



Types of Herbal Medicine Used for HIV Conditions in Vihiga County, Kenya

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Authors' contributions

This work was carried out in collaboration between all authors. Author AOR designed the study, wrote the protocol, collected data, performed the statistical analysis, managed the literature searches and wrote the manuscript drafts. Authors MK, AOM and FMT critically reviewed all the stages of this work. All authors read and approved the final manuscript.

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ABSTRACT

Aim: To identify types of herbal medicine used for HIV conditions in Vihiga county, Kenya.

Study Design: Qualitative ethno botanical survey.

Place and Duration of Study: Hamuyundi sub-location, west Sabatia location, Sabatia Sub County, Vihiga County – Kenya. The study was carried out in December 2014.

Methodology: Information was obtained by interviewing Community health workers (CHW), as key informants using an interview schedule. Hamuyundi community was selected on basis of having the highest number of long serving CHW. All the 11 CHW were interviewed.

Results: Thirty six plant species belonging to 26 families were identified as medicine. The plant species with most consensus for specific conditions were *Cassia occidentalis* L. for malaria/fever at

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36% and *Justicia betonica* (L.) for gastrointestinal conditions at 36%. Most plant species belonged to *Solanaceae*, *Labiatae* and *Rubiaceae*. The most mentioned conditions for which plant medicines were used were gastrointestinal and skin problems.

Conclusion: The majority of plants used by Hamuyundi community as medicine are supported by literature as used elsewhere or contain bioactive compounds. The low consensus on plants used as medicine for specific conditions shows the dynamic state of plant medicine application in HIV conditions. The use of leaves as plant parts for medicine preparation shows the preservation strategy of plant resources. The gastrointestinal and skin problems treated by majority of plant medicines are common HIV associated diseases.

Keywords: Herbal medicine; ethno-botanical survey; HIV; qualitative; Vihiga county; Kenya.

1. INTRODUCTION

According to UNAIDS gap report of 2014, there were about 24.7 million people living with HIV in sub-Saharan Africa accounting for 71% of the world total. Ten countries – Ethiopia, Kenya, Malawi, Mozambique, Nigeria, South Africa, Uganda, United Republic of Tanzania, Zambia, and Zimbabwe accounted for 81% of the sub-Saharan total. In Kenya, about 6% of the country's population were living with HIV in the period of reporting and AIDS related deaths was estimated to be 5% [1]. This is despite expanded antiretroviral therapy (ART) programs. Previous studies have indicated a need for improved care for persons living with HIV (PLHIV), with reports indicating emergence of resistant HIV strains [2], unsustainable donor driven free public sector ART programmes, inhibited access to treatment due to factors such as lack of confidentiality, lack of transport to hospitals, shortage of health workers, long queues, and lack of adherence due to adverse drug reactions [3,4]. Some HIV patients resort to use of ethno-medicinal plants as an alternative or concomitant use with ARTs in an attempt to overcome these challenges [5]. Due to lack of evidence of effectiveness of traditional medicine, many African governments, Kenya included lacks firm policy on the use of ethno medical cures, thus adding to the confusion regarding their use in HIV diseases. In order to address the question of efficacy of the ethno-medicines, there is need to document them against their cure claims. This study therefore sought to document the medicines used by the Luhya community in Hamiyundi sub-location in Vihiga County in Kenya.

Vihiga County is within the region formerly referred to as Western Province in Kenya. The county's HIV profile showed HIV prevalence of 4.9% in 2003, 5.7% in 2007, 7% in 2008 – 2009 and 4.7% in 2012 [6,7]. By the end of 2011,

about 19,632 people were living with HIV in the county, and of the total, the profile report indicate that 48% significantly delayed before joining formal treatment and care programs. Among the HIV positive pregnant women, about 79% did not deliver in health facilities, and only 43% attended the recommended 4 antenatal care (ANC) visits, reflecting poor HIV care seeking behavior [6].

Hamuyundi sub-location is predominantly inhabited by the Maragoli community, of the Luhya sub-tribe. The use of plant medicines by the Luhya community was previously documented by Nyunja et al. [8] but the study focused on the community living around Kakamega forest. The current community of focus is culturally related to the community living around Kakamega forest but have different environmental features including vegetation characteristics. Furthermore, this study sought to document herbal medicines specifically targeted at HIV conditions. The results also reflect conditions whose care is not adequately addressed by conventional health services. Ethno-medical practices have previously been associated with communities' attempt to seek solutions to health problem from their unique social and environmental perspectives [9,10].

The documentation of plant medicines and ailments addressed by the medicines therefore informs on priority health conditions that ought to be addressed and plants to be prioritized for further investigation. This report is also an effort towards preservation of indigenous knowledge and identification of plants for conservation.

The aim of the study was therefore to identify the types of medicinal plants used in care and management of HIV, The parts of the plants used, the conditions for which the plants are used and the methods of preparation.

2. MATERIALS AND METHODS

This study was carried out to obtain information about medicinal plants used by people living with HIV in Hamuyundi community in Vihiga County. Data collected were based on oral interview of key informants, the Community Health workers using an interview schedule. The names of medicinal plants were documented in local language and samples collected through the guidance of the key informants. The samples were taken and preserved according to the instruction of the taxonomist. Thus leaves, flowers and or seeds were taken and pressed between old newspapers and transported to University of Nairobi herbarium where the plants were identified in accordance with taxonomic practice.

2.1 Study Design

A qualitative ethno-botanical survey using a semi-structured interview schedule on community health workers as key informant.

2.1.1 Study site

The study was carried out at Hamuyundi sub-location in Sabatia sub-county in Vihiga County (Fig. 1). The Hamuyundi community health unit was identified for the study because of having the highest number of long term serving community health workers and cumulative number of HIV clients registered under community care as reflected on HIV program reports from the year 2008.

2.1.2 Data collection procedure

Data was collected in December 2014 from the 11 CHW serving under the jurisdiction of Hamuyundi Community Health Unit (CHU), with a registered cohort of 51 HIV clients directly linked to them for primary health care at the time of interview. The age of informants ranged from 31 to 60 years. The informants comprised of 8 females and 3 males. The Community Health extension worker (CHEW) in charge of the CHU who assisted with data collection was a female Luhya of the Maragoli speaking sub-tribe.

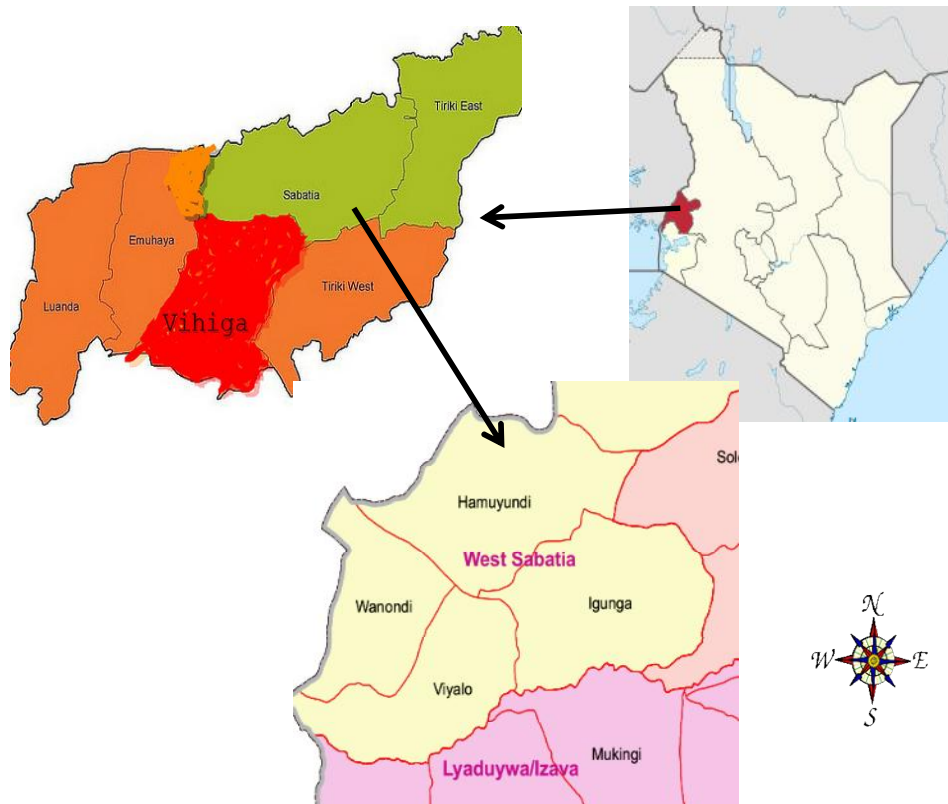


Fig. 1. Map of Vihiga County in Kenya, showing Hamuyundi in Sabatia sub-county

After explaining the objectives of the research and seeking consent, the CHW were engaged in a semi-structured interview. During the conversation, data on the local names of the plants and plant parts used to treat various ailments related to HIV and AIDS were recorded. The CHW were used as guides during field trips to collect plant voucher specimens which were later identified at the University of Nairobi.

3. RESULTS AND DISCUSSION

3.1 Knowledge of Different Profiles of HIV Conditions

Despite inclusion of few conditions like gonorrhoea, syphilis and trachoma (Table 1), all other conditions mentioned by informants were conditions recognized by WHO as associated with HIV [11]. The knowledge of HIV conditions by CHW is not surprising given that they are often the targets of training programs in primary health care. The management of HIV is a component of Kenya essential package for health, under the 2012 health sector reforms, and have been part of primary health care initiatives [12,13].

3.2 Status of Herbal Medicine Use by People Living with HIV in Hamuyundi Community (Question; what is the Situation of Herbal Medicine Use in Your Community)

According to Harrie [14], qualitative survey seeks to determine diversity of cognition or behavior in the population studied, represented by a small group selected on the basis of a specific context. Thus basing on the CHWs' responsibility as primary health care providers for several households and often acting as intermediaries between sick members of the community and formal health care service [15], their views on the situation of herbal medicine use indicate aspects of herbal medicine as perceived by the community and as considered by health sector policy.

The positive attributes of herbal medicine as perceived by the community can be interpreted from the verbatim quotes as; having withstood test of time and possession of benefits lacking in health sector services. The following verbatim quotes illustrates this point:

'I know of some who have been using it for the last five years'.

'I used herbal medicine, had developed herpes and had general body weakness'

'It has healing effect on the disease'

'It is good for support of patients with side effect and herpes zoster'

'Many people use them for problems like fever, headache and stomach aches'

'Herbal medicine can be the best compared to ARVs because most of the herbs are for drinking only'.

The Kenya government health sector policy forbids the use of herbal medicine for patients on ARVs (GOK/MOH, 2007). The following verbatim quotes illustrates the health sector policy;

'The people living with HIV are not supposed to use herbal medicine for effectiveness of ARVs'.

'It is not good to use both HIV medicine with herbal medicine, need advice from health facility'.

'There is no need to use herbal medicine since hospital drugs are refined before being brought to the facility'.

'Can affect one's health, can cause side effects when combined with ARVs'.

'People use herbal medicine but fear to volunteer the information to health workers'.

3.3 Plants Used in the Treatment of HIV Conditions

A total of 36 plant species from 26 families were identified (Table 2). Results show that one condition was managed by different plant species, and in some cases, one plant species was indicated for several conditions. Similar findings have been reported by Chisembu and Hedimbi [16], Tabuti et al. [17]. Both attributed the phenomenon of one condition management by several plant species and the single plant species for several conditions to dynamism in the ethno-medical practice and the diverse compounds present in single plant species respectively.

Table 1. Knowledge of diseases caused by HIV

Informant code	HIV disease named
VGA/HAM/01;	Herpes zoster, TB, Diarrhea
VGA/HAM/02;	Gonorrhea, Syphilis
VGA/HAM/03;	Herpes simplex, coughs
VGA/HAM/04;	TB, Oral thrush, Herpes
VGA/HAM/05;	TB, Diarrhea, Gonorrhea, Trachoma
VGA/HAM/06;	Diarrhea, Oral thrush, TB, Rashes, Herpes, Fever
VGA/HAM/07;	Boils, Mouth sores, Skin rashes, Vomiting, Headache
VGA/HAM/08;	TB, Headache, Swelling of feet, Rashes, Mouth rash, weight loss
VGA/HAM/09;	Skin rashes, Diarrhea, Body wearing
VGA/HAM/10;	TB, Typhoid, Anemia, Diarrhea, Breathing difficulties
VGA/HAM/11;	Malaria, Dysentery, Typhoid, skin rashes, frequent coughing, stomach ulcers

Note: TB; Tuberculosis, HIV; Human Immune Virus

3.3.1 Consensus on plant species used as medicine for specific HIV condition

Table 3 shows that the highest consensus on plant species for specific conditions was *Justicia betonica* for gastrointestinal conditions and *Cassia occidentalis* for malaria or febrile conditions.

In the Nandi County, bordering the county of Vihiga, the community uses the leaves and flower of *Justicia betonica* for coughs, anti-diarrhoea, and orchitis [29]. *Justicia betonica* species has been reported to possess broad antibacterial activity when tested against both gram positive and gram negative bacteria [30]. A study by Bbosa et al. [31] indicated anti-malarial activity, thus the literature suggest that the plant has wide clinical application.

Saganuwan et al. [60] evaluated *Cassia occidentalis* for antibacterial and phytochemical properties. Their results showed that the extracts had activity against both gram positive and gram negative bacteria and the chemical screening revealed the presence of alkaloids, tannins, flavonoids, saponins and glycosides. The plant species has also showed anti-diabetic activity when tested on rat experimental model [63]. However consumption of plant seed was associated with hepato-myo-encephalopathy among young children in India [62]. Previously finding showed that leave extract of *Cassia occidentalis* was hepato protective and anti-inflammatory when given orally to experimental rats [65], indicating that the seed and leaves contained ingredients that produce different responses.

Of all the 36 plant species used for different conditions, majority (14) were used for

gastrointestinal conditions (GI), followed by skin and respiratory conditions (8) and fever/malaria (4) (Table 3). The GI problems were leading as the HIV condition for which herbal medicine was used. In a Tanzanian study, Kisangau et al. [75] reported only 9% herbal medicine use GI conditions. However many studies have highly rated the use of herbal medicine for skin and GI conditions [76,9,77,78]. The two conditions are common symptoms of HIV disease.

3.3.2 Plant families comprising species identified as medicine

The most used plant families were *Solanaceae*, *Labiatae* and *Rubiaceae* with 3 species each (Fig. 2). The *Solanaceae* family contains many species of plants known for nutritional and medicinal value. These include the *Capsicum* species that has shown antimicrobial activity [79]. The capsaicin and dihydrocapsaicin are two ingredients that have been suggested to account for the antimicrobial activity against *Bacillus cereus*, *Bacillus subtilis*, *Clostridium sporogenes*, *Clostridium tetani* and *Streptococcus pyogenes* [79]. In Israel, *Lycium europium*, *Solatium nigram*, *Hyoscyamus aureus*, *Hyoscymus albus* have been reported to be useful for external applications, suggesting that they are active against skin pathogens [80]. The *Cytomandra betacea* (tomato) is known for its nutrition value [81] and is also reported to possess activity against Herpes simplex 1 [82], the antiviral effect being attributed to glycoalkaloids content. The antimycobacterium activity of *Physalis angulate* L. was established by Januario et al. [83], indicating effect against an important opportunistic infection, common among PLWHIV. A species in the same genus, the *Physalis peruviana* Linn. has been reported to be anti-hepatotoxic when tested on rats [84].

Table 2. Plants that are used to treat HIV and AIDS related disease conditions in Hamuyundi sub-location, Vihiga County

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
Curbiteraceae	VGA/16	<i>Kedrostis foetidissima</i> (Jacq.) Cogn	Livunyabukundu	2	Leaves	Skin Rashes (2)	Cold infusion	Drinking and bathing	7, 10- hexadecadienoic acid., 2- hexadecen-1-ol, 3,7,11,15-tetramethyl-[R-[RR-(E)]] and 1H-1,2,4-triazole-3,5-dicarbaldehyde and docosanoic acid [18]	Antibacterial activity against gram negative and gram positive bacteria [19]
	VGA/65	<i>Cucumis aculeatus</i> Cogn.	Kaseveve	2	Leaves	Mouth sores (2)	Ashing	Licking ash	Terpenoids, phenolics, [20]	Activity against <i>Pseudomonas aeruginosa</i> [20]
Lamiaceae	VGA/17	<i>Tetradenia urticifolia</i> (Bak.) Phlipson	Okemba	1	Leaves	Coughs (1)	Cold infusion	Drinking	Polyphenol compounds is abundant in the two species of the family [21]	Ethno-medical use for antimalarial [22]
	VGA/25	<i>Ajuga integrifolia</i> (Buch-Ham)	Imbusi yo Mtakha	1	Leaves	Diarrhea and Malaria (1)	Cold infusion	Drinking	Ergosterol-5,8-endoperoxide (6)ajugarin-(1), 8-O-acetylharpagide (5) [23]	Ethno-medical use for antimalaria and <i>in vitro</i> antimycobacterium and antiplasmodial activity [23]
Lebeceae	VGA/18	<i>Fuerstia africana</i> T.C.E Fr.	Muvunyanyingu	2	Leaves	Mouth sores, STI (2)	Cold infusion	Topical Drinking	Sterols, terpenoids, alkaloids, Saponins, glycooids, Flavanoids and Tannins [24]	<i>In vitro</i> antimicrobial activity against Gram negative and gram positive bacteria and anti plasmodial activity [25,26,27]
Acanthaceae	VGA/19	<i>Justicia betonica</i> (L.)	Indulisia	4	Leaves	Diarrhea and Stomachache (4)	Cold infusion	Drinking	10H-Indolo[3,2-b] quinolone [28]	Ethno-medical use for coughs, anti-diarrhea and Orchitis [28,29] Antibacterial activity [30]

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
	VGA/34	<i>Thuribergia alata</i> Sims	SSanda	1	Leaves	Swollen breast	Ashing, Emulsifying in fats	Rubbing		Anti-plasmodial activity [31] Ethno-medical use for cough and backache [29]
Myrtaceae	VGA/20	<i>Psidium guajava</i> L.	Mapera	2	Young leaves	Stomachache (2)	Pound or chew	Swallow juice	Gallic, Catechin and quercetin [32]	Antiglycation activity [32]
Bignoniaceae	VGA/21	<i>Markhamia lutea</i> (Benth.) K. Shum	Olusiola	2	Young leaves	Stomachache (1), Eye spots and (1) Typhoid (1)	Chewing Ashing, cold infusion Add honey for typhoid	Swallow juice Drop in the eye Drinking	Cycloartane triterpenoids [33]	Toxic to MRC5 and KB cell lines [33]
Solanaceae	VGA/22	<i>Solanum inacanum</i> (L.)	Kitatula/Sirandalwa	1	Roots	Stomach pains (1)	Chewing	Swallow juice		<i>In-vitro</i> antifungal activity [34]
	VGA/31	<i>Solanum nigrum</i> (L.)	Litsutsa	1	Leaves	Chicken pox (1)	Decoction	Drinking decoction and eating leaves		Strong antioxidant activity on DPPH [34] Ethno-medical use for stomach ulcer. Mode of action is by inhibition of H ⁺ K ⁺ ATPase activity [35]
	VGA/47	<i>Nicotiana rabacum</i> (L.)	Tobacco	1	Leaves	Typhoid (1)	Cold infusion	Drinking		
Umbelliferae	VGA/23	<i>Centella asiatica</i> (L.) Urb	Liru lala	1	Leaves	Abscess(1)	Chewing and spiting juice on the boil	Topical		Strong antioxidant activity on Ferric thiocyanate and Thiobarbituric acid [36]

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
Papilionaceae	VGA/24	<i>Indigofera arrecta</i> (A. Rich)	Unknown by local name	1	Roots	Breathing difficulty (1)	Chewing	Swallow juice		Anti-hyperglycemic activity [37]
Asteraceae	VGA/26	<i>Microglossa pyrifolia</i> (Lam.) Kuntze	Ingwe	1	Leaves	Skin infection (1)	Cold infusion	Drinking	Dihydrobenzofurans; (methyl 2-(5-acetyloxy-2,3-dihydrobenzo[β]furan-2-yl)propenoate), 3(methyl 2-(6-acetyl-5-hydroxy-2,3-dihydrobenzofuran-2-yl)propenoate] and 7(6-acetyl-5-hydroxy-2-(1-hydroxy-2-(1-hydroxy-2-propenyl)-3-methoxy-2,3-dihydrobenzofuran), Triterpenes; 3 β -acetoxy-25-hydroxydammar-20,23-diene(9), 3 β -acetoxy-24-oxo-dammara-220,25-diene(11), 17 β -hydroxy-3,16-dioxo-28-norolean-12-ene(12) and 17 β -hydroxy-3,11,16-trioxo-28-norolean-12-ene [38]	<i>In vitro</i> antimicrobial activity of ethanol extract [39]
Xanthorrhoeae/Aloaceae	VGA/28	<i>Aloe sp</i>	Ligakha	1	Leaves	Coughs (1)	Ashing	Licking	Diverse species specific Contents including Alcohols, aldehydes, Ketones, Pyrimidines, Indole, alkaloids, Sterols, Fatty acids, Dicarboxylic acid [40]	Species specific indications including Arthritis, skin cancer, burns, eczema, psoriasis, digestive disorder, hypertension and diabetes [40]
Euphorbiaceae	VGA/29	<i>Croton macrostachus</i> Hochst.	Mutswitswi		Leaves					<i>In vivo</i> anti-plamodial activity [41]

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
Sapindaceae	VGA/30	<i>Cardiospermum halicacabum</i> L.	Obulili	1	Seeds	Eye problems(1)	Taken intact	Swallow seeds		Antioxidant and anti-inflammatory activity [42]
Verbenaceae	VGA/33	<i>Clerodendrum myricoides</i> (Hochst.) Vatke	Esuchi	2	Leaves	Pneumonia (1)	Decoction	Drinking		<i>In vivo</i> anti-malarial activity [43]
					Stem Bark	Stomachache (1)	Decoction	Drinking		
Rubiaceae	VGA/35	<i>Spermaceoce princeae</i> (K. Schum) Verdc.	Lisienjili	1	Leaves	Diarrhea (1)	Cold infusion	Drinking		Ethno-medical use for bacterial infections. Causes constipation, cardiovascular problems, hepatotoxicity and nephrotoxicity at high doses [44]
	VGA/38	<i>Psydrax Shimperiana</i> (A. Rich) Bridson	Esikhuli	1	Leaves	Stomachache (1)	Cold infusion	Drinking		Ethno-medical indication for cancer [45]
Rubiaceae	VGA/34	<i>Keetia gueinzii</i> (Sond.) Bridson	Lisengele	1	Leaves	Chest pain (1)	Pound leaves and mix with fat	Rub on the chest		Ethno-medical use for malaria [46]
Combined with										
Acanthaceae	VGA/3b	<i>Thuribergia alata</i> Sims	Essanda						Glucosides: Thunaloside and alatoside, iridoid glycosides, stilbericosides, 6-epi-stilbericosides and thunbergioside [47]	<i>In vitro</i> antibacterial activity against <i>Salmonella typhi</i> [48]
Rutaceae	VGA/68	<i>Zanthoxylum giletti</i> (De wild) P. G. Waterman	Kikuma	2	Stem bark	Oral thrush (2) Heart diseases and Coughing (1)	Decoction	Drinking	Alkaloids: Peroxysimulenoline, Sanguinarine, Faragarine 1, Norchelerythrine, Dihydranitidine [49]	Ethno-medical use as liniment for back pain and treatment for urogenital infections, stomach ulcers [50]
Pteridaceae	VGA/36	<i>Pellea adiatoides</i> (Willd.) J.SM	Fern	1	Leaves	Aching feet (1)	Cold infusion	Immersing feet in the infusion		

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
Lambiteae	VGA/37	<i>Salvia cocernia</i> L.	Mfunyanyungu	2	Leaves	Oral thrush (2)	Chewing	Swallow juice		Ethno-medical use for inflammatory diseases. Causes release of allergic mediators [51]. Causes side effects of water and salt retention and cancer [52], and gastro-intestinal disturbances [53]
	VGA/75	<i>Leucus calostachys</i> Oliv.	Kiguduri	1	Leaves	STI (1)	Decoction	Drinking		<i>In vitro</i> anti-plasmodial activity [54]
Oxalideceae	VGA/40	<i>Oxalis corniculata</i> L.	Nakhabulu	1	Leaves	Poor appetite (1)	Chewing	Swallow juice		High <i>in vivo</i> antioxidant activity in rats [55]. <i>In vitro</i> antibacterial activity [56,57]. Anti-seizure activity in rats [58]. Antiimplantation and abortifacient activity in rats [59]
Mimoceceae	VGA/41	<i>Albizia grandibrata</i> Taub	Omusenjeli	1	Stem bark	Indigestion (1)	Decoction	Drinking		
Caelspineceae	VGA/42	<i>Cassia occidentalis</i> L.	Imindi	4	Roots	Malaria/Fever (4)	Decoction	Drinking	Alkaloids, tannins, saponin, glycoside and flavonoids [60] Achrosin,, Aloe-emodin, anthraquinones, anthrones, apigenin, aurantiobtusin,	<i>In vitro</i> antibacterial activity [60]. <i>In vitro</i> antibacterial and antifungal activity [62]. <i>In vitro</i> anti-hyperglycemic

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
	VGA/56	<i>Tylosema fassogleuse</i> . Brenan, J.P	Local name unknown	1	Roots	Malaria/ fever (1)	Decoction	Drinking	campesterol, cassiollin, chryso-obtusin, chrysophanic acid, chrysarobin, chrysophanol and chrysoeriol [61] High seed content of Linoleic acid, Oleic and Palmitic acid. Proteins are characterized by high levels of lysine, proline and tyrosine [67]	activity in rats [63]. Acute hepato-myoencephalopathy [64] Hepatoprotective and anti-inflammatory [65,66]
Melaceae	VGA/46	<i>Melia azedarach</i> L.	Mwarubaine	1	Roots and leaves	Malaria (1)	Cold infusion	Drinking	(20S)-5,24(280-ergostadiene-3 β ,7 α , 16 β ,20-tetrol, (20S)- 5-ergostene - 3 β , 7 α , 16 β ,20-tetrol 2 α , 3 β -dihydro-5-pregnen-16-one [68]	High Antioxidant activity on DPPH [69]
Polygoneceae	VGA/51	<i>Rumex abyssinicus</i> (Jascq)	Likachi sacha	1 2	Leaves	Stomachache (1)	Cold infusion	Drinking		Antibacterial activity against <i>Streptococcus pyogenes</i> and <i>Staphylococcus aureus</i> , antiviral activity against Coxsackie virus B3 and anti-inflammatory activity [70]. Anti-helminth activity [71]
	VGA/55	<i>Rumex stendellii</i> A. Rich	Mnyerangokho / Alukava		Leaves	Ulcers (1), HIV (2), Stomachache (1), Malaria	Cold infusion	Drinking		Antifertility effect on rats [72]

Family	Collection number	Scientific name	Local name	Frequency of plant mention as medicine	Part used	HIV condition treated and frequency of plant mention for the condition	Method of preparation	Mode of application	Phytochemical composition	Pharmacological activity / use
Gentianeaceae	VGA/52	<i>Anthocleista vogelii</i> Planch.	Sikhuma	2	Leaves and stem bark	Typhoid (2)	Decoction	Drinking	Saponins, cardiac glycosides, flavonoids, terpenes alkaloids, and steroids [73]	Anti-plasmodial activity in albino mice [73] Hypoglycaemic activity [74]
Convolvulaceae	VGA/61	<i>Ipomoea kiliensis</i> L.	Libilibizi	1	Roots	Constipation (1)	Cold infusion	Drinking		



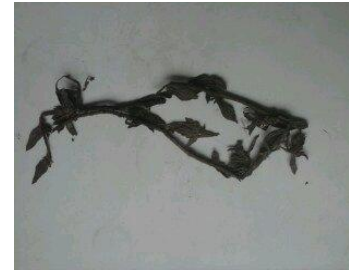
Feedback meeting



VGA 33



VGA 34



VGA 35



VGA 37



VGA 40



VGA 41



VGA 42



VGA 44



VGA 44B



VGA 45



VGA 46



VGA 47



VGA 48



VGA 50



VGA 51



VGA 52



VGA 53



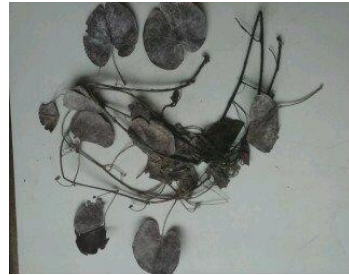
VGA 54



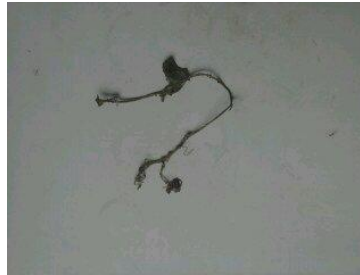
VGA 55



VGA 55B



VGA 56 B



VGA 56



VGA 57



VGA 58



VGA 59



VGA 60



VGA 61



VGA 62



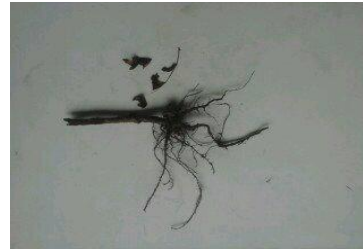
VGA 63



VGA 64



VGA 65



VGA 66



VGA 67



VGA 68



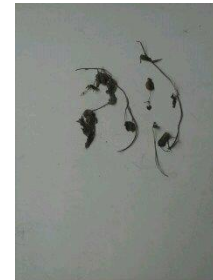
VGA 69



VGA 71



VGA 73



VGA 74



VGA 75



VGA 76



VGA 77



VGA 78



VGA 82



VGA 83



VGA 84

Table 3. Consensus on plant species as medicine for HIV condition

Plant species	Condition	% Consensus
<i>Kedrostis foetidissima</i> (Jacq.) Cogn	Skin	18%
<i>Cucumis aculeatus</i> Cogn	Skin	18%
<i>Tetradenia urticifolia</i> (Bak.) Philipson	Respiratory	9%
<i>Ajuga integrifolia</i> (Buch-Ham)	Gastrointestinal	9%
<i>Fuerstia africana</i> T.C.E Fr	Skin	18%
<i>Justicia betonica</i> (L.)	Gastrointestinal	36%
<i>Thuribergia alata</i> Sims	Neoplastic	9%
<i>Psidium guajava</i> L	Gastrointestinal	18%
<i>Markhamia lutea</i> (Benth.) K. Shum	Gastrointestinal	18%
<i>Solanum inacanum</i> (L.)	Gastrointestinal	9%
<i>Solanum nigrum</i> (L.)	Skin	9%
<i>Nicotiana rabacum</i> (L.)	Gastrointestinal	9%
<i>Centella asiatica</i> (L.) Urb	Skin	9%
<i>Indigofera arrecta</i> (A. Rich)	Respiratory	9%
<i>Microglossa pyrifolia</i> (Lam.) Kuntze	Skin	9%
<i>Aloe sp</i>	Respiratory	9%
<i>Croton macrostachus</i> Hochst	Respiratory	9%
<i>Cardiospermum halicacabum</i> L.	Eye	9%
<i>Clerodendrum myricoides</i> (Hochst.) Vatke	Gastrointestinal	9%
<i>Spermacoce princeae</i> (K. Schum) Verdc	Gastrointestinal	9%
<i>Psydrax shimperiana</i> (A. Rich) Bridson	Gastrointestinal	9%
<i>Keetia gueinzili</i> (Sond.) Bridson	Respiratory	9%
<i>Thuribergia alata</i> Sims	Respiratory	9%
<i>Zanthoxylum giletii</i> (De wild) P. G. Waterman	Skin	18%
<i>Pellea adiatoides</i> (Willd.) J.SM	Musculoskeletal	9%
<i>Salvia cocernia</i> L.	Skin	18%
<i>Fuerstia africana</i> T.C.Fr	Respiratory	9%
<i>Leucus calostachys</i> Oliv	Respiratory	9%
<i>Oxalis corniculata</i> L.	Nutrition	9%
<i>Albizia grandibracteata</i> Taub	Gastrointestinal	9%
<i>Cassia occidentalis</i> L.	Malaria/Fever	36%
<i>Tylosema fassogleuse</i> . Brenan, J.P	Malaria/Fever	9%
<i>Melia azedarach</i> L.	Malaria/Fever	9%
<i>Rumex abyssinicus</i> (Jascq)	Gastrointestinal	9%
<i>Rumex stendelii</i> A. Rich	Gastrointestinal	18%
	HIV	18%
	Malaria/Fever	18%
<i>Anthocleista vogelii</i> Planch	Gastrointestinal	18%
<i>Ipomoea kiliensis</i> L.	Gastrointestinal	9%

The *labiatae* plant family contains several species that are known to be antiviral. These include *Mentha Peperita*, *Salvia cyprea*, *Origanum marojana*, *thymus serpyllum*, *Hedeoma pellegiodes*, *Satureia spp*, *thymus spp*, *Hyssopus officinalis* and *Melissa officinalis* which gave various antiviral activities when tested against Newcastle disease, Herpes simplex virus, vaccinia, Semliki forest and West Nile viruses [85].

Rubiaceae family contain plant species that have been source of medicine and some have shown potential at experimental stages. In a systematic review, Karou et al [86] revealed that 60 species are used for 70 medicinal indications while many species have exhibited antimalarial, antimicrobial, antihypertension, antidiabetic,

antioxidant and anti-inflammatory activities. Suhanya et al. [87] reported high antioxidant and antimicrobial activity in *Mitragyna speciosa*. The foregoing literature findings suggest that plants from the three families contain ingredients that are useful in care and management of HIV.

3.3.3 Plant parts used as medicine

The most plant parts used were leaves, for 27 plants species and the least used were seeds, for one plant species. On plant parts used, many studies agree with findings at Hamuyundi that leaves form the largest proportion of plants parts used as medicine. In a systemic review of the use of medicinal plants for HIV in sub-Saharan Africa. Maroy, [76] reported that leaves constitute 67.6% of all plant parts used as medicine. This

has implication in sustainable use as the harvesting of the leaves preserves the plant.

3.3.4 Method of preparation of crude extract

From the highest to lowest frequency of preparation methods, medicines were prepared by; cold infusion, decoction, chewing, ashing, ashing and fat emulsion, ashing and cold infusion, pounding and ash emulsion, and honey addition (Fig. 4). Cold infusion is the pounding of plant material and soaking in cold water. The extract solution could be administered by drinking or externally applied. By the chewing

methods, the materials were crashed by teeth, the juice obtained could be swallowed or spat out to be externally applied. Ashing methods drying the plant material and burning to form ash. The ash obtained could be licked directly, mixed with fat and applied externally or soaked in water and used as for infusion. Pounding and fat emulsion involved crushing the plant material by teeth or grinding stone and mixing the crushed material with fats for external application. As noted by Kokwaro [50], preparation of same medicines for same purpose could vary from person to person, indicating the dynamic state of plant medicine the utilization.

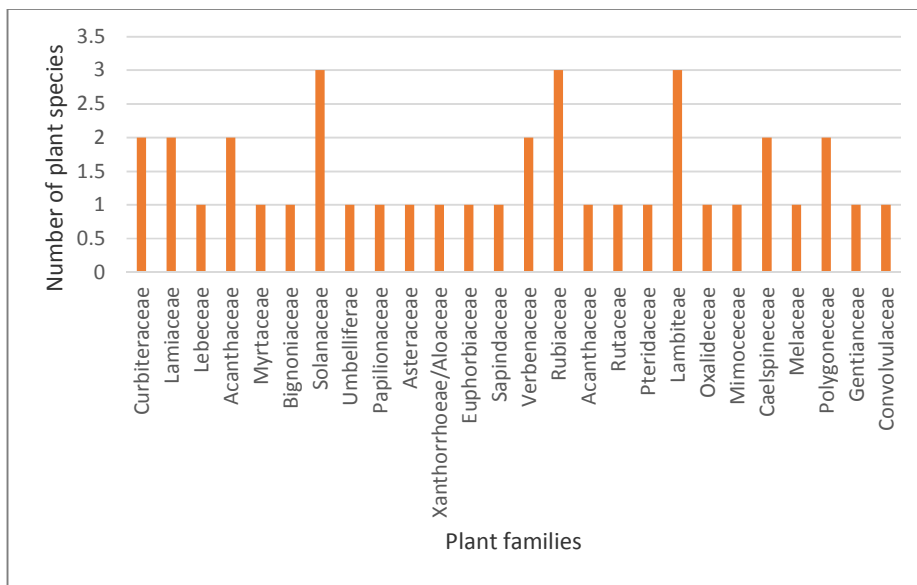


Fig. 2. Plant families of species identified as medicine

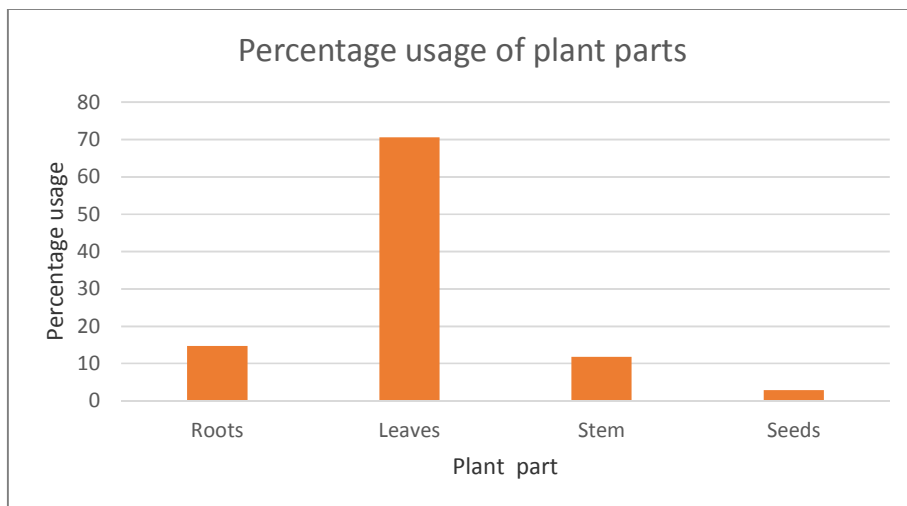


Fig. 3. Leaves was the most widely used part of plants for medicine

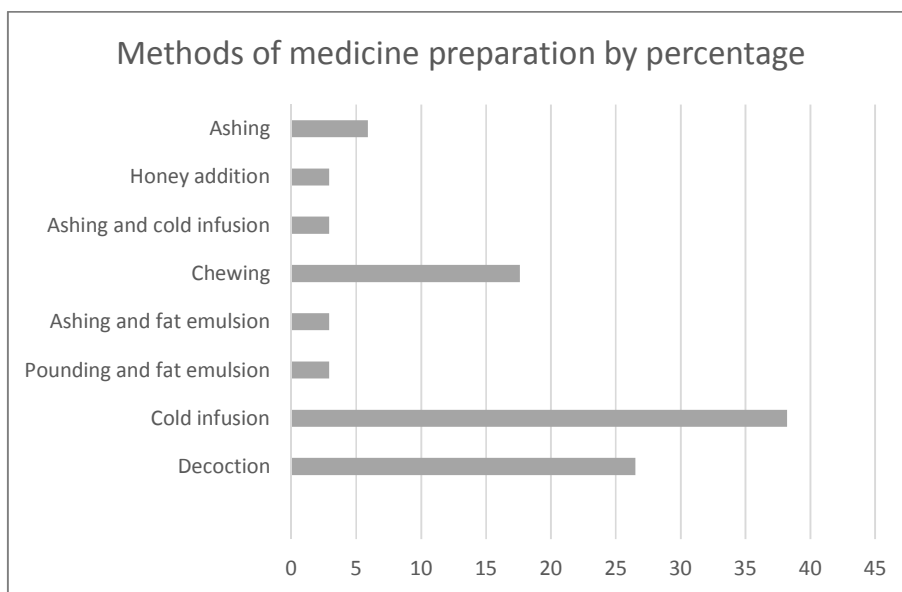


Fig. 4. Methods of medicine preparation. Cold infusion was the most frequent choice for medicine preparation

3.3.5 Study limitation

The study methodology was limited to information known to and provided by CHW. It was not possible to ascertain the authenticity of claimed medicinal value of plant species identified.

4. CONCLUSION

The study shows that Hamuyundi community uses variety of plants as medicine for HIV conditions. Majority of the plants belong to *Solanaceae Labiateae* and *Rubeaceae* families and literature review indicate that they are used as medicine elsewhere and or have bioactive compounds. The low consensus on medicinal plant utilization for specific conditions show the dynamic state of medicinal plant application in HIV associated conditions. The use of leaves as plant parts for medicine preparation shows the preservation strategy of plant resources. The gastrointestinal and skin problems treated by majority of plant medicines are common HIV associated diseases.

CONSENT

Consent for this study was obtained from the government of Kenya (GOK), ministry of health, and the Community Health Workers involved in the study.

ETHICAL APPROVAL

The study was approved by the scientific and ethics review committee (SERU) of the Kenya Medical Research Institute (KEMRI), approval number SSC 2285.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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