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The traditional use of plants to manage candidiasis and related infections in Venda, South Africa

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ABSTRACT

Ethnopharmacological relevance: This paper presents results of an ethnobotanical survey of medicinal plants used for the management of candidiasis and related fungal infections in the Venda area, South Africa.

Materials and methods: Ethnobotanical data about the uses of plants were gathered from eleven rural traditional healers using semi-structured interviews.

Results: A total of 45 species belonging to 24 different families were identified, of which the dominant family was the Fabaceae with 13 species (28.9%) followed by the Asteraceae and Solanaceae with 3 species each (6.7 %). A total of 28 of these plant species (62.2%) have been shown to have anticandidal activity and 14 species (31%) have been recorded for antifungal uses in the literature. Amongst the 45 species recorded, 51% were trees, 33% were shrubs, and 16% were herbs. The most widely used plant species were *Acacia caffra*, *Clerodendrum glabrum*, *Croton gratissimus*, *Elaeodendron transvaalense*, *Faurea saligna*, *Hippocratea longipetiolata*, *Osyris lanceolata*, *Richardia brasiliensis*, *Schkuhria pinnata*, *Schotia brachypetala*, *Spilanthes acmella*, *Strychnos potatorum*, *Vangueria infausta* subsp. infausta and *Withania somnifera*. The plant parts mostly used in the therapeutic preparations were roots (27.7%), bark (23.2%), and a combination of roots, bark (18.7%) and leaves (14.3%). Decoctions (44.4%), infusions (20%), macerations (17.7%), burning (11.4%) and paste (6.5%) were used. Most of the herbal remedies were administered orally. The main factors threatening the conservation status of these plants are unsustainable methods of harvesting, logging for firewood, building materials and crafts.

Conclusion: The Venda area is rich in plant diversity and local indigenous knowledge of medicinal plants can play an important role as a model for low cost primary health care. Further studies are in progress to validate the indigenous plants recorded as traditional remedies in this area

1. Introduction

Since ancient times, plants have been used all over the world as unique sources of medicines and constitute the most common human use of biodiversity (Ribeiro et al., 2010). In Africa and in other developing countries many people depend on medicinal plants because they have no access to modern medicines (Runyoro et al., 2006). The dependence on medicinal plants and traditional healers may be attributed to the low proportion of medical doctors to patients in Africa (South Africa 1:1639; Ethiopia 1:33,000; Kenya 1:7142; Tanzania 1:33,000; Uganda 1:25,000, Malawi 1:50,000; Mozambique 1:50,000; Swaziland 1:10,000) (Bekalo et al., 2009). In these communities, traditional healers operate closer to the people, taking advantage of the diversity of plant species in such areas to treat various diseases and ailments (Kambizi and Afolayan, 2001).

Herbal medicines have been used to treat many diseases that are obstinate and incurable in other systems of medicine and they are gaining popularity because of several perceived advantages such as fewer side effects, better patient tolerance, relatively lower expense and more ready acceptance due to a long history of use (Vermani and Garg, 2002). However, indigenous knowledge on medicinal plants is being lost at a rapid rate with the increase of modern education, which has led the younger generation not appreciating its traditional values (Zerabruk and Yirga, 2012). This useful information about medicinal plants is also still passed on from one generation to another by oral communication, posing the danger of loss of valuable knowledge (Maregesi et al., 2007). There

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is still a need of detailed documentation on the use of medicinal plants in South Africa (Taylor et al., 2001). It is becoming increasingly urgent to document the medicinal use of African plants because of the rapid loss of the natural habitat for some of these plants due to anthropogenic activities (Bisi-Johnson et al., 2010). Thus, there is a need to document the medicinal plants used traditionally before this important knowledge is lost.

Ethnobotanical studies are important in disclosing locally important plants used by communities in the management of a range of ailments affecting them. There is a wide interest in the use of medicinal plants by Venda people and this has led to several publications (Mahwasane et al., 2013; Mulaudzi et al., 2011, 2013; Samie et al., 2010; Tshikalange et al., 2005; Mabogo 1990; Arnold and Gulumiam, 1984). In this region, traditional medicine still plays a significant role in the lives of local people, despite recent advances in Western medicine (Meyer et al., 2008). As far as our literature search could ascertain, this is one of the few studies on the medicinal plants claimed to be used to treat candidiasis and related infections.

Candida infections are relatively easy to identify and it is not difficult to see a positive outcome of treatment. There could therefore be a good correlation between traditional use and *in vitro* efficacy. With the high incidence of HIV/AIDS, about 5.6 million infected people in South Africa (UNAIDS, 2011), candidiasis is a serious challenge to the public health system. The major concern with candidiasis is that it is associated with a mortality rate of 10–49% in immune compromised patients (Pfaller and Diekema, 2007). Thus, the search for alternative cures from traditional medicine is justified. Therefore, the aim of the study was to investigate and document plants used by local traditional practitioners for the management of candidiasis and related fungal infections

2. Materials and methods

2.1. Study site and Venda community

The study took place in four main rural areas of Venda (Mutale, Thohoyandou, Nzhelele and Mashau), Limpopo Province, South Africa (Fig. 1). In this region, traditional medicine still plays a significant role in the lives of local people, despite recent advances in Western medicine (Meyer et al., 2008). The region lies in the north-eastern corner of the Soutpansberg and is located between latitudes 22° 15′ and 23° 45′ S. and longitudes 29° 50′ and 31° 30′ E. with an estimation of 1.1 million people (Bornman et al., 2012). Male and female roles are clearly defined, with the men responsible for keeping livestock, ploughing and the building of huts, while the women do most of the harvesting as well as all the domestic duties. Maximum temperatures vary from 25 to 40 °C in summer and from 22 to 26 °C in winter. Rainfall is seasonal with 80% occurring between October and March (Mzezewa et al., 2010. The Venda community is one of the most remote tribes in South Africa with their own language and a distinct culture and knowledge of medicinal plants. They depend on the natural environment for their health care and survival (Mulaudzi et al., 2012). It is an area covered by the north-eastern mountain sourveld vegetation (Acocks, 1988), used in alleviating hunger, for shelters, fuel, artifacts and traditional medicine (Mabogo, 1990).

2.2. Interviews with the local traditional healers

Traditional healers were identified in the selected villages after consultation with the headman of each area andpermission was granted by the headman to conduct the study. Main areas visited included Nzhelele, Hamashau, Thohoyandou and Mutale. The first author is of Venda origin, teaches ethnobotany at the University of Venda and because he grew up in the rural environment, speaks the local language and knows all the local customs he was trusted by the traditional healers. The aim of the study was explained to the traditional healers before the interview was conducted, and informed consent was obtained so that they could share their knowledge. Ethnobotanical data were collected using semi-structured interviews in the local language (Tshivenda) and later translated into English. The informants were queried about the symptoms of candidiasis as well as information about the plants they use, including their local names, nature of the plant, plant parts used, methods of preparation, administration techniques, dosage form of the remedy and conservation status of the plants. Personal information was also recorded. A monetary incentive was given to the traditional healers for their time.

2.3. Plant collection and preparation of herbarium specimens

Plants were collected from the wild between September 2010 and June 2011 with the assistance of traditional healers, identified by two botanists from the University of Venda and were authenticated by SANBI (South African National Biodiversity Institute) in Pretoria. Voucher specimens were prepared, deposited at the University of Venda herbarium, South Africa and voucher numbers are recorded in Table 1.

2.4. Statistical analysis

Analysis of data was done using inferential and descriptive statistics such as percentages and frequencies. Frequency index (Table 1) was calculated using the following formula:

$$FI = FC/N \times 100$$

where FI is % of frequency of citation for one plant species by informants, FC is the number of informants who cited the use of the plant species, and N is the total number of informants (11 in this study) (Madikizela et al., 2012).

3. Results and discussion

3.1. Interviews with traditional healers

Eleven traditional healers were interviewed, namely three males (27.3%) and eight females (72.7%), ranging in age from 36 to 69 years. The four age groups 30–40, 41–50, 51–60 and 61–70 were represented by 5%, 16%, 52% and 27% of the total respectively. Some of them (18%) received primary school education while 82% did not have any formal schooling. Nine out of these 11 traditional practitioners were registered with the Vhembe Traditional Healers Association and have membership certificates. The association is recognized by the Department of Health but they are not yet allowed to practice in public health facilities. Nevertheless, 18% of the traditional healers indicated that occasionally they refer patients to the hospital for check-up after treatment.

According to some traditional healers, candidiasis is known as “Makuma”, a Tshivenda word referring to ulcers, which may be either oral or genital. They believe that the ulcers begin in the stomach and move up the alimentary tract until they manifest externally either in the mouth or the genitals. With regard to the causes, there are two schools of thoughts: some believe that it is caused by germs and others believe that it is caused by the transmission of sexually transmitted diseases from one person to another. To ensure that the traditional healers understood the symptoms of candidiasis, we described the symptoms as painful

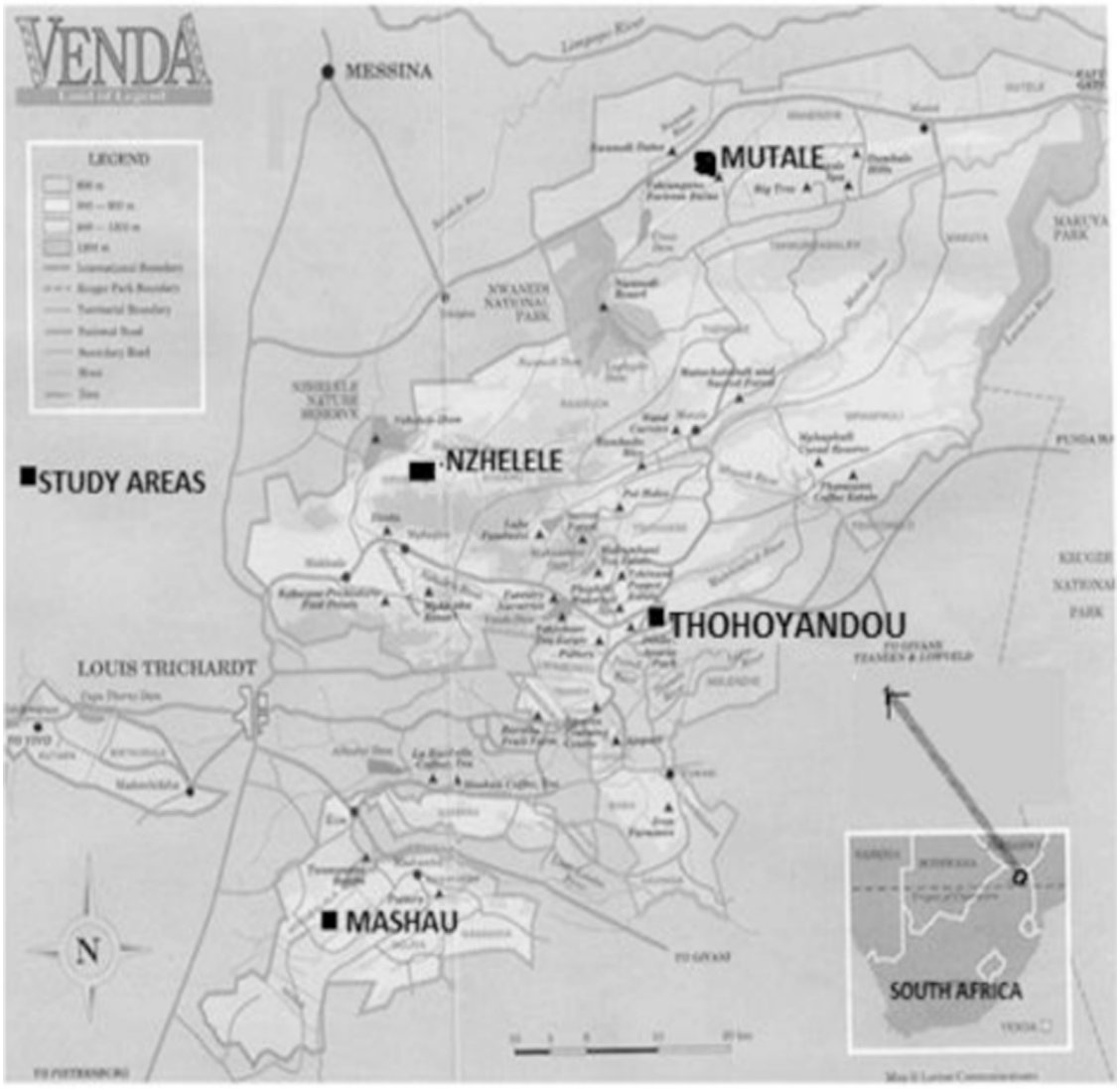

Fig. 1. Map of Venda region in Limpopo province, South Africa.

creamy white/red lesions on the angles of the mouth, tongue and also the palate, creamy white discharge and itching of genitals. We also showed pictures of patients suffering from the disease.

Males were generally not so keen to participate in the survey even though they were assured that the information was for research purposes only. Many indicated that they could not give away their ancestral knowledge to the researchers, and thus only 27.3% of the interviewed traditional healers were male. On the other hand females were open, participated freely and even wanted their pharmacopoeia to be evaluated for efficacy and toxicity. The fact that 52% of traditional healers interviewed ranged in age from 51 to 60 years indicated the wealth of indigenous knowledge gained in this survey as more experienced practitioners could be assumed to have greater knowledge than younger practitioners. On the other hand, this shows an urgent need for documenting more ethnobotanical data in the area because the future of indigenous knowledge is being threatened by remaining largely in the hands of older people. In most of the meetings with the traditional practitioners, there were very few young traditional practitioners; however there was no enquiry as to how many were still undergoing training under the established traditional practitioners.

3.2. Plant species and their families

Forty five plant species claimed to be used by local traditional healers to treat candidiasis and related infections were recorded. Table 1 shows the botanical name, family, Venda common name, voucher number, frequency index, part used, method of preparation, route of administration and reported ethnomedicinal uses of the herbal remedy. Plant species were distributed among 41 genera and 24 different plant families. The Fabaceae was the most represented with 12 plant species, followed by the Asteraceae and Solanaceae (3 plant species each), Apocynaceae, Ebenaceae, Celastraceae, Loganiaceae, Rubiaceae (2 plant species each), and the rest of the families were represented by one plant species each. Frequent use of members of the Fabaceae family has been documented by several surveys in Nigeria (Offiah et al, 2011); Ethiopia (Lulekal et al., 2008), and South Africa (Bisi-Johnson et al., 2010). This is not surprising because it is the third largest family of angiosperm plants with approximately 730 genera and over 19,400 species worldwide (Arabi and Sardari, 2010).

The most popular plants used by traditional healers were *Hippocratea longipetiolata* Oliv., *Spilanthes acmella* (L.) Murray, *Schkuhria pinnata* (Lam.) Kuntze ex Thell, *Clerodendrum glabrum*

Table 1
Plants and procedures used to treat candidal infections by traditional practitioners.

Botanical name family	Local name	Voucher no.	Habit	Frequency index	Part used	Method of preparation	Route of administration	Anti-*Candida* activity/active constituents	Relevant reported ethnomedicinal uses	Previous report on other ethnomedicinal uses
***Acacia karoo* Hayne. Fabaceae**	Muunga	Rn 34	T	9	r, b	Roots and stem bark are boiled together	Mouthwash or applied to genitals, 2x per day for a week	Mulaudzi et al. (2011)	No report	Venereal diseases, diarrhoea (Mabogo, 1990)
***Acacia caffra* (Thunb) Wild. Fabaceae**	Murovhambado	Rn 40	T	45	l	Dried, burnt and mixed with animal fats	Applied directly on mouth ulcers or vaginal ulcers	No report	No report	Blood cleansing, abdominal disorder (Venter and Venter, 1996)
***Amaranthus spinosus* L. Amaranthaceae**	Tshithavhamisis	Rn 5	H	18	l	add fresh leaves in hot water	Oral, ½ cup of the infusion is taken 3x a day	No report	No report	Analgesic, laxative, piles (Kumar et al., 2011)
***Burkea africana* Hook. Fabaceae**	Mufhulu	Rn 24	T	9	se r	Dried roots, seeds are ground up and then boiled	Oral, taken 2x a day, overdose causes diarrhoea	Steenkamp et al. (2007)	No report	Herpes simplex (Chisembu, 2010), dysentery (Grant and Thomas, 2000)
***Carica papaya* L. Caricaceae**	Mupapawe	Rn 9	T	36	r	Grind roots of *C. papaya* and *P. guava*, mixed into hot water	Oral, cup is taken 3x a day or douching	Runyoro et al. (2006)	Vaginal candidiasis (Runyoro et al., 2006)	Infectious diseases (Magassouba et al., 2007), cancer (Otsuki et al., 2010)
***Carpobrotus edulis* (L.) L.Bolus**	**Mesembryanthemaceae**	Lutele	Rn 32	S	9	b	Grind dry bark into fine powder, boil for 20–30 min	Oral, as mouth wash, 3x per day for 1 week	Motsei et al. 2003	Thrush (Thring and Weitz, 2006)
Diarrhoea (Bisi-Johnson et al., 2010)										
***Cissampelos torulosa* E. Mey. Menispermaceae**	Lukandululo	Rn 13	T	27	b	Grind dry bark into fine powder, boil in water	Oral, gargle or douche	No report	No report	Syphilis, toothache (De Wet and Van Wyk, 2008)
***Clerodendrum glabrum* E. Mey, Verbenaceae**	Munkhatingwe	Rn 46	S	64	R, b	Dried, pulverized and then boiled in water	¼ cup of decoction is taken orally 3x per day	No report	Oral ulcers (Mabogo, 1990)	Diarrhoea (Bisi-Johnson et al., 2010), Coughs (McGaw et al., 2008)
***Croton gratissimus* Burch. Euphorbiaceae**	Mafunyungule	Rn 38	S	55	b	Fresh bark is crushed, soaked in hot water or boiled in water for few minutes	Cupful infusion or decoction is drunk orally 2x per day after meals.	Van Vuuren and Naidoo (2010)	No report	Syphilis, earache (Van Vuuren and Viljoen, 2008), pneumonia (McGaw et al., 2008)
***Diospyros whyteana* F. White, Ebenaceae**	Munya vhili	Rn 6	T	27	l	Dried leaves are put in hot water to make tea	Infusion is used as a douche	Isodiospyrin Singh et al. (2012)	No report	Dysmenorrhoea, rash (Steenkamp, 2003)
***Diospyros mespiliformis* Hochst. ex A.DC. Ebenaceae**	Musuma	Rn 31	T	36	f	Crush raw fruit and add little water	Infusion is used as mouth wash or douche 3x per day	Isodiospyrin Singh et al. (2012)	Fungal infections (Mabogo, 1990)	Diarrhoea (Mahwasane et al., 2013), hypertension (Adamu et al., 2005)
***Dodonaea angustifolia* L.f. Sapindaceae**	Muthathavhana	Rn 26	S	18	l	Fresh leaves are crushed and macerated in water. It is used together with the bark of *Dovyalis zeyheri*	Maceration is taken orally, ½ a cup 2x per day	Motsei et al. (2003)	Oral candidiasis (Patel and Coogan, 2008)	Pneumonia, TB (Van Wyk and Gericke, 2000) rhinitis, piles (Vermani and Garg, 2002)
***Elaeodendron transvaalense* (Burtt Davy), Celastraceae**	Mukuvhazwivhi	Rn 41	T	73	r	Dried, powdered and boiled in water	½ cup of decoction is drunk 3x per day	Samie et al. (2010)	Candidiasis (Bessong et al., 2005)	Stomachache, fever (Drewes et al., 1991), dysmenorrhoea (Steenkamp, 2003)
***Elephantorrhiza burkei* Benth, Fabaceae**	Tshisevhufa	Rn 17	S	18	b	Grind dry bark into fine powder	Topical application, 2x per day	Mulaudzi et al. (2011)	No report	Venereal diseases, aphrodisiac (Mabogo, 1990), abortifacient (Steenkamp, 2003)
***Erythrina lysistemon* Hutch. Fabaceae**	Muvhale	Rn 27	T	36	r, st b	Grind up roots and stem bark and boil for 1h	Mouth wash or douche, 2x per day for a week	Motsei et al. (2003)	No report	Wounds, arthritis (Van Wyk and Gericke, 2000) oedema (Mahwasane et al., 2013)
***Faurea saligna* Harv. Proteaceae**	Mutango	Rn 44	T	64	b	Dried, powdered and soaked in warm water for at least 30 min	The infusion is used as a douche for vaginal ulcers	No report	No report	Diarrhoea (Hamill et al., 2000), epilepsy (Stafford et al., 2008)
***Ficus carica* L. Moraceae**	Muhuyu	Rn 3	T	27	f	Latex is collected from fig's raw fruit, crushed leaves and some water added	Mixture is used as mouth wash/douche 3x per day	Aref et al. (2010)	Sore throat (Jeong et al., 2009)	Eyesore, diabetes (Aref et al., 2010)
***Hippocratea longipetiolata* Oliv. Celastraceae**	Mutshaliri	Rn 37	S	55	r, b	Used in combination with few leaves of *O. rochetiana*, boiled in water	A cupful decoction is drunk orally 3x per day.	No report	No report	Invocation of ancestors (Mabogo,1990)
***Knowltonia bracteata* Harv. Ranunculaceae**	Thauyakhomba	Rn 18	S	18	r	Roots are pulverized and soaked in water for at least two days.	Cupful of the maceration is taken 3x per day	Buwa and van Staden (2006)	No report	Sexually transmitted diseases (Buwa and van Staden, 2006)
***Osyris lanceolata* Hochst. & Steud. Santalaceae**	Mpeta	Rn 45	S	64	b	Grind bark into fine powder and then boil in water	Oral, cup of decoction is taken 2x per day	Mulaudzi et al. (2011)	No report	Ringworm (Muthee et al., 2011)
***Ozoroa engleri* R.Fern. & A. Fern. Anacardiaceae**	Mudumbula	Rn 8	T	27	r	Grind dry roots and boil for 1h,	Decoction is used as mouthwash or douche	No report	No report	Sexually transmitted infections (de Wet et al., 2012)

***Pappea capensis* Sond. & Harv. Sapindaceae**	Murodolo	Rn 30	T	9	l	Fresh leaves are pounded in some water and filtered	Juice is used as douche on vaginal ulcers	Mulaudzi et al. (2011)	No report	Aphrodisiac, venereal diseases (Hutchings et al., 1996)
***Peltophorum africanum* Sond. Fabaceae**	Musese	Rn 15	T	36	b	Dry bark is soaked in water for at least two days	Infusion is taken orally, ½ cup 3 times per day	Steenkamp et al. (2007)	Sore throat (Bessong et al., 2005)	Diarrhoea (McGaw et al., 2008), Venereal diseases (de Wet et al., 2012)
***Piper capense* L.f. Piperaceae**	Mulilwe	Rn 21	S	18	b	Grind dry bark into fine powder and boil	Oral, 1 cup taken 3x per day	Steenkamp et al. (2007)	Sore throat (Mabogo, 1990)	Diarrhoea, cough (Chahal et al., 2011), Ulcers, fever (Obi et al., 2002)
***Pterocarpus rotundifolius* Druce, Fabaceae**	Muataha	Rn 29	T	9	st b	Grind bark into fine powder and pour into boiling water	Oral, quarter of a cup taken 2x per day	No report	No report	Sore eyes (Venter and Venter, 1996)
***Richardia brasiliensis* Gomes, Rubiaceae**	Mulegere	Rn 14	H	45	W p	Dried, burnt, pinch mixed with animal fats	Applied directly on mouth ulcers or vaginal ulcers	Adekunle (2000)	No report	Diabetes, anti-emetic (Pinto et al., 2008)
***Rinorea angustifolia* Baill, Violaceae**	Mafambaborile	Rn 28	S	18	r	Roots are boiled for at least1h, inappropriate preparation may cause stomach-ache	Oral, ½ a cup is taken 2x per day	No report	No report	No report
***Schotia brachypetala* Sond. Fabaceae**	Mununzu	Rn 39	T	55	r, b	Roots and barks are ground together, boiled in water	A cupful decoction is taken orally 3x per day after meals	Samie et al. (2010)	No report	Dysentery, diarrhoea (McGaw et al.,2000), ulcers (Venter and Venter, 1996)
***Schkuhria pinnata* (Lam.) Kuntze ex Thell, Asteraceae**	Luswielo	Rn 35	H	73	w p	Dried, powdered and boiled in water	A cupful of decoction is drunk 3x per day. Also used to treat HIV/AIDS	No report	No report	Diabetes, oedema (Mahwasane et al., 2013)
***Senna auriculata* Roxb. Fabaceae**	Muduwishango	Rn 12	T	18	fresh l	Fresh leaves are crushed, water is added and mixed with powdered shell of snail	Oral, ½ cup taken 3x per day after meals	Muthukumaran et al (2011)	No report	Ulcers, leprosy, diabetes (Subhadradevi et al., 2011)
***Senna petersiana* (Bolle) Lock, Fabaceae**	Munembenembe	Rn 2	S	27	se	Dry seeds ground into fine powder and boiled in water	Oral, ½ cup taken 2x per day after meals	Samie et al. (2010)	No report	Venereal diseases (Tshikalange et al., 2005); infertility (Steenkamp, 2003)
***Strychnos madagascariensis* Poir Loganiaceae**	Mukwakwa	Rn 25	T	18	st b	Ground into fine powder and boiled in water	Oral, ½ cup is taken 3x per day for a week	No report	No report	Fever (Ribeiro et al., 2010), diarrhoea (De Wet et al., 2010)
***Solanum nigrum* L. Solanaceae**	Muxe	Rn 7	H	27	f	Green berries are pounded, water is added and is filtered	A cupful of the juice is taken orally 3x per day	Mehjabeen et al. (2011)	No report	Ringworm (Jain et al., 2011), Antiflammatory (Ravi et al., 2009)
***Solanum panduriforme* Dunal, Solanaceae**	Ndhulwani	Rn 19	S	18	f	Dry fruits are burnt, ashes mixed with animal fat.	Topical application on the female genitals 2x per day for a week.	No activity Steenkamp et al. (2007)	No report	Diarrhoea (McGaw et al., 2008)
Spilanthes acmella (L.) Murray Asteraceae	Tshishengelapofu	Rn 36	H	73	wp	Powdered, soaked in warm water for 30 min to 1h	½ a cup of infusion is taken orally 3x per day, also used to treat STI	No report	Sore throat (Pfoze et al., 2012)	Cancer (Graham et al., 2000), toothache (Mbeunkui et al., 2011)
***Strychnos potatorum* L.f. Loganiaceae**	Mukongovhoti	Rn 34	T	45	b	Used together with the roots of *A senegalensis* and then soaked in cold water for 2 days	Maceration is used as mouth wash or douche 2x per day	No report	(Hamza et al., 2006)	Leucoderma, diabetes (Ekambaram et al., 2010)
***Tabernaemontana elegans* Stapf, Apocynaceae**	Muhatu	Rn 1	T	36	r	Dry roots are pulverized and boiled in water	Decoction is taken orally, a cupful 3x per day	Steenkamp et al. (2007)	No report	Sexually transmitted infections (De Wet et al., 2012)
***Tagetes minuta* L. Asteraceae**	Mushashthuri	Rn 20	H	27	l	Grind dry leaves and boil in water	Oral, 1 cup is taken while still hot once per day	Motsei et al. (2003)	Oral candidiasis (Hamza et al., 2006)	Smallpox, earache (Shahzadi et al., 2010)
***Trimeria grandifolia* (Hochst.) Warb. Flacourtiaceae**	Xidengani	Rn 4	T	9	l	Chewing of fresh leaves	Oral, 3x per day	No report	No report	Heart burns
***Vangueria infausta* Burch. subsp. *Infausta*, Rubiaceae**	Muzwilu	Rn 43	T	45	r, b	Chopped into small pieces and then boiled	Oral, cupful decoction is taken 3x per day, also used to treat diarrhoea	De Boer et al. (2005)	Oral candidiasis (Chinsembu and Hedimbi, 2010	Coughs (McGaw et al., 2008) malaria, pneumonia, (Venter and Venter, 1996)
***Warburgia salutaris* (G. Bertol.) Chiov. Canellaceae**	Mulanga	Rn 22	T	36	roots	Ground into powder, 1 spoonful is added into the soft porridge	Oral, twice per day, Overdose causes stomach ache	Motsie et al. (2003)	Thrush (Van and Wyk, 2011)	Malaria (Bussmann and Sharon, 2006), HIV/AIDS (Larmorde et al., 2010)
***Withania somnifera* (L.) Dunal, Solanaceae**	Musalamarubini	Rn 33	S	64	r	Used together with few leaves of *Ensete ventricosum* which are boiled together	A cupful of decoction is taken orally 3x per day	Jain and Varshney (2011)	No report	Cancer, fever (Maregesi et al., 2007), Diarrhoea (McGaw et al., 2008)
***Wrightia natalensis* Stapf. Apocynaceae**	Musunzi	Rn 11	T	27	r, b	Ground into fine powder and put into hot water	Infusion is used as gargle 2x per day	No report	No report	Gonorrhoea, aphrodisiac (Obi et al., 2002)

Key: T=tree, S=shrub, H=herb, l=leaves, b=bark, r=roots, f=fruit, se=seeds, st=stem, wp=whole plant.

E.Mey, *Osyris lanceolata* Hochst. & Steud., *Faurea saligna* Harv., *Richardia brasiliensis* Gomes, *Withania somnifera* (L.) Dunal, *Elaeodendron transvaalense* (Burtt Davy), *Acacia caffra* Thunb. Wild., *Strychnos potatorum* L.f., *Schotia brachypetala* Sond., *Croton gratissimus* Burch. and *Vangueria infausta* Burch. subsp. *infausta,* with their frequency index ranging from 45% to 73% (Table 1).

The fact that the same species are used by several traditional healers, and that several of these species are identified as medicinal plants from other communities in the literature provides confidence on their value. Furthermore, the use of the plant species by different cultural groups may also indicate their potential pharmacological efficacy. It is worth noting that 28 species, representing 62.2% of those recorded, have shown to have anti-*Candida* activity and 14 species (31%) have been reported to have antifungal use elsewhere in the literature (Table 1). Only one plant species, *Solanum panduriforme*, has been reported to be inactive against *Candida albicans* (Table 2). However, this may be due to the fact that water was used as an extraction solvent while in the traditional preparation dried fruits are burnt and mixed with animal fat. This gives some credibility to the information we collected from the informants. Based on our literature search, 12 plant species claimed to be used to treat candidiasis and related fungal infections were recorded for the first time: *Acacia caffra* (Thunb) Wild, *Amaranthus spinosus* L, *Cissampelos torulosa* E.Mey, *Faurea saligna* Harv, *Ozoroa engleri* R. Fern. & A. Fern, *Pterocarpus rotundifolius* Druce, *Rinorea angustifolia* Baill, *Schkuhria pinnata* (Lam.) Kuntze ex Thell, *Strychnos madagascarienses* Poir, *Sophora microphylla* Aiton, *Trimeria grandifolia* (Hochst.) Warb and *Wrightia natalensis* Stapf. These species have never been tested for anti-*Candida* activity

3.3. Growth forms and plant parts used

Twenty-three (51.1%) tree species are highly used by traditional healers more than shrubs and herbs 33.3% and 15.5% respectively. This is because trees are available throughout the year as indicated by traditional practioners. It is reported that trees usually bear greater quantities of compounds such as phenols, tannins, alkaloids, triterpenes and quinones than do shrubs and herbaceous species (Cartaxo and Souza, 2010), and this may also provide a reason why trees are preferred to other growth forms by the traditional healers.

The most widely used plant parts in the therapeutic preparations of remedies were roots and barks followed by roots and bark mixture) (Fig. 2). Several indigenous communities elsewhere also utilize mostly roots for the preparation of herbal remedies (Oyedemi et al., 2009; Appidi et al., 2008). Traditional healers prefer to use roots and bark because they believe that they have more healing powers than other plant parts. Studies by Maroyi (2011) shows that roots and other underground parts have high concentrations of bioactive compounds. On the other hand there were no statistically significant antimicrobial activity differences between leaf and bark extracts of Marula (Eloff, 2001). Worthy of note is that plant species in the area under study are frequently exposed to long periods of drought and they shed their leaves, so this may be an additional reason why roots and barks are preferred. According to the informants, plant materials are mainly collected in the winter season and time of collection is early in the morning. They believe that plants absorb plenty of water during the summer rainfall that may dilute the active principles, resulting in the loss of healing power of the remedy. In a study of the variation in antibacterial activity of *Schotia brachypetala* ethanol and water leaf extracts, McGaw et al. (2002) reported that monthly variation in activity against a panel of bacterial species was not marked, although there appeared to be a tendency towards slightly higher activity in the summer months.Fig. 3

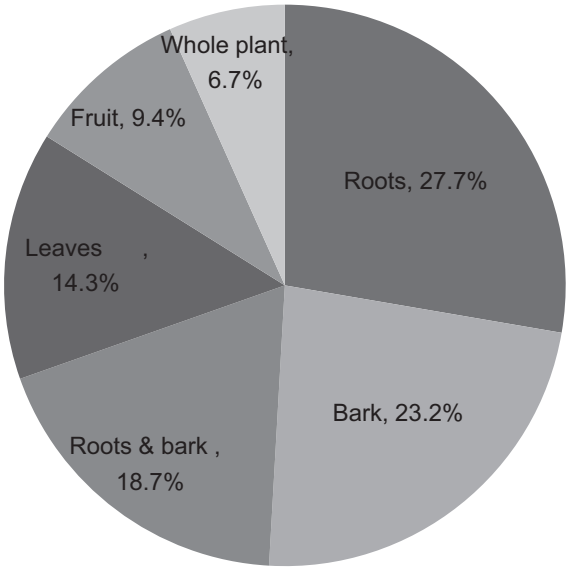

Fig. 2. Percentage of plant parts used for preparing the traditional remedies.

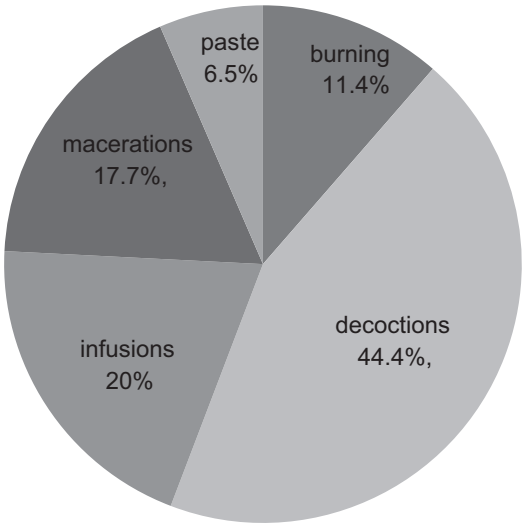

Fig. 3. Reported methods of preparing the traditional remedies in percentage.

Frequent harvesting of roots and bark has a negative influence on the survival of plants, and is therefore discouraged. Some studies (Shai et al., 2009; Eloff, 2001) have shown that plant leaf extracts are as active or even more active than extracts of other plant parts. Thus, to foster sustainability, traditional healers should be encouraged to use plant leaves. However, this might only be valid if the chemistry of the roots or bark is similar to that of the leaves. There are several communities in Africa and elsewhere who are mainly using leaves to treat a variety of ailments, examples are Burkina Faso (Nadembega et al., 2011), Cameroon (Telefo et al., 2011), Uganda (Ssegawa and Kasenene, 2007) India (Namsa et al., 2009)

3.4. Preparation, dosage and route of administration of the remedy

The most frequently used methods in the preparation of the herbal remedies were decoctions followed by infusions macerations and burning). The use of decoctions and infusions as the methods of choice is also supported by other studies (Keter and Mutiso, 2012; Namukobe et al., 2011.

With regard to burning, plant materials such as roots and barks are burnt to a certain degree, and then the fire is doused so that they do not become ash lest they lose their healing properties. In some plant species such as *Dichrostachys cinerea*, dry splinter of wood is burnt at one end, liquid that oozes out is used as a remedy for treating fungal infections.

The majority of these preparations were constituted by single plant species (84%) and 16% was constituted from multiple plant species and similar findings were reported by other researchers (Packer et al., 2012; Ranganathan et al., 2012,). Most traditional healers reported that multiple preparations of the remedy are normally administered to the patient if the disease is severe. There was a consensus among the traditional healers that some plants enhance the action of others, powdered roots of *E. transvaalense* were reported to be added to most of the herbal preparations. *E. transvaalense* is reported as having antiviral and anticandidal properties (Samie et al., 2010; Bessong et al., 2005).

We also found that dosage was estimated using either lids, spoons, cups, pinches or handfuls. It was difficult to get the information on exactly how much plant material was used to make the extracts. In most cases dosage was determined according to the severity of the disease and age of the patient. However, there was a lack of precision in the determination of the dosage to be taken by the patient. McGaw et al. (2007) reported that drawbacks of traditional medicinal plant remedies include uncertain dosages and lack of standardization.

Traditional healers reported that the prepared therapeutic remedies may be stored in powder form, especially for scarce medicinal plants, and liquid remedies (decoctions or infusions) are prepared and administered to patients on a daily basis. The therapeutic preparations are either stored in dried horns or skins of animals, calabashes, clay pots or wooden bottles. The use of either tins, plastics or glass bottles is discouraged because they absorb heat which may destroy the healing properties of the remedy. Unprocessed plant materials such as roots, fruit and stem bark are stored in dried form for future use in the traditional surgery which has a thatched roof.

With regard to the administration routes of the remedies, four main routes were reported, namely douche (20%), oral (56%), mouthwash (13.3%) and topical (10.7%). However, oral application was the most commonly used route of administration. This is in agreement with the results of various ethnobotanical studies elsewhere (Mukazayire et al., 2011; Philander, 2011; Wambugu et al., 2011). The use of the oral route of administration did not come as a surprise because this is in line with orthodox medicine where the preferred route is frequently oral. Most of these remedies were taken with some food twice or three times per day and some additives such as fats were also used, especially for topical application.

3.5. Conservation status of medicinal plants

The main factors threatening the conservation status of medicinal plants recorded during the interviews were unsustainable methods of harvesting, logging for firewood, use of plants for building materials, crafts and current agricultural trends. However, the informants stressed that they practice sustainable methods of harvesting the medicinal plants from the wild because they know that these plants are their primary source of income. In some of the instances, before the collection, they conduct some rituals such as sprinkling of snuff, bowing, invoking of their ancestors, etc. The informants blamed herbalists for the destruction of the medicinal plants.

Some of the harvesting techniques employed by the traditional healers included stripping of bark from the western and eastern sides of the tree to avoid ring barking of the stem; when collecting the whole plant, they ensured that some individuals remained behind; when collecting roots, side roots were collected, leaving the main ones for the plant to survive etc. The informants believed that if the plant from which they collected the plant material dies, then the patient would not be cured by the remedy. This is another way of instilling sustainable methods of harvesting plant material, resulting in the conservation of the medicinal plants. The present inventory represents a contribution of the natural flora of this area to a global approach in controlling candidiasis and related infections.

4. Conclusion

A total of 45 plant species used by the local traditional practitioners to manage candidiasis and related fungal infections were documented. The results of this study have shown that traditional medicine still plays an important role in meeting the primary health care needs of rural people in the area and that the information has a good evidential base. We reported for the first time 12 plants claimed to be used to treat candidiasis, and related fungal infections. This baseline study could help in identifying plant species for in depth investigation in order to establish their claimed potential in the management of candidiasis and related fungal infections. As a follow up on this work research on *Clerodendrum glabrum* one of the species identified, have led to the isolation and characterization of clerodendrumic acid, a new triterpenoid with antimicrobial activity (Masevhe et al., 2013).

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