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Nine medicinal plants used in management of HIV/AIDS in Kisii County, Kenya

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Abstract

In view of the challenges people living with HIV/AIDS face in accessing health care services, approaches based on natural products can play an integral role in tackling the disease. Unfortunately, medicinal plants used in HIV/AIDS management by the Kisii community have not been documented despite their use since time immemorial. The current study therefore aimed at documenting the traditional medicine in management of the disease in Kisii County. Data was obtained through semi-structured oral interviews of fifteen traditional healers from the County. Nine plant species used are *Opuntia ficus-indica*, *Aloe vera*, *Carissa edulis*, *Triumfetta macrophylla*, *Clerodendrum myricoides*, *Leonotis nepetifolia*, *Maesa lanceolata*, *Prunus africanus* and *Azadirachta indica*. The remedies are formulated into liquid and powder forms which are administered as a combination orally. Isolation of the metabolites responsible for the plants' activities and data on preclinical and clinical trials on the herbs and their extracts will be of fundamental importance.

Keywords: HIV/AIDS, Ethnomedicine, Herbalists, Kisii County

Introduction

Globally, HIV/AIDS has continued to be one of the world's health challenge. A global estimate of 38 million people were reported to live with HIV/AIDS in 2019. The adults constituted 36.2 million and 1.8 million were children (<15 years old). An estimated 1.7 million individuals worldwide acquired HIV in 2019, with a 23% decline in new HIV infections since 2010^[1].

Despite advances in scientific understanding of HIV/AIDS and its prevention and treatment as well as years of significant effort by the global health community and leading government and civil society organizations, the global HIV incidence of 2019, indicate that the progress on the prevention of HIV transmission is too low considering the Joint United Nations Programme on HIV/AIDS (UNAIDS) and partners' target of 90-90-90 by 2020^[2]. The UNAIDS envisioned that by 2020, 90% of all people living with HIV/AIDS globally are expected to know their HIV status, 90% of all people who know their status will be on the antiretroviral therapy (ART) and finally, 90% of all people receiving ART will have viral suppression. However, tracking progress towards the achievement of the 90-90-90 UNAIDS target in 2019 indicated that 81% of the people living with HIV/AIDS knew their HIV status, 82% of those who knew their status were accessing ART and 88% of all those receiving ART were virally suppressed^[3]. This statistics indicate that too many people with HIV or at risk for HIV still do not have access to prevention, care and treatment, and there is still no cure for HIV.

Similarly, according to the WHO report^[1], 1.5 million people in Kenya live with HIV/AIDS. Out of this number, 75% of all adults and 63% of all the children living with HIV were receiving ART. This implies that Kenya is also far off the UNAIDS's target of 90-90-90. However, the national HIV prevalence has modestly declined from 5.6% in 2012 to 4.9% in 2017^[4]. Following the promulgation of the Kenya Constitution (2010), the health function and other services were devolved from the national government to the county government in 2013. The Kenya HIV estimate report^[4] indicate a wide geographical variation in HIV epidemic and burden in the forty seven (47) counties in the country. In descending order, counties with the highest adult HIV prevalence in 2017 included Siaya 21.0%; Homa Bay 20.7%; Kisumu 16.3%; Migori 13.3%; Busia 7.7%; Nairobi 6.1%; Vihiga 5.4%; Kitui 4.5%, Kakamega 4.5%; Kisii 4.4%, Tans Nzoia 4.3%; Muranga 4.2%; Nyamira 4.2%; Makuani 4.2%; Mombasa 4.1%; Taita Taveta 4.1%; and Kiambu 4.0%.

Individual counties have been observed to develop strategies for scaling up high impact interventions to reduce HIV/AIDS transmissions.

In reducing new HIV infections, increasing treatment and reducing HIV-related deaths, the County government of Kisii in partnership with the national government, National AIDS Control Council (NACC), National AIDS and STI Control Program (NASCO) and a diverse set of HIV implementing partners in the County has adopted an array of effective HIV prevention tools and methods. In addition, a massive scale-up of HIV treatment has been observed in the region. However, despite all this effort, stigma and discrimination together with other social inequalities and exclusions have remained as the key barriers to access and conventional treatment especially to the vulnerable population. Consequently, this cultural norm has promoted the use of medicinal herbs as complementary and alternative medicine in the management of HIV/AIDS and the opportunistic infections among the Kisii community.

In Kenya, plants are used for both food and therapeutic purposes and this varies from one community to another. For instance, it has been reported that about 85% of the Samburu community of Northern Kenya rely on medicinal plants for their medicare [5]. It is estimated that 289 plants species are used in traditional medicine by the Maasai of Kenya [6]. The diseases commonly treated by the herbalists include: malaria,

colds, stomachache, worms, typhoid, sexually transmitted infection (STI's), diarrhea, ulcers and asthma.

As part of a study on the situational analysis of intervention measures in the management of HIV/AIDS prevalence in Kisii County, the research sought audience of practicing traditional healers to establish how they are managing the HIV/AIDS pandemic as key stakeholders. The study is also motivated at finding alternative antiviral drugs or lead compounds from traditional medicinal sources.

Materials and methods

Study area

The study was conducted in Kisii County which is one of the forty seven (47) counties in Kenya between March 2019 and August 2019. The County is located in the south western region of Kenya. Its neighboring counties are Nyamira to the North East, Narok to the South, Homabay and Migori to the West. It lies between latitude 30° and 10° South and longitude 35°38' and 35° East. The County covers a total area of 1 317.5km² with a population density of 957 persons per Sq. Km [7]. It is divided into nine (9) Sub-Counties namely Bobasi, Bomachoge Borabu, Bonchari, South Mugirango, KitutuChache North, Kitutu Chache South, Nyaribari Masaba, Nyaribari Chache and Bomachoge Chache (Figures 1, 2).

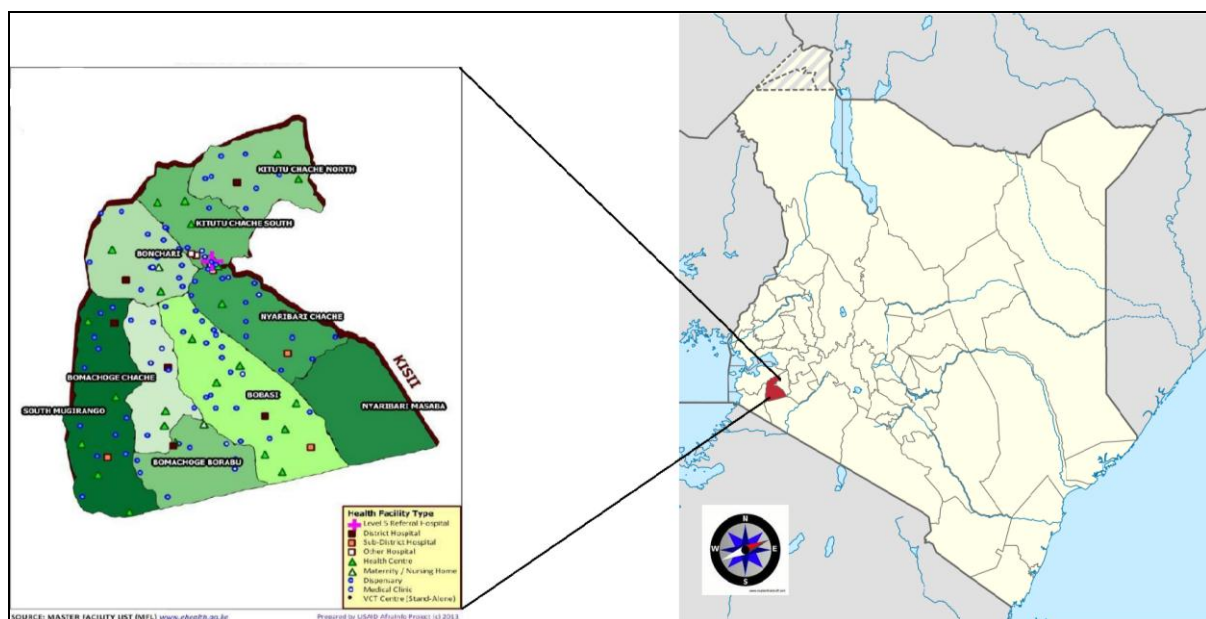


Fig 1: Kisii County Map showing the Nine (9) sub-Counties on the left and Figure 2: Map of Kenya showing the position of Kisii County

Kisii County is characterized by a hilly topography with several ridges and valleys. It can be divided into three main topographical zones. The first zone cover areas lying below 1,500m above sea level located on the western boundary and include parts of Suneka, Marani and Nyamarambe. The second zone covers areas lying between 1500-1800m above sea level located in the Western parts of Keumbu and Sameta divisions, Eastern Marani and Gucha River basin. The third zone covers areas lying above 1800m above sea level in parts of eastern and southern Keumbu, Masaba and Mosoch. The most notable features of these topographical zones are hills of Sameta (1970m), Nyamasibi (2170m), Kiong'anyo (1710m), Kiamwasi (1785m), Kiongongi, Kiombeta, Sombogo, Nyanchwa and Kegochi hills. The general slope of the land is from east to west. The county is dissected by permanent rivers which flow westwards into Lake Victoria. Among the notable ones are Kuja, Mogusii, Riana and Iyabe rivers. There are

also depressions and valleys.

The county does not have a gazetted forest; however, there are non-gazetted forests like Nyangweta, Ritumbe, Ndonyo and Nyansembe forests in Gucha South, Keboye hills in Kisii south, Sameta hills in Sameta, Nyacheki hills in Nyamache, Igorera and Ibencho hills in Kenyena, Taracha hill in Kisii central, Intamocha hill in Gucha and Emborogo forest in Masaba South. The total forest cover is approximately 228.4 ha [8]. The main forest products in the county are timber, electricity and construction poles, firewood, honey and medicinal products. It is important to note that Nyangweta, the largest of the eight designated government forests, has been greatly affected due to human activities. Therefore efforts to have the above forests gazetted need to be made through the forest department in the county and sensitization of the communities need to be enhanced on protection of forests.

The County exhibits a highland equatorial climate resulting into a bimodal rainfall pattern with average annual rainfall of 1500mm with the long rains between March and June while the short rains are received from September to November. The months of January and July are relatively dry. The maximum temperatures in the county range between 21°C – 30°C while the minimum temperatures range between 15°C – 20°C. The high and reliable rainfall coupled with moderate temperatures is suitable for growing crops like tea, coffee, pyrethrum, maize, beans and bananas as well as dairy farming.

Prompted by a disproportionately high HIV/AIDS prevalence in Kisii County in 2012 at 8.0%,^[2] the researchers set out to investigate intervention measures in place in combating the diseases. Earlier researches indicated that most people among the Gusii community seek traditional medicine for the management of many diseases including sexually related disease^[9].

Selection of the respondents and data collection

The research team comprised of a multidisciplinary group of professionals from pharmacognosy, medicinal chemistry, language and linguistics and communication experts. In addition, the researchers are residents of Kisii County and could therefore easily communicate in the local dialect with the study participants who were mainly from the Kisii community. Ethnobotanical survey was initially conducted over a period of three months between January–March 2019. During this time, reconnaissance visits were made in order to identify the legally registered herbalists in the County.

Selection of the herbalist was based on the willingness of the herbalists to voluntarily give information and interact with the researchers during consultative meetings. The meetings were participatory where their team leader who is a Ph.D holder in Medicinal Herbology was the facilitator. The team leader is also their trainer who operates a herbal clinic in Kisii County. There were fifteen (15) herbalists comprising of three (3) women and twelve (12) men aged between 35-70 years with different specialties.

Ethnobotanical data was collected using a structured questionnaire and open interviews within the areas of practice, which were the residential places of the herbalists. In other instances, data was collected at the clinic in Kisii town where the herbalists attend their continuous herbal education (CHE). Data collected was mainly on the medicinal plants used in the management of HIV/AIDS and its opportunistic infections in Kisii County. This also included data on the local names of the plants, their various ethnomedical uses and other uses and the part of the medicinal plant used. In addition, information on the methods of preparation of the herbal materials and mode of administration to the patient was also collected.

The respondents provided nine (9) main plant samples to the research team which had been collected from the natural habitat or from home gardens used in HIV/AIDS and its opportunistic infections management. These plants were then photographed and sample specimens were collected. The plants were further identified by a botanist at Kenyatta University, School of Pharmacy and voucher specimens (GGAM/19/001-009) were deposited at the University's herbarium for future reference. Voucher specimen data included the botanical names, voucher number, the local name of the plant, date of collection, collectors and county where collected, locality, habitat type, habit and extent of population and miscellaneous data which included color of flowers, size and shape of fruits). Information collected was then compared

with previous studies that had been carried out on the same plants to corroborate the claims with the phytochemicals constituents of the plants.

Ethical consideration

To anchor the research process within acceptable ethical standards, clearance was given by Chuka University Institutional Ethics Review Committee under approval Number CU/IERC/NCST/1853. Further, Research Permit Number NACOSTI/P/18/50245/24190 was granted by the National Commission for Science, Technology and Innovation (NACOSTI). First, the researchers explained the aims and objectives of the study to solicit the consent and co-operation of the respondents. The researchers further explained on the immense value which each participant's contribution will make in recording of traditional knowledge on the ethnomedicine in the County.

Results

Demographic profiles of the respondents

A total of fifteen (15) herbalists were interviewed and their ages ranged between 35 and 70 years. Regarding gender, there were 3 female accounting for 20% of the respondents and 12 male (80%). Academically, two (2) were Ph.D holders with one in Medicinal Herbology and the other in Medicinal Biochemistry. Two (2) were diploma holders in herbal medicine, one (1) holds a certificate in primary education (P1-Teacher) and the rest were holders of a certificate in herbal medicine. Besides formal education, the respondents indicated various ways in which they gained herbal knowledge. Majority (75%) indicated that they gained knowledge through apprenticeship from their experienced relatives, 20% through own observation and interest and 5% through induction from mobile practitioners. All are registered by the Kenya Herbalists Society. At the County, they are also members of the Abagusii Traditional Healers Association (ATHA). The respondents had diverse experience in ethnomedicine. Their areas of specialization included: heart related diseases referred to as *Entemi* in *EkeGusii*, wounds (*Amakwege*), epilepsy (*Endurume*), infectious diseases (*Amarwaire yo'ogotambokera*) including HIV/AIDS (*Enyamoreo*) and sexually transmitted diseases (STIs) (*Amarwaire asoni*). Other specialties included diseases of the internal organs (*Enyaroima*), typhoid and amoeba (*Oborwaire bwa'mache*), respiratory diseases-asthma (*Oborwaire bwe'keera/Egekuba gegochura/Egekuba egeku*), arthritis (*Oborwaire bwa'amauga*), surgery (*Okobara*), childhood ailments and non-communicable diseases like malaria and fever. However, most of them reported that they manage other diseases other than the diseases in their line of specialization. The researchers also noted that the respondents had a longstanding experience in ethnomedicine with the least being nine (9) years of practice and the longest with fifty (50) years of practice.

Habit, habitat and diversity of the medicinal plants

The plant biodiversity in the County range from large to stunted trees, shrubs, herbs and others are succulents. Four (4) of the medicinal plants used in the management of HIV/AIDS in the County were shrubs, three (3) were trees and two (2) were herbs. These plants are found throughout the diverse ecosystem which is spread across the three topographical zones and valleys. However, the researchers noted that most indigenous trees in the County have been cleared to pave way for food and cash crops and also for planting exotic trees

which is now a common landscape feature in the County. This has necessitated the herbalists either to collect herbal materials from the neighboring counties of Nyamira and Narok or domesticate the herbs in their medicinal gardens. Out of the fifteen (15) herbalists interviewed, three (3) have herbal gardens for demonstrations consisting of trees, shrubs and herbs. However, all of them reported that they have at least some of the herbs they use at their home gardens. One reported that some herbal materials were being obtained from China. Data collected indicated that the nine (9) medicinal plants used for HIV/AIDS management belong to eight (8) different families. These were Cactaceae, Liliaceae, Apocynaceae, Malvaceae and Lamiaceae. The others were Mrysinaceae, Rosaceae and Meliaceae.

Plant parts used and methods of preparation

The herbs were reported to be formulated in two oral dosage forms namely liquid and powder. To prepare *Opuntia ficus-indica*, thorns on the succulent branches (cladodes) are removed, then the branch is washed and cut into small pieces which is then boiled in water until boiling point. The content is left to soak for 6-7 hours before being decanted. Similarly, the leaves of *Aloe vera* are washed, cut into small pieces and then boiled in water. The mixture is left to stand for 6-7 hours before decanting. For the other six (6) plants namely *Carissa edulis*, *Triumfetta macrophylla*, *Clerodendrum myricoides*, *Leonotis nepetifolia*, *Maesa lanceolata* and *Prunus africanus*, the outer coat of the roots (epidermis) is removed, dried under the shade and then ground into powder. *Azadirachta indica* boiled leaves are used for prophylaxis.

The two dosage forms are then mixed with honey to form a thick paste. Honey is added for energy giving and in promoting wound healing. The herbalists also use honey to

dress and sterilize wounds, reduce pain and odour. The dosage prescribed to the patient is determined by the age and weight of the patient.

Traditional medical practice in Kisii County

Like many traditional medical practices, in Kisii County, the herbalists' approach towards healing is holistic and constitutionally based hence approach to diagnosis and treatment is flexible. They employ patient centered approach in disease management. Emphasis is placed on strengthening and building up the body's inherent resistance to diseases. Diet, exercise, massage, hydrotherapy and prayer among other therapies were also prescribed.

The study ascertained that management of HIV/AIDS using herbal medicines involved targeting immune boosting and eight (8) venereal diseases which include hepatitis B, genital herpes, syphilis, chlamydia, gonorrhoea, trichomoniasis, human papilloma virus (HPV) and pelvic inflammatory disease. In addition, they also manage HIV/AIDS opportunistic infections. The common opportunistic infections they manage include wounds, fever, lack of appetite, cryptococcal meningitis (CM), tuberculosis (TB), skin infections and rashes, diarrhea, cold and cough. These diseases are not confirmed through laboratory diagnosis but identified through association of clinical symptoms as perceived by the traditional healers who have accumulated knowledge on disease identification through clinical signs. For all these ailments, they use combinatorial therapy for purposes of providing synergy by combining the eight (8) plant materials and *Azadirachta indica* is prescribed for prophylaxis (Table 1). A mixture of several other herbs for the opportunistic infections are also added.

Table 1: List of study plants, their phytoconstituents and reported ethnomedical uses

Botanical (Family) name of plant and Voucher No.	Local (common) name and habit	Use by respondent and toxicology	Pharmacological/Phytochemical studies (Literature review)
<i>Opuntia ficus-indica</i> (Cactaceae) Voucher specimen GGAM/19/001	<i>Ebao</i> (Cactus pear) Herb	Wounds, leaf concoction for wellness, fruits for promoting health. Orally, well tolerated but may cause mild diarrhea and nausea.	To treat various types of potential damage to vital organs due to the protective activities and nutritional values ^[10] Nutritional content: carbohydrates, fiber and protein, cellulose, hemicelluloses, pectin, lignin, gums ^[11-12] Phytochemicals: total phenolic and polyphenolic compounds; aromadendrin, taxifolin, dihydroquercetin, isorhamnetin, vitexin, kaempferol, quercetin, betalains, betacyanins, rutin and isorhamnetin, myricetin, orientin and derivatives of pyrone ^[11]
<i>Aloe vera</i> (Liliaceae) Voucher specimen GGAM/19/002	<i>Omogaka</i> (Aloe) Herb	Malaria, wellness, vigor, wound healing, burns, intestinal problems, allergies, improving immunity, cryptococcal meningitis (CM), AIDS and skin infections. No adverse effect reported.	Antiviral activity: Acemannan for herpes simplex; lectins for inhibiting cytomegalo virus proliferation; aloin effective against varicella zoster, influenza and pseudo-rabies viruses Anthraquinone aloin inactivates herpes simplex, varicella zoster and influenza viruses ^[13] . ≈98% water, polysaccharides, sugars, minerals, proteins, lipids and phenolic compounds. Vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids ^[13] .
<i>Carissa edulis</i> (Apocynaceae) Voucher specimen GGAM/19/003	<i>Omonyangateti</i> (Arabic num-num) Shrub	Gonorrhoea, syphilis, herpes simplex, malaria, pain and chest complaints and boosting appetite. No adverse effect reported.	STI, chest complaints, rheumatism, headache, gonorrhoea, syphilis, rabies and as a diuretic, cardiotoxic activity and prolonged blood pressure lowering effect ^[5,14] Cardiac glycoside; lignans- biological effects; antimutagenic, antiviral, cathartic, allergenic and antitumor activities; flavonoids-antioxidants and antiviral; steroids and triterpenes- hepatoprotective, anti-inflammatory, anti-HIV and anti-hyperlipidemic activities; coumarins- Coumarins and their derivatives exert anti-coagulant, anti-tumor, anti-viral, anti-inflammatory and antioxidant effects, as well as anti-microbial and enzyme inhibition properties ^[15] .

<i>Triumfetta macrophylla</i> (Malvaceae) Voucher specimen GGAM/19/004	<i>Ekemiso</i> (Burbark) Shrub	Gynecological pain	
<i>Clerodendrum myricoides</i> (Hochst) R. Br. & Vatke (Lamiaceae) Voucher specimen GGAM/19/005	<i>Omonyasese</i> (Blue glory bower or blue butterfly bush) Shrub	Gonorrhoea, TB, malaria, wound dressing, hemorrhoids, asthma, pneumonia, dry cough and general malaise.	STI ^[5] , the bark of the plant is used for abdominal pains, malaria and against snake bites ^[16] , Root decoction is also applied as antidotes in poisonings ^[17] , The root and the whole plant parts are used to treat leprosy and hemorrhoids, respectively ^[18] .
<i>Leonotis nepetifolia</i> (L.) R. Br. (Lamiaceae) Voucher specimen GGAM/19/006	<i>Risibi ribariri</i> (Klip dagga, Christmas candlestick, or lion's ear) Shrub	Leaf and stem decoction or inhalations used for cough, common cold, influenza, bronchitis, wound healing and asthma. Infusions made from flowers and seeds, leaves and stems used as tonics for tuberculosis, jaundice, muscular cramps, high blood pressure, diabetes, viral hepatitis, dysentery, and diarrhoea. Tea made from the whole plant is used for arthritis, piles, bladder and kidney disorder, obesity, cancer and rheumatism; leaves and stems decoction are applied topically as a treatment for eczema, skin infections and itchiness. Generally the plant was reported to have a general tonic, dermatological, hypertension, anti-inflammatory, pain and wound healing properties.	Leaves, flowers and sepals contain essential oils mostly constituted by monoterpenoids and sesquiterpenoids and labdane diterpenes ^[19] .
<i>Maesa lanceolata</i> (Myrsinaceae) Voucher specimen GGAM/19/007	<i>Omoterere</i> (False Assegai) Small tree ≈5m high	Venereal infections	Phytochemicals: cardiac glycosides, alkaloids, flavonoids, saponins, tannins, terpenoids and anthraquinones.
<i>Prunus africana</i> Rosaceae Voucher specimen GGAM/19/008	<i>Omoiri</i> (Red stinkwood) Tree	The bark is a remedy for enlarged prostate, fever, malaria, wounds, stomach ache, kidney diseases, gonorrhoea, antiviral, antimicrobial and as appetite booster.	Phytochemicals: cyanogenic glycoside amygdalin, phytosterols such as sitosterol, sitostenone, campesterol, and aucosterol; pentacyclic triterpenoids (mainly of the oleanolic and ursolic acid type), coumarin and flavanoids.

Discussion

Ethno-medicine among the Kisii community has been an integral component of their culture from time immemorial. Historically, the Kisii community had an integrated health system that comprised of both herbal treatment and surgery. The herbalists treat common ailments like fever, common cold, diarrhea, malaria, ulcers, arthritis, asthma, epilepsy, mental illness, infertility, diabetes, wounds, snake and insect bites, evil eyes and childhood diseases. The surgeons perform simple to complicated surgery like brain surgery (craniotomy), tonsillectomy and fixing bone fractures. Then they apply herbs on the operated part to aid in healing. One of the respondents that the research team interviewed is a renowned traditional surgeon from the County. Currently, traditional medicine is viewed as complimentary/alternative to biomedicine in the County.

Earlier ethnopharmacological surveys among the Kisii community have reported the used of a diverse range of plant species used in the management of a number of ailments^[19, 20-22]. This high reliance on ethnomedicine demonstrates a strong cultural belief system and the quick and free accessibility to medicinal plants. Similar reasons have been reported for the use of medicinal plants among several other communities^[5, 6, 23, 24].

Comparing with other ethnopharmacological surveys that have been conducted in Kenya^[23, 25], there was gender parity on the practising of herbal medicine in the County where the male healers dominated the practice. This finding was surprising because a study conducted in the neighbouring

Nyamira County where other people of the Kisii community reside revealed that majority of the professional healers were women. According to the report, women are believed to be health care givers^[9]. However, over 80% of the healers from the two counties were above 50 years with more than 10 years of experience. This was a positive indicator since healing profession is apprenticeship which require long experience especially in diagnosis and therapy of the patients. In addition, knowledge and skills in medicinal plant identification and therapeutic use is enhanced with time. This was observed from the study where the herbalists were relating the medicinal plant morphology with the disease or the part of the body they treat. It was clear that they understood the symptoms of the diseases they were managing. However, HIV/AIDS patient are first confirmed from the hospitals before they seek the services of the traditional healers.

Despite HIV/AIDS programs in the County being free, the respondents indicated that about 25-30% of the confirmed cases seek complementary/alternative medical services because of stigma and discrimination from their family members or the community. One of the respondents reported that some of his clients find it difficult to disclose their HIV status. The study noted that some of the clients were combining antiretroviral (ARV) drugs with herbal medicine. Earlier studies have reported herb-drug interactions through various mechanisms. For instance the herbs may alter the drug's pharmacokinetics leading to an increase or a decrease in plasma concentrations, thus altering the therapeutic outcomes.

The interactions may also lead to several other short or long term adverse effects [26-29].

Level of education was not a qualification to practice as a herbalist. However, all the respondents had basic education with two of their members being Ph.D holders in medical related disciplines. This was advantageous since they could scientifically relate the use of the medicinal plants and their phytoconstituents. Additionally, they were offering continuous herbal education to the other herbalists besides educating them on good handling practices of the herbal materials to avoid contamination.

A cross-check in the literature showed that apart from the medicinal plants reported in this study having antimicrobial activity, most of them were used in the management of STI and HIV/AIDS opportunistic infections in other settings. For instance [5] documented the use of *Clerodendrum myricoides* decoction administered per rectum (3%) in the management of chronic and recurrent cases of STIs among the Samburu community of Kenya. The plant roots are taken when in powder form similar to the current study and not while wet to avoid toxicity. However, this contrasted [30] with a report from Ethiopia where the use of *Clerodendrum myricoides* leaves did not exhibit toxicity indicating that toxicity is in the roots. The antibacterial and antifungal activity of the same plant has been reported in a study done in Ethiopia [31]. In African traditional medicine, *Prunus africana* has been reported to treat innumerable diseases including diarrhea, epilepsy, arthritis, hemorrhage, and hypertension [32, 33, 34].

Opuntia species have been used for centuries as food resources and in traditional folk medicine because of their nutritional properties and their benefit in chronic diseases, particularly diabetes, obesity, cardiovascular diseases, wound healing and cancer. Analysis of the phytochemical composition of *Opuntia* spp revealed the presence of antioxidants (flavonoids, ascorbate), pigments (carotenoids, betalains) and phenolic acids. Other phytochemical components present include biopeptides, soluble fibers and vitamins [35]. The presence of these phytoconstituents could be attributed to the claimed medicinal properties of *Opuntia ficus-indica* in the management of HIV's opportunistic infections.

Carissa edulis which is commonly known as the "Magic herb" was another plant of interest in the current study. Previously, it has been cited in literature as a medicinal remedy for STI among the Samburu community of Kenya [5]. The herb has also been used for the treatment of gonorrhoea, breast cancer, headache, chest pains and malaria among some communities in Kenya [36-39]. Its pungent root and leaf have been referred in other studies to be used locally for a variety of medicinal purposes. These include the treatment of HIV/AIDS symptoms [39, 40], tuberculosis [41], chest complaints, rheumatism, headache, gonorrhoea, syphilis, rabies, as diuretic, snake bite, evil eye, malaria [42], epilepsy, abdominal pain and chronic joint pain [43, 44]. Similar to the current study, the root bark was used together with other plants in the management of HIV/AIDS and its opportunistic infections.

Several studies that have been conducted on *Leonotis nepetifolia* verify that the plant has many reputed traditional medicinal applications. Antibacterial, antiviral, antifungal, anticonvulsant, anxiolytic, anticarcinogenic, analgesic, antidiarrheal, antidiabetic, antiplasmodial and anthelmintic activities have been cited from previous studies [19]. This justifies the inclusion of the herb in the current study in the management of HIV/AIDS and its opportunistic infections.

Conclusion

In conclusion, the results of the survey revealed that a combination of eight medicinal plants are used in the management of HIV/AIDS in Kisii County. Although no serious toxic effects were reported, safety standards need to be instituted through good manufacturing practices so that the traditional healers may safely and effectively administer the herbal remedies. Unfortunately, despite the promising data reported on the eight plants in the management of HIV/AIDS and the opportunistic infections, the main parts of the plants used are the roots which pose a danger to the sustainability of the medicinal plants. As a result, there is need for advanced propagation techniques to urgently increase the population of these plants beyond the current level of small scale domestication so as to meet the increasing demand for these plants. The isolation of the metabolites responsible for the plants' activities is underway and data on preclinical and clinical trials on the eight herbs and their extracts will be of fundamental importance.

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References

1. WHO. HIV/AIDS Data and Statistics, 2019.
2. The Joint United Nations Programme on HIV/AIDS. 90-90-90 Ambitious treatment target to help end the AIDS epidemic, JC, 2014, 2684. http://www.unaids.org/sites/default/files/media_asset/90-90-90_en_0.pdf
3. UNAIDS. Global HIV & AIDS Statistics fact sheet, 2020.
4. NACC. Kenya HIV Estimates. Ministry of Health Report, Nairobi, Kenya, 2018.
5. Kamanja IT, Mbaria JM, Gathumbi PK., Mbaabu M, Lanyasunya A, Gakuya DW *et al.* Medicinal Plants Used in the Management of Sexually Transmitted Infections by the Samburu Community, Kenya. *Int. J. Pharm. Res.*, 2015, 7(2).
6. Nankaya NG, Lukhoba C, Balslev H. Medicinal Plants of the Maasai of Kenya: A Review. *Plants*, 2020, 9(44).
7. Kenya National Bureau of Statistics. Kenya Population and Housing Census. Government of Kenya, Nairobi, (2019).
8. <https://www.kisii.go.ke/index.php/county-profile/socio-economics/item/1590-forestry-and-agro-forestry>.
9. Omwenga EO, Hensel A, Shitandi A, Goycoolea FM. Ethnobotanical survey of traditionally used medicinal plants for infections of skin, gastrointestinal tract, urinary tract and the oral cavity in Borabu sub-county, Nyamira county, Kenya. *J. Ethnopharm.* 2015; 176:508-514
10. Anouar BS, Brahmi D, Ilhem R, Amani S, Sana N, Nacim Z *et al.* Phytochemical, antioxidant and protective effect of cactus cladodes extract against lithium-induced liver injury in rats. *Pharm. Biol.* 2017; 55(1):516-525.
11. Osuna-Martínez U, Reyes-Esparza J, Rodríguez-Fragoso L. Cactus (*Opuntia ficus-indica*): A Review on its Antioxidants Properties and Potential Pharmacological Use in Chronic Diseases. *Nat. Prod. Chem. Res.* 2014;

- 2:153. doi:10.4172/2329-6836.1000153
12. Chiteva R, Wairagu N. Chemical and nutritional content of *Opuntia ficus-indica* (L.). Afr. J. Biotech. 2013; 12(21):3309-3312.
 13. Marta Sánchez, Elena González-Burgos, Irene Iglesias Pilar Gómez-Serranillos. Pharmacological Update Properties of *Aloe Vera* and its Major Active Constituents. *Molecules*, 2020.
 14. Fatima A, Singh P, Agarwal P, Irchhaiya R, Alok S, Verma A. Treatment of various diseases by *Carissa spinarum* L.: A promising shrub. Int. J. Pharm. Sci. Res. 2013; 4:2489-2495
 15. Al-Youssef HM, Hassan WHB. Phytochemical and Pharmacological aspects of *Carissa edulis* vahl a Review. Int. J. Curr. Res. Chem. Pharma. Sci. 2014; 1(9):12-24.
 16. Persson E. Clerodendrum flora of Ethiopia and Eritrea. In: Hedberg, I., Emsermu kelbessa, Edwards, S & Sebsebe Demissew (eds.), *Gentianaceae to cyclocheilaceae*. Addis Ababa, Ethiopia; Uppsala, Sweden, 2006, 525-526.
 17. Getahun A. Some common medicinal and poisonous plants used in Ethiopia folk medicine. Addis Ababa University, 1976, 62-63p.
 18. Tadesse M. Some Medicinal Plants of Central Shewa and Suth Western Ethiopia. *Ethiopian Journal of Science*. 1986; 9:143-167.
 19. Jackson de Menezes Barbosa, Noelly Bastos Cavalcante, David Marrero Delange, Jackson Roberto Guedes da Silva Almeida. A review of the chemical composition and biological activity of *Leonotis nepetifolia* (Linn.) R. Br. (lion's ear 2018; *Plantas medicinales*. 23, Número 4 (2018) > Almeida, 2018.
 20. Nyamwamu NC, Nyamwamu LB. An inventory of some medicinal plants used by abagusii traditional healers of South West Kenya. *J. of Medicinal Plants Studies*. 2020; 8(3):127-135.
 21. Sindiga I, Nyagotti-Chacha C, Kanunah MP. *Traditional Medicine in Africa*, East African Publishers, 1995.
 22. Nyamwaya D, *African Indigenous Medicine*. Nairobi: KEMRI, 1992.
 23. Mbuni YM, Wang S, Mwangi B., Mbari N.J. Musili P.M., Nyamolo O.W *et al*. Medicinal Plants and their traditional uses in local communities around Cherangani Hills, Western Kenya. 2020; *Plants* 9, 331. doi: 10.3390/plants9030331.
 24. Maroyi A, Cheikhyoussef AA. comprehensive study of medicinal plants used in rural areas of Namibia and Zimbabwe. *Indian J. Tradit. Knowl*. 2015; 14:401-406.
 25. Kigen G, Kamuren Z, Njiru E, Wanjohi B, Kipkore W. *Ethnomedical Survey of the Plants used by Traditional Healers in Narok County, Kenya 2019*; *Complement. Altern. Med*. 2019; 2019:8976937
 26. Chen XW, Serag ES, Sneed KB, Liang J, Chew H, Pan SY *et al*. Clinical herbal interactions with conventional drugs: from molecules to maladies. *Curr. Med. Chem*. 2011; 18:4836-4850.
 27. Hu Z, Yang X, Ho PC, Chan SY, Heng PW, Chan E *et al*. Herb-drug interactions: a literature review. *Drugs*. 2005; 65:1239-1282.
 28. Izzo AA, Ernst E. Interactions between herbal medicines and prescribed drugs: an updated systematic review. *Drugs*. 2009; 69:1777-1798.
 29. Tsai HH, Lin HW, Simon Pickard A, Tsai HY, Mahady GB. Evaluation of documented drug interactions and contraindications associated with herbs and dietary supplements: a systematic literature review. *Int. J. Clin. Pract*. 2012; 66:1056-1078.
 30. Yineger H, Yewhalaw D, Teketay D. Ethnomedicinal plant knowledge and practice of the Oromo ethnic group in southwestern Ethiopia. *J. Ethnobiol. and Ethnomed*. 2008; 4:11.
 31. Abebe D. The role of medicinal plants in healthcare coverage of Ethiopia, the possible benefits of integration In: *Conservation and sustainable use of medicinal plants in Ethiopia*, Proceedings of the National workshop, 28 April – 01 May 1998. Edited by: Zewdu M. Addis Ababa. Demissie A: Institute of Biodiversity Conservation and Research, 2001, 6-21.
 32. Jimu L. "Threats and conservation strategies for the African Cherry (*Prunus africana*) in its natural range-a review," *J. Ecol. Nat. Env*. 2011; 3(4):118-130.
 33. Nyamai DW, Mawia AM, Wanbua FK, Njoroge A, Matheri F. Phytochemical profile of *Prunus africana* stem bark from Kenya. *J. Pharmacognosy Nat. Prod*. 2015; 1:110, 2015.
 34. Ngule MC, Ndiku MH, Ramesh F. Chemical constituents screening and in vitro antibacterial assessment of *Prunus africana* bark hydromethanolic extract. *J. Nat. Sc. Res*. 2014; 4(16):85-90.
 35. María del Socorro Santos Díaz, Ana-Paulina Barba de la Rosa, Cécile Héliès-Toussaint, Françoise Guéraud, Anne Nègre-Salvayre. *Opuntia* spp.: Characterization and Benefits in Chronic Diseases 2017; *Oxidative Medicine and Cellular Longevity*. 2017; Article ID 8634249:17. <https://doi.org/10.1155/2017/8634249>
 36. Nedi T, Mekonnen N, Urga K. Diuretic effect of the crude extracts of *Carissa edulis* in rats. *J. Ethnopharmacol*. 2004; 95(1):57-61.
 37. Bussmann RW, Genevieve GG, John S, Rumac L, Kimaren K, Nick W *et al*. Plant use of the Maasai of Sekenani Valley, Maasai mara, Kenya. *J. Ethnobiol. Ethnomed*. 2006; 5(2):22.
 38. Tolo FM, Rukunga GM, Muli FW, Njag, EN, Njue, W, Kumon K *et al*. Anti-viral activity of the extracts of a Kenyan medicinal plant *Carissa edulis* against herpes simplex virus. *J. Ethnopharmacol*. 2006; 104(1-2):92-99.
 39. Nagata JM, Jew AR, Kimeu JM, Salmen CR, Bukusi EA *et al*. Medical pluralism on Mfangano Island: use of medicinal plants among persons living with HIV/AIDS in Suba District, Kenya. *J Ethnopharmacol*. 2011; 135:501-509.
 40. Lamorde M, Tabuti JR, Obua C, Kukunda-Byobona C, Lanyero H *et al*. Medicinal plants used by traditional medicine practitioners for the treatment of HIV/AIDS and related conditions in Uganda. *J Ethnopharmacol*. 2010; 130:43-53.
 41. Abdu KB, Rumah MM, Khan ME. Antimicrobial activity and phytochemical screening of extracts from the root bark of *Carissa edulis*, against human / animal pathogens. *Cont. J. Trop. Med*. 2008; 2:1-6.
 42. Teklehaymanot T, Giday M, Medhin G, Mekonnen Y. Knowledge and use of medicinal plants by people around Debre Libanos monastery in Ethiopia. *J Ethnopharmacol*. 2007; 111:271-283.
 43. Kamatenesi MM, Acipa A, Oryem-Origa H. Medicinal plants of Otwal and Ngai Sub Counties in Oyam district, Northern Uganda. *J Ethnobiol Ethnomed*. 2011; 7:7.
 44. Wambugu SN, Mathiu PM, Gakuya DW, Kanui TI, Kabasa JD *et al*. Medicinal plants used in the management of chronic joint pains in Machakos and Makueni counties, Kenya. *J. Ethnopharmacol*. 2011; 137:945-955.