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Medicinal utilization of exotic plants by Bapedi traditional healers to treat human ailments in Limpopo province, South Africa

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ABSTRACT

Ethnopharmacological relevance: Most exotic plants are usually labelled as alien invasives and targeted for eradication. However, some of these exotic plants play an important role in the traditional primary healthcare sector of the Bapedi culture in the Limpopo Province of South Africa. The medicinal uses of most of these species have neither been documented nor their biological activity evaluated.
Aim of the study: To make an inventory of exotic species employed by Bapedi traditional healers to treat different human ailments in the Limpopo Province, South Africa.
Materials and methods: Semi-structured interviews, observation and guided field walks with 52 traditional healers were employed to obtain ethnobotanical data during first half of 2011 on the use of exotic plant species by Bapedi healers to treat human ailments. Based on ethnobotanical information provided by these healers, specimens were collected, numbered, pressed, and dried for identification.
Results: A total of 35 exotics species belonging to 21 families and 34 genera, mostly from the Fabaceae and Solanaceae (11.4% for each), Apocynaceae and Asteraceae (8.5% for each) were used by Bapedi healers to treat 20 human ailments. Trees (45.7%) and herbs (37.1%) are the primary source of medicinal plants. Species most frequently reported were used for the treatment of hypertension (35%), diabetes mellitus, erectile dysfunction and gonorrhoea (25% for each). The highest consensus from individual accounts of the traditional healers on the use of exotic plant remedies in this study was noted for the three ailments. These were for *Catharanthus roseus* (gonorrhoea, 60%), *Punica granatum* (diarrhoea, 38.4%) and *Ricinus communis* (sores, 21.5%). Of the 35 exotic plant species recorded, 34.2% are regulated by the Conservation of Agricultural Resources Act (1983) (CARA) No. 43 of 1983 either as worst weeds or invaders.
Conclusion: The present study demonstrated that exotic plant species play an important part as medicinal remedies employed by Bapedi healers to treat different human diseases in the Limpopo Province. The use of these species as alternative sources of medicinal remedies could alleviate harvesting pressure of wild indigenous plants, thereby enhance biodiversity's region. However, there is a need to formulate an appropriate policy to retain some of the useful medicinal exotics (listed under CARA No. 43 of 1983) within the environment before their medicinal value vanishes as they are eradicated through management strategies adopted by the South African government.

1. Introduction

Exotic plants is a collective term used to describe plants that are not indigenous to a certain country (Ewel et al., 1999). There are different categories assigned to exotic plant species; these include those considered as naturalized, weeds or invasive (Rejmanek and Richardson, 1996; Richartson et al., 2000). According to these authors naturalized exotics are those that reproduce and sustain populations over more than one life cycle without intervention by humans; they often recruit offspring freely, but often just near adult plants, and do not necessarily invade natural, semi-natural, or human made ecosystems. These authors, further state that weeds are plants that are undesirable from a human point of view. This is because weeds normally invade natural vegetation, usually adversely affecting native biodiversity or ecosystem functioning (Heywood, 1995; Westbrooks, 1998) or invade agricultural land, impacting on the growth and productivity of cultivated crops. Alien invasives are exotics that recruit reproductive offspring, often in very large numbers, at considerable distances from parent plants and thus have the potential to

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spread rapidly (Rejmanek and Richardson, 1996; Richartson et al., 2000).

Exotic species are widespread in the Limpopo Province; in cultivated areas, home gardens and in the wild. Thousands of these plant species have been and continue to be transported by humans to areas far from their natural habitats. Some are moved accidentally (Smit, 2004), but more important are the many species that are intentionally introduced and cultivated to serve human needs. Human beings depend heavily on exotics plant species for food, shelter, ecosystem services, aesthetic enjoyment and cultural identity (Sattaur, 1989; Prescott-Allen and Prescott-Allen, 1990; Evans, 1992; Altieri, 1994; Admasu, 2008; Singh et al., 2010).

Apart from the above mentioned potential benefits of exotic plant species to human, studies have also revealed their importance in traditional medicine. In India, of 152 exotics plants recorded by Singh et al. (2010), 24 species were reported to be used by tribals of Sonaghati of Sonbhadra district for medicinal purposes (Singh et al., 2002). Furthermore in India, Pant and Sharma (2010) found that of 18 recorded exotic trees, five are used traditionally as medicine.

A comprehensive study by Stepp and Moerman (2001), which focused on exotics species in the medicinal floras of the Highland Maya in Chiapas, Mexico and in the medicinal flora of Native North Americans revealed a remarkable discovery. They found that of the 2401 North American taxa that are used medicinally by native Americans, 620 are exotics. Furthermore, of 1178 species declared as weed or exotics Rıos and Garcıa (1998) in the Highland Maya of Chiapas, 35 are used by traditional healers as medicine.

The utilization of exotics species for medicinal purposes is also a common practice in African countries. In Kenya, Njoroge et al. (2004) found that 75 exotics species are being used to cure 59 human ailments in traditional medicinal practices of central Kenya. This remarkable finding made Njoroge et al. (2004) to postulate that traditional medicine in their study area is undergoing changing patterns as far as medicinal plant utilization is concerned. South Africa is not excluded; a review on important exotic species by Lewu and Aflolayan (2009) revealed that 34 species are used to treat 21 diseases by major ethnic groups of (Xhosa, Zulus, Vendas and Swatis) of South Africa, excluding Bapedi; one of the largest ethnic group in South Africa. Similarly, Dold and Cocks (2002), noted that of 130 plant species used as medicine by Xhosa traditional healers in the Eastern Cape Province, 33 are declared exotics species.

Today in South Africa, at least 161 exotics species have been declared as the worst invaders and are listed under the Conservation of Agricultural Resources Act (1983) (CARA) No. 43 of 1983. With strong recommendations and strategies to eradicate or control their growth in cultivated lands and in the wild (Bromilow, 2001; Lewu and Aflolayan (2009)); there is however lack of a comprehensive study and documentation to appraise their importance within plant ecology Lewu and Aflolayan (2009) and human wellbeing. This is because they cause serious problems in natural and semi-natural systems (Henderson, 1995), impacting on approximately 80% of the country or roughly 20 million ha (Le Maitre et al., 2000). To clear 20 million ha of these vegetation would cost, according to IOL News (2010), a ″conservative″ estimate of R34 billion over the next 25 years. This cost is further compounded by the need for follow up clearing programmes (Marais et al., 2004).

The medicinal value of exotic plants resources in South Africa is in general often ignored and receives little recognition from the government. This might perhaps be due to lack of information about the extent of their use and their importance to rural economies. Therefore, this study was initiated to document the medicinal use of some exotics plant by Bapedi traditional healers in the Limpopo Province, South Africa. This is the first report on the medicinal use of exotic plants by Bapedi traditional healers in the Limpopo Province; one of the nine Provinces that constitute South Africa.

2. Materials and methods

2.1. Study area

The present study was conducted in the three districts (Fig.1) of the Limpopo Province (South Africa) and their 17 municipalities (Table 1). The majority of people in these districts are heavily reliant on medicinal plants and use herbal medications either alone or in combination with western medicines to treat several diseases (Semenya et al., 2012a). Furthermore in these districts, the Bapedi speaking people constitute the largest cultural group. In fact in the Limpopo Province, Bapedi comprise almost 57% of the population (Lodge, 2005).

2.2. Ethnomedical information

A dual purpose reconnaissance survey was first carried out in each local municipality: (i) to obtain permission to conduct this study within the area of jurisdiction and (ii) also to meet with the traditional healers to request them to participate in the study (Semenya et al., 2012a; Semenya, 2012). Researchers adhered to the ethical guidelines of the International Society of Ethnobiology International Society of Ethnobiology and Invasive alien trees and water resources in South Africa (2006). Information was collected from January 2011 to July 2011. It was collected from 52 traditional healers residing in the 17 local municipalities (Table 1) within the three districts (Fig. 1) of the Limpopo

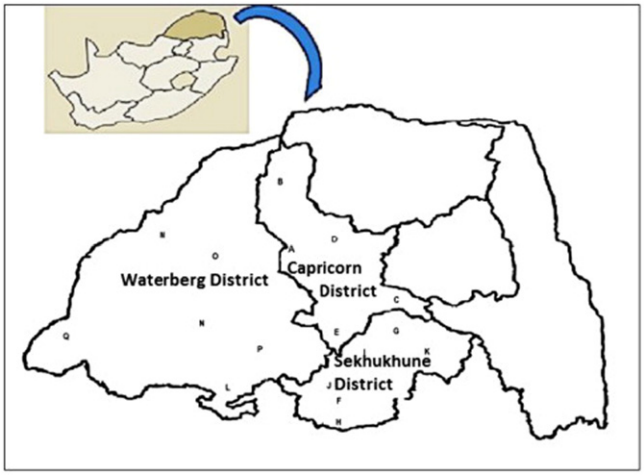

Fig. 1. Study area: Capricorn, Waterberg and Sekhukhune districts, Limpopo Province, South Africa. A–Q designates the involved municipalities.

Table 1
Districts and local municipalities included in this study.

Capricorn district	Sekhukhune district	Waterberg district
Aganang (A)	Elias Motswaledi (F)	Bela-Bela (L)
Blouberg (B)	Fetakgomo (G)	Lephalale (M)
Lepelle-Nkumpi (C)	Groblersdal (H)	Modimolle (N)
Molemole (D)	Makhuduthamaga (I)	Mogalakwena (O)
Polokwane (E)	Marble Hall (J)	Mookgophong (P)
	Tubatse (K)	Thabazimbi (Q)

Province. Per municipality, two traditional healers were randomly selected, and the objective of the study was explained in Sepedi, the local language. Through general interviews and questionnaires, information was collected on the names of plants used for the treatment of human ailments, the source of these plants, the part/s of plants used, as well as methods of preparation of plant materials.

2.3. Collection of plant materials

Medicinal plant materials were collected by researchers from both home gardens and wild during organized tours while accompanied by a traditional healer. The species were initially identified by their local names and their proper identification was done using the herbarium of the University of Limpopo (Larry Leach Herbarium). Voucher specimens of each plant were prepared and deposited at the mentioned Herbarium. Voucher numbers of collections are given in Table 2.

2.4. Exotic species

A preliminary survey (unpublished data) on medicinal plant used by Bapedi traditional healers recorded a total of 214 plant species that are used to treat different human ailments. These species were compared with the publications (Moran and Zimmermann, 1991; Conservation of Agricultural Resources Act (1983); Bromilow, 2001; Henderson, 2001; Van Wilgen et al., 2001; Le Maitre et al., 2002; Macdonald et al., 2003) on plant species declared by South African government as exotics. Subsequently a total of 35 exotics plants were revealed.

2.5. Data analysis

Data associated with the 35 exotics species were stored in Microsoft Excel 2007 programme and were later analysed for descriptive statistical patterns. Descriptive statistics, such as percentages and frequencies, have been used to analyse the data obtained from the questionnaires. Percentages were calculated as the number of species/ailments divided by the total number of species/ailments and multiplied by hundred.

3. Results and discussion

3.1. Diversity of medicinal plants

A total of 35 exotics species belonging to 21 families and 34 genera were reported as used by Bapedi traditional healers to treat different ailments (Table 1). Of these species 34.2% are regulated by CARA No. 43 of 1983, and the rest (65.8%) are naturalised exotics found near homes as weeds or cultivated in home gardens as ornamentals or food plants. This diversity is an indicative that exotic plants are imperative in Pedi traditional healing practices. Plants (17.1%) have been given more than one Pedi vernacular name; a sign that they are widely used and incorporated into the local culture of the Pedi communities. Their extensive utilization can play an important role as alternative substitutes to indigenous medicinal plant species in the studied districts. This will ultimately enhance the regions biodiversity.

The largest number of exotic plants used by Bapedi traditional healers for herbal preparations came from Fabaceae and Solanaceae (11.4% of each), followed by Apocynaceae and Asteraceae (8.5% of each). These families seem to contain a high percentage of important exotic species of medicinal value in traditional healing as was also noted by Njoroge et al. (2004) and Holm et al. (1979). The extensive utilization of species from these families by Bapedi traditional healers still remains un-elucidated. However, studies such as those of Clarkson et al. (2004), Gurib-fakin (2006), Iranbakhsh et al. (2010), demonstrated that most of the species belonging to these families contain important active ingredients that have curative properties against various human ailments. Based on findings of these studies, it is reasonable to speculate that the degree of use of species from these families by Bapedi traditional healers may at least partially be due to their active ingredients.

3.2. Plant habit

Exotic trees (45.7%) are the primary source of medicinal plant species in this study, followed by herbs (37.1%). Shrubs (17.1%) constituted the least plants used by Bapedi traditional healers to treat human ailments. This finding is contrary to that reported by Njoroge et al. (2004) for the local communities of central Kenya. Their study reported the supremacy of herbs (65%), followed by shrubs (32%) whereas trees (3%) constituted the least plants used. Njoroge et al. (2004) argued that since exotics herbs grow fast they can provide a continuous supply of the medicinal products. However, the extensive use of trees by Bapedi traditional healers in the preparation of remedy might be linked to their availability throughout the year. The ease with which plants can be collected might have also contributed to the lower preference for herbs in this study. The high use of exotic trees could also be attributable to that these may comprise a major component of exotic species introduced in the area.

3.3. Plant use reported

The documented medicinal plants were used by traditional healers in this study to treat 20 different human ailments (Table 2). It is important to note that the total number of medicinal plants recorded in this study surpasses the sum of treated diseases. This is because many of the species are used to treat the same ailments. Table 2 clearly indicates that species most frequently reported were used for treating hypertension (35%), diabetes mellitus, erectile dysfunction and gonorrhoea (25% of each). These were followed by diarrhoea and tuberculosis (20% of each). The larger number of species employed to treat a single ailment clearly reflects the diversity of treatment protocols used by Bapedi traditional healers. Furthermore, a number of alternative species can be used, which in itself will ensure that a diversity of treatment options will always be available. Moreover, the diversity of treatment possibilities also contributes to health sovereignty by enabling traditional healers to choose the most appropriate treatments.

It is worth noting that the highest consensus from independent healer accounts on exotic plant remedies used against the 20 ailments treated by Bapedi healers was noted for the three ailments. These were *Catharanthus roseus* which was used for gonorrhoea (60%), *Punica granatum* which was used to treat diarrhoea (38.4%) and *Ricinus communis* which was used for the treatment of sores (21.5%). The degree of informant conformity for these plant species in treating a selective disease is more important in reflecting the bioactivity potential of the plants than the numerical status of the plants used to treat the condition.

The ethno medicinal uses of the above mentioned species have been validated via their extensive use by different cultures in South Africa or elsewhere, or they are supported by scientific proof. For instance, study by Fernandes et al. (2008) reported the use of *Catharanthus roseus* by VhaVenda traditional healers of the Limpopo Province to treat unspecified sexually transmitted diseases. Therefore it is possible that VhaVenda healers also use it for gonorrhoea. Surprisingly, *Catharanthus roseus* contains poisonous alkaloids, yet majority of Bapedi traditional healers prescribe its

Table 2
Therapeutical applications of exotic species used in the traditional medicine by Bapedi healers in the Limpopo province.

Species name	Family	Voucher	Pedi vernacular name	Habit	Used part/s	Method/s of preparation, dosage and administration	Ailment/s treated	The reported biological/pharmacological activities	No. of citations (%)
Acanthus montanus L	Acanthaceae	SS 76	Unknown	Herb	Root	Boiled in water for 20 min and one tin cup of the extract is taken orally. Thrice a day	Stomach disorders	Alkaloids, saponins, tannins and phenols (Asongalem et al., 2004)	1.9
⁎*Agave americana* L.	Agavaceae	SS 02	Mobepi/ kgopha-ya-pala/nsware-ke-ya-robega	Shrub	Leaf	Boiled in water for 25 min and three tin cups of the extract is taken orally. Thrice a day	Hypertension	Saponins and sterols (Sparg et al., 2004)	5.7
Alternanthera pungens Kunth	Amaranthaceae	SS 402	Mosweetswe	Herb	Tuber	Chopped and macerated in cow's milk for 24 h. One tin cup of the decoction is taken orally. Thrice a day	Gonorrhoea	Diuretic activity (Calderon et al., 1998), immunological reactivity (Gayathri et al., 2001)	1.9
Artemisia annua L.	Asteraceae	SS 43	Mohlaswapatla	Herb	Root	Boiled in water for 20 min and one tin cup of the extract is taken orally. Thrice a day	Erectile dysfunction	Phenolic compounds (De Magalhaes et al., 2012)	1.9
Bidens pilosa L.	Asteraceae	SS 214	Mophodisa/ mokolonyane	Herb	Root	Boiled in water for 15 min and one tin cup of the extract is taken orally. Thrice a day	Menstrual disorder	Antibacterial and antimicrobial activities (Rabe and Staden, 1997), Gallic acid and polymeric polyphenolic material (Abajo et al., 2004)	1.9
⁎*Caesalpinia decapetala* (Roth) Alston.	Fabaceae	SS 74	Mokgabane	Tree	Root	Boiled in water for 10 min and one tin cup of the extract is taken orally. Thrice a day	Gonorrhoea	Caesaljapin (Ogawa et al., 1992)	1.9
Cannabis sativa L. var. *sativa*	Cannabaceae	SS 24	Mopatse	Herb	Leaf	Macerated in warm water for 24 h and one tin cup of decoction is taken orally. Thrice a day	Tuberculosis	Tetrahydrocannabinol (Schomacher et al., 2008), antipsychotic activity (Ibrahim et al., 2010), antioxidant effect Javadmosavi and Tehranipour (2011)	1.9
Capsicum chinese L.	Solanaceae	SS 40	Mopherefere	Shrub	Root	Boiled in water for 15 min and one tin cup of the extract is taken orally. Thrice a day	Period pains	Hypoglycaemic activity Oboh et al., (2007)	1.9
Carica papaya L.	Caricaceae	SS 70	Mophopho "wapoo"	Tree	Root	a. Pounded and 5 teaspoons taken orally with a bowl of soft porridge. Thrice a day	a. Erectile dysfunction	Antitumoral activity (Salas et al., 2008), anti-candida albicans (Emeruwa et al., 1982; Caceres et al., 1995; Giordani et al., 1997), abortifacient activities (Lohiya et al., 2002), anti-bacterial activity (Green et al., 2010)	7.6
					Fruit	b. Squeezed juice from unripe fruit and one tin cup of juice is taken orally. Thrice a day	b. Abortion		1.9
					Root	c. Boiled in water for 20 min and one tin cup of the extract is taken orally. Thrice a day	c. Diabetes mellitus		1.9
					Root	d. Mixed with *Cucumis myriocarpus* (tuber) and boiled in water for 20 min. One tin cup of extract is taken orally. Thrice a day	d. Gonorrhoea		1.9
Catharanthus roseus (L.) G. Don	Apocynaceae	SS 33	Lepolomo-le-l-pinki–la *drop*	Herb	Root	a. Boiled in water for 5–20 min. One tin cup of the extract is taken orally. Thrice a day	a. Gonorrhoea	Serpentine (Pereira et al., 2010)	59
						b. Boiled in water for 5 min and one tin cup of warm extract is administered anally via bulb syringe by the healer. Once	b. Gonorrhoea		1.9
Citrus lemon (L.) Burm. F.	Rutaceae	SS 480	Moswiri	Tree	Root	Mixed with *Acanthus montanus* (root), *Carica papaya* (root), *Zea mays* (root) and boiled in water for 20 min. One tin cup of the extract is taken orally. Thrice a day	Malaria	Hesperidin Del Rio et al., (2004)	1.9
⁎*Datura stramonium* L.	Solanaceae	SS 41	Lechoe/thoba	Shrub	Seed	Pounded and mixed with Vaseline in a container (500 g). Five teaspoons of mixture is applied topically and massage affected area. Thrice a day; every time after bathing	Stroke	Littorine (Berkov et al., 2005), tropane alkaloids (Iranbakhsh et al., 2010)	1.9
#*Eriobotrya japonica* (Thunb.) Lindl.	Rosaceae	SS 311	Unknown	Tree	Leaf	a. (i) Boiled in water for 7–10 min and one tin cup of the extract is taken orally. Thrice a day	a.(i) Hypertension (ii) Tuberculosis	Anti-tumor, anti-viral, hypoglycemic, anti-diabetic, and anti-inflammatory properties (Kim et al., 2011)	9.6 1.9
#*Eucalyptus camaldulensis* Dehnh.	Myrtaceae	SS 401	Mopilikomo/ tholodi	Tree	Leaf	Boiled in water for 5–20 min and one tin cup of the extract is taken orally. Thrice a day	Tuberculosis	Antiproliferative activity Topco et al., (2011)	3.8

Table 2 (*continued*)

Species name	Family	Voucher	Pedi vernacular name	Habit	Used part/s	Method/s of preparation, dosage and administration	Ailment/s treated	The reported biological/pharmacological activities	No. of citations (%)
Ficus carica L. subsp. rupestris (Hausskn.) Browicz (Dncir)	Moraceae	SS 89	Mofeiye	Tree	Bark	Boiled in water for 10 min and one tin cup of the extract is taken orally. Thrice a day	Tuberculosis	Phenolic compounds, phytosterols and fatty acids (Oliveira et al., 2009)	1.9
Gomphocarpus fruticosus subsp. *fruticosus*	Apocynaceae	SS 101	Mosotsa poo	Shrub	Root	Boiled in water for 15 min and one tin cup of the extract is taken orally. Thrice a day	Erectile dysfunction	Quercetin glycosides (Heneidak et al., 2006)	9.6
Jatropha curcas L.	Euphorbiaceae	SS 120	Sehlare sa banna	Tree	Root	Boiled in water for 5 min and one tin cup of the extract is taken orally. Thrice a day	Erectile dysfunction	Procoagulant and anticoagulant activities (Osoniyi and Onajobi, 2003)	1.9
∗*Lantana camara* L.	Verbenaceae	SS 324	Sebabane/ motsholla	Shrub	Root	Boiled in water for 5 min and two tin cups of the extract taken orally. Thrice a day	Hypertension	Ursolic and oleanolic acids (Ghisalberti, 2000), cardioactive glycosides (Qaisar et al., 2009)	5.7
∗*Lolium multiflorum* Lam.	Poaceae	SS 15	Botsakatsaka	Herb	Whole plant	Boiled in water for 20 min and one tin cup of the extract is taken orally. Thrice a day	Kidney problem	Phenolic compounds (Ponce et al., 2009)	1.9
Medicago sativa L.	Fabaceae	SS 320	Luserene	Herb	Whole plant	Mixed with *Croton pseudopulchellus* (leaves) and boiled in water for 20 min. One tin cup of the extract is taken orally. Thrice a day	Heart attack	Flavonoids, alkaloids, phytoestrogens, coumarins, digestive enzymes, triterpenes, saponins and phytosterols (Doss et al., 2011)	1.9
Mormordica charantia L.	Cucurbitaceae	SS 103	Monamelala	Herb	Leaf	Boiled in water for 20 min and one tin cup of the extract is taken orally. Thrice a day	Diabetes mellitus	Triterpenoid saponins (Sparg et al., 2004)	1.9
Musa sapientum L.	Musaceae	SS 307	Mopanana	Tree	Leaf	Mixed with *Hypoxis obtusa* (tuber), scale of an ostrich egg and pounded; 3 teaspoons of resulting ashes is applied topically	Wounds/general injuries	Methanolic and aqueous activities (Agarwal et al., 2009), anti-hyperglycaemic effect (Pari and Maheswari, 1999)	1.9
∗*Opuntia ficus–indica* Mill.	Cactaceae	SS 90	Motloro	Tree	Root	a. Boiled in water for 20 min and one tin cup of the is taken orally. Thrice a day b. Boiled in water for 20 min or mixed with *Ziziphus mucronata* (root) and boiled in water for 20 min. One tin cup of the extract is taken orally. Thrice a day	a. Hypertension b. Gonorrhoea	Wound healing activity (Park and Chun, 2001), sarsaparilla activity (Shedbalkar et al., 2010), anti-hypertensive (Chauhan et al., 2010), anti-bacterial activity (Abubakar, 2010)	5.7 3.8
Persea americana Mill.	Lauraceae	SS 92	Moafokhathe	Tree	Root	a. Boiled in water for 10–20 min and on tin cup of the extract is taken orally. Thrice a day	a.(i) Diabetes mellitus (ii) Hypertension	Anti-fungal, anti-inflammatory, and anti-oxidant activities (Lee et al., 2012)	1.9 9.6
Plumeria obtusa L.	Apocynaceae	SS 95	Mohlare wa maswi wa sukiri	Tree	Leaf	Boiled in water for 5–10 min and one tin cup of the extract is taken orally. Thrice a day	Diabetes mellitus	Triterpenoids (Siddiqui et al., 2004)	9.6
Prunus persica (L.) Batsch var. *persica*	Rosaceae	SS 84	Moperekisi	Tree	Root	Pounded and 5 teaspoons are taken orally with a bowl of soft porridge. Thrice a day	Erectile dysfunction	Anti-tumour promoter and anti-Oketsu syndrome effects (Kim et al., 2003)	5.7
#*Psidium guajava* L.	Myrtaceae	SS 408	Mokwaba	Tree	Root	a. Mixed with *Punica granatum* (root) and boiled in water for 5 min. One tin cup of the extract is taken orally. Thrice a day b. Boiled in water for 5–10 min and one tin cup of the extract is taken orally. Thrice a day c. Boiled in water for 7 min and one tin cup of the extract is taken orally. Thrice a day	a. Diarrhoea b. Diarrhoea c. Hypertension	Anti-diarrhoeal activities Gutïerrez et al., (2008)	1.9 3.8 1.9
Punica granatum L.	Punicaceae	SS 73	Mokgarenate	Tree	Root/ Pericarp Root	a. Boiled in water for 5–25 min and one tin cup of the extract is taken orally. Thrice a day b. Boiled in water for 10–20 min and one tin cup of the extract is taken orally. Thrice a day	a. (i) Diarrhoea b.(i) Blood vomiting (ii) Diabetes mellitus	Anti-diarrhoeal activities (Prashanth et al., 2001; Mathabe et al., 2006; Venkatrao et al., 2007), pomegranate antioxidant activity (Lansky and Newman, 2007)	38.4 5.7 3.8

#*Ricinus communis* var. *communis*	Euphorbiaceae	SS 38	Mothoba/ mobabo/ sebetsa	Shrub	Whole plant	a. (i) Boiled in water for 5–30 min and 4–6 cups of warm extract is used to massage	Sore	Antiinflammatory and antiarthritic activities (Ilavarasan et al., 2006)	21.5
Schkuhria pinnata (Lam.) Kuntze ex Thell.	Asteraceae	SS 87	Sebabane	Herb	Whole plant	Boiled in water for 10–20 min and one tin cup of the extract is taken orally. Thrice a day	(i) Hypertension (ii) Blood purifier	Hypoglycaemic activity (Deutschlander et al., 2009)	5.7 1.9
#*Senna didymobotrya* (Fresen.) H.S. Irwin & Barneby	Fabaceae	SS 105	Mothekele	Tree	Leaf	Boiled in water for 10 min and one tin cup of the extract taken orally. Thrice a day	Blood clotting	Anthraquinones and flavonoid glycosides (Alemayehu et al., 1996)	5.7
Sesbania punicea (Cav.) Benth.	Fabaceae	SS 82	Mokgabane	Tree	Root	Boiled in water for 20 min and one tin cup of the extract is taken orally. Thrice a day	Menstrual disorder	None found	1.9
Solanum lycopersicum L.	Solanaceae	SS 490	Motamati	Herb	Fruit	Squeezed juice and 1–3 tin cups of juice is taken orally. Thrice a day	Diarrhoea	None found	5.7
Solanum mauritianum Scop.	Solanaceae	SS 116	Mothola-o-mo-tala	Herb	Fruit	Chopped and macerated in warm water for 24 h and one tin cup of the decoction is administered by healer anally via fatal bulb syringe. Thrice week	Cleaning kidneys	Solasodine compound (Jäger et al., 1996)	3.8
Zea mays L.	Poaceae	SS 119	Mabele	Herb	Root	a. (i) Mixed with *Citrus limon* (leaf) and boiled in water for 20 min. One tin cup of the extract is taken orally. Thrice a day	a. (i) Malaria	Flavone glycosides and antibiotic activity (Liu et al., 2011)	1.9
					Whole plant	b. (i) Pounded and mixed with Vaseline (lotion) and applied topically every time after bathing	b. (i) Malaria		5.7

Key: (*) and (#)= CARA listed species, (*)= exotic weed, and (#)= invasive species.

extract orally to treat gonorrhoea. Its vernacular name "lepolomo le le pinki la drop" alludes to the fact that currently the Bapedi uses it only for gonorrhoea, and not in the treatment of other ailments.

The use of *Punica granatum* as anti-diarrhoeal treatment by Bapedi healers came as no surprise as it was previously noted by Mathabe et al. (2006). The medicinal use of this species for the treatment of diarrhoea is not only restricted to the Bapedi traditional healers as it is also used elsewhere. Studies such as those by Sathyavati et al. (1987), Namsa et al. (2011) and Shanmugam et al. (2011) also reported its diarrhoeal use by both ordinary people and traditional healers in different areas of India. The traditional use of *Punica granatum* to treat diarrhoea is supported by scientific studies (Prashanth et al., 2001; Venkatrao et al., 2007) which demonstrated its effectiveness against diarrhoea. Finding of these studies provides an explanation of the preferences of *Punica granatum* by Bapedi healers to treat diarrhoea.

Xhosa healers of the Eastern Cape (Dold and Cocks, 2002) and Zulu healers of KwaZulu Natal (Hutchings et al., 1996) Provinces (South Africa) as well as traditional healers in Southern and Eastern Africa (Watt and Breyer-Brandwijk, 1962) also use *Ricinus communis* to treat sores. Such a similarity in the cross-cultural usage of plant remedies is a strong indication of the bioactivity potential of this plant. Hossan et al. (2010) noted that if a plant has been reported in different surveys for the treatment of a similar ailment then that plant may be a new source of medication for such ailment in the future. This species therefore can be targeted for phytochemical studies with the aim of identifying active ingredients for therapeutic use on sores.

Interestingly, 20% of exotics species (*Carica papaya*, *Eriobotrya japonica*, *Opuntia ficus-indica*, *Persea americana*, *Psidium guajava*, *Punica granatum* and *Schkuhria pinnata*) documented in this study were used by healers to treat more than one ailment (Table 2). The practice of utilizing a single exotics species for the assortment of human ailments was also reported in Central Kenya (Njoroge et al., 2004), in the Province of Neuquen, Argentina (Estomba et al., 2006) and in the Municipality of Alagoinha, Brazil (Albuquerque, 2006). It is also interesting to state that some of these species are also multi-used for medicinal purposes by different cultures, although not for same ailments; notably *Schkuhria pinna*, is also multi-used (colds/flu, malaria and wound) by people in Central Kenya (Njoroge et al., 2004). It was observed that with the exclusion to *Schkuhria pinnata*, Bapedi healers cultivated these species in home gardens for both food and ornamentals. This would lead one to believe that their multi-utilization is attached to their proximity as well as availability.

3.4. Inventory of selected species

The ethno medical uses of some exotic plants used by Bapedi traditional healers are consistent with data reported previously in other studies. Their efficacy against the reported claims is validated by scientific studies while others pose therapeutic ingredients that might be helpful against the reported ailments (Table 2). *Carica papaya* is a species noteworthy; its traditional use by both VhaVenda (Arnold and Gulumiam, 1984) and Lay people (De Wet et al., 2011) of South Africa for the treatment of gonorrhoea has been reported. Similarly, Goba traditional healers of Chiawa chieftaincy in Lusaka (Zambia) also use this species to treat gonorrhoea. Wide usage of *Carica papaya* by different cultures indicates that it might be effective and safe in the treatment of gonorrhoea and other STDs. It is worth stating that scientific studies such as by Emeruwa et al. (1982), Caceres et al. (1995) and Giordani et al. (1997) listed different parts (leaves, fruits, roots and latex) of *Carica papaya* as containing active ingredients against a number of microorganisms, including *Candida albicans*, as well as a number of species of *Candida* and

fungi. Based on these findings it is reasonable to state that the possibility is high that the use of *Carica papaya* by Bapedi traditional healers might be effective against gonorrhoea. The use of this species by healers of Uganda for erectile dysfunction (Kamatenesi-Mugisha and Oryem-Origa, 2005) and by females in Miami, Florida (Morton, 1987) for abortion also concurs with the findings of the present study. Adebivi et al. (2002) who noted that its unripe or semi-ripe fruit is unsafe during pregnancy and could lead to abortion scientifically confirmed its use by Bapedi healers for abortion. It is interesting to note that a preliminary medical research in animals has demonstrated the potential contraceptive and abortifacient capability of *Carica papaya* (Lohiya et al., 2002). This shows that Bapedi traditional healers do have a basic understanding of the remedial action required for abortion. Similarly, *Carica papaya* leaves have demonstrated anti-tuberculosis activity against the *Mycobacterium tuberculosis* (Green et al., 2010), thus also supporting its utilization by Bapedi healers to treat TB. This species has a great potential which could lead to the useful modern drugs for different human aliments.

Furthermore, *Cannabis sativa* leaves are smoked by Zulu healers to treat TB (Hutchings et al., 1996). However, frequent use of this species (a declared drug) by both Bapedi and Zulu traditional healers might result in addiction. Therefore these healers need to be alerted of this danger. Medicinal use of *Agave americana* in the treatment of hypertension was reported by Duncan et al. (1999) for the Zulu people. This species is also use by Bapedi people as poles for huts and kraals construction. The use of *Bidens pilosa* to treat menstrual disorder by healers of this study is consistent with data reported by Mabogo (1990) for VhaVenda traditional healers. However, there is a clear difference regarding the plant parts used; Bapedi healers prefer to use extracts prepared from root while VhaVenda healers prefer to use leaves. The cultural differences might have contributed to the observed differences. One of the recognised evidences of efficacy and safety of remedy is its long history of traditional use (Van Wyk and Wink, 2004), as well as its cross-cultural use for treating a similar ailment. Thus phytochemical and pharmacological studies of these species are recommended as to understand their mode of action against the reported claims.

To the best of our knowledge, 20% of species documented in this study as used by Bapedi traditional healers are recorded for the first time. These include *Acanthus montanus* (stomach disorders), *Alternanthera pungens* (gonorrhoea), *Artemisia annua* (erectile dysfunction), *Capsicum chinese* (period pains), *Gomphocarpus fruticosus* (erectile dysfunction), *Prunus persica* (erectile dysfunction) and *Sesbania punicea* (menstrual disorder). This finding has made a major contribution in the species used traditionally for the reported aliments in South Africa and other parts of the world. It also offers considerable opportunities for scientific research. However, these species are commonly used as medicinal plants to treat other different diseases elsewhere (Roys, 1931, Hulme, 1954, Alcorn, 1984, Galeffi et al., 2002, Tapsoba and Deschamps, 2006, Estomba et al., 2006, Ndawonde, 2006, Mustafa et al., 2011); an indication that they might contain pharmacologically active substances against different diseases that threaten human species. Some of these species contain chemical compounds or ingredients that might be helpful in the treatment of the reported claims (Table 2).

3.5. Conservation of agricultural resources act (CARA) listed species

About 28.5% of exotics species used by Bapedi traditional healers are caught in the web of conservation policy (CARA Act No. 43 of 1983) in South Africa. These species included *Caesalpinia decapetala*, *Eriobotrya japonica*, *Eucalyptus camaldulensis*, *Lantana camara*, *Opuntia ficus-indica*, *Psidium guajava*, *Ricinus communis*, *Senna didymobotrya*, *Sesbania punicea* and *Solanum mauritianum*. These have been declared as highly invasive and referred to as biological pollutants by Conservation of Agricultural Resources Act (1983). Consequently, CARA legalises their indiscriminate eradication without consideration for their potential economic and human wellbeing importance. The South African Government has adopted chemical, physical and biological strategies to control some of these species.

The present study, however, indicated that Bapedi healers within every studied district (Capricorn, Sekhukhune and Waterberg) used exotics species to treat different human ailments. This is an indicator that these species are widespread in the study area and also form an important part of the traditional medicine of Bapedi healers. Traditional medicinal use of some of these species is in line with previously reported ones in South Africa and other countries. For instance, Semenya et al. (2012b) also noted the use of *Caesalpinia decapetala* by VhaVenda traditional healers to treat STDs. As noted earlier, *Ricinus communis* is also widely used as medicine to treat sores by traditional healers of different cultures in South Africa. Both Vhavenda (Ramalivhana et al., 2010) and Lay people (De Wet et al., 2010) also use *Psidium guajava* to treat diarrhoea. To the best of our knowledge, there is no published record on the traditional use of *Opuntia ficus-indica* to treat gonorrhoea and hypertension in South Africa. However, compound with resemblance to activities of sarsaparilla vine (*Smilax officinalis*), which might be useful in the treatment of gonorrhoea, has been isolated from *Opuntia ficus-indica* (Shedbalkar et al., 2010). Furthermore, Chauhan et al. (2010) also demonstrated various activities of this species including anti-hypertensive activities. Shedbalkar et al. (2010) and Chauhan et al. (2010) thus support the traditional use of this species by Bapedi healers to treat gonorrhoea and hypertension. No record on the use of *Eucalyptus camaldulensis* for TB was found in South Africa. However, its leaf extract inhibited the growth of *Bacillus cereus*, *Escherichia coli*, *Klebsiella pneumonia* and *Staphylococcus aureus* (Abubakar, 2010); major causative agents of TB. Likewise, as far as our literature search goes, this is the first record of *Eriobotrya japonica* use as a remedy for TB and hypertension in South Africa. However, its use for TB by Bapedi healers is consistent with Chinese traditional healers (Gong et al., 2004; Parihar et al., 2011), Japan (Nishioka et al., 2002) and Korea (Ito et al., 2000). The alternative use of these species should be considered as they have now been embedded into the lives of native South African healers and communities through their medicinal use. Many of them have active ingredients against different ailments that were mentioned by Bapedi traditional healers. Therefore they might have a significant use in the finding and production of new pharmaceuticals which are then clinically useful. Indeed, as noted by Lewu and Aflolayan (2009), plant conservationists and policy makers in South Africa need to orchestrate an appropriate programme to protect the medicinal properties hidden in exotics species.

3.6. Plants part/s used

The most commonly used plant part for herbal preparations in this study was the root (52.5%), followed by the leaf (20%), whole plant (12.5%) and the fruit (7.5%). Bark, seed and tuber (2.5% of each) were less frequently used by Bapedi healers to prepare medicine (Table 2). The result of this study is almost similar to that of Albuquerque (2006) who reported the dominance of exotic leaf followed by root. This is because leaves of exotic plants are usually green and available for most of the year (Albuquerque and Andrade, 2002). However, the wide use of roots and leaves to prepare medicine by Bapedi traditional healers is based on the perception that more healing power is stored in these parts (Semenya, 2012). This claim is supported by a scientific study by Hamburger and Hostettmann (1991). However, wide utilization of roots (Birhanu, 2002) and whole plants (Dzerefos and Witkowski, 2001) has serious consequences as it could result in to

the complete destruction of an individual plant species. Thus, it can be argued that extensive use of whole plant and root of CARA listed species could contribute to their control, while simultaneously providing much needed medicinal supply to poor rural communities in the Limpopo Province, South Africa.

3.7. Plant recipes

The plant species encountered in this study are used for 44 therapeutic preparations (Table 2). Thirty-seven (85%) recipes are mono-specific, whether they are associated or not to the non-plants ingredients. Seven (15.9%) recipes are prepared with more than one plant ingredients. It is interesting to note that both Bapedi, and Xhosa traditional healers (Dold and Cocks, 2002) use exotics species independently or in combination with either other exotics or indigenous species. However, the rural community of Alagoinha, Brazil use exotics species alone (Albuquerque, 2006). It is surprising that so little preparations of plant combinations are used by Bapedi traditional healers when it is known that it is common practice in traditional healing to combine plants for increased efficacy. However, at the least preponderance of a single recipe by Bapedi traditional healers may perhaps be in the patients' interest. This is because combining medicinal plants is sometimes dangerous. In Nigeria, about 30% of fatal accidents is caused by medicinal plant mixtures (El-Said et al., 1969).

3.8. Preparations and administrations

The method of preparation and administration of medicine as well as dosage form are very essential. Bapedi traditional healers most often prepared a medicine from plant part/s in the form of extract (79%). However in some instances it is prepared in the form of a powder (9.3%), maceration (6.9%) and by squeezing (4.6%). These are common methods of traditional medicinal preparation as was also noted by Dold and Cocks (2002) and Albuquerque (2006). The majority of extracts reported in this study were prepared with water in the form of cooking or boiling (Table 2). This might be due to the simplicity of cooking and availably of water. However, low-pounding of medicinal material by traditional healers of this study came as no surprise as it is a long and difficult process, the herbs must be cut into very small pieces, dried sufficiently to make them brittle, and then crushed intensively enough to reduce them to a reasonably fine powder. Similarly limited use of maceration as a method to prepare remedy by Bapedi healers might be due to its long duration of preparation. Maceration is normally done over a period of 24 h (Table 2). It is reasonable to postulate that the limited use of squeezing (exclusively for fruits) methods by Bapedi healers might be due to the seasonal availability of fruits.

Most (86.3%) of Bapedi preparations were prescribed orally (three times a day) using a tin cup (300 ml). This conforms with the standard prescriptions in modern medicine. The preferred vehicle for administration of pounded/powdered oral medicine was either in warm water or in soft porridge. Medicine (9%) was applied topically, either as bath, massage or lotion (every time after bathing). In some (4.5%) cases traditional healers administered one tin cup of the medicine anally via a bulb syringe (once or thrice a week). According to Bapedi traditional healers, anal prescription is very dangerous and wrong dosages might result in fatality (Semenya, 2012). Thus healers did the administration to ensure the safety of their patients. In general same herbal prescriptions were given until a patient reported positive results.

4. Conclusion

This study has revealed that exotics species play a vital role in the traditional primary healthcare of the people of the Limpopo Province, South Africa. They are an important part of daily ingredients administered by Bapedi traditional healers for different human diseases. In fact some of these species have become imbedded in their daily lives and cultures of native healers and people of South Africa, through their use in traditional medicine. Therefore, use of these species could alleviate harvesting pressure of wild indigenous plants; thereby enhancing biodiversity conservation in the Province or Country as a whole.

It is worth noting that traditional medicinal uses of some of CARA listed invasive and weed plant species by Bapedi healers are supported by both scientific studies and their extensive by other cultures in South Africa and elsewhere. There is a need to formulate an appropriate policy to retain some of these species within the environment, before their medicinal value vanishes as they disappear through the alien invasive management strategies adopted by South African government. More research on their medicinal use by traditional healers and community members in the Limpopo Province and the rest of South Africa is recommended. This will further help to determine the extent of their use and reliance by South Africans.

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