

# Review of Medicinal Applications, Phytochemistry and Pharmacological Properties of *Aristea ecklonii*

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**Abstract:** *Background:* *Aristea ecklonii* is a perennial herb widely used as herbal medicine in southern Africa. Plants used as traditional medicines to treat various human diseases and illnesses play an important role in the primary healthcare of local communities in developing countries.

*Purpose:* The current study critically reviewed the medicinal uses, phytochemistry and pharmacological properties of *A. ecklonii*.

*Methods:* Literature on medicinal uses, phytochemical and pharmacological properties of *A. ecklonii* was collected from multiple internet sources including Elsevier, Google Scholar, SciFinder, Web of Science, Pubmed, BMC, Science Direct, and Scopus. Additional information was also obtained from pre-electronic sources such as books, book chapters, theses, scientific reports and journal articles obtained from the university library.

*Results:* This study revealed that *A. ecklonii* is used as an ornamental plant, protective charm, and herbal medicine for internal sores, cough, fever, syphilis, shingles, and venereal diseases. Ethnopharmacological research identified quinones and sterols from leaves and rhizomes of *A. ecklonii*. The crude extracts of *A. ecklonii* and the compound plumbagin isolated from the species exhibited antibacterial and antifungal activities.

*Conclusion:* *Aristea ecklonii* should be subjected to detailed phytochemical, pharmacological, and toxicological evaluations aimed at correlating its medicinal uses with its phytochemistry and pharmacological properties.

**Keywords:** *Aristea ecklonii*, Iridaceae, herbal medicine, indigenous knowledge, southern Africa.

## INTRODUCTION

*Aristea ecklonii* Baker is a perennial herb belonging to the Iridaceae family. The genus name *Aristea* Sol. is derived from the Greek word “*arista*” which means “spike” or “point” in reference to the morphology of the leaves [1]. The specific epithet “*ecklonii*” is in honor of Christian Friedrich Ecklon (1795-1868), a Danish pharmacist, botanist, plant collector, and entomologist who was one of the early and most productive botanical explorers in South Africa focusing on plants used as traditional medicines and collected plants associated insects. The synonyms associated with the name *A. ecklonii* include *A. cyanea* De Wild., *A. dichotoma* Eckl. ex Klatt, *A. lastii* Baker, *A. maitlandii* Hutch., *A. paniculata* Pax and *A. stipitata* R.C. Foster [2, 3]. The common English names of *A. ecklonii* include African blue star iris, aristeia, blue corn-lily, blue eyes, blue iris, blue stars, blue flies, blue stars lily, and blue-eyed iris. The genus consists of about 55 species that are native to sub-Saharan and central Africa and Madagascar [4].

*Aristea ecklonii* is a spreading, evergreen rhizomatous, frost-hardy perennial herb growing up to 70 cm in height [4, 5]. The species has several leaves, mostly basal, stiff, upright, grass-like, narrowly lanceolate, sword-shaped, shorter leaves along the often branched and slightly winged stems. The flowers occur in terminal and axillary flower clusters standing above the leaves. The flowers are star-like, bright blue in colour, short-lived but produced in succession over an extensive period. The flowers develop into a three-angled capsule, oblong in shape, containing many red-brown seeds that are dispersed by wind and water. *Aristea ecklonii* has been recorded in well-drained soils, in woodland, shrubland, grassland, open and disturbed forest, margins of evergreen forests, coastal, montane, and streambanks and on rocky and bare land forming a dense clump that is impenetrable. The species has been recorded at an altitude ranging from 30 m to 1980 m above sea level [2-5]. The species has been recorded in Burundi, Cameroon, the Democratic Republic of Congo, Eswatini, Mozambique, Rwanda, South Africa, Tanzania, Uganda, and Zimbabwe [2-6].

## MATERIALS AND METHODS

A literature search for information relevant to the medicinal uses, phytochemistry and pharmacological properties of *A. ecklonii* was carried out from July 2019

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to January 2020. Information was obtained from the main online scientific databases such as ScienceDirect, SciFinder, PubMed, Google Scholar, Medline, and SCOPUS. Searches were also undertaken in the University of Fort Hare library, and dissertation search engines like ProQuest, Open-thesis, OATD, and EThOS. The keywords used in the search included "*Aristea ecklonii*", the synonyms of the species "*A. cyanea*", "*A. dichotoma*", "*A. lastii*", "*A. maitlandii*", "*A. paniculata*" and "*A. stipitata*", English common names "African blue star iris", "aristea", "blue corn-lily", "blue eyes", "blue iris", "blue stars", "blue flies", "blue stars lily" and "blue-eyed iris". Additional searches were also carried out using the keywords "biological properties + *Aristea ecklonii*", "ethnobotany + *Aristea ecklonii*", "ethnomedicinal uses + *Aristea ecklonii*", "ethnopharmacological properties + *Aristea ecklonii*", "indigenous knowledge + *Aristea ecklonii*", "medicinal uses + *Aristea ecklonii*", "pharmacological properties + *Aristea ecklonii*", "phytochemistry + *Aristea ecklonii*" and "traditional uses + *Aristea ecklonii*". Articles included in

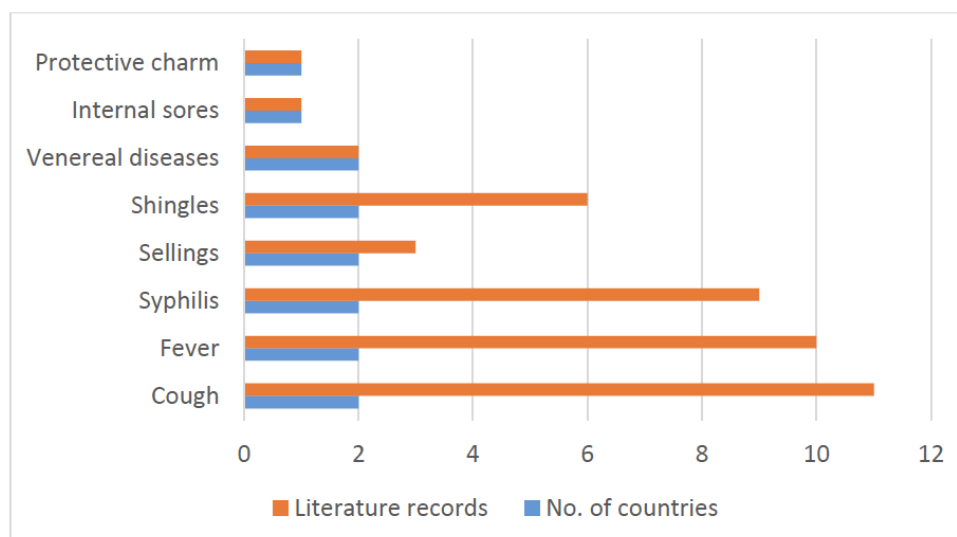
this study focused on the medicinal applications, phytochemistry and pharmacological properties of *A. ecklonii*, including details of the plant parts used and diseases treated.

## RESULTS AND DISCUSSION

The leaf infusions of *A. ecklonii* are mainly used as herbal medicines for cough, fever, syphilis, and shingles [7-19] (Table 1, Figure 1). In South Africa, the whole plant parts of *A. ecklonii* are used as a protective charm and herbal medicine for internal sores [1]. The whole plant parts of *A. ecklonii* are used as herbal medicine for venereal diseases in Eswatini and South Africa [1, 11]. *Aristea ecklonii* is an important medicinal plant species in South Africa with roots of the species sold as herbal medicines in the informal herbal medicine markets in Gauteng and KwaZulu-Natal provinces in South Africa [19]. The leaves and rhizomes of three *Aristea* species, namely *A. cognata* N.E.Br. ex Weim., *A. gerrardii* Weim. and *A. woodii*

**Table 1: Medicinal uses of *Aristea ecklonii***

Medicinal use	Parts of the plant used	Country	References
Coughs	Leaf infusions	Eswatini and South Africa	[1,7-17]
Fever	Leaf infusions	Eswatini and South Africa	[1,7-9,11,13-17]
Internal sores	Whole plant	South Africa	[1]
Protective charm	Whole plant	South Africa	[1]
Shingles	Whole plant applied topically	South Africa	[10,14,15,17-19]
Syphilis	Leaf infusions	South Africa	[7,8,9,13,14,15,16,17,22]
Venereal diseases	Whole plant	Eswatini and South Africa	[1, 11]



**Figure 1: Medicinal applications of *Aristea ecklonii* derived from literature records.**

N.E.Br. are widely used as herbal medicines in South Africa [9, 20].

The ethnopharmacological research of *A. ecklonii* extracts revealed that the species is characterized by quinones and sterols [23]. Plumbagin, 3,3'-biplumbagin, 8,8'-biplumbagin, neoisoshinanolone, and sitosterol have been isolated from leaves and rhizomes of the species while  $\alpha$ -spinasterol was isolated from the rhizomes [23]. Mabona [14] identified the compound plumbagin from leaf extracts of *A. ecklonii*. Similarly, *A. ecklonii* displayed an extensive range of beneficial pharmacological properties that are important for human health effects. Mabona [14] and Mabona *et al.* [15] evaluated the antibacterial activities of aqueous and dichloromethane: methanol (1:1) leaf and root extracts of *A. ecklonii* using the microtitre plate dilution technique against dermatologically relevant pathogens such as *Brevibacillus agri* ATCC 51663, *Propionibacterium acnes* ATCC 11827, *Pseudomonas aeruginosa* ATCC 27858, *Staphylococcus aureus* ATCC 25923, methicillin resistant *Staphylococcus aureus* (MRSA) ATCC 43300, gentamycin – methicillin-resistant *Staphylococcus aureus* (GMRSA) ATCC 33592 and *Staphylococcus epidermidis* ATCC 2223 with ciprofloxacin as the positive control. The extract showed activities with minimum inhibitory concentration (MIC) values ranging from 0.01 mg/ml to 8.0 mg/ml in comparison to MIC values of 0.3  $\mu$ g/ml to 1.3  $\mu$ g/ml exhibited by the positive control [14,15]. Mabona [14] evaluated the antibacterial activities of the compound plumbagin isolated from leaf extracts of *A. ecklonii* using the microtitre plate dilution technique against *Pseudomonas aeruginosa* ATCC 27858, *Staphylococcus aureus* ATCC 25923, methicillin-resistant *Staphylococcus aureus* (MRSA) ATCC 43300, gentamycin – methicillin-resistant *Staphylococcus aureus* (GMRSA) ATCC 33592 and *Staphylococcus epidermidis* ATCC 2223 with ciprofloxacin as a positive control. The compound exhibited noteworthy antibacterial activities with MIC values ranging from 4.0  $\mu$ g/ml to 16.0  $\mu$ g/ml against the tested pathogens in comparison to the MIC values of 0.3  $\mu$ g/ml to 0.6  $\mu$ g/ml exhibited by the positive control [14].

Pretorius *et al.* [24] evaluated antifungal activities of crude extracts of *A. ecklonii* against seven economically important plant pathogenic fungi which included *Botrytis cinerea*, *Fusarium oxysporum*, *Sclerotium rolfsii*, *Rhizoctonia solani*, *Botryosphaeria dothidea*, *Pythium ultimum* and *Verticillium dahliae* using the agar dilution method to determine the inhibition of mycelial radial growth with carbendazim

and difenoconazole (Eria@; 187.5 g/litre EC) as positive controls. The extracts of *A. ecklonii* exhibited 100% mycelial growth inhibition against tested pathogens and outperformed the inhibition exhibited by the synthetic fungicides carbendazim/difenoconazole used as a positive control [24]. Mabona [14] and Mabona *et al.* [15] evaluated antifungal activities of aqueous and dichloromethane: methanol (1:1) leaf and root extracts of *A. ecklonii* using the microtitre plate dilution technique against dermatologically relevant pathogens such as *Candida albicans* ATCC 10231, *Microsporum canis* ATCC 36299 and *Trichophyton mentagrophytes* ATCC 9533 with amphotericin B as the positive control. The extract showed activities with MIC values ranging from 0.05 mg/ml to 4.0 mg/ml in comparison to MIC value of 1.3  $\mu$ g/ml to 25.0  $\mu$ g/ml exhibited by the positive control [14,15]. Mabona [14] evaluated the antifungal activities of the compound plumbagin isolated from leaf extracts of *A. ecklonii* using the microtitre plate dilution technique against *Candida albicans* ATCC 10231 with amphotericin B as a positive control. The compound exhibited noteworthy antifungal activities with MIC value of 2.0  $\mu$ g/ml against *Candida albicans* ATCC 10231, and this was the same MIC value exhibited by the positive control [14].

*Aristea ecklonii* is an important ornamental plant in South Africa recommended for green landscaping to enhance the aesthetic, recreational, and psychological benefits of the coastal belts in South Africa [25,26]. Honig [26] argued that *A. ecklonii* looks best when planted in large groups as a groundcover. *Aristea ecklonii* is also used as a potted plant or outdoors as a mixed perennial border or bed used for courtyard gardens and informal gardens and groundcover. *Aristea ecklonii* was introduced as an ornamental plant in several countries such as Australia, India, New Zealand, and Sri-Lanka [27-34]. *Aristea ecklonii* is now listed as a weed in the global collection of weeds by Randall [34]. In Australia, India, New Zealand, and Sri-Lanka, *A. ecklonii* is listed as an invasive weed, invading coastal scrubland, roadsides, riparian habitats, forest margins and high mountain forests [27-34]. *Aristea ecklonii* is a major invasive alien plant species that was imported into Sri Lanka intentionally as an ornamental plant species [28]. *Aristea ecklonii* is a potentially serious invader of riparian habitats, coastal areas, roadsides, grasslands, shrublands, woodlands, high mountain forests and margins of evergreen forests. The species produces masses of seeds that are dispersed by water, wind, animals and by vehicles or machinery. The rhizomes of *A. ecklonii* form new shoots when conditions are favourable,

allowing the plant to survive adverse conditions. The fine and fibrous roots and rhizomes of *A. ecklonii* enable it to form a dense mat in the upper soil and enhancing its capability to form an extensive and dense ground cover, preventing the regeneration of native plant species [35].

## CONCLUSION

Documentation of the medicinal uses, phytochemistry and pharmacological properties of *A. ecklonii* is crucial as this information forms the baseline data required for future research and development of health-promoting and pharmaceutical products. Findings from this study showed that there are still some research gaps in the phytochemistry, pharmacological, and toxicological properties of the species. More rigorous research is required aimed at evaluating various plant parts used as herbal medicines, assessing their phytochemistry, pharmacological, and toxicological properties. Preliminary pharmacological studies have provided supporting evidence for the therapeutic potential of *A. ecklonii* in the management of bacterial and fungal infections. However, there is little or dearth of information on the ethnomedicinal applications of the species in countries such as Burundi, Cameroon, the Democratic Republic of Congo, Mozambique, Rwanda, Tanzania, Uganda and Zimbabwe. Therefore, in-depth ethnobotanical and ethnopharmacological research is required focusing on the medicinal uses, phytochemistry, biological activities and toxicological properties of the species.

## CONFLICT OF INTEREST

No conflict of interest is associated with this work.

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