Ethnomedical survey of plants used for the management of HIV and AIDS-related conditions in Mbulu District, Tanzania

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The aim of this Study was to document medicinal plants used in the management of HIV and AIDS-related conditions in Mbulu District. An ethnomedical survey was conducted using a semi-structured questionnaire. The main HIV and AIDS-related conditions considered during this study were; cough, frequent fevers, diarrhea, weight loss, oral thrush, genital warts, candidiasis, abscesses, skin rashes, shingles and venereal diseases. Literature survey was also carried out to compile supplementary data on ethnomedical used and pharmacological activities of the respective plants. Thirty seven plant species from 23 families were reported. The plant families with the highest number of documented species were Acanthaceae, Caesalpiniaceae, Compositae and Verbanaceae with three species each. Literature information on the 37 reported plant species showed that, 23 plants could be linked to supporting data on ethnomedical uses, 23 were related to biological activity and 12 had been reported to display varying activities against HIV-1. Sixteen identified medicinal plants recorded new ethnomedical uses related to HIV and AIDS-related conditions, while 8 and 16% of the plant species did not have any previously reported ethnomedical uses or pharmacological activities, respectively.

Key words: Medicinal plants, indigenous knowledge, HIV and AIDS-related conditions.

INTRODUCTION

Due to advances in the development of highly active antiretroviral therapy (HAART), HIV/AIDS has become a...
manageable chronic condition. However, HIV infection is still a disease of public health concern which in 2018 accounted for 770,000 deaths globally (WHO, 2018). Among reported worldwide HIV cases, more than 70% are from Sub-Saharan Africa. In Tanzania, the prevalence of HIV is about 5.1% and in 2017 it was estimated that 1.5 million people were living with HIV, 65,000 new infections were reported and a total of 32,000 AIDS-related deaths occurred (NBS, 2017; WHO, 2018).

The prevalence of HIV in Tanzania by region ranges from 0% in some areas of Unguja and Pemba to 11.4% in Njombe region (NBS, 2017). Manyara Region is currently among regions with low prevalence of HIV in Tanzania mainland. However, in 2002, Manyara Region was among the two regions with the highest prevalence of HIV based on prevalence estimated among blood donors (Tanzania, 2002). At that time, the highest prevalence was noted in Kagera (18.6%), followed closely by Manyara (17.5%) and Iringa (14.1%) regions. In the same year, the prevalence among females by region was highest in Manyara (19.8%), followed by Dar es Salaam (18.9%) and Iringa (18.4%) (Tanzania, 2002). However, currently the prevalence of HIV in Manyara Region is significantly lower than the national HIV prevalence with the most recent prevalence of 1.5% as per 2011-2012 HIV impact survey and 2.3% as per 2016-2017 HIV impact survey (NBS, 2017; Tanzania, 2011).

The World Health Organization (WHO) estimates that about three quarter of the population in some African countries still relies on medicinal plants for their primary health care (WHO, 2008). The great biodiversity in sub-Saharan Africa has provided the indigenous people with a range of plants that are used for traditional medicinal purposes. Mbula District in Manyara Region is inhabited by people of different tribes, particularly Iraqw’, Datooga and Hadzabe with reported use of herbal medicines for treatment and management of their health challenges (Patel and Mwamhanga, 2014; Qwarse et al., 2018). The Hadzabe are hunter-gatherers who live in the eastern rift valley in Northern Tanzania and for most of the time they have relied on natural resources (Marlowe, 2002). This remote area with poor infrastructure has not been extensively reached for the inventory of medicinal plants. The rural community is almost totally dependent on traditional medicine for their health care needs. It is therefore, reasonable to speculate that the use of alternative health seeking and coping strategies in Mbula, including the use of herbal therapies, may have contributed to the progressive reduction of HIV/AIDS prevalence.

Despite the huge biodiversity and the history of use of medicinal plants in Manyara Region, to the best of our knowledge, no study has documented plants used for the management of HIV and AIDS-related conditions. Therefore, the purpose of this study was to identify medicinal plants used for the management of HIV and AIDS-related conditions and to compile supplementary data on ethnomedical used and pharmacological activities of respective plants.

MATERIALS AND METHODS

Study area

Mbula District is one amongst the six districts in Manyara Region, northeastern Tanzania (Figure 1), with an estimated population of 320,279, according to the latest Tanzania National Census of 2012 (NBS, 2013). The district is bordered to the north by the Arusha region and lake Eyasi, to the east by the Babati rural district, to the south by the Hanang district, and to the west by the Singida region. People of different ethnicities inhabit this district, particularly Iraqw’ (also called the Wambulu) one of the earliest agro-pastoralists who migrated south from the region of Ethiopia to Tanzania. The other indigenous ethnic groups are the Hadzabe, living in Yaeda chini and the Datooga people. Local inhabitants engage mainly in agriculture, livestock keeping, farming activities and hunting. There are plantations of onions and wheat in many places of Manyara region which attract many business people from across the country and from neighboring countries. Seasonal open markets for livestock and the presence of the Haydom Lutheran hospital, which provides specialized medical care are among factors that attract people from other parts of the region and the country to visit the district.

Study design

This was a qualitative ethnomedical survey conducted in May 2019. This study design was selected as it offers opportunity for a homogeneous exploration, raise more issues through broad and open-ended inquiry (Choy, 2014). The study employed a purposive sampling method in which selection of respondents only included THPs recognized by Health authorities in the office of Mbula District Medical Officer (DMO). This was important to reduce the likelihood of interacting with fake or inexperienced THPs. Acknowledging the contribution of THPs in health care provision in Tanzania, the Ministry responsible for health is currently advocating registration of THPs through the offices of DMOs all over the country. The legitimacy of a THP is checked well before he/she is registered through the involvement of witnesses like neighbors, village and ward officials where the THP resides or has been practicing. During the conduct of this study, the coordinator from the office of the DMO responsible for the registration of THPs was engaged to locate the THPs, and kindly offered translation services when it was required.

Data collection

The study employed face-to-face interviews to document ethnomedical information about plants used for management of selected disease conditions mainly HIV and AIDS-related conditions using a semi-structured questionnaire. A narrative of symptoms helped in listing plants used by the THPs to treat HIV/AIDS-related conditions. The first sections of the questionnaire sought to gather demographic information about the THPs, and the conditions that the THPs are confident of treating/managing. The other sections aimed at documenting plants that are used to manage conditions/symptoms of HIV and AIDS-related diseases including; tuberculosis, Herpes zoster infection (commonly known as “mkanda wa jeshi” in Kiswahili and characterized by a pruritic rash around the chest or stomach), persistent cough, cough associated with chest pain, skin rashes, frequent fevers, chronic diarrhea, chronic wounds, genital warts and wasting.
Other conditions/symptoms probed were oral candidiasis/oral thrush, which the THPs recognize as “Utando wa mdomoni” in Kiswahili language and vaginal candidiasis. Other information solicited by the questionnaire included the common/local names of the plants, parts used, methods of preparation, dosage, frequency and duration of treatment and side effects. The study also considered and documented plants used for treatment of pneumonia (presented in Kiswahili language by the THPs as “Kichomi”).

Collection of voucher specimen of the listed plant species was done with the THPs and a botanist, Mr Selemani Haji, of the Department of Botany, University of Dar es Salaam to avoid misidentification. The voucher specimens are kept in the Herbaria of the Institute of Traditional Medicine, Muhimbili University of Health and Allied Sciences (MUHAS) and Department of Botany, University of Dar es Salaam in Tanzania.

Literature survey to support medicinal plant uses

Literature information on the collected medicinal plant species was compiled using different search engines including Google Scholar, Pubmed/Medline, Research Gate and Hinari. The plant’s name was used in combination with different keywords such as, ethnomedical, ethnopharmacology, ethnobotany, HIV, AIDS, antimicrobial, antibacterial, antifungal, anti-HIV, tuberculosis, Herpes zoster, oral candidiasis, sexually transmitted infections, cough, skin rashes, fevers, diarrhea, wounds, warts, oral thrush, weight loss, vaginal candidiasis etc. In this review, only articles written in English language were considered. The review covered the ethnobotanical and ethnopharmacological literature from 1989 to 2019.

Data analysis

Data were entered into Excel spreadsheet and summarized using descriptive statistics. The descriptive statistics were applied to identify the number and percentage of species, genera and families of medicinal plants. They were also applied to identify the percentage distribution of plant parts used and diseases treated by the identified medicinal plants. The graphs were plotted by GraphPad prism software version 8.

Ethical approval and consent to participate

This study was awarded Ethical clearance by the MUHAS institutional review board (Ethical clearance No. 2018-04-04/AEC/Vol. XII/87; Dated, 4th April 2018). Permission to conduct the study in Mbulu District was sought from all government authorities from the district to village level. All THPs gave prior informed consent before they were interviewed.

RESULTS

Socio-demographic characteristics of the THPs

The study interviewed six THPs from Mbulu District. Four of them were males and two were females. Six different wards of Mbulu District were visited for the survey including Gidhim, Labay, Endamilay, Masqaroda, Yaeda chini and Haydom. The wards were chosen purposively based on the availability of THPs recognized by the coordinators from the office of DMO responsible for handling matters related to THPs. The average age of the THPs interviewed was 61.3 ranging from 45 to 75 years. The average training time and experience of the study participants was 12.2 and 22.5 years respectively. Four of the six THPs reported to have gained their knowledge of traditional medicines from their parents and the remaining two reported to have learned from their fellow THPs and other people with previous knowledge on traditional medicines. Four of the THPs had an apprentice under them. The average number of patients attended by these THPs per month was 101 ranging from 4 to 360 patients. Five THPs reported to be attending patients coming from all over Tanzania. Details are summarized in Table 1.

General conditions treated by THPs

THPs are diverse in their professional skills and are sometimes specialized. In order to gain an insight in the overall expertise all THPs participating in this study were asked to mention disease conditions which they generally treat. All six interviewed THPs reported to be able to treat at least one type of cancer. The majority stated also being capable of treating other conditions including gonorrhea 5(83%), typhoid fever 5(83%) and syphilis 4 (67%).

HIV and AIDS-related conditions encountered by THPs

Most of the interviewed THPs were aware of the common symptoms of HIV related conditions including tuberculosis and candidiasis. The THPs reported that they often encounter several common symptoms of HIV/AIDS-related conditions including persistent cough (50%), cough and chest pain (66.7%), frequent fevers (66.7%), diarrhea (66.7%), skin rashes (66.7%), oral thrush (66.7%), genital warts (66.7%) and vaginal candidiasis (83.3%). However, patients complaining of weight loss were rarely attended by these THPs (16.7%).

Medicinal plant species documented

This study documented 37 plant species used in Mbulu for the management of a variety of human disease conditions, majority of which (81%) were for management of HIV and AIDS-related conditions (Figure 1). The plants represent 23 families and the families with the highest number of species documented were Acanthaceae, Caesalpinaceae, Compositae and Verbenaceae with 3 species each (Figure 2).

Out of the 37 reported plant species, 23 (62%) had related cited ethnomedical uses, 23 (62%) had scientifically proven related cited biological activity and 12 (32%) had been reported to have varying activities.
Table 1. Characteristics of the interviewed THPs.

| THPs | Gender | Age | Marital status | Ward       | Place of birth (District) | Education level | Knowledge gained from | Training time | Duration of practice | Training others | Estimated number of patients served per month | Patients from | Type of patients          |
|------|--------|-----|----------------|------------|---------------------------|-----------------|----------------------|---------------|----------------------|----------------|---------------------------------------------|---------------|---------------------------|
| 1    | F      | 60  | Married        | Gidhim     | Mbulu                     | No formal education | Mother               | 5             | 10                   | Yes            | 20                           | All over Tanzania | Children and adults       |
| 2    | M      | 45  | Married        | Labai      | Karatu                    | No formal education | THP                  | 2             | 15                   | No             | 12                           | All over Tanzania | Children and adults       |
| 3    | F      | 69  | Married        | Endamila   | Babati                    | Primary education  | Mother               | 20            | 30                   | Yes            | 150                          | All over Tanzania | Children and adults       |
| 4    | M      | 75  | Married        | Maskaruda  | Mbulu                     | Primary education  | Father and others    | 6             | 21                   | Yes            | 4                            | All over Tanzania | Children and adults       |
| 5    | M      | 60  | Married        | Yaeda chini| Mbulu                     | Primary education  | Father               | 20            | 40                   | No             | 60                           | Manyara region       | Children and adults       |
| 6    | M      | 59  | Married        | Haydom     | Babati                    | Primary education  | Several people        | 20            | 19                   | Yes            | 360                          | All over Tanzania | Children and adults       |

against HIV-1 (Table 2), while 8 and 16% species did not have any previously reported ethnomedical uses or pharmacological activities, respectively. About 44% of the plant species recorded new ethnomedical uses related to HIV and AIDS-related conditions. Some of these plants include *Conyza pyrrhopappa* Sch. Bip. ex A.Rich for persistent cough, *Croton megalocarpus* Hutch for candidiasis, *Croton cheffleri* Pax for cough and STIs, *Embelia schimperi* Vatke for HIV and STIs, *Ensete ventricosum* (Welw.) Cheesman for genital warts, candidiasis, tuberculosis and STIs, *Hymenodictyon floribundum* (Hochst. & Steud.) B.I.Rob for vaginal candidiasis, *Justia subsessilis* Oliv for STIs, *Balanites aegyptica* (L.) Delile for chronic wounds, *Ozoroa insignis* Delile for gonorrhea and *Teclea simpliformis* Thonn for diarrhea.

**Plant part used, dosage forms and routes of administration**

The most frequently used plant parts by the THPs were roots (58.1%) whereby 37.2% use root barks and 20.9% reported to use whole roots. The other plant part used is stem bark (23.3%) followed by leaves (11.6%) (Figure 3). The main method of preparation used by the THPs was decoction (52%), followed by dry powder (38.1%) (Figure 4). The methods of drug administration were oral application (81.1%) and topical application, mainly used for wounds and other skin infections (19.9%).

**Disease conditions treated by the plants**

More than 20 different disease conditions are treated with the documented 37 plant species, including gonorrhea (35%), syphilis (35%), cough (30%), chronic wounds (30%) and oral candidiasis (24%), (Figure 5). Fifty nine percent (59%) of the reported plant species were indicated for more than one conditions; *Elaeodendron buchananii* (Engl) Verdc and *Embelia schimperi* Vatke were indicated for five conditions, *Zanthoxylum chalybeum* Engl was indicated for six conditions, *Ozoroa insignis* Delile and *Croton cheffleri* Pax were indicated for eight conditions, *Ximenia americana* L, *Ximenia caffra* Sond. and *Zanha africana* (Radlk) Exell were indicated for ten conditions and *Ensete ventricosum* (Welw.) Cheesman was indicated for twelve conditions.

**DISCUSSION**

The study reports 37 plant species which are used in the management of various conditions related to HIV/AIDS, of which 12 (32%) are previously reported to have anti-HIV activity, including *Balanites aegyptica* (L.) Delile, *Barleria eranthemoides* R.Br. ex C.B.Clarke, *Cassia abbreviata* subsp. *beareana* (Holmes) Brenan, *Erythrina abyssinica* DC, *Lippia javanica* L, *Pappea capensis* Eckl & Zeyh, *Plectranthus barbatus* Andrews, *Plumbago zeylanica* L, *Terminalia sericea* Burch. ex DC, *Warburgia ugandensis* Sprague, *Ximenia Americana* L and
Figure 1. Map showing the location of Mbulu District in Manyara Region, Tanzania. The map was originally generated using ArcGIS software version 10.7.1 (https://www.esri.uconn.edu/software/arcgis-student/).

Ximenia caffra Sond (Chothani and Vaghasiya, 2011; Kapewangolo et al., 2013; Leteane et al., 2012; Maregesi et al., 2010; Maroyi, 2014; Mohammed et al., 2012; Mujovo et al., 2008; Mulauldi et al., 2011; Rukunga et al., 2002; Tshikalange et al., 2008). The majority of the plants with reported anti-HIV activity were not collected from Tanzania. Barleria eranthemoides whose methanolic extract exhibited anti-HIV activity (IC50 value 2.1 μg/ml) was collected from Bunda district in Tanzania, not too far away from the Manyara Region (Maregesi et al., 2010; Maregesi et al., 2007). Barleria eranthemoides recorded the highest anti-HIV activity of the 50 plant extracts obtained from 39 different plant species collected from Bunda district, Tanzania and tested for anti-HIV-1 activity (Maregesi et al., 2010).

C. abbreviata and Plumbago zeylanica L. were among 10 plants ethnobotanically identified in Botswana and tested by our collaborators for anti-HIV activity in recent years. Both plants were among 3 plants with the highest ability to inhibit HIV-1c (MJ4) replication as measured by p-24 antigen Elisa kit (Leteane et al., 2012). Their study revealed that C. abbreviata subsp. beareana (Holmes) Brenan inhibited HIV-1c in a concentration dependent manner but the activity of P. zeylanica L. was linked to its tannin content. They also tested another plant Cassia sieberiana which is in the same genus as C. abbreviata subsp. beareana (Holmes) Brenan and had the highest ability to inhibit HIV-1c replication among the 10 tested plants in a concentration dependent manner. During the survey in Manyara other plants from the Cassia genus
were also reported and collected which include *Cassia didymobotrya* and *Cassia singueana*. *C. didymobotrya* has been reported to have no anti-HIV activity as it failed to protect the MT-4 cells from HIV cytopathy measured by MTT (Cos et al., 2002). However, there are no reports on anti-HIV activity of the other plant *Cassia singueana*. In Mbulu, Tanzania, *C. abbreviata* is mixed with several other plants for treatment of diarrhea and some of these plants have been proven scientifically to have varying antimicrobial activities including anti-HIV-1 activity. These plants include *Elaeodendron buchananii*, *Ozoroa insignis*, *Ximenia americana* and *Zanha africana*. *Ximenia americana* has been reported to have ability to inhibit HIV-1 replication (Maroyi, 2014). Therefore, there is a need to test the individual plants and combinations to see if the combinations will have improved antimicrobial and/or anti-HIV activity.

High percentage of the reported plant species (62%) had similar cited ethnomedical uses elsewhere and 62% have similar proven biological activities. All interviewed THPs in Mbulu reported to have ability to treat cancer and majority reported to be able to treat STIs (STIs), typhoid fever and brucellosis, diseases which are relevant in their area. Therefore, the results are indicative of how strong the THPs in Mbulu district are managing infections and cancers. This is supported by the big number of patients these THPs are receiving and attending per month. Some other reported plant species have not been screened for anti-HIV activity but some species from the same genus have been tested and found to have anti-HIV activity. A good example is *Vernonia glabra*, used in Mbulu for management of STIs and is confirmed to have weak antimalarial and antimicrobial activity (Frank, 2012; Kitonde et al., 2012; Ramadhani et al., 2015) but has no reports on anti-HIV activity. However, *Vernonia amygdalina* and *Vernonia*
Table 2. Plants used for management of selected conditions in Mbulu district, Manyara region.

| Scientific name (voucher specimen number) | Family name | Vernacular name (tribe) | Uses | Part used | Method of preparation and use | Previous ethnomedical use | Pharmacological activities |
|-----------------------------------------|-------------|-------------------------|------|-----------|-------------------------------|--------------------------|---------------------------|
| Aloe lateritia Engl. (AIM-07)            | Aloaceae    | Ahhweri/Avurmo (Iraqw’) | Persistent cough | Roots | Dry powder mixed with porridge or tea | Leaves decoction is drunk or applied topically for fungal infections and also used against typhoid, wounds, and snakebites (Tanzania) (Hamza et al., 2006; Mbunde et al., 2017). Leaves are used for treatment of liver diseases, wounds, pneumonia and constipation (Rwanda) (Alphonse et al., 2010). | Toxic to brine shrimps (Moshi et al., 2007). |
| Balanites aegyptiaca (L.) Delile (AIM-25) | Balanitaceae | Putluputlu (Hadzabe) | Chronic wounds (Cancer), chronic abdominal ulcers | Roots | Decoction. One table spoonful is taken three times a day for three days. | Stem bark decoction is used in Tanzania for Cough and chest infections (Maregesi et al., 2007). In Uganda roots and leaves decoction is drunk for yellow fever (Tugume et al., 2016). | Anti-HIV/antiviral, antimicrobial, anticancer, wound-healing and anthelmintic properties (Chothani and Vaghasiya, 2011; Hussein et al., 1999; Kabbashi, 2015; Runyoro et al., 2006). An oral administration of the aqueous extract for the treatment of HIV patients has shown good results (Chothani and Vaghasiya, 2011). |
| Barleria eranthemoides R.Br. ex C.B.Clarke. (AIM-27) | Acanthaceae | Palangate (Hadzabe) | Fever (malaria) | Roots | Decoction. One tea cup is taken twice a day for two days. | In Tanzania root decoction or infusion of leaves is drunk for treatment of dysentery and it is very potent for several infectious diseases (Maregesi et al., 2007). In Ethiopia, it is used for wound healing and cancer (Bitew et al., 2019; Tuasha et al., 2018). | Methanol extract exhibited anti-HIV activity (Maregesi et al., 2010). |
| Blepharis affinis Lindau. (AIM-37)      | Acanthaceae | Ngwilla (Hadzabe) | Frequent fevers, epilepsy | Roots | Decoction. One tea cup is taken twice a day until recovered. | No reports | No reports |
| Plant Name                                | Family          | Common Name       | Uses in Treatment                                                                                      | Additional Information                                                                 |
|------------------------------------------|-----------------|-------------------|-------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Cassia abbreviata subsp. boreana (Holmes) | Caesalpinaceae  | Quarerei darma (Iraqw') | Frequent fevers, all types of diarrhea; Root bark, stem bark. Used in Zimbabwe for STIs (Kambizi and Afolayan, 2001), in Mozambique for eye infection, stomach ache, diarrhea, and malaria (Ribeiro et al., 2010). Used in Botswana for general cleansing, abdominal pain, womb problems, menstrual pains, and STIs (Leteane et al., 2012). Anti-HIV activity (Leteane et al., 2012). It is reported to exhibit antimicrobial, antimalarial and anthelmintic activity (I, 2013; Shai et al., 2013). |
| Cassia didymobotrya Fresen (AIM-21)      | Caesalpinaceae  | Quarerei aya (Iraqw') | To induce vomiting before initiation of any treatment; Leaves, roots. Decoction. In Kenya leaves and roots are used for treatment of cancer, skin diseases, malaria, gonorrhea, ring worms, emetic, excess bile and as a purgative (Jeruto et al., 2008). In Rwanda it is used against ascariasis, and neuropsychopathy (Cos et al., 2002). In Tanzania it is used for treatment of anemia, as laxative and anthelmintic (Kamuhabwa et al., 2000). It exhibited moderate cytotoxicity (Kamuhabwa et al., 2000) but had no anti-HIV activity (Cos et al., 2002). It also exhibited antimicrobial activity (Singh et al., 2010). |
| Cassia singueana Del (AIM-23)            | Caesalpinaceae  | Gitalashayi (Hadzabe) | Tape worm, Diabetes mellitus. Roots. Decoction. One cup is taken once per day for one day. In Zimbabwe it is used for treatment of STIs (Kambizi and Afolayan, 2001). It is reported to have toxicity against brine shrimps LC50 of 11 µg/ml (Adoum, 2016). |
| Clerodendrum myricoides (Hochst.) R.Br. ex Vatke (AIM-01) | Verbenaceae | Tloqomo (Iraqw') | STIs, chronic wounds (cancer). Roots. Dry powder applied topically. Management of HIV/AIDS (Uganda) (Lamorde et al., 2010). Treatment of pneumonia and stomach ache (Kenya) (Radol et al., 2016). Constipation, hepatitis, syphilis (Rwanda) (Cos et al., 2002). Analgesic, management of fever, treatment of infections (Kamuhabwa et al., 2000). No protection against HIV induced cytopathy (Cos et al., 2002). Cytotoxic (Kamuhabwa et al., 2000) but low cytotoxicity in plant from Rwanda (Cos et al., 2002). Strong activity against Plasmodium berghei (Deressa et al., 2010). |
### Table 2. Contd.

| Plant Name                          | Family          | Common Name (Iraqw') | Part Used | Treatment/Use                                                                 | Notes                                                                 |
|-------------------------------------|-----------------|----------------------|-----------|--------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Conyza pyrrhopappa Sch.Bip. ex A.Rich. (AIM-04) | Compositae  | Ankwey (Iraqw')      | Leaves, roots | A decoction of the roots and infusion of the leaves are used for treatment of fevers. The infusion of the leaves with Zanthoxylum chalebeum Engl. leaves or roots is used for treatment of persistent cough. | No reports                                                                 |
| Crassocephalum picridifolium (DC.) S.Moore. (AIM-34) | Compositae  | Amabei (Iraqw')      | Roots     | Treatment of infections including STIs (Guinea) (Magassouba et al., 2010). Mixed with other plants in treatment of sores in infants (Tanzania) (Ramathal and Ngassapa, 2008). Used for treatment of diarrhea (Ethiopia) (Woldeab et al., 2018). | No reports                                                                 |
| Croton megalocarpus Hutch | Euphorbiaceae  | Aloi (Iraqw')        | Stem bark  | Dry powder mixed with porridge or tea                                                                                        | No reports                                                                 |
| Croton scheffleri Pax. (AIM-11)    | Euphorbiaceae  | Girgirimo/ Daat (Iraqw') | Stem bark  | Dry powder mixed with porridge or tea for treatment of tonsillitis, mumps and cough. Decoction used for treatment of gonorrhea, syphilis, boils. | Antibacterial activity (Kariuki et al., 2014). |
| Dregea macrantha Klotzsch. (AIM-24) | Asclepiadaceae | Tsamu (Iraqw')       | Aerial parts | White sap from the fresh leaves and stem applied locally                                   | No reports                                                                 |
| **Table 2. Contd.** |
|---------------------|
| **Elaeodendron buchananii** (Engl) Verdc (AIM-13) | Celastraceae | Ghamro (Iraqw’)<br>Roots bark, stem bark | All types of diarrhea, oral thrush, genital warts, vaginal candidiasis, syphilis | Dry powder can be applied topically for treatment of oral thrush, genital warts, vaginal candidiasis. It can be mixed with *Ozoroa insignis* Delile and taken orally for treatment of genital warts. | It is used in Kenya for treatment of microbial infections (Odak et al., 2018). Decoction used as aphrodisiac (Moshi et al., 2010). Antibacterial and antifungal activities (Odak et al., 2018). Contains cytotoxic the compound elabunin (Kubo and Fukuhara, 1990). |
| **Embelia schimperi** Vatke. (AIM-30) | Myrsinaceae | Qaytia (Iraqw’)<br>Fruits, stem bark | Helmintic infestation, Sexually transmitted infections, HIV, typhoid | Dry powder mixed with porridge and tea. Mixed with *Cassia singueana* Del. for treatment of tape worm infestation | Used in Tanzania to treat chronic cough, and tuberculosis (Thabeet et al., 2017) and tapeworm infestation (46). In Ethiopia it is used for treatment of leprosy, ascariasis and taeniaisis (Giday et al., 2009). Anti-Staphylococcal, anti-helmintic activity (Bogh et al., 1996; Debebe et al., 2015; Rondevaldova et al., 2015). |
| **Ensete ventricosum** (Welw.) Cheesman (AIM-36) | Musaceae | Ndizi pori (Swahili)<br>Anwor do netlangw/ Anwor do netlangw (Iraqw’)<br>Cough, tuberculosis, typhoid, brucellosis, skin rashes, oral thrush, vaginal candidiasis, wound, cancer, genital warts, diabetes mellitus, sexually transmitted infections | Dry powder drunk with water or applied locally | In Ethiopia the roots are used for management of abdominal pain and diarrhea (Mesfin et al., 2009). Antimicrobial and anti-nematodal activity (Tesfaye and Girma, 2017). |
| **Erythrina abyssinica** DC. (AIM-09) | Leguminosae (Pap) | Qanqari (Iraqw’)<br>Seeds | Sexually transmitted infections | Dry powder applied locally | In Tanzania the stem bark and root decoction is used in dysentery and jaundice (Maregesi et al., 2007). In Uganda it is used in the management of HIV/AIDS-related conditions (Lamorde et al., 2010; Nyamukuru et al., 2017). In Rwanda it is used to treat dysentery (Maikere-Faniyo et al., 1989). In Zimbabwe it is used in the |

*It contains Anti-HIV-1 alkaloids (Mohammed et al., 2012).*
| Plant Name                      | Family            | Common Name(s)  | Uses                                                   | Parts Used                  | Preparation                  | Other Information                                                                 |
|--------------------------------|-------------------|------------------|--------------------------------------------------------|-----------------------------|-----------------------------|----------------------------------------------------------------------------------|
| Hymenodictyon floribundum      | Rubiaceae         | Tsere (Iraqw’)   | Genital warts, vaginal candidiasis, cancers           | Leaves/Stem bark            | Dry powder applied locally and decoction drunk for treatment of diarrhea         | Treatment of STIs (Kambizi and Afolayan, 2001). In Ethiopia it is used for tonsillitis (Kebebew and Mohamed, 2017). |
| Justicia subsessilis Oliv.     | Acanthaceae       | Tonganayi (Iraqw’) | Sexually transmitted infections including gonorrhea. It is also used to manage anuria | Roots                       | One tea cup of decoction is taken before meal once a day for 3 days              | No reports                                                                        |
| Lippia javanica L.             | Verbenaceae       | Not provided     | Pneumonia                                               | Roots                       | Decoction                    | Inhibition of HIV-1 reverse transcriptase enzyme by (E)-2(3)-tagetenone epoxide and piperitenone which are compounds from this plant (Mujovo et al., 2008). Antimicrobial activity against gram positive and gram negative bacteria, Aspergillus niger, Fusarium solani. |
| Mirabilis jalapa L.            | Nyctaginaceae     | Not provided     | Wounds, ear infections                                  | Seeds                       | Decoction applied locally      | In Philippines it is used in the management of dermatological diseases          | Antimicrobial activity against Entamoeba histolytica (Samie et al., 2009). |

Kebebew and Mohamed, 2017; Temam and Dillo, 2016; Fernandes et al., 2015; Ngezahayo et al., 2015; Ngezahayo et al., 2017; Ngezahayo et al., 2017.
### Table 2. Contd.

| Species                  | Family      | Common Name | Uses                                                                 |
|--------------------------|-------------|-------------|----------------------------------------------------------------------|
| **Ozoroa insignis**      | Anacardiaceae | Makri (Iraqw’ Makri) | Cough, diarrhea, genital warts, vaginal candidiasis, cancer, boils, gonorrhea, syphilis (Tantiado, 2012). It is used as antidiarrheal, carminative, detoxifier, digestive stimulant, diuretic, purgative, tonic, vermifuge. It is also used in wound healing and skin problems (Zachariah et al., 2011). Dry root bark powder is mixed with *Terminalia senicea* Burch. ex DC. stem bark for treatment of persistent cough. Dry powder is applied on genital warts. Root bark is mixed with *Ximenia caffra* Sond. or *Ximenia Americana* L. roots, *Zanha Africana* (Radlk) Exell. roots and *Elaedendron buchananii* (Engl) Verdc. stem bark/roots for treatment of diarrhea including dysentery. |
| **Pappea capensis**      | Sapindaceae  | Getaquabay | Chronic wounds (Cancer) (Semenya and Maroyi, 2012). Venereal diseases, painful eyes, aphrodisiac (Mulaudzi et al., 2011). In Tanzania it is used in the management of skin rashes, *Tuberculosis*, *Herpes simplex*, *Herpes zoster*, *Cryptococcal meningitis*, *Oral candidiasis*, *bilharzia* (Kisangau et al., 2007; Moshi et al., 2009). Very toxic to brine shrimps and cytotoxic to human hepatocellular carcinoma, human mammary adenocarcinoma and human hepatocellular carcinoma cells (Moshi et al., 2009; Rea, 2003). Dry powder applied locally. Inhibition of HIV-1 reverse transcriptase and antimicrobial activities (Mulaudzi et al., 2011). Broad spectrum of activity against *Bacillus subtilis*, *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans* (Pendota et al., 2017). Little or no cytotoxicity against Vero monkey kidney cells (Pendota et al., 2017). Used in the management of diarrhea in South Africa (Semyna and Maroyi, 2012). Venereal diseases, painful eyes, aphrodisiac (Mulaudzi et al., 2011). |
| Plant Name                          | Family        | Local Name       | Common Name          | Part Used       | Uses                                                                 |
|------------------------------------|---------------|------------------|----------------------|----------------|----------------------------------------------------------------------|
| *Pergularia daemia* (Forssk.) Chiov. (AIM-29) | Asclepiadaceae | Tsamu (Iraqw')   | Fungal infections with Tinea | Aerial parts   | White sap from the fresh leaves and stem applied locally             |
|                                    |               |                  |                      |                | Used as anthelmintic, antiseptic, antivenin and also used for management of amenorrhea, diarrhea, asthma, whooping cough, wounds, bronchitis, and venereal diseases (Karthishwaran and Mirunalini, 2010). |
|                                    |               |                  |                      |                | In Tanzania it is used for treatment of oral candidiasis, Herpes zoster, Herpes simplex, skin rashes (Kisangau et al., 2007). It is also used to treat intestinal disturbance, liver disorders, respiratory disorders, heart diseases and nervous system disorders (Al Ashaal et al., 2010; Alasbahi and Melzig, 2010). |
| *Plectranthus barbatus* Andrews. (AIM-08) | Labiatae      | Hhongay (Iraqw') | Genital warts        | Roots          | Dry powder is applied on the affected areas                           |
|                                    |               |                  |                      |                | In Uganda it is used in the management of HIV/AIDS (Lamorde et al., 2010). Sexually transmitted infections, sores, external rashes, thrush, and herpes (Letane et al., 2012). Management of diarrhea, hypercholesterolemia, abortifacent, anemia, loss of appetite, psoriasis and peptic ulcers (Yuvaraj, 2011) |
| *Plumbago zeylanica* L. (AIM-10) | Plumbaginaceae | Alaali (Iraqw')   | Boils, cancer        | Root barks     | Dry powder mixed with porridge or tea. The powder can also be applied to the affected area locally |
|                                    |               |                  |                      |                | In Namibia it is used for treatment of cough (Hedimbi and Chinsembu, 2012). Used for treatment genital illness in animals in South Africa (Luseba et al., 2007). |
| *Pterocarpus angolensis* DC. | Papilionaceae | Tsere (Iraqw')   | All types of diarrhea, chronic wounds | Stem bark | Dry powder is applied on the affected areas. Dry powder mixed with Clerodendrum myricoides (Hochst.) R.Br. ex Vatke, root powder for treatment of chronic wounds(cancers) |
|                                    |               |                  |                      |                | Used for treatment of cough in Namibia (Hedimbi and Chinsembu, 2012). Used for treatment genital illness in animals in South Africa (Luseba et al., 2007). |

**Table 2. Contd.**
| **Terminalia brownii** Fresen. (AIM-22) | **Combretaceae** | **Sabamba** (Hadzabe) | **Pneumonia** Roots | **Yellowish decoction** |
|----------------------------------------|-----------------|----------------------|--------------------|----------------------|
| **Antimicrobial activities**           |                 |                      |                    | Used to treat diarrhea and other abdominal problems in Tanzania and in Congo it is used to treat urogenital infections, urethral pain, syphilis and gonorrhea (Mbwambo et al., 2007). |
| **Terminalia sericea** Burch. ex DC.   | **Combretaceae** | **Ssohhi** (Iraqw’) | **Persistent cough, vomiting** Stem barks | **Decoction mixed with decoction of Ozoroa insignis Delile root decoction for induction of vomiting just before initiation of treatment and mixed with Zanha africana (Radlk) Exell. stem bark decoction for treatment** |
| **Antimicrobial activities**           |                 |                      |                    | Used for management of Diabetes, diarrhea and gonorrhea in Tanzania (Moshi and Mbwambo, 2005). Used for treatment of sexually transmitted infections, measles, leprosy and wounds in South Africa (Chauke et al., 2015; Mongalo et al., 2016). In Namibia and Botswana it is used in management of meningitis, diarrhea, gonorrhea, syphilis, diarrhea, stomach disorders and pneumonia (Chinsembu et al., 2015; Mukanganyama et al., 2011). |
| **Vernonia glabra** (Steetz) Vatke.    | **Compositae**  | **Afaxawi** (Iraqw’) | **STIs, impotence Roots** | **Dry powder or decoction** |
| **Antimicrobial activities**           |                 |                      |                    | Review of the genus Vernonia have indicated a number of species which are widely reported to be used in the management of HIV infection including Vernonia amygdalina and Vernonia adoensis (Toyang and Verpoorte, 2013). Used in Tanzania for treatment of malaria (Ramadhani et al., 2015). |

### Table 2. Contd.

**Antimicrobial activities** against *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aerugirosa*, *Klebsiella pneumoniae*, *Salmonella typhi*, and *Bacillus anthracis* and the fungi, *Candida albicans*, *Cryptococcus neoformans* etc mild cytotoxicity against brine shrimps (Mbwambo et al., 2007; Salih et al., 2017).

**Antimicrobial activity** (Frank, 2012; Kitonde et al., 2012). Some members from the same genus have been reported to have anti-HIV-1 activity (Toyang and Verpoorte, 2013). Weak antimalarial activity (Ramadhani et al., 2015).
| Species                        | Family       | Common Name (Iraqw') | Symptoms                                                                                                             | Part Used       | Preparation | Uses                                                                                                                                  | Other Activities                                                                 |
|-------------------------------|--------------|----------------------|----------------------------------------------------------------------------------------------------------------------|----------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| *Ximenia americana* L.        | Olacaceae    | Maayangu (Iraqw’)    | All types of diarrhea, STIs, vaginal candidiasis, brucellosis, typhoid, cancer, persistent cough, tuberculosis, cough with chest pain, oral thrush, genital warts, diabetes mellitus | Root bark       | Decoction   | Used in the treatment of gonorrhea and candidiasis in Namibia (Chinsembu, 2010; Hedimbi and Chinsembu, 2012). Used for treatment of diarrhea in South Africa (Semenya and Maroyi, 2012). It is used as antiabortifacient, and in the treatment of HIV/AIDS, menstrual cycle irregularities, stabbing heart, stomach ache, wounds in Mozambique (Ribeiro et al., 2010). | Inhibits HIV-1 replication (Maroyi, 2014). Methanolic root extract exhibited antimicrobial activity (James et al., 2007). |
| *Ximenia caffra* Sond.        | Olacaceae    | Maayangu (Iraqw’)    | All types of diarrhea, STIs, vaginal candidiasis, brucellosis, typhoid, cancer, persistent cough, TB, cough with chest pain, oral thrush, genital warts, diabetes mellitus | Root bark       | Decoction   | Treatment of gonorrhea in Namibia (Hedimbi and Chinsembu, 2012), diabetes mellitus, sexually transmitted infections, eye aches, bilharzias in South Africa (Chauke et al., 2015). Diarrhea, dysentery, fever, cough and venereal diseases (98). Used for treatment of STIs in Zimbabwe (Kambizi and Afolayan, 2001). Treatment of thrush, herpes, STIs in Botswana (Leteane et al., 2012). | Inhibition of HIV-1 reverse transcriptase enzyme activity and varying antimicrobial activities (Mulaudzi et al., 2011). Weak anti-*Mycobacterium tuberculosis* activity (Green et al., 2010). Weak inhibition of HIV-1c replication measured by quantification of p24 antigen levels (Leteane et al., 2012). Antigonococcal activity (Nair et al., 2013). |
| *Zanha africana* (Radlk) Exell. | Sapindaceae  | Daalusamo (Iraqw’)   | Tuberculosis, asthma, persistent cough, all types of diarrhea, skin rashes, boils, sexually transmitted infections, typhoid, brucellosis, oral thrush, vaginal candidiasis, genital warts | Stem roots, barks | Dry powder mixed with porridge or tea | Treatment of tuberculosis in Tanzania (Augustino and Gillah, 2005). Treatment of STIs in Zimbabwe (Hedimbi and Chinsembu, 2012). | Significant inhibition against Gram-positive and Gram-negative bacteria (Kambizi and Afolayan, 2001). Antifungal activities (Runyoro et al., 2006). |
Table 2. Contd.

| Plant Name                        | Family   | Common Name | Medicinal Uses                          | Preparation Method                      | Additional Information                                                                 |
|-----------------------------------|----------|-------------|-----------------------------------------|-----------------------------------------|----------------------------------------------------------------------------------------|
| Zanthoxylum chalybeum Engl.       | Rutaceae | Marongi (Iraqw') | Persistent cough, frequent fevers, UTI, gonorrhea, typhoid, brucellosis, tonsillitis | Roots, leaves, stem bark                | Mixed with Conyza pyrhopappa Sch.Bip. ex A.Rich leaves or roots and decoction used for treatment of persistent cough. Stem bark powder mixed with porridge for management of frequent fevers. |

STIs (Tshikalange et al., 2008). Treatment of malaria in Kenya (Kiraithe et al., 2016).

52.40% Decoction
38.10% Dry powder
7.10% Infusion
2.40% Fresh juice

**Figure 3.** Percentage of method of preparation used.
Figure 4. Percentage of plant parts used.

Figure 5. Percentage use of plants to treat disease conditions (N=37).
adoensis from the same genus have been reported to have anti-HIV-1 activity (Toyang and Verpoorte, 2013). Another plant is Terminalia brownii which is used in Mbulu for treatment of pneumonia. The plant is proven to have antimicrobial activity against a big number of microorganisms (Machumi et al., 2013; Salih et al., 2017). However, the plant has not been tested for anti-HIV activity but Terminalia sericea from the same genus has been reported to have strong HIV-1 reverse transcriptase inhibitory activity (Tshikalange et al., 2008). Zanthoxylum chalybeum, used for various infections in Mbulu and elsewhere, has no reports on anti-HIV activity while Zanthoxylum davyi, a member of the same genus, has anti-HIV activity (Tshikalange et al., 2008). In Mbulu the plant in some cases is combined with Conyza pyrrophopappa leaves or roots for treatment of persistent cough and therefore, the plant and the combination are worthy of screening for antimicrobial, anti-HIV and antimycobacterial activity. Despite the previous reported ethnomedical uses of some of the reported plants, reports on clinical evaluation of the patients who were treated with these plants are lacking. To support the traditional uses of these plants clinical evaluation in patients is important.

Conclusion

This survey identified sixteen medicinal plants with new ethnomedical uses related to HIV and AIDS conditions. Ten of the documented plants had no reported biological reports related to HIV and AIDS-related conditions. Reports from the literature provide a strong support to the traditional medicinal use practices of Mbulu THPs for the management of HIV and AIDS-related conditions. Although the results of this study are consistent with ethnomedical and antimicrobial data from the literature, more studies are needed to validate the antimicrobial efficacies, pharmacological, cytotoxicity, and active phytochemicals in the plants.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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