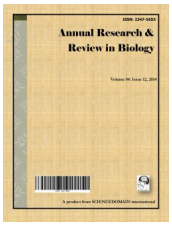

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A Review on Yellow Peeling Plane (*Brackenridgea zanguebarica* Oliv.): A Critically Endangered Endemic Plant Species

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Authors' contributions

This work was carried out in collaboration between all the authors. Author MAPT designed the study, performed literature review and wrote the first draft of the manuscript. Authors MPT and ETG managed the literature search and finalization of manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Brackenridgea zanguebarica Oliv. is among the most popular and frequently used tree species in Vhembe District, Limpopo Province of South Africa. However, the increasing illegal overexploitation coupled with the reproductive inefficiency have caused a severe depletion of this plant population bringing the species on the verge of extinction. *B. zanguebarica*, commonly known as "yellow peeling plane" and locally known as "Mutavhatsindi" is an important tree usually used both for medicinal and magico religious purposes in the region. This most sought after species is a critically endangered species with its distribution in South Africa restricted to Thengwe village in Vhembe District municipality. It is therefore crucial to develop various propagation protocols in order to increase the availability of this species and expand its distribution area in the region. Despite the

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risk of extinction and the multipurpose uses, there is a lack of scientific knowledge about many aspects of this plant species. This study revealed that mostly bark is being collected for medicinal use. The aim of the current study was to compile up-to-date scientific information about this critically endangered plant species to promote its conservation. In view of the importance of conservation of such a red-listed plant species, the present review focused on various aspects necessary in strengthening its conservation strategies.

Keywords: Brackenridgea zanguebarica; conservation; critically endangered plant; endemic plant; Vhembe District.

1. INTRODUCTION

Plants with medicinal properties have been used since thousands of years in many countries for the treatment of various ailments [1]. Medicinal plants have now gained large importance because of their efficacy, cultural acceptability, affordability and lesser side effects [2]. As many Africans, the majority of South Africans relies on medicinal plants for their primary health care and as a source of income.

Brackenridgea zanguebarica Oliv., which belongs to Ochnaceae family is one of the most sought-after plant by traditional healers in the Limpopo Province (South Africa). The plant is locally known as "Mutavhatsindi" and is endemic to Thengwe area in Vhembe District of Limpopo Province (Fig. 1). The plant is overexploited for magico religious purposes by Vhavenda [3]. There is immense need to standardize sustainable harvesting methods of this plant so that natural populations of this species remain stable.

Being medicinally as well as magico religious *B. zanguebarica* is traded in many traditional medicine shops or "muthi shops" around the province. It is valued for its bark and root, which are always collected from the wild. These plant parts are used in the treatment of several ailments such as amenorrhea, conjunctivitis, jaundice, anaemia, wounds, diarrhea, venereal diseases and other ailments [4,5,6]. Some findings revealed that the bark has a strong antibacterial activity against Gram-positive strains and various phytochemical constituents like calodenin B have been isolated from the species [5]. The increasing harvesting of *B. zanguebarica* for medicinal and magical purposes coupled with its poor natural regeneration ability and its poor conservation strategies in the reserve; pose a serious threat to the future availability of this endemic plant in the region. Due to its overexploitation, natural populations are getting depleted at alarming rate with high risk of extinction in the wild [7]. *B. zanguebarica* has been listed as Critically Endangered plant by the International Union for the Conservation of Nature (IUCN) [8].

Literature review showed that, there are numerous threatened medicinal plant species in South Africa and *B. zanguebarica* is one of them which is listed in the South African Red List of Plants Species [8]. However, there is little published information available about this multipurpose plant. Scientific information of this plant in the areas of taxonomy, description, distribution, traditional uses, phytochemistry, pharmacology, population status, propagation and conservation is scanty. To fulfill this gap as well as to highlight the importance of this plant by making people aware about its conservation this attempt has been made. The conservation of this plant is essential in maintaining the biodiversity of the region, because the removal of a single species can affect the functioning of global ecosystems [9].

2. TAXONOMIC DISTRIBUTION AND DESCRIPTION OF BRACKENRIDGEA ZANGUEBERICA

2.1 Distribution and Habitat

B. zanguebarica is distributed in eastern Africa including Kenya and Tanzania. In southern Africa, it occurs in the northern side of Mozambique, eastern part of Zimbabwe, northern part of South Africa [10] and in some parts of Zambia. It can also be found in Madagascar. In South Africa, the species has a narrow distribution and occurs only at Thengwe area in Vhembe District [3]. This indigenous species is reported to be endemic to Vhembe District (Fig. 1). The area is semi-arid with summers from October to March and winters from April to September [11]. The mean annual rainfall is 688 mm and annual mean temperature range between 16 - 26.5°C. Naturally, this plant grows in stony, light gray and sandy loam soil at low altitude in open woodland, deciduous woodland and coastal bush [12].

2.2 Description of the Species

B. zanguebarica is a plant species belonging to the Ochnaceae family. This is a family of 30 genera and 250 species worldwide [13]. The genus Brackenridgea to which *B. zanguebarica* belongs comprises of 12 species distributed in Africa, Madagascar, Malaysia to Australia [14].

B. zanguebarica is a shrub or small deciduous tree growing up to 10 m high at maturity (Fig. 2). It has very rough and corky dark gray to black bark. The scratching of the bark shows the yellow pigment beneath it. The leaves are variable in shape and size, elliptic to obovate, about 4-5 cm long, glossy dark green and hairless, lateral veins fine and numerous; margin with very fine, gland-tipped teeth [10]. The attractive flowers are whitish or pinkish and very ephemeral. The fruits of this species are ovoid drupes indehiscent and greenish when unripe and then turn black when mature. The fleshy outer layer attracts the attention of animals, especially birds as a food. The fruits contain a single seed which is very hard to separate from the pulp when dry. The seeds are small and pale brown in color. *B. zanguebarica* regenerates by coppice, which according to [15] is a significant regeneration strategy to conserve viable populations of several threatened plant species.

3. TRADITIONAL USES

B. zanguebarica is medicinally used in many countries for treatment of various diseases. In Africa, the species has been used as a traditional African remedy to treat various ailments. A study by Neuwinger [4] documented that the bark of *B. zanguebarica* could be used in the treatment of wounds, conjunctivitis and jaundice. In East Africa, it is used in the treatment of anaemia, swollen ankles, amenorrhoea, worms and mental illness [5]. In Mozambique, root and bark macerated in water are used to speed the delivery process, treatment of miscarriage, diarrhea, venereal diseases and wounds [6]. Bruschi et al. [6] also reported that the root or bark is used to protect against adversities. In Tanzania, the vapors of boiled stem bark are used in the treatment of conjunctivitis [16]. In Limpopo Province of South Africa, this multipurpose tree is one of the most used medicinal tree species [10]. Steenkamp [17], revealed that some traditional healers in South Africa used *B. zanguebarica* to treat gynecological disorders and the root is useful in the treatment of Amenorrhoea. For many years, the Vhavenda have been using the plant mainly for magico religious purposes as protection against witchcraft, adversities and all sorts of evil [18,3]. It is also reported to bring a person luck in a relationship or business.

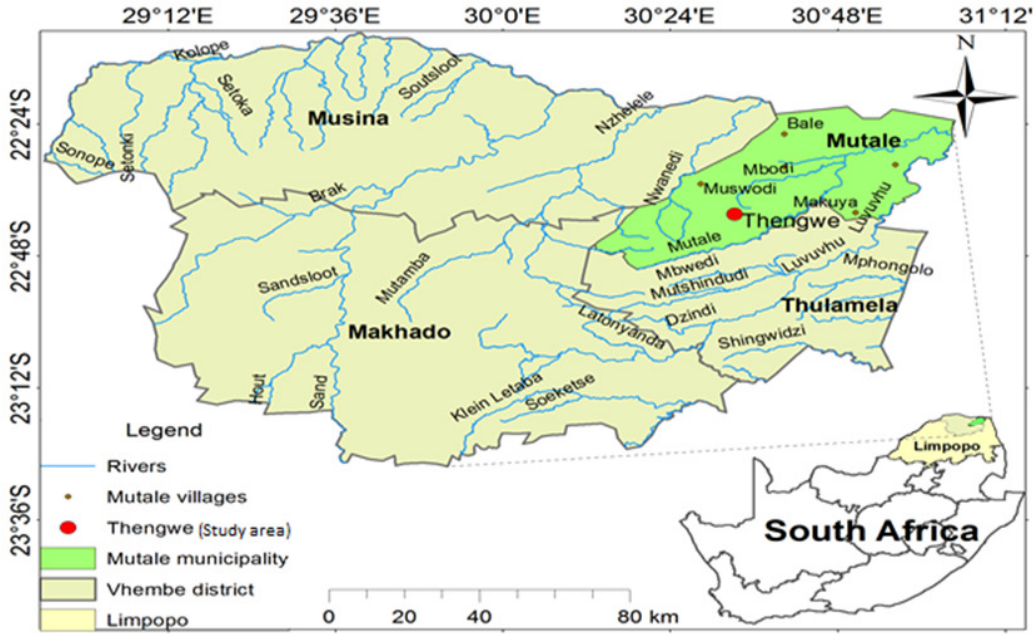

Fig. 1. Map showing the distribution of *B. zanguebarica* Oliv. within Thengwe village in Vhembe District, Limpopo Province, South Africa

Based on this review it has been noted that in many countries the most frequently collected parts of *B. zanguebarica* are the root and bark used in the treatment of various ailments. The species seems to be more efficient in the treatment of wounds, amenorrhoea, and conjunctivitis. It has been reported by most authors that this plant species is not only used for its medicinal importance but also for its highly magical significance. It is reported to protect people and properties against adversities in Mozambique and South Africa [6,3].

Fig. 2. Standing *B. zangueberica* tree in the reserve

4. PHYTOCHEMICALS STUDIES

Phytochemicals are non-nutritive plant chemicals that occur naturally and have protective or disease preventive properties. Some phytochemicals isolated from *B. zanguebarica* contain various chemical compounds that are responsible for its biological activity. Möller et al. [5] reported several phytochemicals from the bark of *B. zanguebarica* like tannins, brackenin, calodenin B, flavonoids, isochamaejasmin and a derivative of isoswertisin. The same author showed brackenin, calodenin B, isochamaejasmin as the important compounds isolated from the dry bark of *B. zanguebarica*. The chemical structures of the major compounds are shown in Fig. 3. Intensive phytochemical studies have revealed the Ochnaceae family as an important source of biflavonoids which is well represented in some genera such as Lophira, *Luxemburgia, Ochna, Ouratea* than others [19,20].

Brackenin is an uncommon biflavonoid consisting of two α, and α'-coupled dihydrochalcones which is naturally the only existing compound in this class [18]. It is a new dimeric dihydrochalcone isolated from the stem bark and root of *B. zanguebarica* that has been shown to consist of two dihydroisoliquiritigen [21].

Calodenin B is an isometric biflavonoid isolated from stem bark of *B. zanguebarica*. Ponnapali et al. [18] extracted the calodenin B from the powdered stem bark of *Ochna afzelii* R Br. which is one of the members of Ochnaceae family.

Isochamaejasmin is a biflavonoid that consists of two units of 5,7,4'-trihydroxyflavanone joined together at position 3 and 3''. The stem bark of *B. zanguebarica* has been found to contain the biflavonoid isochamaejasmin [5]. Reddy et al. [22] extracted this compound from the stem bark of *Ochna lanceolata* Spreng.

These major compounds extracted from the bark, root and stem of *B. zanguebarica* confirmed the presence of this molecule in the members of Ochnaceae family. Most of these compounds have been isolated from the bark of the species of this family. Therefore there is a significant need to investigate the presence of biflavonoids in all parts of this plant. Although, the two main compounds of *B. zanguebarica* such as Calodenin B and Isochamaejasmin are found in other genera of the Ochnaceae family, it has been noticed through this review that Brackenin is found only in Brackenridgea genus.

5. PHARMACOLOGICAL STUDIES

Pharmacological studies on *B. zanguebarica* have shown a range of biological activities. Some research has confirmed the potential of *B. zanguebarica* used by traditional healers for curing and relieving many diseases. After investigation, this plant has revealed some biological activities such as antibacterial, antiviral, antiproliferative, antifungal and antitumor activities [5]. However, there is lack of information regarding their specific mode of administration and action.

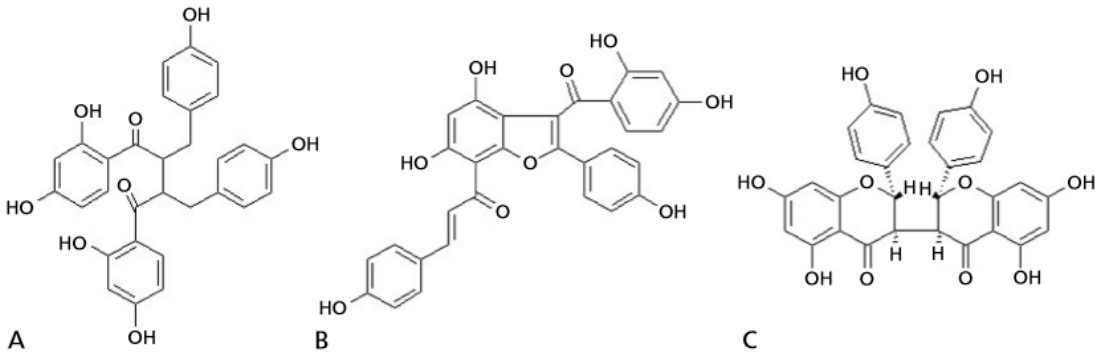

Fig. 3. Chemical Structures of major compounds occurring in *B. zanguebarica* (A: Brackenin, B: Calodenin B, C: Isochamaejasmin)

5.1 Antibacterial Activity

Möller et al. [5] showed a significant antibacterial activity of the ethanolic bark extracts of *B. zanguebarica* that were tested by using a minimum inhibitory concentration (MIC) method against eleven pathogenic bacterial strains of which seven were Gram-positive (*Staphylococcus aureus*, *Staphylococus epidermidis*, *Staphylococcus saprophyticus*, *Enterococcus faecalis*, *Enterococcus faecium*, *Streptococcus pyogenes,* methicillin resistant *S. aureus*) and four were Gram-negative (*Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Proteus mirabilis*). Steenkamp et al. [23] studied the antibacterial activity of *B. zanguebarica* on selected strains (*S. aureus*, *S. epidermidis, P. aeruginosa, E. coli*) and the extracts showed activity against the Gram-positive. These results support the use of *B. zanguebarica* in treating bacterial diseases. Crude methanol and water extract of the root have been evaluated and the research claims that none of the extracts showed activity against the Gram-negative organisms whereas, the tested root revealed a high antibacterial effect against Gram-positive organisms [23]. The pharmacological effects of *B. zanguebarica* have been fairly investigated. Bark extracted in ethanol and root extracted in water and methanol showed antibacterial activity against Gram-positive bacterial strains. The acetone leaf extracts of three *Ochna* species investigated such as *O. pretoriensis, O. gamostigmata* and *O. pulchra* showed significant antibacterial activity based on their MIC against *E. coli* and *E. faecalis* [24]. All these results suggest further studies using all the plant parts of *B. zanguebarica* with different solvents in different concentrations.

5.2 Antiviral Activity

Considering the high prevalence of viral infections without specific treatment and the constant appearance of resistant viral strains, the development of new antiviral agents is necessary [25]. The yellow bark used for the preparation of an ethanolic extract of *B. zanguebarica* was tested for antiviral activity against Herpes simplex virus type 1 (HSV-1) and it was found that the ethanolic extract from the bark had effectively a strong antiviral activity against free HSV-1 [5]. Some members of the Ochnaceae family such as *Ouratea castaneafolia*, *O. spectabilis*, *O. castaneafolia* and *O. semisrrata* have shown activity against selected viruses assayed namely HSV-1, vaccinia virus and murine encephalomyocarditis virus and *O. spectabilis* and *O. semiserrata* were the most active against HSV-1 [26]. Thus, the presence of antiviral constituents from some genera of the Ochanaceae family against various viruses should be an opportunity to further studies on *B. zanguebarica* in order to test the potential of its antiviral activity against various viruses.

5.3 Antifungal Activity

Steenkamp et al. [23] evaluated the antifungal activity of *B. zanguebarica* against *Candida albicans* and the aqueous extract of this medicinal tree species inhibited *C. albicans* growth, while the methanol extracts were ineffective. However, the authors did not reveal the plant part extracts for the antifungal activity. Few studies investigated the antifungal properties of this plant species. However, Araújo et al. [27] evaluated the antifungal activity of extracts from *Ouratea hexasperma* and O. *parviflora* on *C. albicans* and the results obtained

from *O. hexasperma* with the ethyl acetate extract of the roots and n-butanol extract of the leaves exhibited a higher antifungal activity. These results from some members of Ochnaceae family could be helpful to investigate different plant parts of *B. zanguebarica* with various solvent for antifungal activities.

The pharmacological review of this plant species presented an interesting potential of biological activities against bacteria, viruses and fungi. However, very few studies have been carried out to explore deeply the biological activities of this species. Therefore, more studies are necessary to investigate the biological activity of other compounds occurring in the plant part extracts.

6. POPULATION STATUS

The current population size of *B. zanguebarica* is very small, although this species is known to have been more abundant until recently. Todd et al. [28] reported that uncontrolled harvesting of this species has been high, leading to an 86% decline in density from 140 trees/ha in 1990, to 25 trees/ha in 1997. The plant has been intensively collected from the wild due to its highly medicinal and magico religious properties. The bark of this species is often removed from almost the entire stem in different diameter size classes (Fig. 4A and 4B) and sometimes the tree is cut off (Fig. 4C), leading to its mortality. Todd et al. [28] stated that 100% of trees sampled outside the Brackenridgea Nature Reserve (BNR) had been debarked and their roots removed while, inside the reserve, 74% of trees showed evidence of harvesting, and of this 35% were dead. However, Tshisikhawe and Van Rooyen [3] assessed the harvesting impact of this species in BNR and recorded stem bark regeneration. Although the extent to which the bark is collected is well known, the same cannot be said for the duration the bark of this plant takes to regenerate because no studies have been done on this matter. *B. zanguebarica* has a poor seed germination and has become increasingly threatened throughout its range.

Harvesting has to a lesser extent altered the population structure outside the reserve as well as within the reserve [12]. The numbers of individuals have fluctuated over time and the remaining population within the reserve is not a guarantee for the survival of this species. Therefore more population studies are needed to understand trends of this plant in order to formulate a management plan and conservation measures to maintain this dwindling endemic species. Due to its overexploitation and its extreme rarity, *B. zanguebarica* is Red-Listed as Critically Endangered plant species [8].

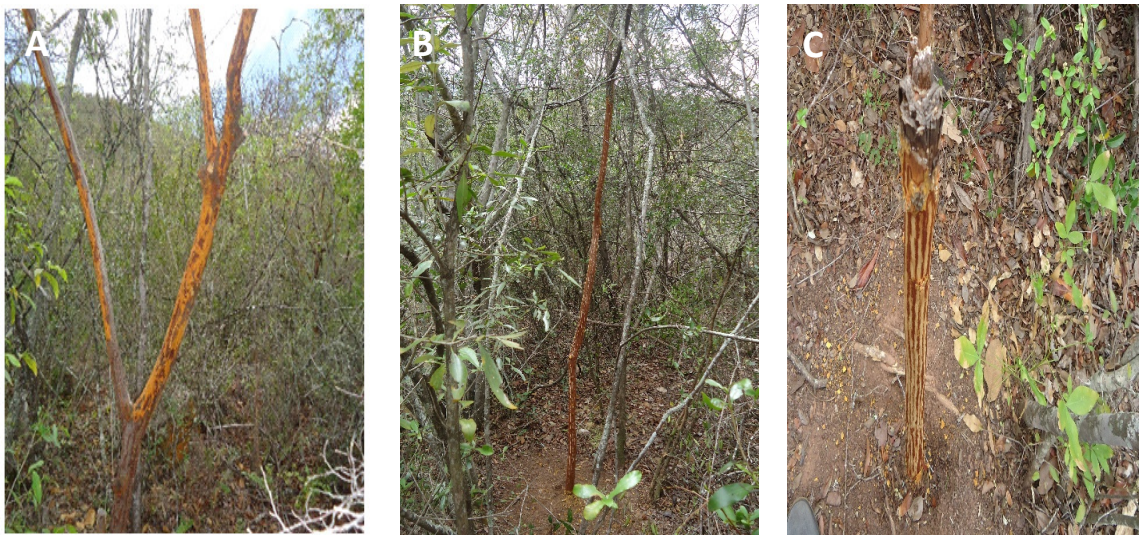

Fig. 4. *Brackenridgea zanguebarica* **tree stripped for bark from almost the entire stem in different growth stage: (A) Adult, (B) Juvenile (C) Stem cut off**

7. PROPAGATION

Both sexual and asexual propagation is poorly known in *B. zanguebarica*. Although to date, the artificial propagation of this tree seems to be unsuccessful, the regeneration of this plant under natural condition is also very challenging [3].

The germination of seeds under natural condition is unpredictable and very slow. Seeds are very difficult to germinate in the wild and this poor germination appears to be due to the presence of parasites affecting them. However, seeds of other plants species in the Ochnaceae family germinate very readily [10]. As fallen seeds are often parasitized leading to low viability, freshly mature seed should be collected from the standing trees and several methods of pre-treatment must be used to overcome the dormancy of *B. zanguebarica* seeds. Asexual propagation of this species is still unknown in practice. To date, studies have not indicated any research effort concerning the vegetative propagation of this medicinal tree. Since propagating of *B. zanguebarica* has been very difficult, a review of several successful methods of propagating many medicinal plants could potentially be helpful to gain insight on how to propagate *B. zanguebarica*.

Successful seed propagation techniques of many plants producing drupe fruits have been documented. [29,30], respectively found that to achieve best results, *Ochna pretoriensis* E.Phillips and *Ochna serrulata* Walp. fruit should be cleaned to get rid of the pulp and be sown as quickly as possible. A light scarification with hot water or acid treatment would aid rapid germination of *Ochna natalitia* Walp. [31]. Lilabati and Sahoo [32] reported that pre-treatments such as scarification, stratification, gibberellic acid, hot water on seed extracted from the drupe fruit of *Emblica officinalis* Gaertn (Euphorbiaceae) were used to overcome seed dormancy and improve seedling vigour.

As an alternative to overcome seed viability problems and slow seedlings growth, various vegetative propagation methods can be used. But, with restricted distribution and a small population of this plant, micropropagation methods can be an excellent alternative for conservation of *B. zanguebarica* because small pieces of plant material can be used for mass propagation without damage to the donor plant. Various endangered plants have been successfully propagated using *in vitro* mass propagation methods. The application of tissue culture methods for improving large-scale propagation of many medicinal trees has been demonstrated by several authors. The review by Afolayan and Adebola [33] reported micropropagation protocols for some medicinal plants of South Africa and highlighted the need of using this method for the mass propagation of over-used medicinal plants. During our field work, we observed that *B. zanguebarica* has the potential to regenerate from axillary buds (coppice shoot) which according to Upadhaya et al. [15] is a significant regeneration strategy to conserve a viable population of plant species.

8. CONSERVATION AND SUSTAINABLE USE

According to the findings of many researchers, various sets of recommendations relating to the conservation of medicinal plants have been developed, such as *in-situ* and *ex-situ* conservation [34]. However, as stated by Sutherland [35], the number of wild plant species necessitating specific conservation methods is so large to include all of them in conservation plans. According to Hamilton [36], several actions must be considered in favor of the conservation and sustainable use of medicinal plants in order to benefit continuously from the natural resource. A combination of indigenous and modern knowledge can be a fundamental starting point in any conservation strategy. Medicinal plants with limited distribution, small population, destructive harvesting and poor germination like *B. zanguebarica* generally resulted in species extinction. Therefore, the conservation and sustainable use of this species could be effective through a combination of indigenous and modern knowledge systems. Both approaches follow the same purpose which is to enable this plant species to maintain itself within the context of the ecosystem in which it naturally occurs.

Mathibela [37] revealed the importance of indigenous knowledge as a conservation strategy by emphasizing on the traditional management practices or rituals that promote sustainable resource use. According to Kambizi and Afolayan [38], the management of plants with medicinal properties in the Guruve district of Zimbabwe has been facilitated by several inadvertent or indirect controls. Taboos, seasonal and social restrictions have all helped reduce the harvesting of medicinal plants in the area [38].

Mutshinyalo [10] reported a large number of myths related to the use of *B. zanguebarica*.

After the collection of plant materials for medicinal or magical purposes, it is prohibited to take them to the house or be touched by women because they may hamper menstruation. Either a young virgin or an old member of the Vhatavhatsindi clan who is no longer sexually active collect the plant for medicinal or magical purposes [3]. This is because plant can make any sexually active collector become sterile. All these traditional strategies served to limit medicinal plant harvesting and improve or promote plant conservation.

Despite these indigenous knowledge practices related to conservation of medicinal plant species, there are a few studies investigating traditionally concerning endangered, rare and threatened medicinal plants and how they could be integrated into conservation strategies. However, numerous published papers showed several policies, plans, acts and laws that have been put together to fill some gaps in traditional knowledge and to control overharvesting of natural resources.

South Africa has done extensive work to conserve plants, including protected areas, nature reserves, parks and Botanical gardens. However, despite this intensive work and regulation towards conservation, it is still difficult to prevent local people from overexploitation of the plants around them. The Brackenridgea Nature Reserve (BNR) was established in 1987 as a strategy to protect the population of *B. zanguebarica*. It is now classified as a critically endangered medicinal tree in the Red List of South Africa by the IUCN [8]. But, this enforcement is still inadequate and has been shown by human activities that greatly threatened the population of this plant outside the reserve as well as within the reserve. It is now necessary to use various customary conservation practices such as taboos, religious values to protect some threatened plants species. These approaches of conserving biodiversity depending on cultural and religious beliefs are usually much more reliable than those relying only on the statutory regulation. A combination of all these approaches is needed to conserve this endemic medicinal tree species. If endemic plants are not protected, they may become extinct. The conservation status of some protected medicinal plant species in the Limpopo Province is reviewed and presented in Table 1 and summarized in Fig. 5 in terms of the number of plant species in different conservation categories in the province.

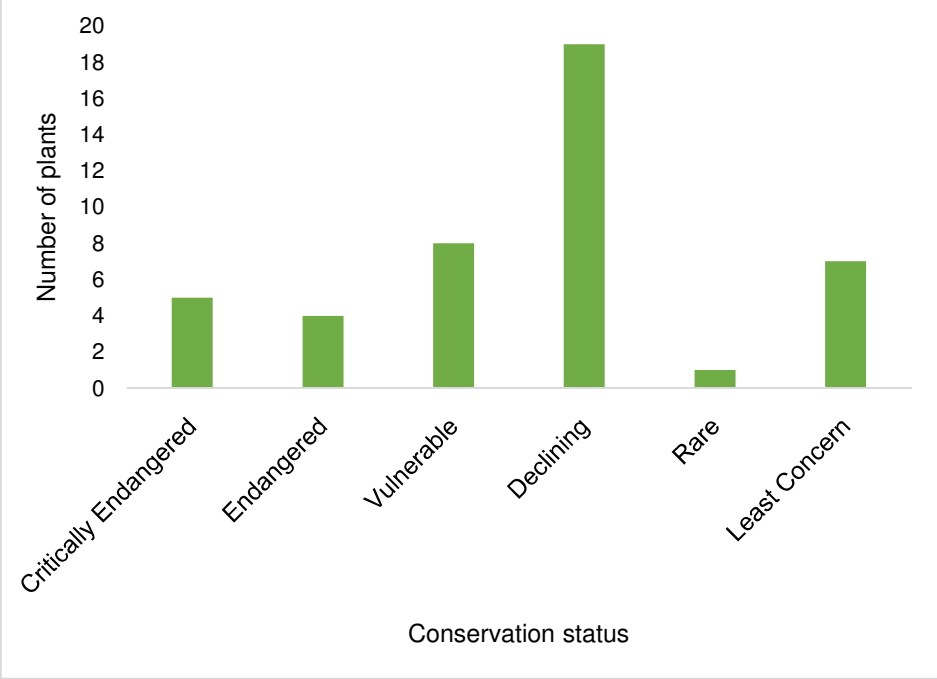

Fig. 5. Number of plant species in different conservation categories in Limpopo Province

Table 1. Conservation status of some red listed medicinal plants species in Limpopo Province [39]

Conservation category	Plants species	English common name	Habit	Part harvested	Family
Critically Endangered	*Brackenridgea zanguebarica*	Yellow peeling plane	Tree	Roots, Bark	Ochnaceae
	Encephalartos dolomiticus	Wolkberg Cycad	Tree	Roots, Corms	Zamiaceae
	Encephalartos hirsutus	Venda Cycad	Tree	Roots, Corms	Zamiaceae
	Encephalartos laevifolius	Kaapsehoop cycad	Tree	Roots, Corms	Zamiaceae
	Siphonochilus aethiopicus	Natal ginger	Herb	Roots, Rhizomes,	Zingiberaceae
Endangered	*Encephalartos eugene-marais*	Waterberg cycad	Tree	Roots, Corms	Zamiaceae
	Mondia whitei	White's ginger, tonic root	Herb	Roots, leaves	Apocynaceae
	Ocotea bullata	Black-stinkwood, Cape laurel	Tree	Bark	Lauraceae
	Warburgia salutaris	Pepper-bark tree	Tree	Root-bark, stems	Canellaceae
Vulnerable	*Alepidea amatymbica*	Giant alepidea, larger tinsel flower	Herb	Rhizomes	Apiaceae
	Bowiea volubilis	Climbing Green Lily, Climbing Onion	Herb	Bulbs	Hyacinthaceae
	Ceropegia cimiciodora	Parasol flower	Herb		Asclepiadaceae
	Cucumis humifructus	Aardvark pumpkin	Herb	Fruit	Cucurbitaceae
	Dioscorea sylvatica	Forest Elephant's Foot	Herb	Bulbs	Dioscoreaceae
	Ocotea kenyensis	Bastard stinkwood	Tree	Bark	Lauraceae
	Prunus africana	Red stinkwood	Tree	Bark	Rosaceae
	Rhynchosia vendae		Herb		Fabaceae
Near Threatened	*Adenia fruticosa*	Green-stem	Herb	Bulbs	Passifloraceae
	Clivia caulescens	Stem clivia	Herb	Bulbs	Amaryllidaceae
	Curtisia dentata	Assegai	Tree	Bark	Curtisiaceae
	Drimia sanguinea	Rooislangkop	Herb	Bulbs	Hyacinthaceae
	Elaeodendron transvaalense	bushveld saffron	Tree	Bark	Celastraceae
	Gasteria batesiana	knoppies-beestong	Herb	Leaves	Asphodelaceae
	Lithops lesliei	Living stones , Stone plants	Herb		Aizoaceae
Declining	*Adenia gummifera*	Monkey Rope, Snake-climber	Herb	Roots	Passifloraceae
	Aloe cooperi	Cooper's aloe	Herb	Leaves	Asphodelaceae
	Ansellia africana	leopard orchid	Herb	Bulbs	Orchidaceae
	Balanites maughamii	Green Thorn, Torch Wood, Torch-fruit Tree	Tree	Roots and bark	Zygophyllaceae
	Boophone disticha	century plant, poison bulb, sore-eye flower	Herb	Fresh leaves	Amaryllidaceae
	Callilepis leptophylla	Wild Daisy	Herb		Asteraceae

Conservation category	Plants species	English common name	Habit	Part harvested	Family
	Cassipourea malosana	Onionwood	Tree	Bark	Rhizophoraceae
	Crinum macowanii	river crinum, river lily	Herb	Leaves, bulbs	Amaryllidaceae
	Crinum stuhlmannii	Candy-striped crinum	Herb	Bulbs	Amaryllidaceae
	Cryptocarya transvaalensis	Mountain Wild-Quince	Tree	Bark	Lauraceae
	Drimia altissima	Tall White Squill	Herb	Bulbs	Hyacinthaceae
	Elaeodendron croceum	saffron; saffron wood, forest saffron	Tree		Celastraceae
	Eucomis autumnalis	pineapple flower, pineapple lily	Herb	Bulbs	Hyacinthaceae
	Eulophia speciosa	Large Yellow Eulophia	Herb		Orchidaceae
	Gunnera perpensa	Pumpkin, Wild Rhubarb	Herb	Roots	Gunneraceae
	Hypoxis hemerocallidea	Star-flower, Yellow Star	Herb	Roots	Hypoxidaceae
	Ilex mitis	African holly, wild holly, water tree	Tree		Aquifoliaceae
	Pterocelastrus rostratus	Red Candlewood, White Pear	Tree	Barks	Celastraceae
	Rapanea melanophloeos	Cape Beech,	Tree	Roots, barks	Myrsinaceae
Rare	*Euphorbia sekukuniensis*	Sekhukhune Candelabra Tree	Tree		Euphorbiaceae
Least Concern	*Alsophila capensis*	Cape Tree Fern, Forest Tree Fern	Tree		Cyatheaceae
	Boscia albitrunca	Shepherd's tree	Tree	Roots, Leaves and Fruits	Capparaceae
	Capparis sepiaria	Wild caper bush	Shrub	Roots, Bark	Capparaceae
	Catha edulis	Bushman's tea	Tree	Leaves, Bark and Roots	
	Encephalartos transvenosus	Modjadji cycad	Tree	Roots, Bark and Leaves	Zamiaceae
	Pittosporum viridiflorum	Cheesewood	Tree	Roots, Stem-bark	Pittosporaceae
	Securidaca longepedunculata	Violet tree	Tree	Root-bark	Polygalaceae

9. CONCLUSION

B. zanguebarica an indigenous and endemic plant to Thengwe village in Vhembe District municipality, popularly known and well reputed for its medicinal and magical properties is critically endangered according to the listing of the IUCN. Review of literature revealed the frequent traditional uses and a variety of biological activities found in this plant have built a heavy pressure on the remaining population of this plant in the reserve. Considering the restricted distribution of *B. zanguebarica* in South Africa as well as throughout Africa, the species has received less attention and a few scattered studies have been conducted by researchers. However, most of the studies have been directed to the medicinal aspects of this plant. But, there are still many important challenges that need to be overcome in order to discover new potent compounds and further investigations for the biological activities of this plant species. This review summarized for the first time some aspects of *B. zanguebarica* so that this information gather together in one place can be used as a guide to understand the present situation of this species. Therefore, there is significant necessity to continue doing research in various aspect of this species. Knowledge on the reproduction biology of this endemic plant species is strongly needed, because the availability of such information is crucial to develop a significant conservation strategy.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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