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## Ethnomedicinal uses of exotic plant species in Mogalakwena Municipality of Waterberg District, Limpopo Province South Africa

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### ABSTRACT

Traditional medicine still constitutes a large part of the primary health care sector in South Africa. However, limited information exists about the ethnomedicinal uses of exotic plant species. Thus an ethnobotanical survey was conducted to investigate its use in Mogalakwena Local Municipality of Waterberg District of the Limpopo Province, South Africa. This was done by interviewing 30 traditional health practitioners, from 15 villages between April and November 2015. The study documented 8 exotic plant species that are used to treat various diseases. The documented species are distributed across 7 families, of which the Asteraceae (2) is the most prominent, while the remaining families are represented by single species. The plant parts, most used was roots (36.4%), followed by fruits (27.3%), whole plant (18.1%), whereas leaves and flower contributed 9.1% each. It was further evidenced that preparation of remedies were mainly through infusions (30%) and decoctions (30%), administered orally. It is concluded that exotic plants now form an integral part of the materia medica of Bapedi traditional health practitioners. It is further concluded that with proper and careful management exotic plant species can reduce overexploitation of heavily harvested indigenous medicinal plants in South Africa

### Keywords:

Ethnobotanical survey, medicinal plants, tradition health practitioners and Conservation.

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## INTRODUCTION

Throughout history, plants have been used as the source of medicinal agents to treat diseases and to relieve physical suffering. The use of plants in traditional medicine is still common and widespread in Africa (Shale *et al.*, 1999). This is because despite the current sophisticated therapeutic agents developed from modern drug discoveries, traditional medicine is seen as the more accessible and affordable by people in developing countries (Truter, 2007). It is estimated that over two-thirds of Africans and other developing countries rely on traditional medicine for primary health care (WHO, 2002).

An estimated 10% of indigenous plant species in South Africa are threatened as results of unsustainable harvesting practices (Williams *et al.*, 2013). Some of these species have been exploited to such an extent that they are seldom found in unprotected areas (Wiersum *et al.*, 2006). This in turn results in difficulties for traditional health practitioners in treating some of the ailments. Thus, according to Street and Prinsloo (2012) there is a need for an alternative supply of medicinal plant material.

South Africa is estimated to have more than 8500 exotic plants, with some of these being increasingly utilized by traditional health practitioners for primary health care (Wojtasik, 2013). The term exotic plants refer to plants that are distributed outside their native region, but they are not invasive in nature. The distribution of exotic plants may occur unintentionally or intentionally by human activities. Unintentional introduction of exotic plants can result via road corridors (Christen and Matlack, 2008) and railways lines Hulme (2009). However, most of exotic plants are intentionally introduced for economic reasons, especially for foods, horticultural, and forestry purposes (Jacobs *et al.*, 2014).

Wilson *et al.* (2013) reported that more than 750 exotic tree species and 8000 exotic shrubby and herbaceous species occur in South Africa. Exotic species are estimated to have invaded almost 10 million hectares (8.28%) in South Africa (Wilson *et al.*, 2013). This has resulted in biodiversity decline; impaired ecosystem services and have negative impact on human wellbeing (Pyšek and Richardson, 2010). However, not all exotic plants have negative impact in biodiversity.

Wojtasik *et al.* (2013) noted that more than 300 exotic plants are used medicinally and are traded in South African markets. This is mainly because they are widespread and are easily accessed by traditional health practitioners on communal lands and in home gardens (Maroyi, 2006). Ethnomedicinal uses of exotic plants sometimes serve as substitute for scarce indigenous plants (Wojtasik, 2013). In areas of high ecological disturbances, with high level of infestation, the extent of use of exotic species can be high. For example, Thring and Weitz (2005) noted that 33% of ethnomedicinal plants used in Elim region of the Western Cape Province in South Africa are exotic. Maema *et al.* (2016) documented exotic plant of Mogalakwena Local Municipality that are invasive in nature. No reports on the medicinal usage of the exotic plant species in Waterberg district have been reported in the available literature. Therefore this study was conducted to determine medicinal uses of exotic plants by Bapedi traditional health practitioners in Mogalakwena Local Municipality.

## MATERIALS AND METHODS

### Study area and demographics

The study was conducted in the Mogalakwena Municipality of the Waterberg District, Limpopo Province, South Africa (Figure 1). Geographically, Mogalakwena Municipality lies between 23°10'–24°20'S and 28°10'–29°10'E (BGIS.Sanbi.org). The municipality host 614 139 people, with black Africans the dominant group, comprising 90% of the population. Poverty due to high levels of unemployment still remains a major challenge in this area. Consequently, the majority of the people rely primarily on agricultural and subsistence farming activities to meet their livelihood needs (Stats SA, 2012).

### Ethnobotanical survey

Data was collected from April 2015 to November 2015 in 15 local villages within the study area. Two Bapedi (the dominant cultural group) traditional healers per village were selected via the convenient sampling method, resulting in 16 females and 14 male healers been interviewed. Respondents were of between 25 and 70 years old. Data was collected using a semi-structured questionnaire using the face-to-face interview technique as described in similar studies (Akay-

din, 2013; Seid and Aydagnehum, 2013), supplemented with guided field tours with traditional healers to verify the species names and collect voucher specimens. Information such as vernacular name, source of plants collection, plant part(s) used, ailments treated (Table 1), as well as preparation methods (Figure 3) and dosage were documented.

### Plant collection and identification

Voucher specimens, as pointed out by accompanied traditional healers, were collected from home gardens and communal areas. Plant species were initially identified by their vernacular names (Table 1). Later, taxonomic identification was done by a trained taxonomist at the Larry Leach Herbarium (UNIN) of the University of Limpopo.

### Statistical analysis

The data was captured in Microsoft Excel 2010. A descriptive statistic procedure like percentage and frequency distribution were employed for data analysis.

### Ethical considerations

A permit was requested and obtained from various traditional councils within the Mogalakwena Municipality to conduct research within the area of jurisdiction and to meet with traditional healers in order to request them to participate in the study. Each traditional healer was requested to sign a consent form as approved by the University of Limpopo ethics committee. As such all ethics related to people's privacy, confidentiality, anonymity, were observed, adhered to and respected. Participants in this study were voluntary, and participated freely and anonymously. The sources of primary and secondary data and information are acknowledged.

## RESULTS

### Plant diversity

The current study documented 8 exotic plants that are used by Bapedi traditional health practitioners in Mogalakwena Local Municipality. Two exotic plants namely *Tagetes minuta* and *Bidens pilosa* belong to the family Asteraceae and all other families are represented by single species (Table 1).

The predominant plant life forms used was trees (50%), followed by shrubs and herbs, with each contributing 25%.

### Plant parts used

The most used plant parts were roots (36.4%), followed by fruits (27.3%), whole plant (18.1%), with leaves and flower each contributed 9.1% to total usage.

### Ailments treated

The reported exotic plant species are used to treat 9 different ailments. The reported ailments are of gynaecological in nature (womb cleaner as a results of miscarriage), a sexually transmitted infection (gonorrhoea), skin related ailment (wounds and skin rash), gastrointestinal disorders (dysentery and diarrhoea), cardiovascular (Heart failure and blood purifier), and respiratory ailments (cold and Flu). It is important that *Tagetes manuta* was also applied in ethnoveterinary to control nematodes and ticks in livestock.

About 75% of the above mentioned ailments were treated using a single plant species, except in two incidences were cold and flu is treated, two plant species *Moringa oleifera* and *Citrus lemon* are used. *Agave angustifolia* and *Carica papaya L* were also used to treat gonorrhoea.

### Plant extraction

Bapedi traditional healers use various protocols for plant extraction. Preparation was mainly through infusions and decoctions, each preparation accounting for 30% of the total methods employed. It was further noticed that squeeze, burning and paste contributed 10% each.

### Mode of administration

Only two modes of administration were encountered. The prepared extract was prescribed orally (73%) whereas topical application was the preferred (37%) mode of administration for skin related ailments (wounds and skin rash).

## Discussion

### Plant diversity

Eight exotic plants were documented in *materia medica* of Babedi traditional health practitioners in Mogalakwena Local Municipality (Table 1).

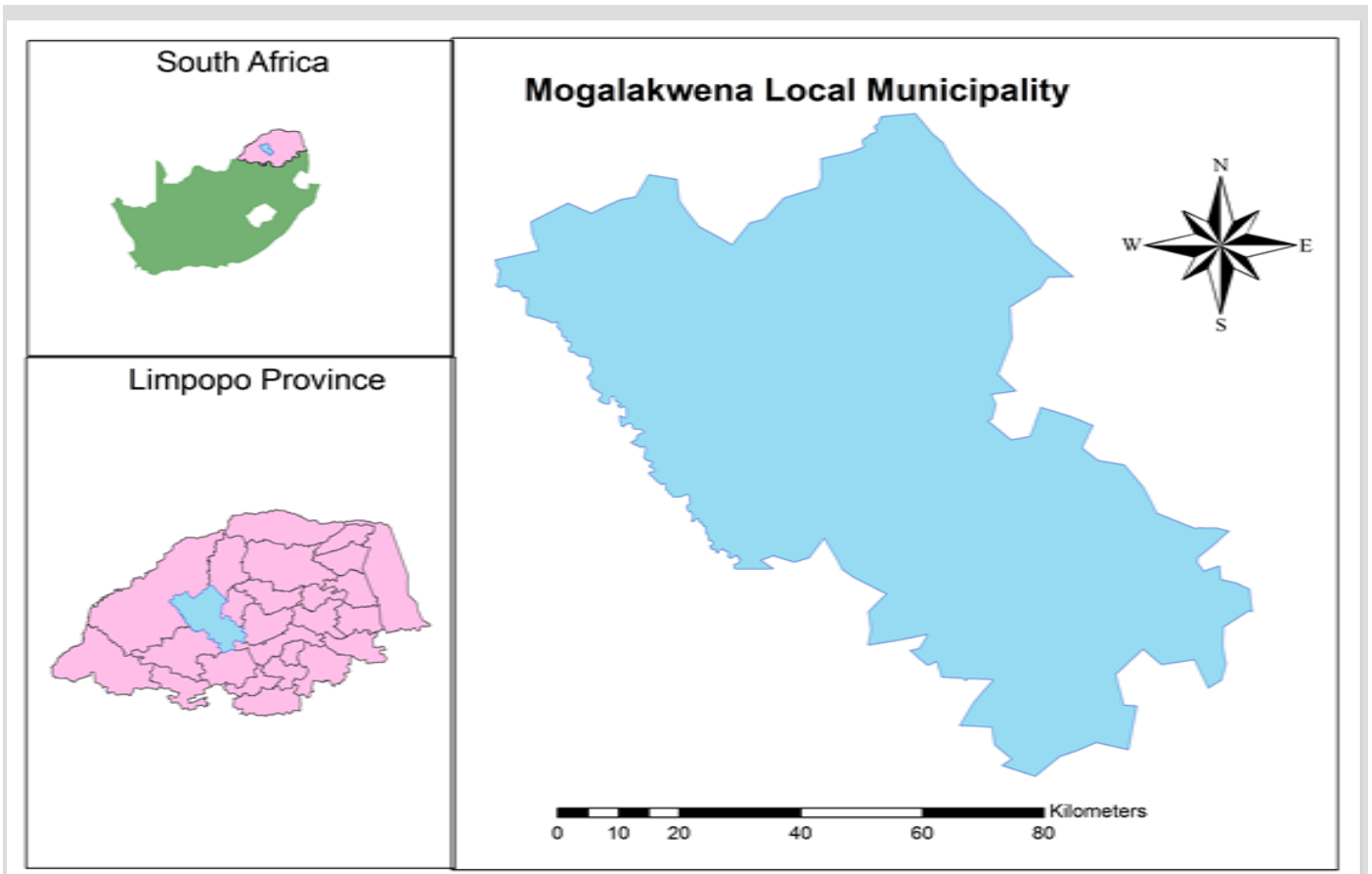


Figure 1: Study area

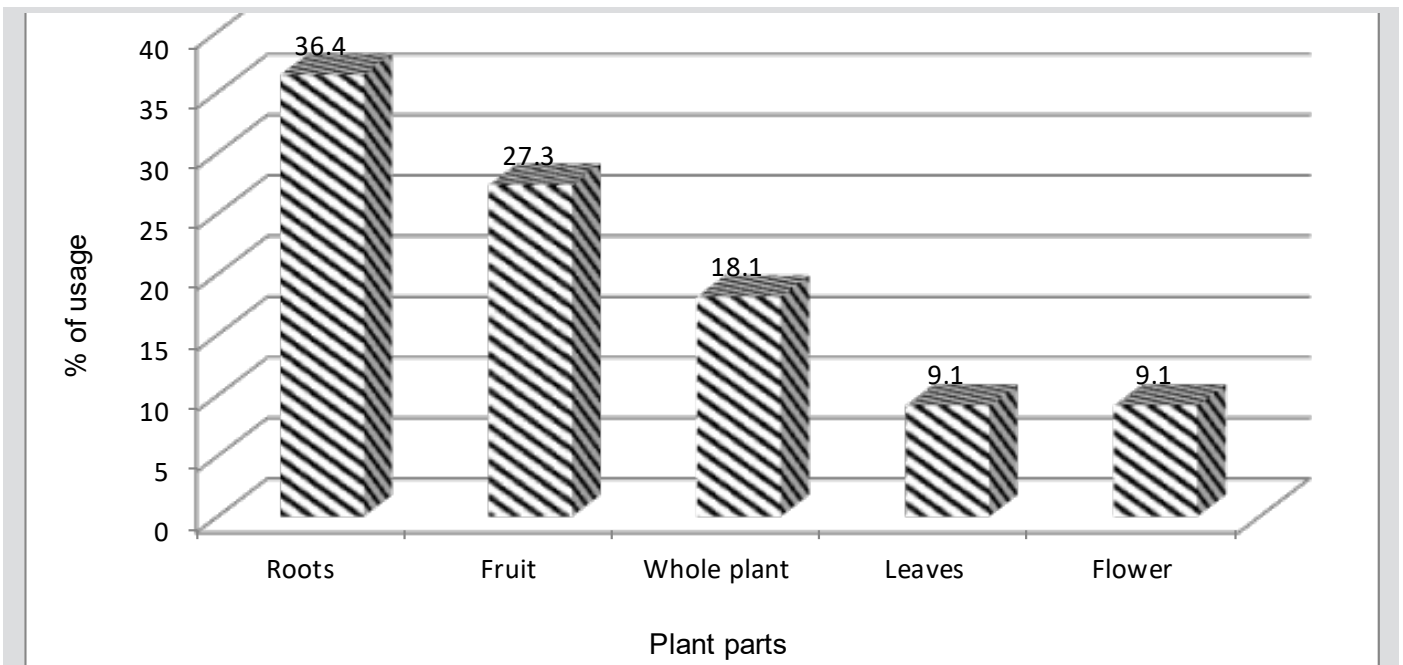


Figure 2: Plant parts used

The low diversity of exotic plants in the study area can be linked to the varying spreading pattern as well as ethnomedicinal knowledge towards exotic plants. Most of the documented exotic plants were cultivated (75%). According to Foxcroft *et al.* (2008) most exotic plant are cultivated in home gardens and consequently escape to natural systems.

The family Asteraceae is represented by two herbaceous plants (*Bidens pilosa* and *Tagetes minuta*) that are widespread in tropical and sub-tropical regions (Deba *et al.*, 2008; Senatore *et al.*, 2004). In South Africa, *B. pilosa* and *T. minuta* are common weedy plants that grow mostly in unwanted places such as cultivated land, disturbed areas and roadsides. The use of *B. pilosa* and *tagetes minuta* by Bapedi traditional health practitioners can be ascribed to its abundance in the study area, as are common weedy plants that are found in cultivated and disturbed area. *Carica papaya* L., *Musa acuminata* and *Punica granatum* are not only used for medicinal purposes but also used as nutritional plants for rich source of vitamin C (Valente *et al.*, 2011) and are cultivated in the study area. *Agave angustifolia* is cultivated for ornamental purpose in most of the study area. The plant species *Citrus lemon* is cultivated for its fruit that is used as flavour additive and it is widely known to treat cold and flu. Mosina *et al.* (2014) noticed that most of the garden plants in the remote and rural areas are cultivated for fruit, vegetables, medicinal as well as for ornamental purposes.

### Plant parts used

The preference for roots is mostly due to the high content of medicinal properties (Semenya *et al.*, 2012) and local accessibility. However, there is significant use of fruit (27%) as a plant part by Bapedi traditional health practitioners to treat different ailments. This is unusual because fruit are seasonal as compared to other plants parts. Despite high medicinal uses of fruit (27%) from exotic plants, the fruit are also consumed for their nutritional value. Fruit harvested from *Musa acuminata* (Banana tree) forms multimillion industries in tropical and subtropical regions for commercial production (Anyasi *et al.*, 2013).

### Ailments treated

This study reports treatment of gonorrhoea us-

ing two plant species namely *Carica papaya* and *Agave angustifolia* (Table 1). Gonorrhoea is one of the most widespread contagious infections in the world (Mulaudzi *et al.*, 2015). The medicinal use of *Carica papaya* for treatment of gonorrhoea is reported in different regions of South Africa and elsewhere. Semenya *et al.* (2012) reported the use of *C. papaya* for treatment of gonorrhoea by Bapedi traditional health practitioners in Limpopo Province of South Africa. Lay people in Mpumalanga Province also use *Carica papaya* for gonorrhoea (De Wet *et al.*, 2011). The use of *C. papaya* in gonorrhoea treatment is important, especially for people residing in rural areas where exotic plants are widespread and easily accessed as opposed to unavailable modern health care facilities and declining indigenous medicinal plants. The common use of *C. papaya* by different ethnic groups suggests that this plant species might contain secondary metabolites that can inhibit pathogens of sexually transmitted infections. Antibacterial essays have demonstrated broad-spectrum activity against STI pathogens (Naidoo *et al.*, 2013).

*Agave angustifolia* is also documented for treatment of gonorrhoea. Root decoction is prepared and administered orally. As far as literature search, there is no record of treatment of gonorrhoea using *A. angustifolia*. The medicinal use of *A. angustifolia* warrant further investigation.

*Bidens pilosa*, an aggressive weedy species found growing in disturbed and cultivated area of most South African land. The species have been documented for medicinal uses in South Africa (Lewu and Afolayan, 2009; Semenya *et al.*, 2012). In this study, a root from *B. pilosa* is combined with whole plant of *Dicerocaryum eriocarpum* to prepare decoction to clean womb after birth or after miscarriage (Table 1). The combination of plants might be linked to enhancement of the efficacy of remedy. Plant extract mostly contains broad mixture of compound that work synergistically to regulate infections and therefore plant might not work alone (Lewis and Ausubel, 2006). Semenya *et al.* (2012) noted the use of *B. pilosa* for treatment of menstrual disorder among Bapedi healers in Limpopo Province. Leaf or root infusion from *Bidens pilosa* is used by Xhosa tribe in Eastern Cape of South Africa for stomach pains (Lewu and Afolayan, 2009). Rojas *et al.* (2006) noticed water extracts of *B.*

*pilosa* to have higher activity against *Bacillus cereus* and *Escherichia coli* than organic solvents. This finding validates the traditional preparation for gastrointestinal disorder noted by Lewu and afolayan (2009) for stomach pains. Lewu and Afolayan (2009) noticed that exotic plants were mostly used by Xhosa tribe in Eastern Cape of South Africa to treat gynaecological ailments. Therefore, ethnomedicinal uses of exotic species like *B. pilosa* could help to clean womb after birth.

The whole plant from *Tagetes minuta* is ground to fine powder for treatment of wounds (Table 1). Babedi traditional health practitioners use the same preparation protocol to control nematode and ticks in livestock. Although, Kenyans people prepare decoction from *T. minuta* to control ticks, this preparation method is helpful for people in rural areas to protect their livestock (Njoroge and Bussmann (2006). This plant has been validated *in vivo* in ethno-veterinary remedies to control ticks (Nchu et al., 2012; Andreotti et al., 2013). *T. minuta* is important in ethnomedicine for treatment of wounds and other ailments. Abbasi et al., (2010) documented the application of *T. minuta* for wounds by tribal people of North-West Frontier Province in Pakistan. In East Africa, *T. minuta* is used for stomachache; Toothache as well as wounds treatment (Njoroje et al., 2004). It can be concluded that ethnomedicinal records of *T. minuta* and *in vivo* studies from various regions validate treatments for wounds and nematode control by Babedi traditional health practitioners.

*Moringa oleifera* is documented for treatment of blood cleansing, cold and flu in our study (Table 1). Dried leaves or fruit/pods are grounded to fine powder and infusions are prepared. The ethnomedicinal use of *M. oleifera* for treatment of cold and flu corroborates the findings of Ramalingum and Mahomoodally (2014). Babedi healers prepare crude extracts from *Moringa* pods or leaves through infusions prior to oral administration. This method of traditional preparation might extract secondary metabolites that include alkaloids and morigine that are important in respiratory infections (Flora and Pachauri, 2011). *Moringa* is gaining popularity both in nutrition and medicinal research due to its high nutritional values and ethnomedicinal uses (Silva et al., 2014). Most studies report *Moringa* in ethnomedicine to treat multiple ailments including the ones

reported in this study (Silva et al., 2014). For example, *Moringa* is reported as stimulant in paralytic afflictions and can also act as a cardiac or circulatory tonic (Anwar et al., 2007). This finding is in agreement with our finding with regard to blood cleansing (Table 1). However the report of Anwar et al., (2007) makes use of roots as plant parts while our study use leaves or pods.

Gastrointestinal infections such as dysentery and diarrhoea are treated with *Punica granatum*. According to the world Health Organization, intestinal infections account 3–4 million deaths annually, especially to young people (WHO, 1996). The ethnomedicinal use of *P. granatum* for intestinal infections is common in Limpopo Province of South Africa (Semenya et al., 2012) and elsewhere (Pradeep et al., 2008). Either fruit or roots are used for preparation of remedy. Anti-diarrhoeal activities of *Punica granatum* has been confirmed *in vitro* (Mathabe et al., 2006).

*Musa acuminata* is documented for heart fail and skin rash. Babedi traditional healers slices banana flower to prepare infusion for treatment of heart fail. Orhan, (2001) noted that soluble and insoluble fibres fractionated from banana pulp had a cholesterol-lowering effect. Furthermore, the reported finding noted that freeze-dried banana pulp was responsible for lowering cholesterol while this study noted the use of the flower. *Musa paradisiaca* and *Musa sapientum* showed the cholesterol lowering effect (Usha et al., 1989; Ercan et al., 1993). High cholesterol can lead to cardiovascular problem such as heart fail. Plant species within same taxa are characterised by similar chemical compounds (Wink M, 2003). This might apply to locally grown and medicinally used banana tree known as *M. acuminata*.

A banana peel is burnt, crushed and mixed with Vaseline™ to apply on rushed skin. No information is been found in literature with respect to ethnomedicinal use of Banana peel for skin rash treatment. The ethnomedicinal use of banana peel warrant further investigation for validity. This information also needs to be validated through antibacterial assays and phytochemical analysis.

### Plant extraction and mode of administration

Babedi traditional healers employed various protocols for plant extract. However, in case of

exotic plants, preparation was mainly through infusions and decoction, each preparation accounted 30%, it was further noticed that burning, chew, paste and squeeze contributed 10% each.

Preparation methods do not depend on whether plants are exotic or indigenous. Infusions and decoctions are favoured as the method of plant extraction. The high preference of decoction (30%) and infusions (30%) is in agreement with other ethnomedicinal studies based on exotic plants (Semenya *et al.*, 2012), as well as ethnomedicinal uses of indigenous plants (Njoroje and Bussmann, 2009). Some of the noticed extraction procedure includes fruit squeeze, burning and past (Figure 3). These are common preparation methods employed by traditional healers in South Africa (De Wet *et al.*, 2012) and other parts of Africa (Igoli *et al.*, 2005; Ribeiro *et al.*, 2010; Shanmugam *et al.*, 2009). Preparations of plant extract were (87.5%) from single plant species. Of all 8 exotic plants documented, *B. pilosa* is the only plant species that is used in combination with whole plants of *Dicerocaryum eriocarpum* (indigenous problem plant) to prepare decoction for womb cleaning.

Only two mode of administration was documented in this study. Most plants extract are taken orally (77%) when contrasted with topical mode (23%). Preference of oral administration could be simplicity in absorption. Semanya *et al.* (2013) noted that oral administration allow quick absorption of metabolites through human intestine. Topical mode was method advocated for skin related ailments such as skin rash and wounds. This also provides a direct method of treatment on affected area. Ribeiro *et al.*, (2010) also noticed oral and topical modes are mostly used administration mode in district of Massingir, Mozambique.

### Role of exotic plants in the local medical systems

The exotic plants are now widespread in natural and semi-natural systems of South Africa and other countries. Various habits of plants from all taxonomic groups are introduced in native flora of South Africa. Many of exotic plants are incorporated into *metaria medica* of local traditional health practitioners. Therefore, traditional medicinal in South Arica cannot be static system that does not change. Exotic plants have found rel-

evance in traditional medicine system of South Africa because some of exotic plants are used medicinally by local traditional health practitioners (Lewu and Afolayan 2009). Today more than 300 exotic plants are used medicinally and some are traded in South African market (Wojtasik, 2013). According to Alencar *et al.* (2014) the role of exotic plants possesses two important actions. They could firstly provide alternative form of medicine and maintain local medicine system through preservation of therapeutic indications. Secondly they provide therapeutic indications that other indigenous plants cannot perform. In Eastern Africa, exotic medicinal plants are domesticated as part of increasing the income and availability of medicinal plants to traditional health practitioners (Njoroje *et al.*, 2004).

### Conclusions

Bapedi traditional health practitioners in Mogalakwena Local Municipality utilise exotic plant species for primary health care. This information could further help traditional health practitioners elsewhere to enhance primary health care. The ethnomedicinal record of exotic plants can be used for *in vitro* studies for drug development.

A sustainable use of indigenous plants is of a great concern in South Africa. Exotic plants are widespread in natural and semi-natural system of South Africa and are becoming integrated into *materia medica* of Bapedi tradition health practitioners. An ethnobotanical study on substitutions of indigenous plant species with exotic plant species is recommended. This could lead to better natural resource management for sustainable use of some of the scarce and endangered indigenous plant species. In conclusion, exotic plant species are becoming important source of medicinal plants in Limpopo Province and their documentation is recommended as an alternate medicinal plant material.

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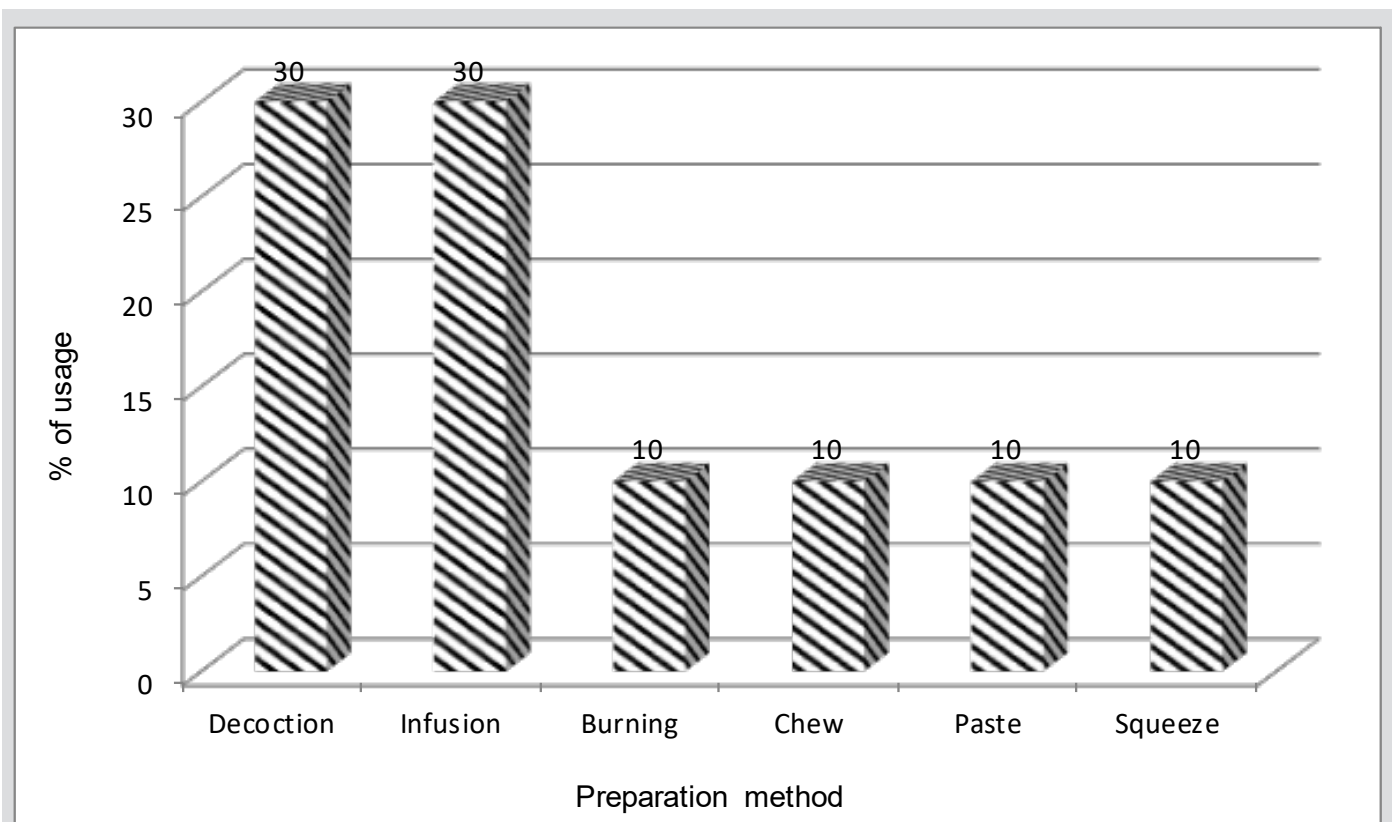


Figure 3: Method of preparation

Table 1: Exotic plants used medicinally for various diseases in Mogalakwena Local Municipality

Family	Scientific name	Voucher numbers	Parts used	Habit	Traditional uses	Preparation method	Mode of administration
Agavaceae	<i>Agave angustifolia</i> L.	UNIN 12299	Roots	Shrub	Gonorrhoea	Infusion	Orally
	<i>Bidens pilosa</i> + <i>Dicerocaryum eriocarpum</i>	UNIN 12205	Roots + Whole plant	Herb	Womb cleaner miscarriage	decoction	Orally
Asteraceae	<i>Tagetes minuta</i>	UNIN 12217	Whole plant	Herb	Wounds and Veterinary	Paste	Topically
Caricaceae	<i>Carica papaya</i> L.	UNIN 12273	Roots	Tree	Gonorrhoea	Decoction	Orally
Moringaceae	<i>Moringa oleifera</i> Lam.	UNIN 12223	Fruit and Leaves	Tree	Blood cleaning, cold and flu	Infusions	Orally
Musaceae	<i>Musa acuminata</i> L.	UNIN 12328	Flower	Shrub	Heart fail	Infusion	Orally
			Fruit peel		skin rash	Burning	Topically
Punicaceae	<i>Punica granatum</i>	UNIN 12293	Fruit/roots	Tree	Diarrhoea and dysentery	Decoction prepared from roots. Dried or fresh fruit / chew	Orally
Rutaceae	Citrus lemon	UNIN 12327	Fruit	Tree	Flu and cough	Squeeze	Orally



## Reference

- Alencar, N.L., Santoro, F.R. & Albuquerque, U.P. 2014. What is the role of exotic medicinal plants in local medical systems? A study from the perspective of utilitarian redundancy. *Revista Brasileira de Farmacognosia*, **24**: 506-515.
- Anyasi, T.A., Jideani, A.I. & Mchau, G.R. 2013. Functional properties and postharvest utilization of commercial and noncommercial banana cultivars. *Comprehensive Reviews in Food Science and Food Safety*, **12**: 509-522.
- Andreotti, R., Garcia, M.V., Cunha, R.C. & Barros, J.C. 2013. Protective action of *Tagetes minuta* (Asteraceae) essential oil in the control of *Rhipicephalus microplus* (Canestrini, 1887) (Acari: Ixodidae) in a cattle pen trial. *Veterinary parasitology*, **197**: 341-345.
- Anwar, F., Latif, S., Ashraf, M. & Gilani, A.H. 2007. *Moringa oleifera*: a food plant with multiple medicinal uses. *Phytotherapy research*, **21**: 17-25.
- Christen, D.C. & Matlack, G.R. 2008. The habitat and conduit functions of roads in the spread of three invasive plant species. *Biological Invasions* **11**: 453-465.
- Deba, F., Xuan, T.D., Yasuda, M. & Tawata, S. 2008. Chemical composition and antioxidant, antibacterial and antifungal activities of the essential oils from *Bidens pilosa* Linn. var. *Radiata*. *Food control*, **19**: 346-352.
- De Wet, H., Nzama, V.N. & Van Vuuren, S.F. 2012. Medicinal plants used for the treatment of sexually transmitted infections by lay people in northern Maputaland, KwaZulu-Natal Province, South Africa. *South African Journal of Botany*, **78**: 12-20.
- Flora, S.J.S. & Pachauri, V. 2011. *Moringa (Moringa oleifera)* seed extract and the prevention of oxidative stress. Nuts & seeds in health and disease prevention. Elsevier Inc. Amsterdam, The Netherlands, 776.
- Foxcroft, L.C., Richardson, D.M. & Wilson, J.R. 2008. Ornamental plants as invasive exotics: problems and solutions in Kruger National Park, South Africa. *Environmental Management*, **41**: 32-51.
- Horigome, T., Sakaguchi, E. & Kishimoto, C. 1992. "Hypocholesterolaemic effect of banana (*Musa sapientum* L. var. *cavendishii*) pulp in the rat fed on a cholesterol-containing diet". *Br. J. Nutr.*, **68**: 231-244.
- Igoli, J.O., Ogaji, O.G., Tor-Anyiin, T.A. & Igoli, N.P. 2005. Traditional medicine practice amongst the Iggede people of Nigeria. Part II. *Afr. J. Trad. CAM*, **2**: 134 – 152.
- Jacobs, L.E.O., Richardson, D.M. & Wilson, J.R.U. 2014. *Melaleuca parvistaminea* Byrnes (Myrtaceae) in South Africa: Invasion risk and feasibility of eradication. *South African Journal of Botany* **94**: 24-32.
- Kalwij, J.M., Robertson, M.P. & Rensburg, B.J. 2008. Human activity facilitates altitudinal expansion of exotic plants along a road in montane grassland, South Africa. *Applied Vegetation Science*, **11**: 491-498.
- Lewis K. & Ausubel F.M. 2006. Prospects for plant-derived antibacterials. *Nat Biotechnol*, **24**: 1504-1507.
- Light, M.E., Sparg, S.G., Stafford, G.I. & Van Staden, J. 2005. Riding the wave: South Africa's contribution to ethnopharmacological research over the last 25 years. *Journal of Ethnopharmacology*, **100**: 127-130.
- Mathabe, M.C., Nikolova, R.V., Lall, N. & Nyazema, N.Z., 2006. Antibacterial activities of medicinal plants used for the treatment of diarrhoea in Limpopo Province, South Africa. *Journal of Ethnopharmacology*, **105**: 286–293.
- Maroyi, A. 2012. Garden Plants in Zimbabwe: Their ethnomedicinal uses and reported toxicity. *Ethnobotany Research & Applications*, **10**: 045-057.
- Meyerson, L.A. & Mooney, H.A. 2007. Invasive alien species in an era of globalization. *Frontiers in Ecology and the Environment* **5**: 199-208.
- Mulaudzi, R.B., Ndhlala, A.R. & Van Staden, J. 2015. Ethnopharmacological evaluation of a traditional herbal remedy used to treat gonorrhoea in Limpopo province, South Africa. *South African Journal of Botany*, **97**: 117-122.
- Naidoo, D., Van Vuuren, S.F., Van Zyl, R.L. & De Wet, H. 2013. Plants traditionally used individually and in combination to treat sexually transmitted infections in northern Maputaland, South Africa: antimicrobial activity and cytotoxicity. *Journal of ethnopharmacology*, **149**: 656-667.
- NEMBA, 2014. National Environmental Management: Biodiversity Act 2004 (Act No. 10 of 2004. Alien and Invasive Species Regulations, Department of Environmental Affairs). [https://www.environment.gov.za/.../legislations/nemba10of2004\\_aliemand](https://www.environment.gov.za/.../legislations/nemba10of2004_aliemand)

- invasive\_species**regulations.pdf (Accessed on 27 February 2016).
- Nchu, F., Magano, S.R. & Eloff, J.N. 2012. *In vitro* anti-tick properties of the essential oil of *Tagetes minuta* L. (Asteraceae) on *Hyalomma rufipes* (Acari: Ixodidae). *Onderstepoort Journal of Veterinary Research*, **79**: 01-05.
- Njoroge, G.N. & Bussmann, R.W., 2006. Traditional management of ear, nose and throat (ENT) diseases in Central Kenya. *Journal of Ethnobiology and Ethnomedicine*, **2** : DOI: 10.1186/1746-4269-2-54.
- Pyšek, P & Richardson, D.M. 2010. Invasive Species, Environmental Change and Management, and Health. *Annual Review of Environment and Resources*, **35**: 25-55.
- Ramalingum, N. & Mahomoodally, M.F. 2014. The Therapeutic Potential of Medicinal Foods. In: Neal Davies (ed.), *Advances in pharmacological sciences*, **2014**: 1-18.
- Pradeep, B.V., Manojbabu, M.K. & Palaniswamy, M. 2008. Antibacterial activity of *Punica granatum* L. against gastro intestinal tract infection causing organisms. *Ethnobotanical Leaflets*, **12**: 143.
- Ribeiro, A., Romeiras, M. M., Tavares, J. & Faria, M. T. 2010. Ethnobotanical survey in Canhane village, district of Massingir, Mozambique: medicinal plants and traditional knowledge. *J Ethnobiol Ethnomed*, **6**: 33-48.
- Rojas, J.J., Ochoa, V.J., Ocampo, S.A. & Muñoz, J.F. 2006. Screening for antimicrobial activity of ten medicinal plants used in Colombian folkloric medicine: A possible alternative in the treatment of non-nosocomial infections. *BMC complementary and alternative medicine*, **6**: 2.
- Semenya, S.S., Potgieter, M.J., Tshisikhawe, M.P., Shava, S. & Maroyi, A. 2012. Medicinal utilization of exotic plants by Bapedi traditional healers to treat human ailments in Limpopo province, South Africa. *Journal of ethnopharmacology*, **144**: 646-655.
- Semenya, S.S., Potgieter, M.J. & Tshisikhawe, M.P. 2013. Use, conservation and present availability status of ethnomedicinal plants of Matebele Village in the Limpopo Province, South Africa. *African Journal of Biotechnology* **12**: 2392-2405.
- Senatore, F., Napolitano, F., Mohamed, M., Harris, P.J.C., Mnkeni, P.N.S. & Henderson, J. 2004. Antibacterial activity of *Tagetes minuta* L. (Asteraceae) essential oil with different chemical composition. *Flavour and fragrance journal*, **19**: 574-578.
- Shai, L.J., McGaw, L.J., Masoko, P. & Eloff, J.N. 2008. Antifungal and antibacterial activity of seven traditionally used South African plant species active against *Candida albicans*. *South African Journal of Botany*, **74**: 677-684.
- Shanmugam, S., Manikandan, K. & Rajendran, K. 2009. Ethnomedicinal survey of medicinal plants used for the treatment of diabetes and jaundice among the villagers of Sivagangai District, Tamilnadu. *Ethnobotanical Leaflets*, **2009**: 22.
- Silva, M.F., Nishi, L., Farooqi, A. & Bergamasco, R. 2014. The many health benefits of *Moringa oleifera*. *Journal of Medical and Pharmaceutical Innovation*, **1**: 9-12.
- Street, R.A. & Prinsloo, G. 2012. Commercially important medicinal plants of South Africa: A review. *Journal of Chemistry* **2013**: 1-16.
- Truter, I. 2007. African traditional healers: Cultural and religious beliefs intertwined in a holistic way. *SA Pharmaceutical Journal*, **74**: 56-60.
- Usha, V., Vijayammal, P.L. & Kurup, P.A. 1989. "Effect of dietary fibre from banana (*Musa paradisiaca*) on metabolism of carbohydrates in rats fed cholesterol-free diet" *Indian journal of experimental biology*, **27**:445-449.
- Weitz, F.M. & Thring, T.S.A. 2005. Medicinal plant use in the Bredasdorp/Elim region of the Southern Overberg in the Western Cape Province of South Africa. *Journal of Ethnopharmacology* **103**: 261–275.
- Wiersum, K.F., Dold, A.P., Husselman, M. & Cocks, M. 2006. Cultivation of medicinal plants as a tool for biodiversity conservation and poverty alleviation in the Amatola region, South Africa. *Frontis*, **17**: 43-57.
- Williamson, M. & Fitter, A. 1996. The varying success of invaders. *Ecology* **77**: 1661-1666.
- Williams, V.L., Victor, J.E. & Crouch, N.R. 2013. Red listed medicinal plants of South Africa: status, trends, and assessment challenges. *South African Journal of Botany*, **86**: 23-35.
- Wink, M. 2003. Evolution of secondary metabolites from an ecological and molecular phylogenetic per-

spective. *Phytochemistry*, **64**:3-19.

Wojtasik, E.M. 2013. Richness and diversity of alien ethnomedicinal plant taxa used and sold for traditional medicine in South Africa. MSc Dissertation, University of the Witwatersrand, Johannesburg.

World Health Organisation, 1996. *Water and Sanitation: Fact sheet*, vol. 112. Geneva, World Health Organisation.

World Health Organization (WHO). 2002. *Traditional medicine strategy 2002–2005*. World Health Organization, Geneva.

