

An ethnobotanical survey of plants used traditionally to treat tuberculosis in the eastern region of O.R. Tambo district, South Africa

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Abstract

Worldwide, tuberculosis (TB) is a major human killer claiming about 1.5 million lives per annum. Medicinal plants are believed to serve as a source for products that can serve as anti-TB agents. Despite the importance of plants for human health and subsistence in both developed and developing countries, loss of biodiversity-based cultural knowledge and traditions is a commonly reported phenomenon, therefore, documenting such knowledge before it disappears completely is a necessity. The study was carried out to document medicinal plants that are traditionally used for the treatment of TB in the eastern region of O.R. Tambo district, Eastern Cape Province of South Africa. Information about plants (names, parts and methods of preparation) that are used for treating TB was gathered from traditional medical practitioners (TMP) using questionnaires. Twenty-four plant species belonging to 19 families that are used for the treatment of TB were revealed by this study. The Apiaceae, Amaryllidaceae, Asparagaceae, Compositae, and Leguminosae were the most prominent, represented by two species each. Out of the 24 plants reported, *Protorhus longifolia* (Bernh.) Engl (Anacardiaceae), *Phymaspermum acerosum* Källersjö (Compositae) and *Strychnos henningsii* Gilg (Loganiaceae) were the most frequently mentioned species, and were reported for the first time for TB treatment. Most of the plants (91%) documented are

administered orally; the root (54%) is the most common plant part used, while decoctions and infusions are the main preparatory methods. Indigenous knowledge of medicinal plants used in the treatment of TB exists in the eastern region of OR Tambo district, and TMP still play an important role in delivering primary healthcare services. The ethnobotanical information about the plant species mentioned in this study may serve as baseline data for future studies on their pharmacological effects and to identify those that have potential in the development of anti-TB drugs.

Keywords: Tuberculosis, Medicinal plants, *Protorhus longifolia*, *Phymaspermum acerosum*, *Strychnos henningsii*.

1. Introduction

Increasing numbers of immunocompromised individuals and microbial evolution are some of the factors that have contributed to the emergence as well as the reemergence of infectious diseases worldwide (De Luca and Giraldi, 2011). Many infectious diseases such as tuberculosis (TB) have reemerged as a serious world health problem in recent years. According to the WHO (2015) report, the number of TB cases has been decreasing slowly, putting the world on track towards achieving the millennium development goal to reduce TB by 2015, however the death tolls from this disease are still unacceptable as it claims about 1.5 million lives per annum worldwide. Worldwide, plants still serve as a rich and much needed resource of novel biologically active compounds, including anti-TB agents (Leitão et al., 2013). In many parts of South Africa, medicinal plants are used to treat TB and related symptoms including chest complaints, respiratory ailments, fever and coughing (McGaw et al., 2008). Traditional herbalists have long played an important role in the provision of primary health care by prescribing plant-based treatment, and each culture in South Africa has traditional medical remedies for the cure of various diseases including TB (Van Wyk et al., 2009). Several reviews of traditional plant use are available from Southern Africa, however further work needs to be done regarding the documentation of ethnobotanical knowledge that exists. In South Africa, several plant species used for traditionally treating TB have been recorded by ethnobotanical studies

conducted in parts of Limpopo, Eastern Cape, rural Maputaland and KwaZulu-Natal (Green et al., 2010; York et al., 2011; Semenya and Maroyi, 2013; Lawal et al., 2014). There is, however, a lot of undocumented ethnobotanical information that still needs to be collected from the local people in South Africa. Such data needs urgent documentation as much traditional knowledge concerning plants and their uses is diminishing due to socio-economic and land use changes. Knowledge of plants has become an important part of developing new pharmaceuticals, and documenting such information would highlight a relationship between a culture and its environment. In South Africa, and many other parts of the world, knowledge about the use of plants links education, knowledge institutions and health issues. Therefore, inventories of plants with therapeutic potential should be conducted. The eastern region of O.R. Tambo district, South Africa, known as Pondoland, is famous for high plant diversity and endemism. Traditional medicines still play an important role in traditionally treating TB in this region as many people use herbal remedies to curb diseases. Hence, this study focused on documenting plants used for the treatment of TB in the eastern region of O.R. Tambo district, South Africa. This research was conducted under the auspices of Walter Sisulu University, Mthatha.

2. Study area

The Eastern Region of O.R. Tambo district is the most populous district in the Eastern Cape Province of South Africa along the Indian ocean coastline (Fig.1) (Census 2011, 2012). It is widely regarded as one of the most fertile in the country, benefiting from a temperate climate, fertile soil, predominantly frost-free conditions and crucially, higher-than-average annual rainfall of around 700 mm per annum (Van Wyk and Smith, 2001). The area is more than 2700 m above sea level and covers an area of 16.617 km². The eastern region of O.R. Tambo district was chosen for the study because of the availability of local knowledge of plant use in traditional medicine. Many people in these areas, especially in rural communities rely heavily on natural resources for their primary health care needs.

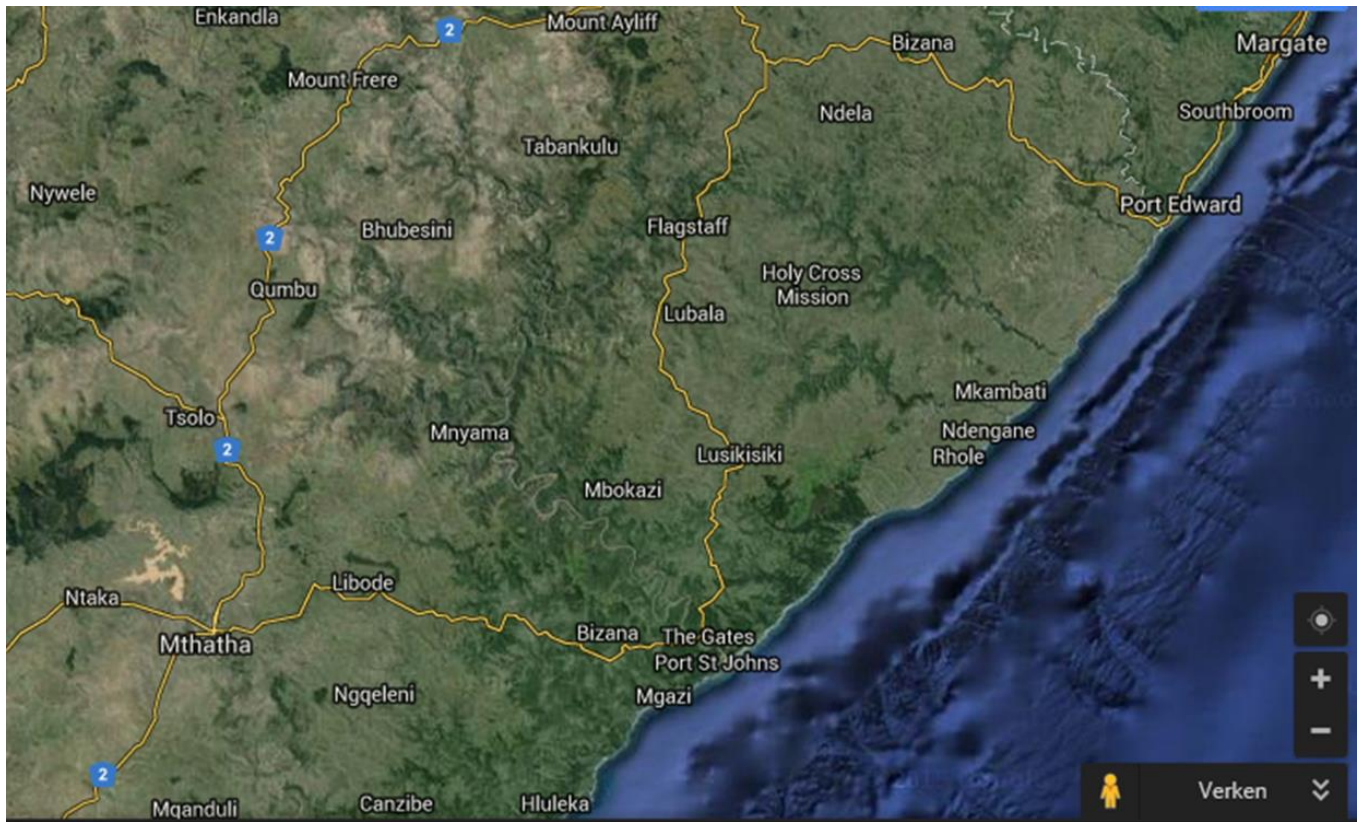


Figure 1: Map showing the eastern region of O.R. Tambo district (google maps)

3. Materials and methods

3.1. Data collection

Full informed consent of all participants was sought with further verbal agreement and understanding that the research would be used to serve as enlightenment regarding the diversity of medicinal plants used for treatment of TB in the study area. The survey was conducted between March and December 2009 in Bizana, Lusikisiki, Flagstaff, Tabankulu and Port St Johns. Information about the plant species used for traditionally treating TB was collected from TMP. Interviews were conducted in places where interviewees lived or worked, and were carried out in Xhosa (a local language) for easy communication with the local people. Preliminary interviews took place by appointment and a basic questionnaire was followed where possible to gather information on plants that are used for traditionally treating TB, including methods of preparation. A more specific questionnaire was used in follow-up interviews using the information already gathered. This was aimed at finding out more about what had already been mentioned

and finding out the actual methods of preparation as well as dosage of the various herbal remedies. The information on TB plants was documented as follows: the local name of the plant, parts used, method of preparation, and mode of administration. There was an initial problem involving the identification of several plants due to the fact that some plants have the same or more than one common name. This problem was solved by taking some textbooks to the interviewees so that they could page through them and look closely at the photographs and recognize certain plants. This helped in coming to an agreement for each plant in use and in triggering memories of plants that were used for treating TB. Many of the informants also helped in the identification of plants by bringing along samples of plant material to the meetings and all the samples were kept. Collection was done in the wild while accompanied by the informants to ensure that the correct plant species was collected. All the plant species mentioned by TMP were identified, given a voucher specimen number and deposited at the Walter Sisulu University herbarium.

3.2. Data analysis

Simple calculations, histograms, pie-chart and plant species frequencies were determined using Excel spreadsheets. To calculate relative frequency of citation (RFC), defined as the percentage of frequency of mentioning a single plant species by respondents, the following formula was used:

$$\text{RFC} = (\text{FC}/\text{N}) \times 100$$

Where FC is the number of times a particular species is mentioned, and N is the number of all respondents.

4. Results and discussion

4.1. Details of respondents

Recording of knowledge about the traditional use of plants is important and a necessity in South Africa, as well as worldwide to avoid its loss. A total of 30 participants from the eastern region of O.R. Tambo district were interviewed. Of the 30 participants interviewed, 18 were females with ages ranging from 20-75 years and 12 were males with ages ranging from 20 to 65 years. Concerning the educational level of the respondents, 53% were illiterate, whereas others had at least primary (20%), junior secondary (7%) and senior secondary (10%) education. However, only three (one female and two males) of the respondents had received tertiary education. In terms of employment, only two TMP were formally employed, and were both primary school educators. One out of the three respondents was a trained pathologist with an Honours degree in pathology. All the respondents had formal training after receiving ancestral calling, and were of Mpondo ethnicity, a group of people that resides in the part of Eastern Cape known as Pondoland. The survey demonstrated that 100% of the respondents claim to treat TB on a regular basis using medicinal plants, and described its symptoms as blood in the sputum, persistent coughs, weight loss, chest pain and shortness of breath. The respondents mentioned that they received their knowledge of medicinal plants from their ancestors and through formal training.

4.2. Medicinal plants used for TB treatment

Twenty-four plant species belonging to 19 families that are used for treating TB in the eastern region of O.R. Tambo district were identified by this study (Table 1). Forty-two percent of the species were represented by the Amaryllidaceae, Apiaceae, Asparagaceae, Compositae, and Leguminosae families comprising about two species each (Fig. 2). Other families were represented by one species each and they were Acoraceae, Anacardiaceae, Apocynaceae, Cannabaceae, Celastraceae, Gerrardinaceae, Hypoxidaceae, Pittosporaceae, Rubiaceae, Ranunculaceae, Talinaceae, Thymelaeaceae, Xanthorrhoeaceae and Loganiaceae. This shows the huge plant diversity of South Africa with its rich ethnomedicinal properties, which serves as the main therapeutic reserve for the majority of the people in this region. Out of 24 plant species revealed by this study, three were frequently mentioned by the interviewees, and those were *Protorhus*

Table 1: Medicinal plants used for treating tuberculosis in the eastern region of O.R. Tambo District

Family and botanical name	Local name, frequency of being mentioned, and voucher specimen number	Use, and plant part used. Therapeutic application and preparation	Conservation status according to 2015 Red Data list
Acoraceae, <i>Acorus calamus</i> L.	Indawulutho 8 B. Madikizela 15	TB, rhizome. Orally, infusion/dry rhizomes chewed.	Not assessed
Amaryllidaceae, <i>Haemanthus albiflos</i> Jacq	Umathinga 12 B. Madikizela 3	TB, bulb. Orally, infusion.	Least concern
Amaryllidaceae, <i>Tulbaghia alliacea</i> L.f.	Umwelela 7 B. Madikizela 2	TB, bulb. Orally, infusion.	Least concern
Anacardiaceae, <i>Protorhus longifolia</i> (Bernh.) Engl	Uzintlwa 18 B. Madikizela 5	TB, bark. Orally, infusion.	Least concern
Apiaceae, <i>Alepidea amatymbica</i> Eckl. & Zeyh.	Iqwili, Ikhathazo 6 B. Madikizela 6	TB, colds, chest complaints, asthma and influenza, rhizome/root. Orally, infusion.	Vulnerable
Apiaceae, <i>Heteromorpha trifoliata</i> (H.L. Wendl.) Eckl. & Zeyh.	Umbangandlela 13 B. Madikizela 4	TB, root. Orally, and rectally, infusion.	Least concern
Apocynaceae, <i>Pachycarpus concolor</i> E. Mey.	Ishongwe/ Itshongwe 12 B. Madikizela 14	TB, root. Orally, infusion.	Vulnerable
Asparagaceae, <i>Bowiea volubilis</i> Harv.	Umagaqana 11 B. Madikizela 9	TB, bulb. Taken rectally, decoction.	Vulnerable
Asparagaceae, <i>Eucomis comosa</i> (Houtt.) Wehrh.	Umphompo 14 B. Madikizela 17	TB, bulb. Taken orally and then vomited, decoction.	Declining

Cannabaceae	Umya, Intsangu 8	TB, leaf/root.	Not evaluated
<i>Cannabis sativa</i> L.	B. Madikizela 10	Orally, infusion.	
Compositae	Umhlonyane 6	TB, Persistent cough, leaf.	Least concern
<i>Artemisia afra</i> Jacq. ex Willd.	B. Madikizela 24	Inhalation of steam, decoction.	
Compositae,	Isibara, Isibaha	TB, root.	Least concern
<i>Phymaspermum acerosum</i> (DC.) Källersjö	segceke 18	Orally and rectally, infusion.	
	B. Madikizela 20		
Celastraceae,	Usahlulamanye 14	TB, bark.	Least concern
<i>Pterocelastrus echinatus</i> N.E.Br.	B. Madikizela 18	Orally, infusion.	
Gerrardinaceae,	Umaluleka 13	TB, root/bark.	Least concern
<i>Gerrardina foliosa</i> Oliv.	B. Madikizela 8	Orally, infusion	
Hypoxidaceae,	Ilabatheka 14	TB, tuber.	Least concern
<i>Hypoxis colchicifolia</i> Baker	B. Madikizela 13	Orally, decoction.	
Leguminosae,	Umgxam 15	TB, bark.	Least concern
<i>Schotia latifolia</i> Jacq.	B. Madikizela 19	Orally, decoction.	
Leguminosae,	Isikhonde 14	TB and persistent coughs, root.	Least concern
<i>Rhynchosia totta</i> (Thunb.) DC.	B. Madikizela 22	Orally, infusion.	
Loganiaceae,	Umnonono	TB, bark.	Least concern
<i>Strychnos henningsii</i> Gilg	18	Orally, infusion/chewed.	
	B. Madikizela 11		
Pittosporaceae,	Umkhwenkwe 14	TB, bark.	Least concern
<i>Pittosporum viridiflorum</i> Sims	B. Madikizela 21	Taken orally, infusion.	
Rubiaceae,	Isicishamlilo/	TB, root.	Least concern
<i>Pentanisia prunelloides</i> (Klotzsch) Walp.	Icimamlilo 15	Taken orally, decoction.	
	B. Madikizela 23		

Ranunculaceae, <i>Ranunculus multifidus</i> Forssk.	Umvuthuza 13 B. Madikizela 16	TB, root. Orally, infusion.	Least concern
Talinaceae, <i>Talinum caffrum</i> (Thunb.) Eckl. & Zeyh.	Uphuncuka 15 B. Madikizela 1	TB, rhizome. Rectally, decoction.	Least concern
Thymelaeaceae, <i>Gnidia capitata</i> L.f.	Isidikili 6 B. Madikizela 12	TB, root. Orally, infusion.	Least concern
Xanthorrhoeaceae, <i>Aloe hexapetala</i> Salm-Dyck	Ikhala 16 B. Madikizela 7	TB, root/leaf. Orally, infusion.	Least concern

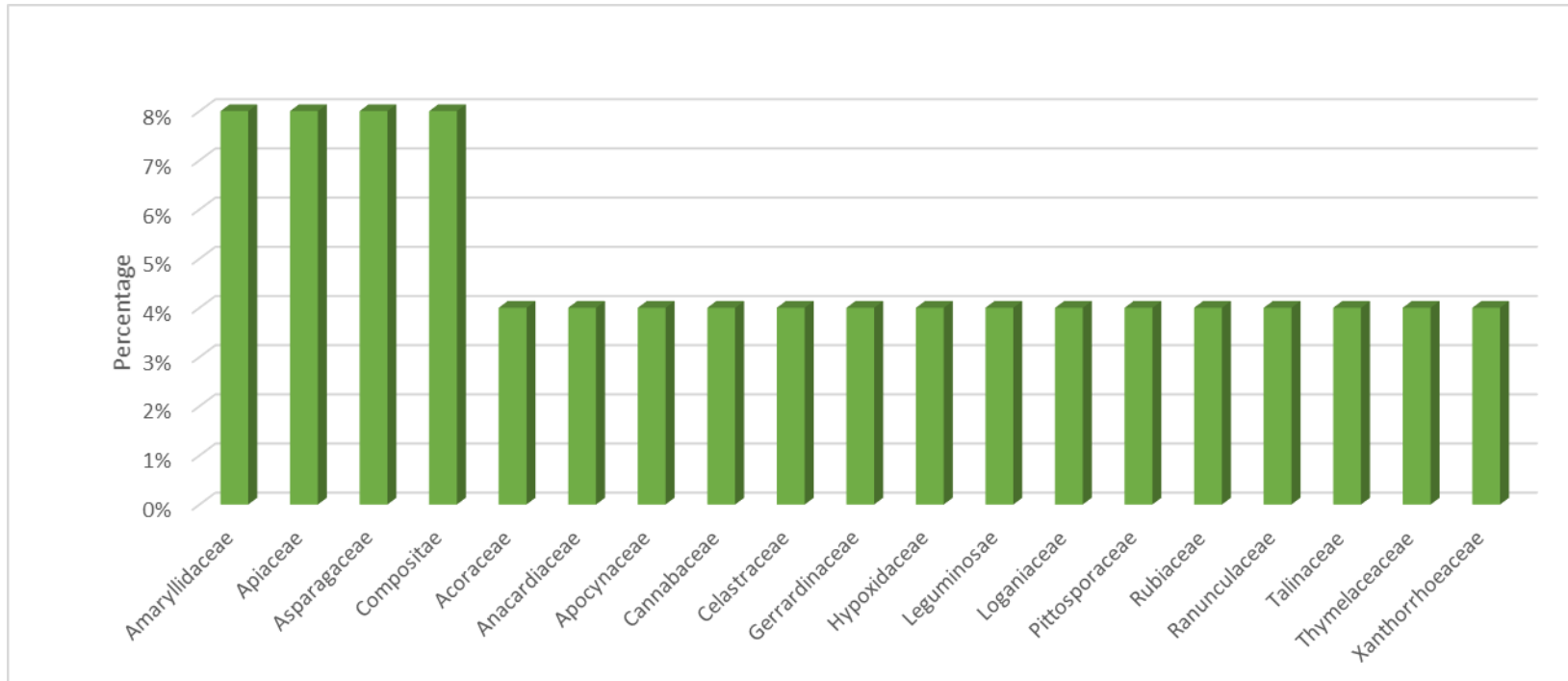


Figure 2: Family representation of plants used for traditional treatment of tuberculosis in the eastern region of O.R. Tambo District

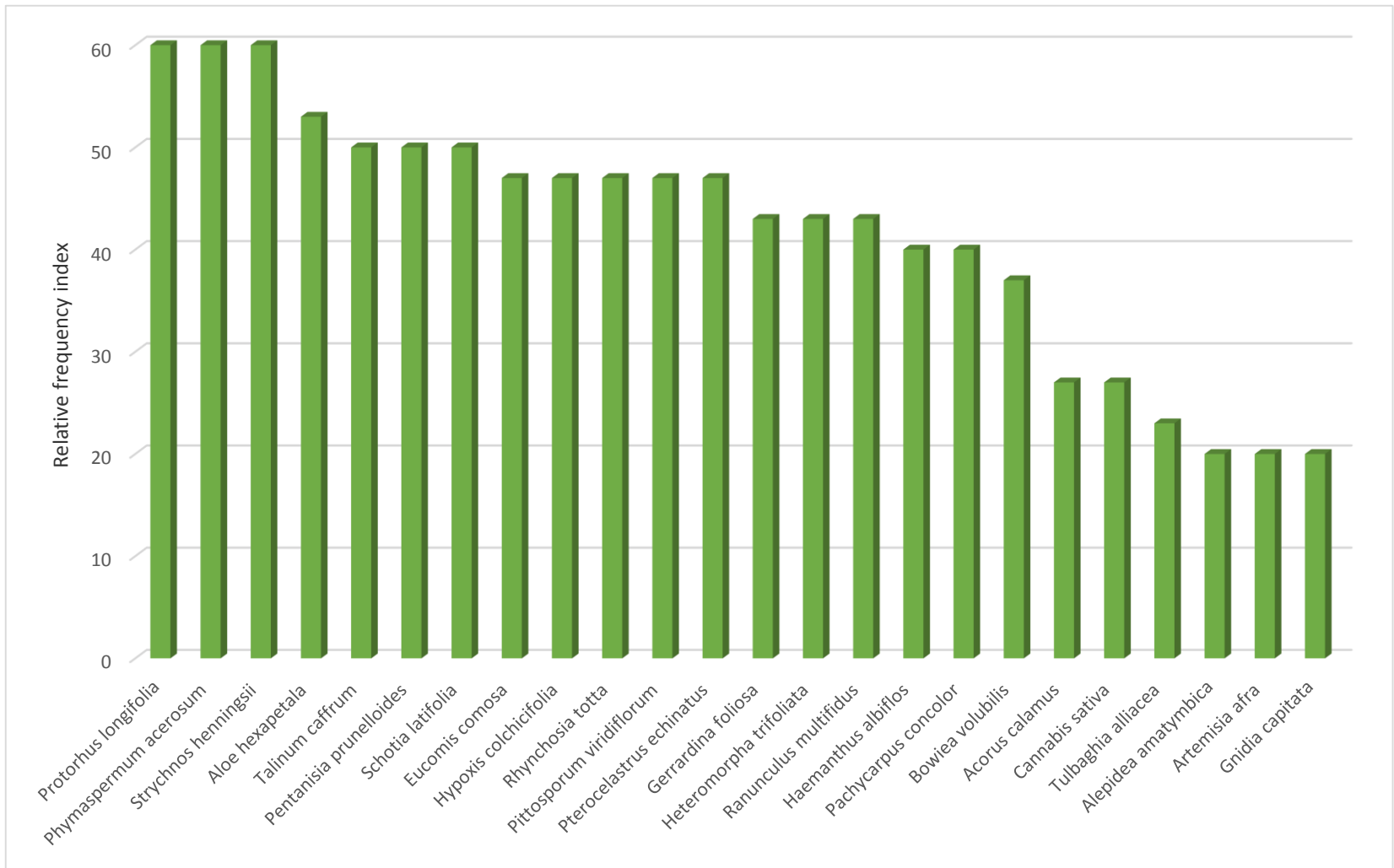


Figure 3: Relative frequency of citation of plant species used for traditionally treating tuberculosis in the eastern region of O.R. Tambo

longifolia, *Phymaspermum acerosum* and *Strychnos henningsii* (Fig. 3). According to our knowledge, this is the first report of the use of *P. longifolia*, *P. acerosum* and *S. henningsii* in the traditional treatment of TB. *Artemisia afra*, *Alepidea amatymbica* and *Gnidia capitata* were the least frequently mentioned plant species used for treating TB in this region, however these plants have been reported in several studies in South Africa for use as traditional anti-TB agents (Hutchings et al., 1996). The TMP mentioned that they collect most of the plants they use from the wild in remote areas, and buy some in muthi markets. This might explain the frequent use of some of the species as they may be easily accessible to these TMP.

A. afra, *H. albiflos*, and *C. sativa*, just as in our study, were mentioned in an ethnobotanical survey done in Nkonkobe municipal district, Eastern Cape as some of the plants used for traditionally treating TB in that region (Lawal et al., 2014). Hutchings et al. (1996) reported *A. afra* to be used in the traditional treatment of TB among the Zulu people, and the same plant was mentioned in an ethnobotanical survey in the Free State by Phungula et al. (2014). Similarly to the Xhosas in the Eastern Cape, the Bapedi people in the Sekhukhune and Waterberg districts, Limpopo province, were reported to use *C. sativa*, *A. afra*, *Eucomis* and *Hypoxis* species to traditionally treat TB (Semenya and Maroyi, 2013). *C. sativa*, *A. afra*, and different *Hypoxis* and *Tulbaghia* species from the ones mentioned in our study were reported to be used for traditional treatment of TB in Nkonkobe district, Eastern Cape (Lawal et al., 2014). *P. viridiflorum* (bark), *T. alliacea* (rhizome), *A. amatymbica* (rhizome/root), *H. trifoliata* (root/stem/bark/leaves), *A. afra* (leaf/root), *G. foliosa* (root/bark), *T. caffrum* (root), *R. multifidus* (leaf), and *P. echinatus* (bark) were reported for use in treating respiratory ailments such as colds, chest problems, influenza, and fever in South Africa (Mc Gaw et al., 2008; Bhat, 2014). Watt and Breyer-Brandwijk (1962) as well as Hutchings et al. (1996) reported the use of *P. prunelloides* (root) in the traditional treatment of TB by the Zulu people. In an ethnobotanical survey conducted in Lesotho, *P. prunelloides* was one of the most frequently mentioned plants; the roots and leaves of this plant were reported in that study for use against TB (Kose et al., 2015).

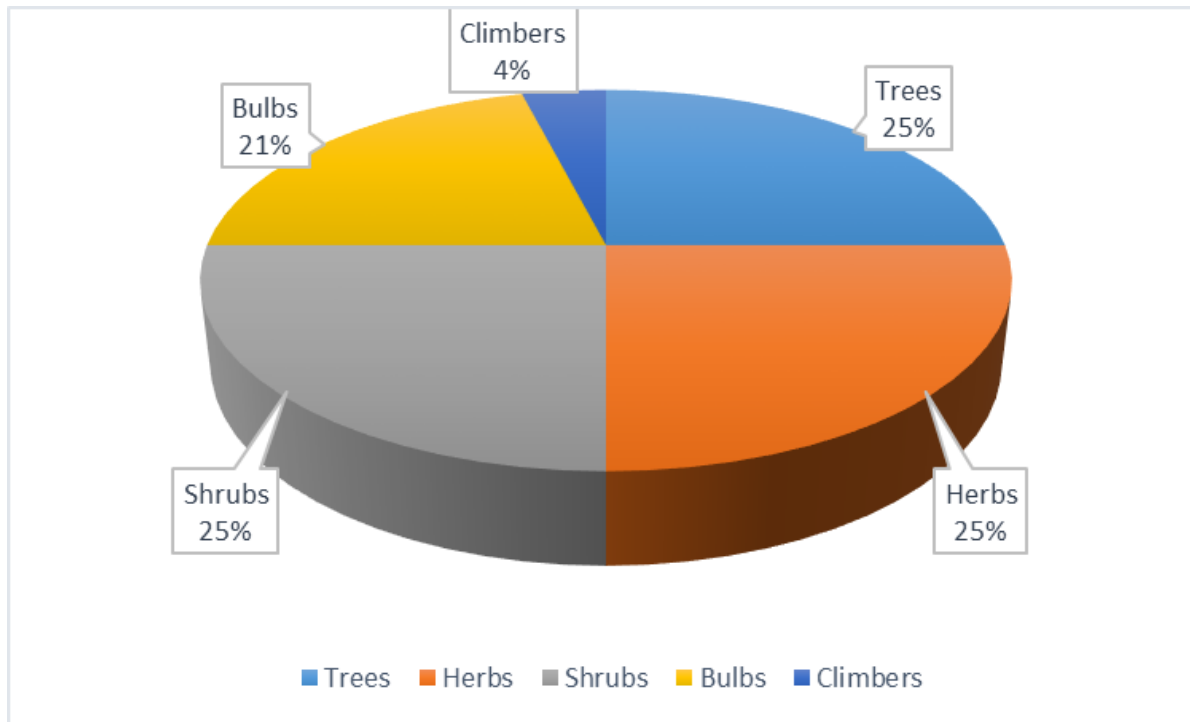


Figure 4: Growth forms of plant species used for traditionally treating tuberculosis in the eastern region of O.R. Tambo District

4.3. Growth forms, plant parts used, preparation and administration methods

Different growth forms of plants used for TB were revealed in this study; trees, herbs, and shrubs represented the largest proportion with 25% each (Fig. 4). The bulbs were represented by 21%, whereas the proportion of climbers was 4%. The recipes for treating TB were derived from different plant parts, and the most frequently used plant part was root (39%), followed by bark (21%) and bulbs (14%) (Fig. 5). Leaves, and rhizomes were cited for TB treatment in equal proportions constituting 11%, while tubers constituted 4%. The use of roots/bark/bulbs for therapeutic purpose for most of the plants mentioned in this study might result in some of the species becoming endangered in this region, and this poses a huge problem for those species that are endemic in the study area. However, according to the 2015 red data list, the conservation status of these plants in South Africa is that 18 of them are of least concern, three vulnerable, one declining and two have not yet been assessed. *A. amatymbica*, *P. concolor*, and *B. volubilis* were reported to be vulnerable, whereas *E. comosa* was reported to be declining. This is disturbing as the parts critical for survival of these plants are used for TB therapy in the study area, and thus it would be valuable to compare scientifically the antimycobacterial effect of the leaves with that of roots/bulbs/rhizomes. Surprisingly, *A. calamus* and *C. sativa* have not been assessed for their conservation status according to the 2015 Red Data list, but are reported to be used in traditional treatment of several respiratory ailments.

The indigenous TB remedy preparatory method included the use of single species or combinations of plants, and it varied from one traditional healer to another. The herbal remedies from all the plant species were made from either dried or fresh plant material. Preparation methods mentioned in this study were infusions (71%) and decoctions (29%). Eighty-three percent of TB remedies were prepared from single plant species. Only 17% of the plants were reported by the interviewees to be used in combination and those include *T. caffrum*, *G. foliosa*, *R. multifidus*, and *P. echinatus*. Methods of administration of the TB herbal medicine included oral (79%), rectal (8%) as well as both oral and rectal (8%) of the prescriptions to patients of TB, whereas inhalation of the medicine was involved in about 4%. The medicinal plant remedies that are used for treating TB patients

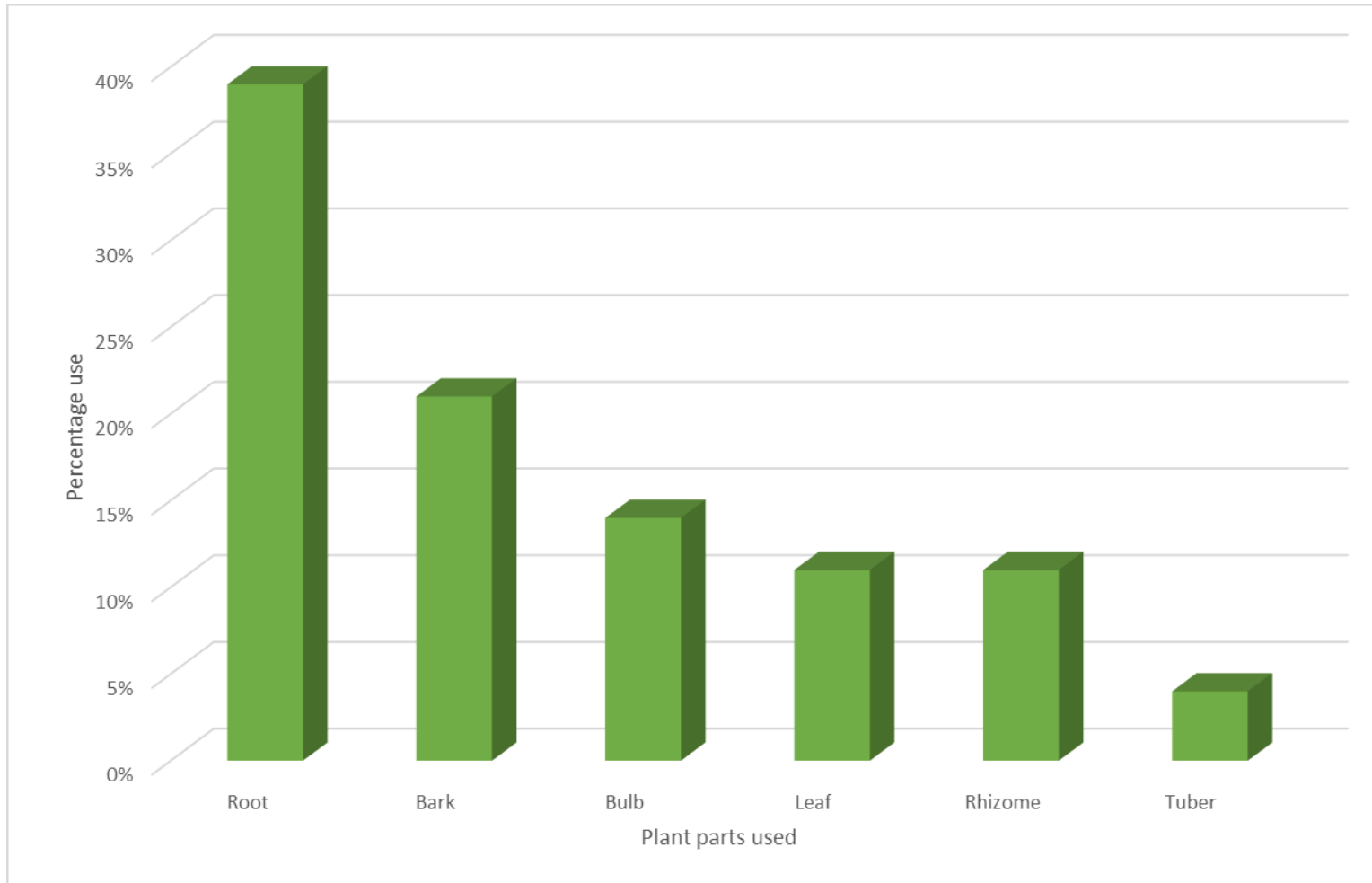


Figure 5: Percentage use of plant parts used in the eastern region of O.R. Tambo District for treating tuberculosis

were reported to be used by all age groups. Children were reported by the interviewees to be given half of what was dosed to adults. Adults were given one full cup of the medication three times a day, whereas the children were given half a cup three times a day.

5. Conclusion

The results of this investigation highlighted herbal medicines used in the treatment of TB by TMP of the eastern region of O.R. Tambo district. Three plant species frequently mentioned in this study were reported for the first time to be used in the treatment of TB; and those were *P. longifolia*, *P. acerosum* and *S. henningsii*. However, *A. afra*, *H. albiflos*, *C. sativa*, *P. prunelloides*, and species of *Eucomis*, *Tulbaghia* as well as *Hypoxis* have already been reported in several studies in South Africa to be used for treating TB. The results of this study may be used for further research on bioactivity screening of the plants that have not yet been evaluated pharmacologically, such as *T. caffrum*, *R. totta*, *G. foliosa*, *P. echinatus*, *P. acerosum*, and *P. concolor* against *Mycobacterium* species, pathogens that cause TB.

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