

Full Length Research Paper

Ethnobotanical survey of medicinal plants used in the management of opportunistic fungal infections in HIV/AIDS patients in the Amathole District of the Eastern Cape Province, South Africa

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An estimated 5.7 million people were living with HIV and AIDS in South Africa in 2009, more than in any other country. Up to 90% of all HIV/AIDS patients develop opportunistic fungi infections (OFIs) at some point during the course of the disease and 10 to 20% dies as a direct consequence of these. Despite the broad use of medicinal plants in South Africa, there is a dearth of knowledge regarding the use of such plants in the management of opportunistic fungal infections in HIV/AIDS patients. Knowledge of these plants is very important as this can serve as leads in the discovery of new antifungal agents. The purpose of this study was to document the indigenous knowledge of medicinal plants used in the management of opportunistic fungal infections in HIV/AIDS patients in the Eastern Cape, South Africa. Information was obtained through conversations with traditional healers and AIDS patients with the aid of semi-structured questionnaires, direct observations and by reviewing studies reported in the literature. A total of 123 informants participated in the study, including 22 (21.8%) traditional healers and 101 (78.2%) HIV/AIDS patients. Thirty two plant species distributed in 26 families and 32 genera were identified as being used to treat one or more of the OFIs. Considering the widespread use of these medicinal plants to treat various ailments and their current use in the management of opportunistic fungal infections in HIV/AIDS patients, it therefore becomes crucial to scientifically validate the therapeutic uses and safety of these plants through phytochemical screening, antifungal susceptibility tests and toxicological studies.

Key words: Medicinal plants, opportunistic fungal infections, human immunodeficiency virus/acquired immunodeficiency syndromes (HIV/AIDS), ethnobotanical survey, Eastern Cape Province, South Africa.

INTRODUCTION

An estimated 5.7 million people were living with HIV and AIDS in South Africa in 2009, more than in any other country (UNAIDS, 2010). It has been shown that up to 90% of all HIV/AIDS patients contract opportunistic fungal infections (OFIs) at some point during the course of the disease and that 10 to 20% die as a direct consequence of these (Hamza et al., 2006). Opportunistic

fungal infections such as mucocutaneous candidiasis, pneumocystosis, cryptococcosis, and aspergillosis are the most common AIDS-defining conditions in HIV-positive individuals (WHO, 2009), with oral candidiasis being the earliest and most frequent infection (Reichart, 2003). Infection with the pathogenic fungus *Cryptococcus neoformans* is a more serious condition that often produces pneumonia and meningitis in HIV-infected patients (Hamza et al., 2006). Among the pathogenic fungi, the dermatophytes have the ability to invade keratinized tissues of humans and cause dermatophytosis, the most common human contagious

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fungal disease (Sidat et al., 2006). Treatment of such infections is therefore one of the most important factors for the management of HIV/AIDS. It is estimated that in the Eastern Cape Province of South Africa, 21,294 adults and 1,220 children living with HIV were on antiretroviral therapy in 2006 (ECDH, 2006). This may lower the incidence of OFIs in patients with AIDS (WHO, 2009). However, poverty, resistance to conventional medicine and the serious side effects associated with antiretroviral drugs are the main draw backs to the use of conventional therapies (Kisangau et al., 2007). These factors, coupled with the severe shortage of health personnel in South Africa (Demmer, 2007) might have prompted many HIV/AIDS patients to develop coping mechanisms by adopting alternative sources of symptom management, one of which has been the use of herbal therapies (Kisangau et al., 2007). In South Africa, there are over 3,000 species of plants which have been found to be used in traditional medicine and an estimated 200,000 indigenous traditional healers, which up to 60% of the population consult with (Van Wyk et al., 1997). Despite the broad use of medicinal plants in South Africa, there is a dearth of knowledge regarding the use of such plants in the management of opportunistic fungal infections in HIV/AIDS patients.

The purpose of this study was to identify and document the plants that are used by traditional healers and HIV/AIDS patients in the management of opportunistic fungal infections in HIV/AIDS in the Eastern Cape, South Africa. Knowledge of these plants is very important as this can serve as leads in the discovery of new antifungal agents (Bisi-Johnson et al., 2010). Because much of the knowledge is being lost due to not being passed on from one generation to the next, from a cultural perspective, it is important to document such knowledge for future generations (Thring and Weitz, 2006).

MATERIALS AND METHODS

Study area

This study was carried out in the Amathole District of the Eastern Cape Province, South Africa. The Eastern Cape Province falls within the latitudes 30°00' to 34°15'S and longitudes 22°45' to 30°15'E (Grierson and Afolayan, 1999). It is bounded by the sea in the East and the drier Karroo (semi-desert vegetation) in the west. The elevation ranges from sea-level to approximately 2200 m in the north of the province. The Amathole district lies at the heart of the Eastern Cape Province and presently about 1.7 million people live there (Afolayan, 2003). The population is 91% African, 3% coloured and 5% white.

The economy of the district is dominated by Buffalo City Municipality, which comprises the coastal city of East London, King William's Town, Mdantsane and the provincial administrative capital of Bhisho. The area of the district is 23,675 square kilometres. Formal employment comes from public services (75,000 jobs), manufacturing (27,000 jobs), trade (25,000 jobs) and agriculture (17,000 jobs). The automotive industry, food processing, textiles and clothing are the major manufacturing areas, in that order (Grierson and Afolayan, 1999).

Ethnobotanical survey

The survey was conducted from May to August 2010, and the study sites included King William's Town, Alice, Fort Beaufort and Hogsback. The survey was done through interviews with traditional healers and HIV/AIDS patients who use medicinal plants to treat fungal infections associated with HIV/AIDS. The interviews were conducted in *Xhosa*, the local language of the informants. The interviews were facilitated by a local field assistant and two HIV-care workers who were fluent in both *Xhosa* and English.

Semi-structured questionnaires were administered to traditional healers who were trained practitioners of repute (Bisi-Jobson et al., 2010) within the various communities. A non-governmental organization (HIV Hope Project) at Hogsback served as the recruitment site for AIDS patients. Exhaustive field notes were taken on the medicinal uses of the plants, following the methodology of Abassi et al. (2010). The following data were collected for the plants that are commonly used in the treatment of opportunistic fungal infections in HIV/AIDS patients: the local name of the plant, life form, plant parts used the method of preparation and the mode of administration of the herbal remedy. In order to avoid confusion with respect to the identity of the medicinal plants, the traditional healers assisted in the collection of the medicinal plants from the wild.

Identification of medicinal plants

Identification of the collected plants specimens was done in the Department of Botany at the University of Fort Hare, South Africa, with the help of floristic works of South Africa (Dold and Cocks, 1999; Bhat and Jacobs, 1995 and Van Wyk et al., 1997). Voucher specimens were deposited in the Griffin Herbarium of the University of Fort Hare. Further characterization of the plants and their previous reported usage was established by a literature search (Togola et al., 2005) within the online databases available in the library of the University of Fort Hare, namely Elsevier Science Direct, Springer link and Jstor.

Opportunistic fungal infections in HIV/AIDS patients

The opportunistic fungal infections considered in the present study were candidiasis (oral, vaginal and oesopharyngeal candidiasis), cryptococcal meningitis, aspergillosis and dermatophytoses in AIDS patients. During the interviews, the symptoms of the various OFIs (Table 1) (Wark, 2004; Kisangau et al., 2007; Ahmad and Khan, 2009) were described to the healers and AIDS patients so as to enable them to give the appropriate plant species they usually use to manage the infections. An inventory of the identified plant species was compiled and the plants were grouped according to their corresponding OFIs. Ethical approval for the study was provided by the Research Ethics Committee at the University of Fort Hare, South Africa.

RESULTS AND DISCUSSION

A total of the 123 informants (aged between 21 and 63 years) participated in the study, including 22 (21.8%) traditional healers and 101 (78.2%) HIV/AIDS patients. There were 71 (57.7%) females and 52 (42.3%) males. Only 14.3% of the respondents were above 50 years. This suggests that the legacy of the use of herbal remedy in the management of opportunistic infections in HIV/AIDS is not yet endangered in the study area

Table 1. Signs/symptoms of opportunistic fungal infections in HIV/AIDS patients.

Opportunistic fungal infection	Symptoms
Oral candidiasis	Oral thrush, oral mucosal lesions, burning pain in the mouth, altered taste
Vaginal candidiasis	Abnormal vaginal discharge. Itching and burning in or around the vagina
Oesopharyngeal candidiasis	Pain and difficulty when swallowing, change in the sense of smell
Cryptococcal meningitis	Fever, frequent headache, mental confusion, seizures, malaise and fatigue
Aspergillosis	Pulmonary disease; cough and difficult breathing, chest pain, fever and night sweats
Dermatophytoses	Ring-like patch on the skin, skin itch and skin rash

(Kisangau et al., 2007).

Medicinal plant diversity

In this study, 33 plant species distributed in 26 families and 32 genera were identified as being used to treat one or more of the OFIs (Table 2). This is indicative of a considerable diversity and abundance of plant species used in the treatment of the OFIs in the study area. This could be attributed to South Africa's large floral biodiversity. South Africa is home to over 30,000 species of higher plants and 3,000 of these species have been found to be used in traditional medicine across the country (Van Wyk et al., 1997). The most representative family was the Asphodelaceae with 4 species, followed by Asteraceae and Hypoxidaceae with 3 species each and Rutaceae with 2 species (Table 2). The other families had 1 species each associated with the treatment of the reported OFIs in HIV/AIDS patients. The dominance of the above families may be indicative of the presence of antifungal compounds within their plant species.

Growth form and plant parts used

Of the 33 plant species studied, 6 growth forms were identified: herb, herbaceous perennial, shrub, epiphyte, tree and robust perennial (Figure 1). The majority of the medicinal plants were herbs with 10 species (31%), followed by trees (9 species, 27%) and shrubs (6 species, 18%), and 1 species each (3%) for succulents, epiphyte and robust perennial.

The dominance of herbs concurs with the general pattern seen in most ethnobotanical surveys. This could be attributed to the abundance and year round availability of herbs in the study area (Lulekal et al., 2008)

The leaf (43%) was the most commonly utilized plant part (Figure 2) followed by the root (21%), bark (15%), corm (6%), fruit (6%), rhizome (6%) and bulb (3%). The fact that the usage of roots accounts for up to 21% of all plant parts used is worthy of note as this may have a negative influence in the survival and continuity of the medicinal plants (Lulekal et al., 2008) and hence affects

the sustainable utilisation of the plant species used in the treatment of the OFIs in the study area.

Preparation and administration of herbal remedy

Three different methods are used for the preparation of the medicinal plants used for the management of the OFIs in the study area. Decoction (15, 45.5%) and infusion (15, 45.5%) are the most utilised forms of preparation followed by lotion which is used for only 3 plant species (9%). Application of the medicinal plants preparations is done through 5 different routes of administration (Figure 3). Oral application (22, 67%) was the most frequently cited route of administration followed by topical (6, 18%), bathing (3, 9%), while applications through enema and inhalation are used for only 1 (3%) species each.

The results in Figure 4 indicate that candidiasis (oral, vaginal and oesopharyngeal) was the OFI with the highest number (19) for which medicinal plants were used, followed by aspergillosis (8), cryptococcal meningitis (6) and dermatophytoses (6). According to the World Health Organisation (WHO, 2009), candidiasis is the most common fungal infection found in HIV/AIDS patients. Extensive oesophageal candidiasis is an AIDS-defining infection. In one prospective study, 84% of HIV-infected patients had oropharyngeal colonization by *Candida* species on at least one occasion, and 55% developed clinical thrush (Sangeorzan et al., 1994).

The medicinal plants with the highest frequency of citations (Table 2) for the various OFIs were *Alepidea amatymbica* for both aspergillosis and cryptococcal meningitis, *Hypoxis hemerocallidea* for candidiasis and *Gasteria bicolor* for dermatophytoses. The following plants were used for the treatment of two or more OFIs: *A. amatymbica*, *Citrus limon*, *Allium sativum*, *Agathosma betulina*, and *H. hemerocallidea*. The relatively high frequency of citation for these species in the treatment of one or more OFI may reflect the likelihood of the presence of antifungal compounds which may curtail the various OFIs (Kisangau et al., 2007). To assess the importance of a single species, it is reasonable to state that the greater the independent citation of a particular species for the treatment of a certain illness category, the

Table 2. Medicinal plants used in the treatment of opportunistic fungal infections in HIV/AIDS.

Scientific name / voucher no.; Local name (isiXhosa) Family	Life form	Part used	Preparation/ Administration	Other reported uses/ (Frequency of citation, n = 123)	References
A. Plants used for aspergillosis					
<i>Alepidea amatymbica</i> Eckl. and Zeyh /W1. (Iqwili) Apiaceae	Robust perennial	Rhizome root	Decoction oral	Sore throat, gastro-intestinal complaints, fever, rheumatism, headache, diarrhea and abdominal cramps. (9)	Somova et al. (2001), Afolayan and Lewu (2009)
<i>Allium sativum</i> L /W2. (Ivimbampunzi) Alliaceae	Herb	Root	Decoction oral	Broad spectrum antibiotic, hypertension, gastrointestinal disorders, cough. (7)	Harris et al. (2001)
<i>Cannabis sativa</i> L /W3 (Umya) Cannabinaceae	Herbn	Leaf	Infusion oral	Asthma, headache, epilepsy, colds, hypertension. (3)	Van Wyk et al. (1997), Dold and Cocks (2000)
<i>Citrus limon</i> L /W4. (Ulamula) Rutaceae	Tree	Fruit	Decoction oral	Rheumatic arthritis, cataracts, sunburn-induced skin damage, and cardiovascular diseases. (6)	Van et al. (1997)
<i>Helichrysum cymosum</i> L /W5.(Imphepho) Asteraceae	Herbaceous Perennial	Root	Infusion oral	Infections of the skin, colds, coughs and wounds. (4)	Lourens et al. (2008)
<i>Strychnos henningsii</i> Gilg. /W6 (Umnonono) Loganiaceae	Shrub	Bark	Decoction oral	Rheumatism, gastrointestinal pain, malaria and diabetes mellitus. (5)	Oyedemi et al. (2010), Hutchings (1989)
<i>Warburia salutaris</i> (Bertol. f) Chiov /W7 (Isibhaha) Canellaceae	Tree	Bulb	Decoction oral	Rheumatism, malaria, headache. (3)	Van et al. (1997)
<i>Zingiber officinale</i> /W8 (Ginja) Zingiberaceae	Herbaceous Perennial	Rhizome	Decoction oral	Nausea and vomiting, arthritis and heart disease. (4)	Ali et al. (2008)
B. Plants used for cryptococcal meningitis					
<i>Alepidea amatymbica</i> Eckl. and Zeyh. /W1 (Iqwili) Apiaceae	Robust perennial	Rhizome, root	Decoction oral	Sore throat, gastro-intestinal complaints, fever, rheumatism, headache, diarrhea and abdominal cramps. (4)	Somova et al. (2001), Afolayan and Lewu (2009)
<i>Citrus limon</i> L. /W4 (Ulamula) Rutaceae	Tree	Fruit	Decoction oral	Arthritis, cataracts, colds, fever, and cardiovascular disease. (6)	Van et al. (1997)
<i>Pittosporum viridiflorum</i> Sims. /W9 (Umkhwenkwe) Pittosporaceae	Tree	Leaf	Infusion oral	Stomach complaints, abdominal pains and fever. (3)	Van et al. (1997)
<i>Rubia petiolaris</i> DC /W10 (Impendulo) Rubiaceae	Shrub	Leaf	Decoction enema	No reported previous uses. (1)	

Table 2. Contd.

<i>Talinum sp.</i> /W11 (Umhlabelo) Portulacaceae	Herb	Bulb	Infusion oral	Leishmaniasis. (4)	Odonne et al. (2009)
<i>Tulbaghia violaceae</i> Harv. /W12 (Utswelane) Alliaceae	Herb	Leaf	Decoction oral	Fever, asthma, constipation, oesophageal cancer and hypertension. (4)	Van et al. (1997)
C. Plants used for oesopharyngeal candidiasis					
<i>Agathosma betulina</i> Herba /W13 (Ibuchu) Rutaceae	Shrub	Leaf	Decoction oral	Cough, colds and flu; a diuretic; kidney and urinary tract infections, prostatitis, cholera, rheumatism, gout and bruises. (5)	Van et al. (1997)
<i>Alepidea amatymbica</i> Eckl. and Zeyh. /W8 (Iqwili) Apiaceae	Robust Perennial	Rhizome, Root	Decoction oral	Sore throat, gastro-intestinal complaints, fever, rheumatism, headache, diarrhea and abdominal cramps. (5)	Somova et al. (2001), Afolayan and Lewu (2009)
<i>Allium sativum</i> L. /W2 (Ivimbampunzi) Alliaceae	Herb	Root	decoction oral	Broad spectrum antibiotic, hypertension, gastrointestinal disorders, cough. (4)	Harris et al. (2001)
<i>Artemisia afra</i> Jacq. ex Wild /W14 (Umhloniyane) Asteraceae.	Shrub	Corm leaf	Decoction oral	Cough, colds, influenza, malaria, intestinal worms. (5)	Van et al. (1997)
<i>Curtisia dentata</i> Burm.f /W15 (Umlahlani selefile) Cornaceae	Tree	Leaf root	Decoction inhalation	Diarrhoea, to purify the blood, as an aphrodisiac, pimple. (2)	Grierson and Afolayan (1999)
<i>Hydnora africana</i> Thunb. /W16 (Umafumbuka) Hydnoraceae	Epiphyte	Bulb	Decoction oral	Fever, asthma, constipation, oesophageal cancer and hypertension. (4)	Van et al. (1997)
<i>Hypoxis hemerocallidea</i> Fisch. Mey. and Avé- Lall /W17 (Umhlaba, Ikhala) Hypoxidaceae	Herbaceous Perennial	Corm	Decoction oral	Common cold, flu, hypertension, diabetes mellitus, urinary infections, testicular tumours, prostate hypertrophy and internal cancer, HIV/AIDS and some central nervous system disorders. (9)	Albrecht (1995), Fagelman and Lowe (2002)
<i>Olea europaea</i> L. /W18 (Umquma) Oleaceae	Tree	Bulb	Decoction oral	Diarrhoea, sore throats. (3)	Van et al. (1997)
D. Plants used for oral candidiasis					
<i>Carpobrotus edulis</i> L. /W19 (Unomatyumtyum) Mesembryanthemaceae	Herbaceous Perennial	Fruit	Infusion oral	Dysentery, digestive troubles, tuberculosis, eczema and wounds. (4)	Forbes (1986)
<i>Eucalyptus sp.</i> /W20 iGumtriya Myrtaceae.	Tree	Leaf	Infusion oral	Heal wounds, fungal infections, analgesic, cold, flu, and sinus. (5).	Gomes-Carneiro et al. (1998)

Table 2. Contd.

<i>Hypoxis hemerocallidea</i> Fisch. /W17 (Umhlaba, Ikhala) Hypoxidaceae	Herbaceous Perennial	Corm	Decoction oral	Common cold, flu, hypertension, diabetes mellitus, urinary infections, testicular tumours, prostate hypertrophy and internal cancer, HIV/AIDS and some central nervous system disorders. (5)	Albrecht (1995), Fagelman and Lowe (2002)
<i>Solanum aculeastrum</i> /W21 (Umthuma) Solanaceae	Shrub	Leaf	Infusion oral	Gonorrhoea, rheumatism. (3)	Aboyade et al. (2010)
E. Plants used for vaginal candidiasis					
<i>Aloe ferox</i> Mill. /W22 (Umhlaba, Ikhala) Asphodelaceae	Herb	Root	Lotion topical	Sexually transmitted diseases. (8)	Kambizi et al. (2004)
<i>Bulbine latifolia</i> Roem. and Schult. /W23 (Rooiwater - Afrikaans) Asphodelaceae	Herb	Root	Infusion Topical	Sores, wounds, skin rashes, cracked lips, eczema and ringworm. (9)	Van et al. (1997)
<i>Bulbine natalensis</i> Baker /W24 (Ingcelwane) Asphodelaceae	Herb	Leaf	Infusion bathing	HIV/AIDS. (3)	Van et al. (1997)
<i>Euclea natalensis</i> A.DC. /W25 (Umtshekeseane) Ebenaceae	Shrub	Leaf	Infusion bathing	Respiratory complications such as chest pains, bronchitis, asthma, tuberculosis. (4)	Van et al. (1997)
<i>Hypoxis hemerocallidea</i> Fisch. /W17 (Umhlaba, Ikhala) Hypoxidaceae	Herbaceous Perennial	Corm	Decoction oral	Common cold, flu, hypertension, diabetes mellitus, urinary infections, testicular tumours, prostate hypertrophy and internal cancer, HIV/AIDS and some central nervous system disorders. (6)	Albrecht (1995), Fagelman and Lowe (2002)
<i>Psidium guajava</i> L. /W26 (Gwava) Myrtaceae	Tree	Leaf bulb	infusion oral, enema	Diarrhoea, diabetes, ulcers, and boils. (6)	Van et al. (1997)
<i>Xysmalobium undulatum</i> L. /W27 (Ishongwe) Asclepiadiaceae	Herb	Root leaf	Decoction oral	Dysentery, headache. (4)	Bisi-Johnson et al. (2010)
F. Plants used for dermatophytoses					
<i>Arctotis arctotoides</i> (L.f.)O.Hoffm /W28 Ibushwe Asteraceae	Herbaceous perennial	Root leaf	Infusion bathing	Indigestion, catarrh of the stomach.	Afolayan (2003)
<i>Cassipourea flanaganii</i> Schinz. /W29 (umMemezi) Rhizophoraceae	Tree	Bulb	Infusion topical	Cosmetic, protection of skin against sun burns. (5)	Bhat and Jacobs (1995)

Table 2. Contd.

<i>Euphorbia hirta</i> L. /W30 (Intsema) Euphorbiaceae	Succulent shrub	Root	Lotion topical	Dysentery, worms, colds, bronchitis and asthma. (5)	Ogueke et al. (2007)
<i>Gasteria bicolor</i> Haw. /W31 (Intelezi) Asphodelaceae	Herb	Leaf	Lotion topical	Prophylactic purposes, to banish evil spirits. (6)	Dold and Cocks (2000)
<i>Limeum aethiopicum</i> L. /W32 (Inceba) Molluginaceae	Herb	Leaf	Infusion oral	Insomnia, purification of the blood. (2)	Van et al. (2008)
<i>Protorhus longifolia</i> (Bernh.) Engl. /W33 (Izintlwa) Anacardiaceae	Tree	Leaf	Infusion topical	Diarrhoea, Heart burn and stomach bleeding. (3)	Dold and Cocks (2000), Bisi-Johnson et al. (2010)

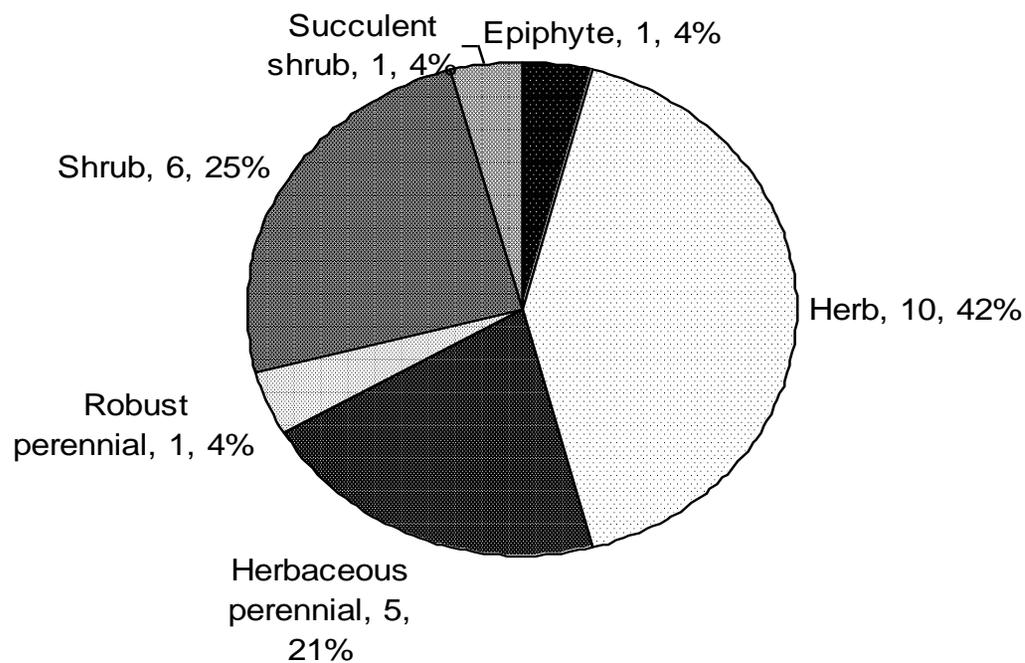


Figure 1. Growth forms of medicinal plants used in the management of OFIs in HIV/AIDS patients.

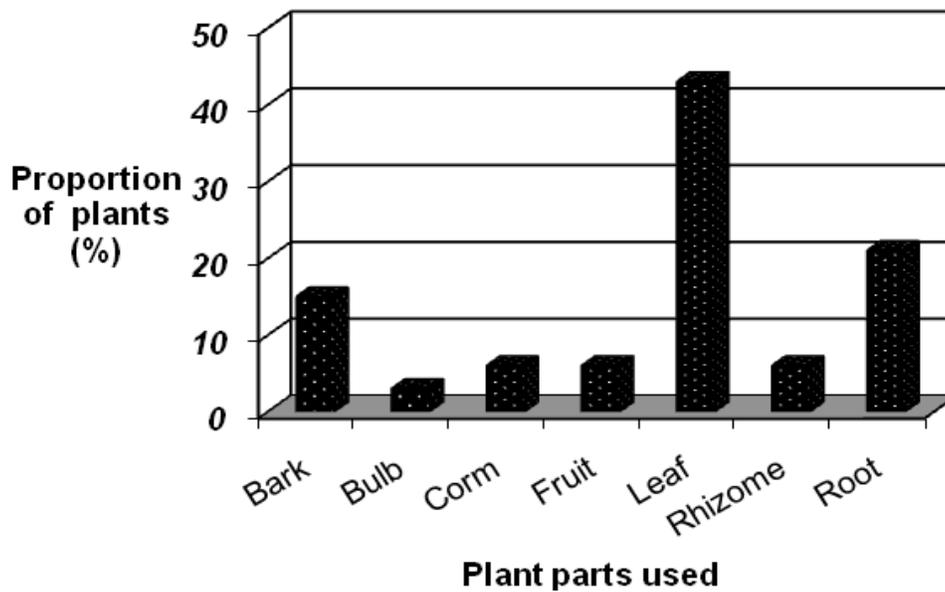


Figure 2. Plant parts used in the treatment of opportunistic fungi infections in HIV/AIDS.

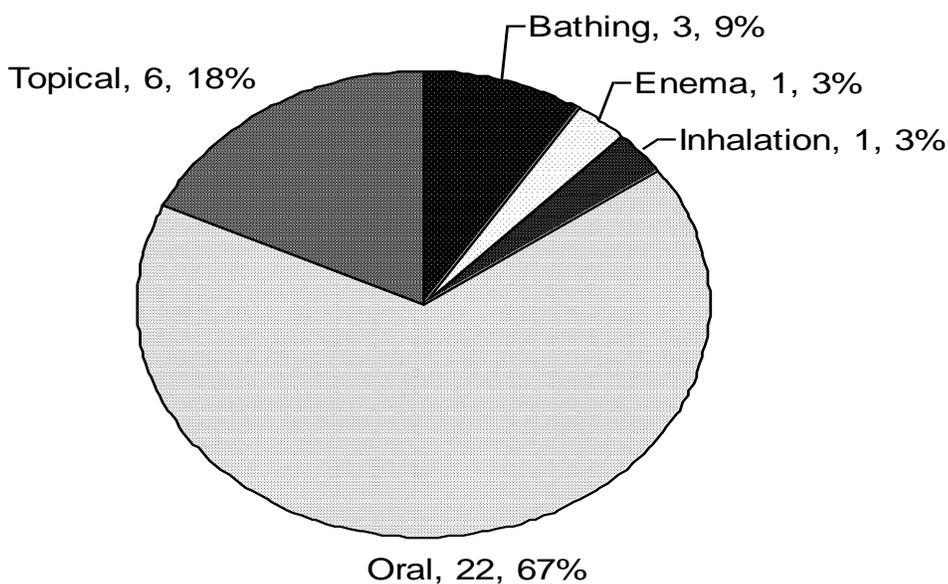


Figure 3. Mode of application of medicinal plants in the management of OFIs in HIV/AIDS.

greater its cultural importance (Kisangau et al., 2007). The medicinal plants identified in this study for the treatment of OFIs in HIV/AIDS patients have previously been cited in literature for the management of other ailments in South Africa (Table 2). For example, *Artemisia afra* (Asteraceae) is a popular plant with many uses in literature, including coughs, colds, influenza, fever, headache, and inflammation (Van Wyk et al., 1997; Thring and Weitz, 2006). *A. betulina* (Rutaceae) is a very popular plant used since the 17th and 18th centuries in

the Cape to treat stomach ailments, infections of the kidney, bladder, urinary tract, rheumatism and wounds (Thring and Weitz, 2006). Two principal African herbs used for HIV/AIDS treatment in sub-Saharan Africa include *H. hemerocallidea* (common name: African potato), and *Sutherlandia frutescens* (Mills et al., 2005). These two herbal remedies are currently recommended by the South African Ministry of Health for HIV management. Considering the widespread use of these medicinal plants to treat various ailments (Table 1) and

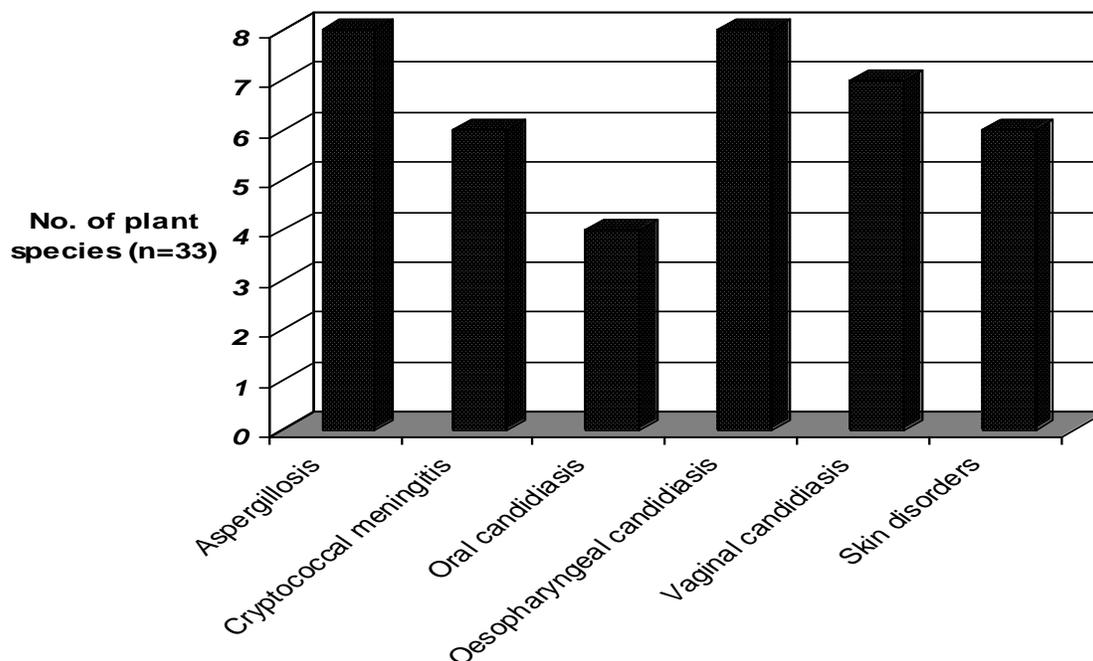


Figure 4. Opportunistic fungal infections versus number of medicinal plants.

their current use in the management of opportunistic fungal infections in HIV/AIDS patients, the presence of secondary metabolites with antifungal properties is therefore hypothesized. This is a subject of investigation in our laboratory.

Conclusion

There is a considerable diversity and abundance of plant species used in the treatment of the opportunistic fungal infections in the Amathole District of the Eastern Cape Province. The dominance of the Asphodelaceae, Hypoxidaceae and Rutaceae families may indicate the presence of antifungal compounds within their plant species. It is therefore crucial to scientifically validate the therapeutic uses and safety of these medicinal plants through photochemical screening, antifungal susceptibility tests and toxicological studies.

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