

# Pharmacological Potential, Botany, Biological and Chemical Properties of *Albuca setosa* (Asparagaceae) Endemic to Southern Africa

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**Abstract:** *Albuca setosa* is a flowering bulb in the Asparagaceae family, endemic to southern Africa, thrives well on rocky ground, flats and mountain slopes. This review is an appraisal of the current information on *A. setosa* and a systematic and comprehensive literature search was conducted using electronic scientific journal articles, books and theses. The bulbous plant is extensively used for medicinal purposes, cultural purposes and to end quarrels between enemies. In the framework of the taxonomic revision of *Albuca*, a complete description of *A. setosa* and data on cytology, morphology, ecology and distribution and economic importance are discussed. Pharmacological screening showed that *A. setosa* possesses some anti-ulcerogenic, anti-inflammatory and antimicrobial properties. The bulbous plant is used for the treatment of wounds, articulation problems, rheumatoid arthritis, digestive disorder and venereal diseases.

**Keywords:** *Albuca setosa*, Asparagaceae, cultural practices, herbal medicine, South Africa.

## INTRODUCTION

The genus *Albuca* L. is a monophyletic group of approximately 160 species [1]. However, Manning *et al.* [2] treated *Albuca* in a broad sense, together with *Stellarioides* Medikus, *Coilonox* Rafinesque, *Trimelopter* Rafinesque and *Battandiera* Maire based on their shared somewhat fleshy tepals with a darker longitudinal band that is associated with 3-5 medially aggregated veins [1]. All of these genera, including *Albuca*, have also been lumped together in genus *Ornithogalum* L. at times, but molecular phylogenetics studies support their separation [1]. The genus *Albuca* is characterized by “*petalis alternis patentibus, interioribus erectis*”, differing from *Ornithogalum* which had equal and dispersed tepals. This distinct flower structure was accepted by most of the recent authors to recognize *Albuca* as a different genus. *Albuca*, as traditionally circumscribed, is monophyletic and can be easily accepted as a genus of its own, remaining as an intuitive unit, well characterized morphologically, and therefore easy to understand for users [1].

*Albuca* are perennial herbs growing from bulbs with a stem sheathed in leaves with linear to strap-shaped blades [3]. They can be 0.8 m to 1.0 m in height and are flat or keeled. They are generally fleshy and sappy

with a mucilaginous juice that inspired the common name “slime lilies” [3]. The genus has flowers which are borne in racemes. They are usually slender having six free tepals which are persistent after flowering and the inner tepals are also cucullate and connivant [4]. The flowers of some species are scented, flat-topped, may be on stiff or slender, nodding stalks, [3], held erect or drooping. *Albuca* genus has flattened or filiform stamen-filaments, oblong and freely moving anthers that wrap around the three-celled multi-ovulate ovary and a triquetrous or filiform style with a usually three-lobed stigma [4]. Some *Albuca* species consist of six fertile stamens, and in others the outer stamens are staminodes which do not produce pollen [5]. *Albuca* tepals (six) are white, green or yellow and may have a broad keel which is green or reddish-brown and their inflorescence is a cylindrical or corymbose raceme [4]. The outer three tepals spread open while the inner three are connivant, curving inward so that the tips meet [5]. *Albuca* fruits are rounded or oval three-lobed capsules containing shiny black seeds [6].

All the karyotypes of the *Albuca* species comprise of three large chromosome pairs with each species differing in the number of small chromosomes present [7]. Goldblatt and Manning [7] deduced that the ancestral basic chromosome number of the genus *Albuca* is  $x=9$ . They are endemic to southern Africa and are variable in morphology [8] with some species covering most of the tropical and southern African range [9].

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## JUSTIFICATION OF THE STUDY

*Albuca setosa* Jacq. is extensively used and very useful to the immediate community and the entire Eastern Cape province of South Africa because of its medicinal properties [8]. However, its revisions are out of date and its biodiversity and evolutionary histories need to be assessed for conservation purposes [10]. Depending on the season and its availability, *A. setosa* is often traded commercially at around US\$ 3.5 /kg [11] and it can possibly be threatened by trade, should unsustainable harvesting of these plants continue and escalate.

## RESEARCH METHODOLOGY

The literature search was performed from September 2018 to January 2019 and the study is based on a mixed-method review approach, which included combining quantitative and qualitative research. A systematic and comprehensive literature search was conducted using electronic scientific journals articles, books, and theses. The databases and literature sources were chosen based on the topic covered and the main search key terms included “*Albuca setosa*”, “taxonomy”, “*Albuca* genus”, “traditional medicines” and “economic importance”. Search terms were set to be in the title, keywords and abstract. To avoid too much filtering of literature, the search terms were done individually.

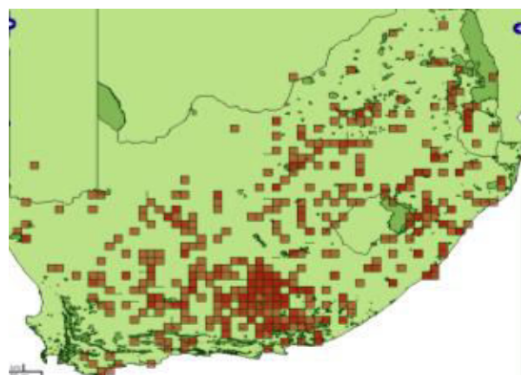
### Description of *Albuca setosa*

*Albuca setosa* is a species of flowering medicinal plants that develops from a bulb within the family Asparagaceae, subfamily Scilloideae [12]. Synonyms of *A. setosa* include *A. affinis* J.M. Wood & M.S. Evans, *A. baurii* Baker, *A. pachychlamys* Baker, *A. patersoniae* Schönland, *Branciona setosa* (Jacq.) Salisb. and *Ornithogalum setosum* (Jacq) J.C. Manning & Goldblatt. *Albuca setosa* is also known as “inqwe beba”

by the people of Xhosa, living in the Eastern Cape province of South Africa [13]. *Albuca setosa* shares the same name “inqwe beba” as *Albuca bracteata* (Thunb.) J.C. Manning & Goldblatt. and both of them are bulbous species. For this reason, it is difficult to differentiate these species. *Albuca setosa* is a perennial, very hardy, evergreen plant which grows from 0.15 m to 0.5 m [13] though Kirby [14] noted that it can grow up to 1.82 m. *Albuca setosa* has narrow leaves, it is broad at the base, dark green in colour, slightly fleshy and often dries up in adverse conditions (dry weather) and sometimes while the plants are flowering. *Albuca setosa* has flowers on long pedicels in a flat-topped raceme, it's white in colour with broad green to brownish central stripes and inner tepals which are sometimes tipped yellow.

The inner tepals of *A. setosa* stay together and erect while the outer three open widely. The upper part of the bulb has a notable tough tunic. These species bloom in spring and the flowers often do not fully open [13,14]. *Albuca setosa* has flowers that face up, unlike other *Albuca* species which have pendulous flowers. The flowers have a spicy vanilla scent [14]. *Albuca setosa* reproduces naturally by the means of seed which germinates readily and by producing bulblets. Its fruit is a capsule with many black seeds [14]. *Albuca setosa* has prominent septal nectaries [15] and it is insect-pollinated (16). *Albuca setosa* can be pollinated by bees and it shares the same mode of pollination with all the other *Albucas* [7]. According to the previous counts on chromosomes, *A. setosa* recorded  $2n = 18$  [17] and also  $2n = 40$  [7,18].

*Albuca setosa* is endemic to southern Africa [3,12]. It is prevalent across South Africa from Namaqualand, the Southwest Cape to the Eastern Cape province and extending in to Lesotho, Swaziland, Botswana, Namibia, southern Mozambique and Zimbabwe, [3] on rocky ground, dry open woodland, flats and mountain



Key: Distribution of *A. setosa*



Figure 1: Source: [www.redlist.sanbi.org/albuca](http://www.redlist.sanbi.org/albuca).

slopes [19]. The specie is drought tolerant, has prominent septal nectaries [15] and is insect-pollinated [16].

The genus *Albuca* seems not as important as few of its species that have been classified by the Red Data List for South Africa. *Albuca setosa* falls in the Least Concern category of the Red Data List of Southern African Plants. However, it is commercially traded [20] so the species can be threatened by trade. Xego [21] reported *A. setosa* as one of the most traded or used species in South Africa. The Red Data List for South Africa lists three other *Albuca* species as Endangered (*A. clanwilliamigloria* U. Müll.-Doblies), Vulnerable (*A. crudenii* Archibald), and Critically Endangered (*A. thermanum* Van Jaarsv.). Should unsustainable harvesting of these plants continue and escalate, more species could become threatened [22].

### Pharmacological Properties

*Albuca setosa* possesses some anti-ulcerogenic properties, which may support evidence for its traditional use [11]. *Albuca setosa* is used by the people of Xhosa, living in the Eastern Cape province of South Africa, for cultural purposes such as ritual wash, inducing vomiting (an emetic), facial and body steam treatment or spraying to protect against bad luck and sorcery [23]. It is also used as a protective charm against lightning and to end quarrels between enemies [14,24]. In the Eastern Cape region of South Africa, its usage as traditional medicine is very extensive [20,25] and it is often referred to as "inqwebeba" by local Xhosa people. They also use it for the treatment of wounds, articulation problems, rheumatoid arthritis, digestive disorder and venereal diseases in human beings [11,20,26]. *Albuca setosa* acts as a medication used to kill parasitic worms (anthelmintic) [27], it is also used as a lotion for washing animal's wounds for

treatment [20]. Saponins are synthesized by plants and are used for protection against pathogens thus serving as natural antibiotics [28,29]. Congruently, the natural tendency for saponins in plants to ward off microbes may designate that the presence of saponins in *A. setosa* make it a notable prospective antifungal or antibacterial agent [30].

Chronic inflammation has become the major health problems in the world and many people have resorted to *A. setosa* to relieve inflammation, painful conditions and digestive disorders [11,20]. Inflammation is a normal protective response to tissue injury which is commonly associated with pain and embroils incidences such as the increase of vascular permeability, increase of protein denaturation and membrane alteration [20]. Umapathy [20] reported some anti-inflammatory potential of aqueous leaf extract of a plant in the same Asparagaceae family. *Albuca setosa* possesses higher tannin and proanthocyanidins content and these tannins are astringent, bitter plant polyphenols that either bind and precipitate or shrink proteins [31]. This attribute of tannins could indicate *A. setosa* to be a good anti-inflammatory agent by means of inhibiting the synthesis or the release of mediators that might be involved in inflammation such as serotonin, histamine and prostaglandins [25]. *Albuca setosa* possibly will be valuable in alleviating oxidative stress and degenerative diseases [30].

Previous work by other authors revealed that an *A. setosa* possesses some membrane stabilization properties, which could limit the process of protein denaturation and decrease white blood cell migration during acute inflammation [20,33]. The aqueous extract of *A. setosa* is used as an ethnomedicine to ease in the evacuation of bowel movement (purgative and

**Table 1: Phytochemical Analysis of Different Solvent Extracts of the *Albuca setosa* Bulb after Odeyemi [32]**

	Aqueous	Acetone	Methanol
Phenonls <sup>1</sup>	281.449±1.687	165.511±2.054	165.511±2.054
Flavonols <sup>2</sup>	124.31±0.126 a	2.066±0.287	1.59±0.064 b
Flavonoids <sup>2</sup>	128.39±0.029	2.542±0.153	1.853±0.039
Proantho cyanidins <sup>3</sup>	124.66±0.00	97.08±0.34	43.88±0.67
Tannin <sup>1</sup>	10.7±0.00245	0.103±0.0004	0.095±0.0006
Saponin	147.43±0.06	24.3±0.04	63.0±0.16
Alkaloids	211.365±0.80	45.361±0.77	44.439±0.03

<sup>1</sup>Expressed as mg/g of the extracts as tannic acid equivalent.

<sup>2</sup>Expressed as mg/g of the extracts as quercetin equivalent.

<sup>3</sup>Expressed as mg/g of the extracts as catechin equivalent.

vermifuge) for animals and humans [34]. Previous work of qualitative analysis of different extractions of *A. setosa* by [35] suggests the presence of phenolics, flavonoids, flavonols, saponins, , homoisoflavonoids, alkaloids and polyhydroxy alkaloids [36; 37] which justifies its use as traditional medicine [20].

The results by [30] demonstrated that *A. setosa* extracts possess high antioxidant activities which could be as a result of the presence of polyphenols, saponins and alkaloids in *A. setosa* plants. The presence of alkaloids in *A. setosa* have been associated with analgesic effects and bactericidal activities [28,38]. The antioxidant activities of *A. setosa* were determined by percentage inhibition of free radicals and the plant shows higher inhibition of DPPH radical [30]. *Albuca setosa* usage in diabetes treatment is significant because the bulbous plants have high levels of flavonoids which have antioxidant activities which they exhibit by scavenging free radicals [30,39,40] and the antioxidant and antidiabetic activity of alkaloids have been reported [41].

## CONCLUSION

*Albuca setosa* is extensively used throughout southern Africa as traditional medicine for animals and human beings. *Albuca setosa* possesses some anti-ulcerogenic, anti-inflammatory and antimicrobial properties probably because of the presence of saponins, phenolics, flavonoids, flavanols and alkaloids in the bulb hence this justifies its use as traditional medicine. The bulbous plant is also used for cultural purposes such as ritual purification, spraying to protect against bad luck and sorcery, as a protective charm against lightning and to end quarrels between enemies. The potential of the *A. setosa* exclusively in terms of pharmacology cannot be overemphasized. Therefore, future studies should focus on evaluating the chemical compounds isolated from these species for the manufacturing of drugs in the pharmaceutical industries.

## AUTHORS CONTRIBUTIONS

CM and SMM wrote the first draft while AM supervised the research and assisted with writing the manuscript.

## CONFLICT OF INTEREST STATEMENT

The authors have not declared any conflict of interest.

## ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the Govan Mbeki Research and Development Centre (GMRDC), University of Fort Hare for financial support to conduct this research.

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