

INVASIVE ALIEN PLANT SPECIES USED FOR THE TREATMENT OF VARIOUS DISEASES IN
LIMPOPO PROVINCE, SOUTH AFRICA

Lesibana Peter Maema, Martin Potgieter, Salome Mamokone Mahlo*

223

University of Limpopo, Faculty of Science and Agriculture, School of Molecular and Life Sciences,
Department of Biodiversity, Private BagX1106, Sovenga, 0727, South Africa

*Corresponding author E-mail: mamokone.mahlo@ul.ac.za

Abstract

Background: Invasive alien plant species (IAPs) are plants that have migrated from one geographical region to non-native region either intentional or unintentional. The general view of IAPs in environment is regarded as destructive to the ecosystem and they pose threat to native vegetation and species. However, some of these IAPS are utilized by local inhabitants as a substitute for scarce indigenous plants. The aim of the study is to conduct ethnobotanical survey on medicinal usage of invasive plant species in Waterberg District, Limpopo Province, South Africa.

Materials and methods: An ethnobotanical survey on invasive plant species was conducted to distinguish species used for the treatment of various ailments in the Waterberg, District in the area dominated by Bapedi traditional healers. About thirty Bapedi traditional healers (30) were randomly selected via the snowball method. A guided field work by traditional healers and a semi-structured questionnaire was used to gather information from the traditional healers. The questionnaire was designed to gather information on the local name of plants, plant parts used and methods of preparation which is administered by the traditional healers.

Results: The study revealed that *Schinus molle* L., *Catharanthus roseus* (L.), *Datura stramonium* L., *Opuntia stricta* (Haw.) Haw., *Opuntia ficus-indica*, *Sambucus canadensis* L., *Ricinus communis* L., *Melia azedarach* L., *Argemone ochroleuca* and *Eriobotrya japonica* are used for treatment of various diseases such as chest complaint, blood purification, asthma, hypertension and infertility. The most plant parts that were used are 57.6% leaves, followed by 33.3% roots, and whole plant, seeds and bark at 3% each. Noticeably, most of these plants are cultivated (38%), followed by 28% that are common to the study area, 20% abundant, 12% wild, and 3% occasionally. *Schinus molle* is the most frequently used plant species for the treatment of various ailments in the study area. National Environmental Management Biodiversity Act (NEMBA) (10/2004) and Conservation of Agricultural Resource Act (CARA) were consulted to confirm the invaders status. Only eight plants (60%) are regulated by CARA (10/2004). Of 10 IAPs, 80% (8 species) are listed in both NEMBA and CARA legislation. Only 20% (2 species) are listed in NEMBA alone.

Conclusion: Invasive alien plants are utilized by communities to combat various ailments in humans and these plants can help to reduce pressure on heavily harvested indigenous plant.

Key words: Ethnobotanical survey, Invasive plant species, Traditional healers.

Introduction

Invasive alien plant species (IAPs) are plants that are distributed outside their native region either through intentional or unintentional means and may cause harm to the environment. Moreover, IAPs outcompete with the indigenous medicinal plants and therefore, are destructive to the biodiversity and ecosystem in South Africa. This destruction results in loss of ecosystem function, lead to the extinction of indigenous species, and subsequently reduce biodiversity richness and diversity, ultimately leading to socio-economic decline of rural communities (Vila et al., 2010). Most invasive species have been introduced into an environment in which they did not evolve. Moreover, this plant species have no natural enemies to limit their reproduction and spread. However, they compete with agricultural crops for water, light and nutrients, causing enormous losses in food production. Some of the invasive plant species are also toxic to livestock (Mdee et al., 2009). In South Africa, more than 120 species have been declared unwanted invasive plants (Bromilow, 2001). Previous work indicated that almost 10 million hectares of South Africa has been invaded by various alien plant species (Versveld et al., 1998).

Invasive alien plant species are categorized into three major groups by virtue of their invasiveness and they appear under the Conservation of Agriculture Resources Act 1983 (Act 43 of 1983). Furthermore, these plants differ considerably with regard to their invasiveness in different provinces. However, IAPs are being incorporated into everyday usage of indigenous traditional people as building material, food and fuel wood (Geldenhuys and MacDevette, 1989). More importantly, some IAPs are being harvested for their perceived medicinal properties by local people. In South Africa, various studies revealed that IAPs are utilized by communities to treat different ailments. For instance, *Bidens pilosa*, have been reported to have antimicrobial, anti-helminthic, anti-malaria, protozoocidal and anti-ulcerogenic properties (Lewu and Afolayan, 2009).

The impacts of invasive alien plant species have prompted South African government to establish the Working for Water Programme (WFW). The programme aims to protect the water catchment from the negative impact of invasive alien species by taking appropriate action for eradication of IAPs (Gorgens and van Wilgen, 2004; Marais and Wannenburg, 2008). Since the inception of WFW in 1995, South African government has adopted eradication of IAPs with various mechanisms. Furthermore, it has been established these plants vary considerably with regard to their invasiveness in different provinces. The WFW Programme has launched national strategies that aim to protect the ecosystems from the negative impact of invasive alien species by taking

appropriate action for eradication of IAPs. Local people use some of IAPs as substitutes for scarce indigenous species. However, utilization of alien invasive plant species for medicinal uses is not well-studied (Mooney, 2001).

The motivation for investigating invasive plant species is that these species are used by the traditional healers for medicinal purpose in Waterberg District, Limpopo Province to combat various ailments in human. Invasive plant species pose threat to the biodiversity in South Africa and compete with the indigenous medicinal plants. However, invasive plant species out-compete with native plant species for resources such as nutrients, light, space or water (Thebaud et al., 1996; Gloria and Osborne, 2014). Some of these plants could be used as substitute for the indigenous medicinal plants. No reports on the medicinal usage of the invasive plant species in Waterberg district have been reported in the available literature. Therefore, the study aimed at identifying invasive plant species used for medicinal purposes by traditional healers and to document their medicinal usage before major eradication takes place.

Materials and methods

Study area

The study was conducted in the Mogalakwena Municipality of the Waterberg District, Limpopo Province, South Africa (Fig. 1). Geographically Mogalakwena Municipality lies between 23°10'–24°20'S and 28°10'–29°10'E (BGIS.Sanbi.org). The Mogalakwena Municipality covers an area of 6166 km². The Waterberg population is about 614 139 people with black Africans as the most dominant group, comprising 90% of the population while 48% of the total Waterberg population resides in the Mogalakwena Municipality. Poverty and unemployment still remain the major challenge in Mogalakwena Municipality. Consequently the majority of the people resides in villages, and rely primarily on agricultural and subsistence farming activities to meet their livelihood needs (Stats SA, 2012).

Ethnobotanical survey

Permission was granted by Mokopane Traditional Council to conduct ethnobotanical survey in the study area between March and August 2014. Each traditional healer was requested to sign a consent form approved by the University of Limpopo. Bapedi traditional healers were randomly selected via the snowball method, resulting in 30 healers being interviewed. Of the total number of the traditional healers interviewed, 53.3% were female and 46.7% were male traditional healers. Data was collected using a semi-structured questionnaire and guided field work with traditional healers. Questionnaire was designed to gather information on the local name/s of plants used to treat different ailment, source of these plants, plant part/s used to treat ailments, methods of preparation of remedy, diagnosis of different ailments and other relevant information.

Plant collection

Invasive alien species were initially identified by their vernacular names. Collected plants were identified using literature and specimen at the Larry Leach Herbarium at University of Limpopo. Voucher specimen of the plants were prepared and deposited at the University herbarium. Data was analysed using descriptive statistics.

Climate

The Mogalakwena Local Municipality area experience summer rainfall, with the rainy season lasting from November to March and a cool dry season for the rest of the year. Rainfall ranges from 600 mm to 650 mm annually. In the Waterberg Mountains precipitation range from 650 mm to 900 mm. Temperature variety from –3°C (winter season) to 40°C (summer season), with an average of 21°C. The predominant wind direction is Northwest (www.routes.co.za).

Vegetation

Vegetation is classified as savanna by Mucina and Rutherford (2005). The study area is dominated by Makhadosweet bushveld, previously known as Mixed Bushveld (Acocks, 1988), with small patches of Polokwane Plateau Bushveld and Central Sandy Bushveld and Waterberg Mountain Bushveld. There are five main veld types in Waterberg District namely: Sour bushveld, mixed bushveld, arid sweet bushveld, North Eastern Mountain Sourveld and Sourish mixed bushveld. This district is rich in water streams, hence the name Waterberg. More importantly, various wetland habitats exist within Waterberg district that are currently under national priority for conservation (Acocks, 1988).

Data Analysis

Data were captured in Microsoft Excel 2010 programme and were later analysed by descriptive statistics. Descriptive statistics, such as percentages and frequencies, have been used to analyse the data. Percentages were calculated as the number of species/ailments divided by the total number of species/ailments and multiplied by hundred.

Results and discussion

Demographic Information of respondents

The survey was conducted through consultation of both female and male traditional healers in Mogalakwena Municipality. Females predominated the survey constituting 53.3% (n= 16), while male traditional healers constituted 46.7 % (n=14) of the total. Majority of traditional healers (80%) have received profession of traditional health practitioners through ancestral callings, the remaining 20% have obtained it through teaching at home (inheritance). Moreover, the participants are generally older people, with 53% of the participants aged above 60 years. This shows that elders are the mainstay of ethnomedicinal knowledge in the Waterberg District. The predominance of older people in the profession can probably be explained by comments from Acharya (2012), who noticed that these days young people are generally reluctant to learn about traditional knowledge. Furthermore, the availability of modern health care facilities, though inadequate, could also be responsible for lack of interest among young people. However, it is crucial for young people to learn about indigenous knowledge as this information will pass from generation to generation.

Educational background and professional knowledge

In the current study, two thirds of participants do not have a formal education. This is in agreement with Mabogo (1990) regarding the Venda region, and Yiniger and Yewhalaw (2007) in South-western Ethiopia. However, the result of this study is not in agreement with other ethnobotanical studies conducted throughout South Africa. For instance, in KwaZulu-Natal, Puranswai (2006) found that all Zulu traditional healers had attended school, while 20% even had a University degree or diploma. Previous research indicated that half of the Xhosa traditional healers had attended secondary school, 35% primary school, and 3% tertiary institution Mintsu MiNzue (2009). Low level of education amongst Bapedi traditional healers compared to the above mentioned South African cultures is indicative of a need to document their knowledge of *materia medica* before it get lost.

Richter (2003) emphasized that nowadays educational skills are vital to traditional healers to empower them with particular competencies such as reading that might be important for counselling, and to understand the necessity to conserve and manage natural resources. Thus initiating programmes such as ABET (Adult Basic Education and Training) is important to empower not only Bapedi traditional healers, but all other traditional healers, with basic educational skills such as writing and reading. Basic education is therefore vital for healers to broaden their knowledge regarding conservation issues related to protected and threatened species, and medically-related issues such as diagnoses and treatment of ailments.

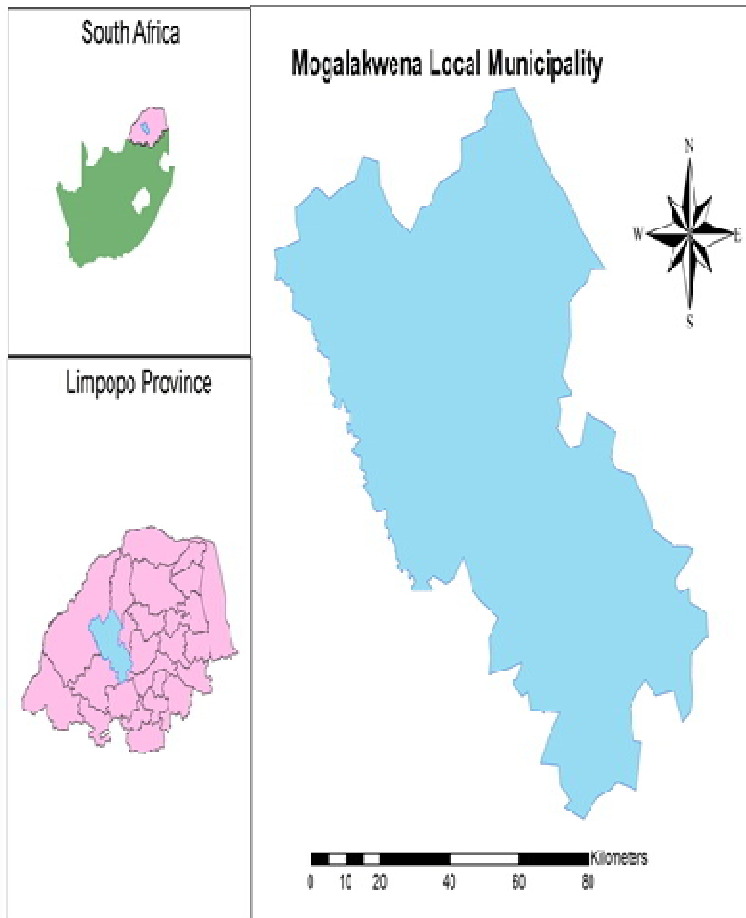


Figure 1: Mogalakwena local Municipality.

Plant collection and sources

Almost 96.7% of the traditional healers surveyed collect medicinal plants from the wild and 3.3% use cultivated plants. According to the traditional healers, wild plants are more effective than cultivated plants and also these plants are preferred by ancestors due to higher efficacy. Different plant parts are used for medicinal preparation of invasive plant species, leaves are highly utilized (50%), followed by roots (30%), whole plant and fruit (7%) each, bark and stem contributing 3% each (Fig. 3). Plant parts are either crushed or sliced into small pieces, some plant parts are grounded to fine powder. Preparation of remedy is through boiling (decoction), burning of plant parts, soaking plant parts in water (infusions) and maceration (Table 1).

Medicinal properties and storage

According to the current survey, about 83.3% of respondents revealed that medicinal plants do not lose their healing properties and 16.7% indicated that plants do lose medicinal properties after some time. Traditional healers indicated that prior to storage, some plants are dried, powdered and stored in sealed bottles or plastic bags to ensure long lasting and plant does not spoil. More importantly, medicinal properties of plants vary significantly among the parts of the plant. Based on our findings, some traditional healers mentioned that some plant parts are highly toxic, while others are less harmful. Medicinal plant material, such as the leaf of *O. stricta* and the leaves of *S. molle* can only be used when they are fresh to treat toothache and chest complain, respectively. The highest frequency of used invasive alien plant species were observed in *S. molle*; *O. ficus-indica*; *O. stricta* and lowest invasive plant species was *E. japonica*, *M. azedarach* and *S. canadensis* (Fig. 2). This indicates that these invasive plant species are used most frequently to combat various diseases in the study area compared to other invasive plant species. The frequency of medicinal plant used in Bapedi form a fundamental indicator to screen them for antimicrobial activities.

Our findings revealed that decoction (68.4%) was a general preparation method, followed by 15.8% infusions, 5.3% maceration, while burning, grounding, squeeze and crush contributed 2.6% each. It should be noted that the use of leaves is associated with sustainable harvest of plant species but the whole plant and roots are destructive and could lead to decline of important invasive plant species. More importantly, some herbs are utilized for their corms, roots, tubers, and in some instances the entire plant is used.

Table 1: Alien invasive plant species used in Mogalakwena Municipality for treatment of various ailments.

Scientific name	Voucher	Vernacular	Parts used	Ailment treated	Preparation	Mode	Dosage
Anacardiaceae <i>Schinus molle</i> L.	LP05	Thoba	Leaves	Chest complains	Decoction	Streaming	2-5litre is administered through
steam inhaling				Muscle pains	Decoction	Bathing	2-5litre is administered
body massage			Bark/Roots		Gonorrhoea	Decoction	Orally
300ml cup twice a day							
Apocynaceae <i>Catharanthus roseus</i> (L.) G.Don	LP30	Lepolomole lepinkie	Entire plant	Asthma	Maceration	Orally	300ml cup taken thrice a day for a week
			Roots	Drop	Decoction	Orally	
Cactaceae <i>Opuntia stricta</i> (Haw.) Haw.	LP10	Motoro o hwibidu	Roots Leaves	Drop Stroke	Decoction Decoction Toothache	Orally Orally Infusion	½ cup three times per day 1 full cup thrice a day Orally ½ cup mouth rinse
<i>Opuntia ficus-indica</i> (L.) Mill.	LP11	Motoro o sorolwana	Roots	Drop	Decoction Chest complain	Orally Decoction Toothache Leaves	300ml cup thrice a day Orally 1 full cup Decoction Sugar diabetes Infusion
once a day							
Sublingually	½ cup mouth/Gum rinse						
Orally	300ml cup taken thrice a day						
Caprifoliaceae <i>Sambucus canadensis</i> L.	LP25	Unknown	Leaves	Erectile dysfunctions	Decoction	Orally	300ml cup taken twice a day
Euphorbiaceae <i>Ricinus communis</i> L.	LP01	Mokhure	Leaves	Swollen legs	Decoction	Bathing	2-3 Litres, twice a day
Meliaceae <i>Melia azedarach</i> L.	LP17	Mosarablome	Roots	Blood purifier	Decoction	Orally	½ cup is taken thrice a day
Papaveraceae <i>Argemone ochroleuca</i>	LP12	Matjhakgatjha	Roots	Asthma	Decoction	Orally	300ml cup is taken sweet subsp. thrice a day

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Rosaceae									
<i>Eriobotrya japonica</i>	LP42		Mohlatswa	Leaves		Hypertension	Decoction	Orally	½ cup is taken thrice a day
Solanaceae									
<i>Datura stramonium L</i>	LP08	Kgookgoo		Roots		Infertility	Decoction	Orally	Plant is mixed with roots from and <i>Ziziphus mucronata</i> . 300ml
<i>Ximenia caffra</i>									
Roots/seeds	Headache	Burnt	Nasally	Smoke taken twice a day.					

Argemone achroleuca is a weed and commonly used for treatment of asthma and toothache. Lubbe et al. (2007) also found the use *A. achroleuca* in traditional medicinal purpose in North West of South Africa. Noticeably, this plant preferred disturbed area and cultivated land. Stepp et al. (2004) demonstrated that weedy plants are dominant in disturbed habitat. *E. japonica* is recorded for treatment of hypertension in our study (Table 1). Previous work indicates that this plant had anti-diabetic activities and antiviral properties (De Tommasi et al., 1992; De Tommasi et al., 1991).

Sambucus canadensis has been reported as purgative, emetic, diuretic, laxative, topical emollient, expectorant, and diaphoretic (Charlebois, 2007). Our study recorded the use of its leaves to treat erectile dysfunction and this is the first record. However, Joshi and Edington (1990) have recorded that *S. canadensis* is used for the relief of rheumatic pains. Previous work indicates that rheumatic diseases can affect sexual functioning (Tristano, 2009; Hong et al., 2004). Such family include Anacardiaceae, Apocynaceae, and Euphorbiaceae which are highly used as recorded.

Diagnosis of different ailments

In order for the traditional healers to assess the effectiveness of the medication, 37% rely on both ancestors and patients, while 26% rely on divination, and 37% rely on patients alone. Traditional healers (73.3%) further reported that their patients do not come back if they were treated but 26.7% report that it is possible for the patient to come back and among them 87.5% recommend patient to visit health facility while 12.5% recommend colleague as alternative.

Preparation and treatment

Prior to plant preparation, clean utensils are used to wash plant parts for hygienic practices. Plant parts are either crushed or sliced into small pieces, some plant parts are grounded to fine powder. Preparation of remedy is through boiling (decoction), burning of plant parts, soaking plant parts in water (infusions) and maceration. Prepared medicine is stored in clean and sealed bottles. In this study, decoction (76.7%) was a general preparation method, followed by 16.7% infusions, 3.3% maceration, and 3.3% burning. These are widely common methods in traditional medicine system. Prepared remedy is often taken with a tin cup (300ml), thrice a day for period of four days. Administration of medicine was mainly orally (54.8%), followed by 19.4% bathing, 12.9% sublingually, 9.7% streaming and 3.2% nasally. Our study recorded *D. stramonium* as mixed with the roots of *Ximenia caffra* and *Ziziphus mucronata* to treat infertility.

Diagnosis of ailments

Traditional healers are well recognized for the use of divination worldwide. It was noticed in our study that healers relied on divination (26%) and patients (37%) to diagnose the ailments, while many healers (37%) relied on both ancestors and patients. Truter (2007) noted that diagnosis normally comprises a combination of information from both personal observations and explanations of symptoms from patients. More importantly, patients play an integral role in explaining what they are feeling.

Expiry date of remedy

All participants reported that remedy has the expiry date. The average expiry date is 3 days in summer and 5 days in winter or when stored in refrigerator. More importantly, the traditional healers indicated that the remedy usually changes colour and odour when expired. It was also indicated that traditional healers in the study area do not use preservatives for the preparation of their medicine.

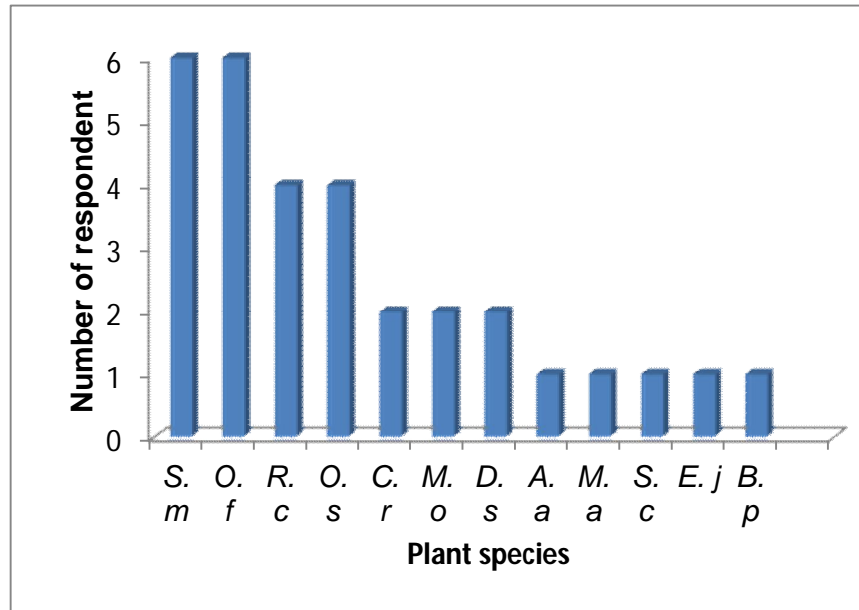


Figure 2: Frequency of used Invasive alien plant species. S.c-*Schinus molle*; O.f-*Opuntia ficus-indica*; R.c-*Ricinus communis*; O.s-*Opuntia stricta*; C.r-*Catharanthus roseus*; D.s-*Datura stramonium*; A.o-*Argemone ochroleuca*; M.a-*Melia azedarach*; S.c-*Sambucus canadensis*; E.j- *Eriobotrya japonica*.

Table 2: Invasive plants species used in Mogalakwena Municipality and their categories.

Scientific name	Category	Appearance
<i>Argemone ochroleuca</i>	1	NEMBA & CARA
<i>Catharanthus roseus</i> (L.)	1b	NEMBA
<i>Eriobotrya japonica</i>	1 in Western Cape only	NEMBA & CARA
<i>Datura stramonium</i> L.	1	NEMBA & CARA
<i>Melia azedarach</i> L.	1b and 3 in urban areas	NEMBA & CARA
<i>Opuntia ficus-indica</i>	1	NEMBA & CARA
<i>Opuntia stricta</i> (Haw.) Haw	1	NEMBA & CARA
<i>Ricinus communis</i> L.	2	NEMBA & CARA
<i>Sambucus canadensis</i> (L.)	1	NEMBA
<i>Schinus molle</i> L.	3	NEMBA

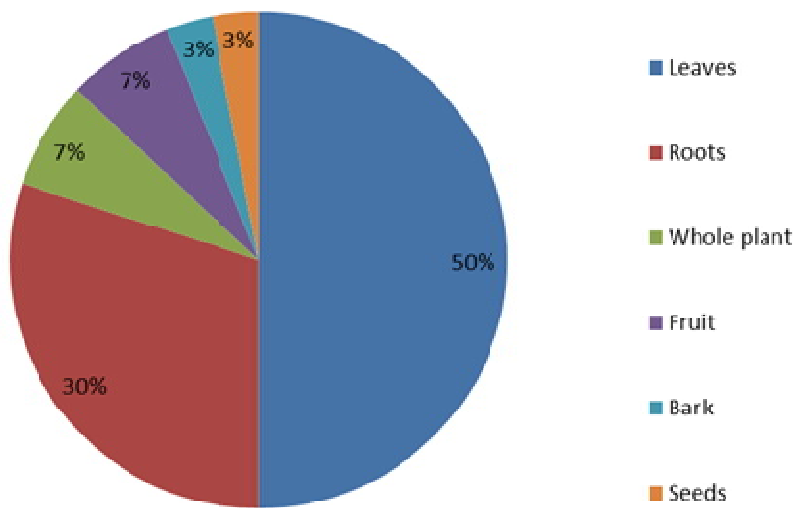


Figure 3: Plant parts used for the treatment of various diseases.

Identified invasive plant species

The study revealed that 10 alien plants species are used for treatment of human diseases such as chest complaint, blood purification, asthma, hypertension and infertility (Table 1). We hence noted that (CARA) and National Environmental management Biodiversity Act (NEMBA) data base were used to confirm the status of the collected invasive plant species (Table 2). Only eight plants (60%) are regulated by NEMBA (10/2004). Most plant species belong to the family Asteraceae and Cactaceae. Of 10 IAPs, 80% (8 species) are listed in both NEMBA and CARA legislation. Only 20% (2 species) are listed in NEMBA alone (Table 2).

Therefore, (70%) of invasive plant species listed are in category 1, 10% category 2, 10% category 3, and 10% has multiple categories (1 and 3). Invasive plant species in Category 1 are not allowed to spread in inland water surfaces and is prohibited to propagate. This category faces an immediate control for eradication. Plants that belong to this category are *A. ochroleuca*, *C. roseus*, *D. stramonium*, *E. japonica*, *O. ficus-indica*, *O. stricta* and *S. canadensis*.

Ricinus communis is the only invasive plant that belongs to category 2, this category is allowed to occur in demarcated area or biologically controlled reserves and permit is required to propagate. IAPs that belong to category 2 are declared category 1b if they spread outside demarcated area and they therefore face eradication control (Table 2). Our study found that *R. communis* is extensively used for swollen legs. *Datura stramonium* and *R. communis* have been reported to possess antifungal agents against plant fungal pathogens (Mdee et. al., 2009). *Melia azedarach* belongs to multiple categories; it belongs to category 3 in urban areas and category 1 in areas other than urban areas.

Following the above discussions and findings, the implication of eradication control is important. The impacts of invasive alien plant species have prompted South African government to establish the Working for Water Programme (WFW). The aim of this programme is to protect the ecosystems from the negative impact of invasive alien species by taking appropriate action for eradication of IAPs. However, local people use some of IAPs as substitutes for scarce indigenous species. More importantly, some IAPs are being harvested for their perceived medicinal properties by local people.

Conclusion

The current study indicated that traditional healers in Waterberg District use invasive plant species to combat various ailments in human. There are high levels of ignorance about the medicinal usage of invasive alien plants, and very little existing research on ethno-medicine of invasive plant species. Therefore, IAPs can be used to sustain some of the endangered and declining indigenous plant species. The decline of these plants under careful consideration can be substituted by invasive alien plants such as *O. ficus-indica* and *S. molle* for chest complain. Therefore, the use of invasive alien plants can be helpful to other traditional healers elsewhere for traditional health care practices which can alleviate pressure on indigenous plant species. Noticeably, it is more interesting to point out that to the best of our knowledge, 10 alien invasive alien plant species used by the population of Mogalakwena to combat various ailments were not reported previously in the relevant phyto-chemical literature. Phytochemical analysis and antimicrobial activities of the identified invasive plant species should be investigated further.

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