbalists are now aging and would prefer to pass information on TM orally, and in most cases to close relatives who might not necessarily be interested in the practice. Rampant deforestation, overexploitation and lack of regulation also pose major challenges to the practice of TM in Kenya. There is therefore risk of the knowledge on traditional medicine disappearing completely in many parts of Kenya. The popularity of herbal medicine has also introduced several other challenges related to the practice, including the emergence of bogus herbalists out to swindle unsuspecting patients [10]. In fact there have been recent reports of fake herbalists who mix conventional medicine with decoctions from plants, and sell them as herbal medicine to unsuspecting patients, thus compromising their health [22].

It is therefore important to develop a database of the medicines that have been used by various Kenyan communities for research and potential development of new drugs [17,23,24]. A number of Kenyan recorded traditional herbs have undergone evaluation, and many have shown potential efficacies [25-30]. This study aims to for the first time comprehensively document the herbal medicines used by the Keiyo community, as part contribution to ethnomedical knowledge reservoir for future reference and research.

Methods

Study area

Ethnobotanical survey was conducted in Keiyo district. The district is in the Rift Valley region, which together with Marakwet district constitute the Elgeyo Marakwet County. It is located in the Southern part of the County (Figures 1and 2). Figure 3 shows the position of Elgeyo Marakwet County, within the Kenyan Map. The narrow-stripped district is sandwiched between Uasin Gishu (now Wareng County) to the West, Baringo to the East, and is bordered by Marakwet district to the North and Koibatek to the South - East. It extends from Latitude 00 10" to 00 52" North and Longitude 350 25" to 350 45" East, covering a total area of 1439.30 km² [31,32]. The district, and indeed the whole County is divided into three topographical zones which run parallel to each other in a north-south direction across the district; the highland, "*Teng'unin*"; escarpment, "*Mosop*" and lowland, "*Soin*" regions respectively. The lowland region is located in the Kerio Valley, where Kerio River runs parallel to the escarpment in the south-northerly direction. The highlands rise up to an altitude of 2400m to 2700m above the sea level, and the valley provides magnificent scenery when viewed from the highlands. In between the escarpment and highland is the thickly forested escarpment referred to as "*Tumoo*", in which the high parts have cool temperatures and adequate rainfall and low parts drier and hotter [31-33].

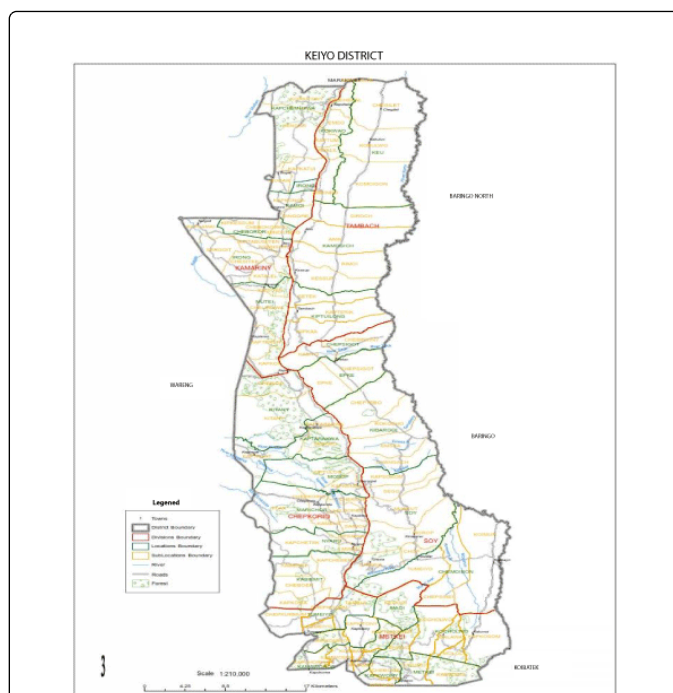


Figure 1: Map of Keiyo District.

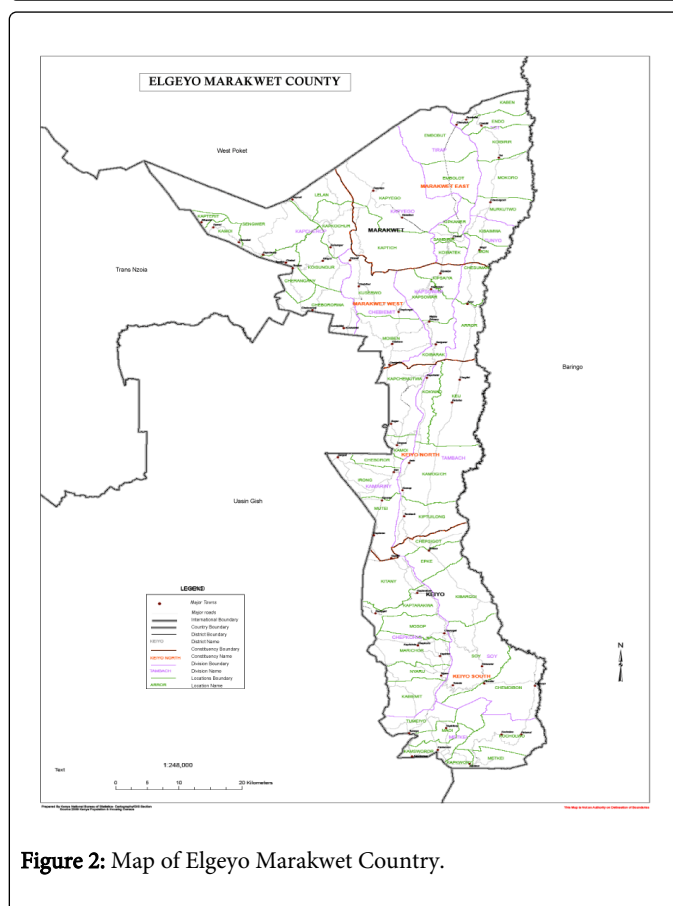


Figure 2: Map of Elgeyo Marakwet Country.



Figure 3: Map of Kenya showing the position of Elgeyo Marakwet Country.

The escarpment stands out distinctly causing relief differences of up to 1500m in some areas. Due to the great range in altitude over short distances, the climatic and physical conditions vary considerably. The average temperature at the valley is about 26°C whereas in the highlands it is between 14 to 18°C, but can drop to as low as 6°C. The rainfall pattern also varies considerably with dry conditions at the valley, and high rainfall in the highland region [33]. Thorn trees (acacia) and occasional swamps bordered by shrub-covered foothills are mainly found in the valley. With increasing altitude, one encounters a canopy of tropical green forest at the top and the region bordering the escarpment consisting of bamboo, cedar and climbing plants among many others. The highlands are mainly covered by tropical rain forests with groundsel on the hilltops [31,32].

The residents of Keiyo district are mainly from the Keiyo community. The community is one of the larger Kalenjin tribes residing in the Rift Valley. They border their fellow Kalenjin tribesmen Marakwet to the North, Nandi to the West, Tugen to the East and Kipsigis to the South [33-35]. The highland part of the district is in close proximity to Eldoret town, a major commercial town in the region. A large proportion of the Keiyo population also resides in Uasin Gishu District [32,35,36]. The community, just like their other Kalenjin cousins has produced some of the best athletes in the world including the current world marathon champion [37-39], and immediate past champion [40,41]. The district headquarters Iten town, also the current County headquarters is now the venue used by both local and foreign athletes for high-altitude training [42-45].

Just like many other parts of rural Kenya, herbal medicines are still widely used, especially in children, and for treatment of chronic disorders such as hypertension, diabetes and infertility. However, the practice is not as prominent as in neighbouring Marakwet district, except in the valley region [34]. Health services are not quite accessible in some parts of the lower region and escarpment due to the difficult terrain. The residents in these areas do still therefore to a large extent rely on herbal medicine [31]. One of the factors that may have contributed to the decline in the use of herbal medicine in Keiyo

district is the close proximity to former white-highland settlement district, Uasin Gishu and Eldoret town. In fact most of the genuine practicing herbalists in the town are from Marakwet district. A good number of practicing Keiyo herbalists also obtain some of their herbs from either the valley region or Marakwet district, although they use plants from the Keiyo highlands as well.

The most prevalent diseases in the district are malaria, upper respiratory tract infections (URTI), diarrhoea, diseases of the skin including ulcers, and urinary tract infections (UTI). Disease prevalence differs according to agro-ecological zones. Malaria tends to be more prevalent on the lowland region and escarpment; whereas URIs, including pneumonia tend to be more prevalent on the highland region [31].

Data collection

Permission to conduct the research was obtained from Institutional Research and Ethics Committee (IREC) of Moi University, Eldoret, Kenya. The research was conducted between March 2012 and January 2013. The research team was composed of professionals from both the medical field and botany including a pharmacologist (GK), physician (FS), surgeon (JK), ophthalmologist (HK), botanist (EK), taxonomist (BW) and plant specialist (WK). GK, FS, JK and HK interviewed the herbalists and patients, in order to identify the illnesses treated. EK, BW, and WK identified the plants. The herbalist (PK) provided some valuable medicinal information, introduced us to her colleagues and helped in the identification of the plants. A reconnaissance mission was initially conducted with aid of local leaders, community elders, church leaders and other stakeholders in order to identify the genuine herbalists. The same group always accompanied us when we visited the herbalists, in order to ward off any suspicion from the herbalists and explain our mission to them. We also had in our group one local person who was familiar with the local names of trees and shrubs, terrain and vegetation who together with the local practicing herbalist (PK) helped in the location and identification of the plants.

Semi structured interviews were used to collect information from the herbal practitioners. The interviews were conducted within the premises or practice of the herbalists [46-49]. The interviews were conducted in either Kalenjin or Swahili. GK, JK and WK are from the County while EK, FS and HK are from neighbouring Counties and speak Kalenjin. We therefore did not have any communication problems. In total, 52 herbalists were interviewed, 35 being women and 17 men, with their age groups ranging from 38 to 75 years. Indigenous knowledge on medicinal plants was documented following interviews, observations and group discussions with the herbalists. The names of the practitioner, age, sex, level of education, duration of practice and source of the knowledge on traditional medicine were recorded [46]. Details of the medical conditions treated, symptoms of the diseases, plants and herbal preparations used, methods of treatment, local names of the medicinal plants, methods of collection of the herbs and any other information relevant to the practice were recorded. GK, FS and JK interviewed the herbalists in order to identify the diseases that they treated.

We then accompanied the herbalists to the sites where they collected the herbs in order to assist in the identification, unless they were in urban areas. The plants were identified in the field, and where there was a problem in the identification, samples were collected and taken to the Botany department at University of Eldoret for further identification. The plants and their habitats were photographed and the specimen samples labeled, dried and deposited at the University of

Eldoret Herbarium. WK, BW and EK identified the medicinal plants. The herbalist in our group, PK also helped in locating the plants and identification. The specimen were identified and named as per taxonomic keys [50-53], and data compared to those from previous studies that have been undertaken in the region.

Results and Discussion

Diversity of medicinal plants

A total of 73 medicinal plant species belonging to 33 families were identified, and were reported by their local and botanical names. The description of the plants including local and botanical names, habitat and uses are outlined in supplementary Table. They consisted of 26 species of trees (36%), 19 shrubs (26%), 9 herbs (12%), 9 climbers (12%), 7 lianas (10%), 2 sub shrubs (3%) and 1 algae (1%). Lamiaceae family had the highest number of species (9, 12%) followed by Asteraceae which had 8 species (11%) and Fabaceae 6 species (8%). Euphorbiaceae and Cucurbitaceae had 5 species each (7%), whereas Rubiaceae, Rutaceae, Salicaceae and Verbenaceae had 3 species each (4%). The rest of the families had less than 3 species. Most of the plant species used were from highland habitat, 30 (41%). 13 plant species (18%) each were from either escarpment, or highland/escarpment habitats, while 8 plants (11%) were from either highland/escarpment or lowland habitats. One recorded plant (*Spirogyra spp.*) was from riverine habitat.

With regards to plant use, *Leucas calostachys* was the most widely used (17 medicinal uses) followed by *Vachelia xanthophloea* (10), *Carissa edulis* (9), *Trimeria grandifolia* (8), *Terminalia brownii* (7), *Rhamnus prinoides* (6), *Aloe kedongensis* (5), *Plectranthus barbatus* (5), *Rhoicissus tridentate* (5), *Toddalia asiatica* (5), *Rotheca myriocoides* (4), *Dovyalis abyssinica* (4) and *Erythrina abyssinica* (4). The others had less than four recorded medicinal uses.

Herbal preparations

The preparations used were similar to those reported in the Marakwet study, albeit with slightly different names [34]. They included roots, tubers, barks, leaves, twigs, seeds, sap and fruits and were prepared in various forms depending on the intended medicinal use. They were formulated into decoctions, ashes from dried and burnt leaves, "Tusanik" and extracts from crushed or pound leaves. The proportions of the parts used are as outlined in Table 1. Roots were the most widely used parts (37%), followed by leaves (26%) barks (23%), tubers (5%) and whole plant (4%). Fruits, seeds, bark and leaves, leaves and flowers, leaves and roots, leaves and stems, roots and stems, and roots and twigs had 1% each.

| Part | % |
|-------------|----|
| Roots | 37 |
| Leaves | 26 |
| Bark | 23 |
| Tubers | 5 |
| Whole plant | 4 |
| Fruits | 1 |
| Seeds | 1 |

| | |
|--------------------|---|
| Bark and leaves | 1 |
| Leaves and flowers | 1 |
| Leaves and roots | 1 |
| Leaves and stem | 1 |
| Roots and stem | 1 |
| Roots and twigs | 1 |

Table 1: Proportions of plant parts used in treatment.

Disease types and treatment methods

There were 46 recorded human and 3 veterinary diseases which were treated by the herbalists (Table 2). The medical condition that was treated using the largest number of plant species was heartburn (17 species, 9%) followed by cancer (9 species, 5%). In addition, red clay is also used to treat heartburns. Eight plant species (4%) were used to either treat infertility in women or arthritis, whereas peptic ulcers, hypertension, headache, chest congestion and colic pains in infants were each treated by seven plant species (4%). Most of the treatment regimens involved concoctions made from combination of one, two or sometimes up to three main plants, and a combination of several other synergistic plants, which are added to improve the potency. More synergistic plants were used (11, 6%) compared to the Marakwet study, and *Zanthoxylum chevalieri* was used by herbalists as a synergistic plant in both Keiyo and Marakwet districts [34].

| Disease | No of species used | % |
|-----------------------------|--------------------|---|
| Heartburns | 17 | 9 |
| Synergistic plants | 11 | 6 |
| Cancer | 9 | 5 |
| Infertility in women | 8 | 4 |
| Arthritis | 8 | 4 |
| Peptic ulcers | 7 | 4 |
| Hypertension | 7 | 4 |
| Headache | 7 | 4 |
| Colic pain in infants | 7 | 4 |
| Chest congestion (wheezing) | 7 | 4 |
| Toothache | 6 | 3 |
| Renal disorders | 6 | 3 |
| Amoebiasis | 6 | 3 |
| Diabetes | 5 | 3 |
| "Rueniat" condition | 5 | 3 |
| Wounds | 4 | 2 |
| Skin disorders | 4 | 2 |
| Eye ailments | 4 | 2 |

| | | |
|---|---|---|
| Antivenom | 4 | 2 |
| Malaria | 3 | 2 |
| Infertility in men | 3 | 2 |
| Epilepsy | 3 | 2 |
| Common colds/cough | 3 | 2 |
| Abdominal pains | 3 | 2 |
| Throat cancer, "Koroitab mokto" | 3 | 2 |
| Purgatives | 2 | 1 |
| Poultice | 2 | 1 |
| Oral thrush | 2 | 1 |
| Mumps | 2 | 1 |
| Heart ailments | 2 | 1 |
| "Kiplelgutyet" condition | 2 | 1 |
| Diarrhoea | 2 | 1 |
| Throat infection/tonsillitis | 1 | 1 |
| Ringworms | 1 | 1 |
| Measles | 1 | 1 |
| Jaundice | 1 | 1 |
| Goitre | 1 | 1 |
| Erectile dysfunction | 1 | 1 |
| Enlarged prostate | 1 | 1 |
| Emetic | 1 | 1 |
| Ears | 1 | 1 |
| Determination of foetal sex | 1 | 1 |
| Coughing | 1 | 1 |
| Burns | 1 | 1 |
| Abdominal distension | 1 | 1 |
| Abdominal disorders in women | 1 | 1 |
| Veterinary use | | |
| Heal the wounds on the legs of animals | 4 | 2 |
| To treat chicken disease and foot and mouth disease in cattle | 1 | 1 |
| To treat chicken | 1 | 1 |

Table 2: Diseases treated by the various plants.

Synergistic plants

The roots of the following plants are used as synergistic plants: *Carissa edulis*, "Legetetwet"; *Leucas calostachys*, "N'gechebchat"; *Rhamnus prinoides*, "Kosityet"; *Erythrina abyssinica*, "Kokorwet", *Cissampelos Pereira*, "Tabaryetab koita", *Trimeria grandifolia*,

"Chepkererlong" and *Launaea cornuta*, "Kipche". The leaves of *Aloe kedongensis*, "Tengeretwet"; and the barks of both *Zanthoxylum chevalieri*, "Kokiat" and *Vachelia xanthophloea*, "Leng'net" are also included. The tubers of *Cucumis prophetarum*, "Chepsawoy" which we were informed are very better, are also used as synergistic plants.

Heartburn

Treated by using the boiled concoction of a mixture of the tubers of *Rhoicissus tridentate*, "Torotwet"; bark of *Terminalia brownii*, "Kaloswet"; roots of *Leucas calostachys*, "N'gechebchat" and *Jasminum fluminense*, "Kipkoburo" (Marakwet). It is also treated by licking burnt ashes, "Tusanik" from the leaves of the following plants: *Leucas calostachys*, "N'gechebchat"; *Rubia cordifolia*, "Chepsalaitet"; *Momordica foetida*, "Cheptenderet"; *Trimeria grandifolia*, "Chepkererlong"; *Leonotis nepetifolia*, "Kipchuchuniet"; *Rothea myriocoides*, "Ketbaiyat"; *Vernonia myriantha*, "Teben'gwet"; *Dregea abyssinica*, "Kibanyiny"; *Lantana trifolia*, "Kipkormom/Chepkeremek"; *Conyza stricta*, "Pichen'gwo" (Marakwet), *Conyza Sumatrensis* "Kantelwo" (Marakwet) and *Fuerstia Africana*, "Birirwo" (Marakwet). Red clay, "Kipnyawet (Ng'enda)" may also be chewed to relieve heartburn. "Tusanik" are also used to treat oral thrush in both adults and children.

Peptic ulcers

The main plants used include the roots of *Leucas calostachys*, "N'gechebchat" and *Erythrina abyssinica*, "Kokorwet" and *Carissa edulis*, "Legetetwet". The tuber of *Rhoicissus tridentate*, "Torotwet" is also included. The other drugs that are added include the barks of *Vachelia xanthophloea*, "Leng'net"; *Pygeum africanum*, "Tendwet" and *Albizia amara*, "Katutwet".

Abdominal distension

The juice made from the pressed leaves of *Leucas calostachys*, "N'gechebchat" is drunk.

Colic pain in infants

A concoction made from the boiled roots of the following plants is used: *Leucas calostachys*, "N'gechebchat"; *Rhamnus prinoides*, "Kosityet"; *Plectranthus barbatus*, *Clutia abyssinica*, "Chepkelel"; *Carissa edulis*, "Legetetwet" and *Dovyalis abyssinica*, "Mindililwo". A little amount of *Momordica foetida*, "Cheptenderet" is also added as it is very bitter.

Abdominal pains (adults)

A concoction made from the boiled roots of *Cucumis dipsaceus*, "Chepkewel" and *Dregea abyssinica*, "Kibanyiny" is used to treat "Katef", a condition described by the herbalists as presenting with sharp lower abdominal pains. The leaves and stem of *Rumex acetosella* "Chebon'gyol" and those of *Dregea abyssinica*, "Kibanyiny" are chewed to relieve abdominal pains.

Emetic

Momordica friesiorum, "Chepkin'gun'git" tuber is dried and ground. About one teaspoonful of the resulting powder is then administered to the patient. It usually administered with strong tea to

mask the bad nauseating taste. The tuber may also be boiled and administered for the same purpose.

Purgative

A concoction made from the boiled leaves of *Senna didymobotrya*, “*Senetwet*” is drunk. *Ricinus communis*, “*Maniat*” is also used both as a purgative and laxative. The seeds are crushed and about half a tablespoon of the oil taken to induce purgation, and lower dosage for laxative effect.

Diarrhoea

Red clay, “*Kipnyawet*, (*Ng’enda*)” is chewed to stop diarrhoea. An alternative treatment involves drinking a decoction made from the boiled tubers of *Rhoicissus tridentate*, “*Torotwet*”. The juice from the crushed leaves of *Leucas calostachys*, “*N’gechebcha*” is also drunk to stop diarrhoea.

Amoebiasis

A concoction made from the boiled roots of: *Terminalia brownii*, “*Koloswet*” and *Tecleanobilis* “*Kuriof*”; the bark of *Vachelia xanthophloea*, *Len’gnef*”, *Maerua decumbens*, “*Chepyetabe*” and that of *Leucas calostachys*, “*N’gechebcha*” is used. The leaves of *Bersamaa byssinica*, “*Kibumetiel*” (Nandi) may also be included in the preparation.

Malaria

The extract from the crushed leaves of *Aloe kedongensis*, “*Tengeretwet*” is diluted with water and drunk. We were informed that the patient will then sweat profusely before the healing process begins. A concoction made from the boiled roots of *Cissampelos pereira*, “*Tabararyetab koita*”; is also used to treat malaria. The boiled tubers of *Cucumis prophetarum*, “*Chepsawoy*” are also used to treat malaria-like symptoms.

Headache

The bark of *Warburgia ugandensis*, “*Soget*” is burnt and inhaled. A concoction made from the boiled roots of the following plants is also used: *Dovyalis abyssinica*, “*Mindililwet*”; *Carissa edulis*, “*Legetetwet*”; and *Leucas calostachys*, “*N’gechebcha*”. The same preparation is used for the treatment of severe headache that may potentially lead to blindness. An alternative treatment involves pressing and inhaling the whole of *Satureia pseudosimensis*, *Chepkonuk* (*Marakwet*); or *Lippia japonicum*, “*Chemosong*” (*Marakwet*) plant. The squeezed leaves and flowers of *Clematis simensis*, “*Bising’wet*” are also sniffed to treat headache.

Toothache

The leaves of either *Thunbergia alata*, “*Cheptereret*” (Nandi) or *Trimeria grandifolia*, “*Chepkererlong*” are pressed and applied on the affected tooth. The whole of *Acmella calirhiza*, “*Butbutik*” plant is chewed and the juice from the pound leaves applied on the affected tooth. The leaves of *Indigofera arrecta*, “*Menjeiwet*” are also chewed. An alternative treatment involves chewing the fruits of *Solanum terminale*, “*Labotwet* ne mining” mixed with honey as they are very bitter. The leaves of *Trimeria grandifolia*, “*Chepkererlong*” are also chewed to strengthen teeth and prevent a condition the herbalists

referred to as “*Brastab Kelek*”, which manifests as teeth falling off. The symptoms were suggestive of periodontitis.

Eyes

The leaves of *Bidens pilosa*, “*Kipkatiwet*”; are squeezed and juice applied on the affected eye. The juice from the pressed leaves of *Terminalia brownii*, “*Kaloswet*” as well as the pressed two top apical leaves of *Plectranthus barbatus*, “*Kan’gurwet*” may also be used. An alternative treatment involves the use of a concoction made from the boiled the roots of *Dovyalis abyssinica*, “*Mindililwet*”. *Terminalia brownii* has been shown to possess antibiotic activity [54,55].

Ears

The leaves of *Aloe kedongensis*, “*Tengeretwet*” are crushed and the sap applied on the affected ear.

Wounds

The pressed leaves of *Bidens pilosa*, “*Kipkatiwet*”, are applied on the wound. A concoction made from the boiled roots of *Carissa edulis*, “*Legetetwet*”; *Dovyalis abyssinica*, “*Mindililwet*” and *Rhus natalensis*, “*Siryat*” is then administered to the patient.

Burns

Green algae, *Spirogyra* spp., “*Kapn’yalgilyet*” is applied on the burns area. We met a child who had recovered from scalds he developed after sitting on a bucket containing hot water, after treatment with algae.

Oral thrush

The whole of *Acmella calirhiza*, “*Butbutik*” plant is chewed. Alternatively, the crushed leaves of *Plectranthus barbatus*, “*Kan’gurwet*” are mixed with honey from ground bees, “*Kosomiot*” and applied on the tongue. The ash from the burnt leaves, “*Tusanik*” of the plants described in the management of heartburn is also used to treat oral thrush.

Tonsillitis/throat infections

The ground powder from the bark of *Myrica salicifolia*, “*Kabunbunit*” is mixed with honey and administered to the patient.

Common colds

The leaves and flowers of *Clematis simensis*, “*Bising’wet*” are pressed and inhaled for the treatment of common colds, especially to clear stuffy nose. The leaves of *Artemisia abyssinica* “*Kibisich*” (*Marakwet*) are also inhaled for the same purpose. The leaves and bark of *Toddalia asiatica*, “*Ketemwet*” are chewed to relieve common colds.

Coughing/Asthma

The inner layer of the bark of *Sabina procera*, “*Tarakwet*” is chewed to relieve coughing; whereas the bark of *Zanthoxylum chalybeum*, “*Kokial*” is chewed to treat severe cough, including asthma. The ground powder from the bark of *Myrica salicifolia*, “*Kabunbunit*” is mixed with honey is also administered to the patient. We met two patients who informed us that chewing of *Zanthoxylum chevalieri* bark and use of the ground powder mixture of *Myrica salicifolia*

relieved their wheezing whenever they developed chest congestion. Alternatively, the tuber of *Echinops hispidus*, “*Kipkutwet*” may also be chewed or boiled together with the roots of *Leonotis ocymifolia*, “*Chepchai*” and *Solanum terminale*, “*Labotwet* ne mining”. Chest congestion is also relieved through the inhalation of the whole of crushed *Satureia pseudosimensis* “*Chepkonuk*” (Marakwet) plant, or *Lippia japonicum*, “*Chemosong*” (Marakwet).

“Rueniat”

This condition was described by herbalists as presenting with drooling, thick mucus and phlegm. Treatment involves a concoction made from boiled roots of *Rotheca myriocoides*, “*Ketbaiyat*”; *Trimeria grandifolia*, “*Chepkererlong*”; *Rhamnus prinoides*, “*Kosisitye*”; *Leucas calostachys*, “*N’gechebcha*” and *Acacia xanthophloea*, “*Leng’net*”. The patient is then given “*TusaniK*”, (ash from burnt leaves of several plants described earlier) to lick.

Hypertension

A concoction made from the boiled bark of the following plants is used: *Vachelia xanthophloea*, “*Leng’ne*”, *Erythrina abyssinica*, “*Kokorwet*”, *Pygeum africanum*, “*Tendwet*”, *Carissa edulis*, “*Legetetwet*”, *Flacourtica indica*, “*Tangururwet*”, *Albezia amara*, *Katutwet*” (Nandi) and *Combretum apiculatum*, “*Buukwet*” (Nandi).

Heart ailments

For the treatment of increased heart rate, the juice from the squeezed leaves of *Leucas calostachys*, “*N’gechebcha*” is administered to the patient. If there is no improvement, or in treatment of any other ailment, the leaves of *Ajuga remota*, “*Chelegatiatia*” are soaked in water, or squeezed and the extract administered. Typically, a little amount, say about two teaspoonfuls is administered as it is very bitter.

Jaundice (yellow eyes)

The bark of *Terminalia brownii*, “*Kaloswet*” is boiled and administered to the patient. The preparation is also used for treatment of a patient who has lost a significant amount of blood.

Renal disorders

A concoction made from the boiled tubers of *Rhoicissus tridentate*, “*Torotwet*” together with roots of *Leucas calostachys*, “*N’gechebcha*” is the mainstay for treatment. The others that are added to improve the efficacy include the roots of *Trimeria grandifolia*, “*Chepkererlong*”, *Rhamnus prunoides*, “*Kosisitye*”; and *Toddalia asiatica*, “*Ketemwet*” as well as the bark *Vachelia xanthophloea*, “*Leng’ne*”.

Diabetes

Treatment involves the administration a concoction made from the boiled roots of *Maerua decumbens*, “*Chepyetabel*” to the patient. The roots are also chewed by the patient. An alternative treatment involves use of a concoction made from the boiled roots of *Carissa edulis*, “*Legetetwet*”, *Maerua decumbens*, “*Chepyetabel*” and bark of *Terminalia brownii*, “*Kaloswet*”. A concoction made from the boiled roots of *Ocimum kilimandscharicum*, “*Sisiyat*” and *Leonotis ocymifolia*, “*Chepchai*” is also used.

Goitre

Ground powder of *Myrica salicifolia*, “*Kabunbunit*” is mixed with honey and administered.

Enlarged Prostate

The tender leaves of *Olea europaea* “*Emtit*” are crushed and the juice administered, in order to allow the patient to pass urine.

Erectile dysfunction

A concoction made from the boiled roots of *Euphorbia dregeana*, “*Mokotorwo*” (Marakwet) is administered.

Infertility in men

A concoction made from the boiled roots *Euphorbia dregeana*, “*Mokotorwo*” (Marakwet), and bark of *Berchemia discolor*, “*Muchukwo*” (Marakwet) is administered. An alternative treatment involves the use of boiled roots of *Vernonia myriantha*, “*Teben’gwet*” and *Vanguera madagascariensis*, “*Komolwet*”.

Infertility in women

A concoction made from the boiled bark of *Heeria reticulata* “*Mutung’wo*” (Marakwet), is first administered to the patient to “clean the womb”. This is followed by administration of a decoction made from the boiled tubers of *Tylosema fassoglensis* “*Cheptebesiel*” (Nandi); and bark of *Albizia amara*, “*Katutwet*” (Nandi) and *Combretum apiculatum*, “*Buukwet*” (Nandi). An alternative treatment involves the use of a decoction made from the boiled tubers of *Cucumis prophetarum*, “*Chepsawoy*” together with the bark of *Acacia xanthophloea*, “*Len’gnet*”, and roots of both *Rhoicissus tridentate*, “*Torotwet*”, and *Carissa edulis*, “*Legetetwet*”.

Abdominal pains in women

A concoction made from the boiled roots of *Cissampelos Pereira*, “*Tabararyetab koita*” is used in the treatment of severe abdominal pain in women.

Determination of foetal sex

A concoction made from the boiled roots of *Lantana camara*, “*Chemosong*” (Marakwet) is administered to mothers who intend to have children of a specific sex, in most cases boys for those who have had girls in succession.

Epilepsy

The leaves of *Ajuga remota*, “*Chelegatiatia*”, are pound and the resulting juice administered to the patient. A concoction made from the boiled tubers of *Tylosema fassoglensis*, “*Cheptebesiel*” (Nandi) is then administered. An alternative treatment is by the use of a mixture containing boiled roots and twigs of *Euphorbia tirucalli*, “*Kortnotwo*” (Marakwet).

Measles

The roots of *Plectranthus barbatus*, “*Kan’gurwet*” are boiled, and the child covered in hot vapour emanating from the steam for the child to inhale.

Mumps

A concoction made from the boiled bark of *Erythrina abyssinica*, “Kokorwet” and that of *Vachelia xanthophloea*, “Leng’net” is administered.

Skin disorders

The pressed leaves of *Zehneria scabra*, “Sisyo” are rubbed on the affected area of the skin. A concoction made from the boiled roots of *Rhamnus prinoides* “Kosisitye” and *Leucas calostachys*, “N’gechebcha” is then administered. An alternative treatment involves the use of a concoction made from the boiled bark of *Olinia europaea* “Nerkwo” (Marakwet), especially for the treatment of skin allergy.

Ringworms

The pressed leaves of *Zehneria scabra*, “Sisyo” are rubbed on the area of the scalp or skin affected with ringworms. Some triterpenoids with potential antifungal and cytotoxic activity have recently been isolated from this plant [56].

“Kiplel gutyet”

The symptoms of this condition were described by the herbalists to include itching of the skin, general malaise, tremors, fever, headache, dizziness and tinnitus. Treatment involves boiling the leaves of either *Momordica foetida*, “Cheptenderel” or *Zehneria scabra*, “Sisyo”; and covering the patient with a blanket in order to inhale the vapour. The patient is then asked to shower with the decoction.

Cancer

A concoction made from the boiled roots of the following plants is used: *Toddalia asiatica*, “Ketemwet”; *Leucas calostachys*, “N’gechebcha”; *Rotheca myriocoides*, “Ketbaiyat”; and *Trimeria grandifolia*, “Chepkererlong”. Treatment also includes the bark from *Olea africana*, “Emiti”, *Vachelia xanthophloea*, “Len’gnet”, *Terminalia brownii*, “Kaloswet”, and *Ficus thonigii*, “Simotwet nebo chego”. If the patient develops a swelling, then the pound leaves of *Thunbergia alata*, “Cheptererel” (Nandi) are applied on the site which will lead to the production of a thick black substance upon the pressing of the site. Alkaloids derived from *Toddalia asiatica*, have been demonstrated to show some significant cytotoxic, antimicrobial and antifungal activities [57-59]. One *Acacia* species, *Acacia nilotica* has also been shown to inhibit the tumour load proliferation in mice [60].

“Koroitab mokto” (throat cancer)

This is a condition translated to mean “disease of the throat” was described by the herbalists to present with symptoms which our medical team concluded that they were similar to those of throat cancer. The main plants for the treatment include a concoction from the boiled roots of *Launaea cornuta*, “Kipche”, *Rotheca myriocoides*, “Ketbaiyat” and *Toddalia asiatica*, “Ketemwet”. The stem of *Launaea cornuta*, “Kipche” is also chewed.

Arthritis

A concoction made from the boiled roots of *Rhamnus prinoides*, “Kosisitye”, *Carissa edulis*, “Legetetwet” and *Trimeria grandifolia*, “Chepkererlong” provides the mainstay of the treatment. Treatment

also includes the boiled roots of *Toddalia asiatica*, “Ketemwet”, *Leucas calostachys*, “N’gechebcha” and the bark from *Olea europaea*, “Emiti”, *Vachelia xanthophloea*, “Len’gnet” and *Terminalia brownii*, “Kaloswet”.

Poultice and setting of broken bones

The leaves of *Phytolacca decandra*, “Patkawa” are burnt and covered on the affected area of the skin to soothe the painful part of the body. The barks of *Sabina procera*, “Tarakwet” are then tied around the area to set broken bones.

Antivenom

The leaves of *Plectranthus barbatus*, “Kan’gurwet” are pounded and the juice applied on incisions made on the bitten area. Alternatively the dry roots of *Tragia brevipes*, “Kimelei ne mining” (Marakwet) are ground and mixed with those of *Gardenia volkensii*, “Mogilio” (Marakwet), and *Euclea divinorum*, “Uswet”. The powder mixture is then applied on incisions made on the bitten area.

Veterinary use

Wounds

The leaves of *Rubia cordifolia*, “Chepsalaitel” are pressed and the extract applied on the wounds, usually on the legs of animals. The leaves of *Fuerstia africana* “Birirwo” (Marakwet) may also be used. An alternative treatment involves the use of an extract from the pounded leaves of *Aloe kedongensis*, “Tengeretwet”. It is orally administered to the animal and applied on the wounds as well in the treatment of foot and mouth disease. The leaves of *Leucas calostachys*, “N’gechebcha” may also be used.

Poultry

The juice obtained from the crushed leaves of *Aloe kedongensis*, “Tengeretwet” is added to the water drunk by the chicken in order to treat various chicken diseases especially that with symptoms whereby they appear dull and sleepy (*Chepkonuchit*). The leaves of *Leucas calostachys*, “N’gechebcha” may also be used.

There were fewer herbalists compared to those in the Marakwet study [34]. Just like in Marakwet district, most of the herbalists that we interviewed had inherited or learnt the art from a close relative. Curiously, we found a number, especially the younger herbalists who did not even know the vernacular names of quite a number of the plants that they used. They just knew how the plant looked like, or where it was obtained but had forgotten the name that whoever had shown them had used. This is in part contributed by the secrecy of the practice. The trend is quite worrying and provides evidence on how fast the knowledge is disappearing; especially considering that it is orally transmitted [10]. Some of the plants used by herbalists were obtained from the neighbouring Marakwet or Nandi districts and therefore have Marakwet, or Nandi names.

There were some conditions whereby the herbalists were not willing to divulge the plants used, or methods of treatment. This included herbs used in pregnancy in order to have a child of a particular sex and male fertility drugs. After a lot of persuasion, only one herbalist confided in us one plant, *Lantana camara*, but informed us that she was not in a position to reveal the other two that she normally combines with. We concluded that they were probably paid

handsomely for these treatments. Men from most African communities often desire to have male offspring and would therefore try anything to have a son especially if they have had girls in succession [61,62]. Likewise, male infertility is considered some kind of curse or failure in some communities, and men would try all forms of treatment to get children at any cost [63-66]. Malaria and several other diseases presenting with general malaise, nausea and vomiting were associated with excessive bile, “*N’gwonet*” or “unclean body systems” just as in Marakwet. Emetics and purgatives were therefore routinely used to prevent disease, or as part of treatment. The perception and treatment of cancer was also similar to that of their Marakwet cousins [34].

There were some medical conditions that the herbalists described which were not present, or were not described in the Marakwet study including “*Ruenial*”, “*Kiplelgutiel*”, “*Katef*”, and “*Koroitab mokto*” (disease of the throat). “*Ruenial*”, was described as manifesting with thick mucus and phlegm, or drooling of saliva outside the mouth. “*Ruenial*” essentially means phlegm, or thick saliva or mucus. From the symptoms described by the herbalists, it appeared to be a respiratory infection, possibly bronchitis. The symptoms of “*Kiplelgutiel*”, were described by the herbalists to include itching of the skin, general malaise, tremors, fever, headache, dizziness and tinnitus. “*Kiplelgutiel*” literally means “white mouth” and from the symptoms described by the herbalists the condition appears to be, or is associated with severe allergy. We did not see a patient with any of the two conditions. “*Katef*” was described as presenting with severe lower abdominal pain, whereas the symptoms of “*Koroitab mokto*” appeared to be those of throat cancer, and is in fact treated with anticancer herbs. Likewise we did not see any patient with these conditions in order for our medical team to make the correct diagnosis.

We did however meet and interview three different patients with histories of respiratory disorders who were in the process of collecting more medicinal herbs from one of the herbalists. They were a combination of *Myrica salicifolia*, “*Kabunbuni*” and *Zanthoxylum chevalieri*, “*Kokiaf*”. The patients informed us that they had gotten relief from their chest congestion symptoms after using the herbs. We were indeed surprised when we found out later from literature that *Myrica spp.* including *Myrica salicifolia* have been extensively investigated, and demonstrated to show potential for several pharmacological effects including bronchodilator [67,68], antibiotic [69,70], antifungal [71-73], antiviral [74-76], antimalarial [77], analgesic [78,79], anticoagulant [80], anxiolytic [81], antihypertensive [82-84] antihyperlipidemic [85] and antiandrogenic actions [86]. One of the herbalists also directed us to a three year-old recovering patient within her neighbourhood whom we visited. The young boy had been severely scalded after accidentally sitting on a bucket filled with hot water. His mother informed us that the injuries had subsided after the herbalist applied Green algae (*Spirogyra spp.*), “*Kapn’yalgilyet* on the wounds.

Conclusions

The study has for the first time documented traditional medicines used by the Keiyo community. It also revealed that traditional medicine use is still widespread but faces several challenges, chief of which being the secrecy involved in passing of knowledge orally to the next generation, typically to a close family member who may not be keen on the practice. This was evinced by the fact that some of the practitioners, especially the younger ones, could not even remember the plant names. This coupled with several other challenges such as

lack of regulation, overexploitation, deforestation, advent of modern medicine, lack of interest of the young generation in traditional medicine and bogus herbalists pose a major risk to indigenous knowledge on traditional medicine. From the available literature, little research has been carried out on most of the identified plants, except a few however which have been demonstrated to possess pharmacological activities, including those mentioned by the herbalists. These include *Myrica salicifolia* (bronchodilator) [67,68], *Toddalia asiatica* (cytotoxic) [57-59] and *Zehneria scabra* (antifungal) [56]. Perhaps future research on the documented plants may yield more results. There should therefore be more efforts to document medicinal plants not only in Keiyo district, but the whole country as the challenges tend to be similar, for future research and potential for development of new drugs.

Competing interests

The authors’ declare that they have no competing interests.

Authors’ contributions

All the authors shared the contributions to the work fieldwork of the manuscript. Kigen, Fatma, Kibosia and Rono interviewed the herbalists and patients, in order to identify the illnesses. Kipkore, Kiprop and Wanjohi identified the plants Prisca; the herbalist provided some valuable medicinal information, introduced us to her colleagues and helped in the identification of the plants. Kipkore and Kigen analyzed the data and prepared the manuscript. All authors read and approved the final manuscript.

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