IJBPAS, August, 2026, 15(8): 3855-3866

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

PHARMACOLOGICAL AND ETHNOBOTANICAL INSIGHTS INTO *RAVENALA MADAGASCARIENSIS* (TRAVELLER'S TREE)

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Received 26th July 2025; Revised 14th Aug. 2025; Accepted 5th Jan. 2026; Available online 1st Aug. 2026

https://doi.org/10.31032/IJBPAS/2026/15.8.10397

ABSTRACT

Ravenala madagascariensis, commonly known as the Traveler's tree, is a medicinally rich plant native to Madagascar and well adapted to tropical and subtropical regions. It has been traditionally used by the native people of Madagascar for various therapeutic purposes. The purpose of this review is to present an extensive overview of the plant's pharmacological activities, which include antioxidant, antithyrosine, insulin secretagogue, antidiabetic, antibacterial, antifungal, antithrombolytic, anticholinesterase, anticancer, and antiurolithiatic effects the ethnobotanical uses and phytochemical interpretations reveal that different parts of the plant contain diverse bioactive compounds. A total of ten pharmacological studies have been reviewed, covering extracts such as methanol, ethanol, n-hexane, and ethyl acetate, which were tested against microbes (bacteria and fungi) as well as in animal models (rats). The results indicate that *R. madagascariensis* possesses significant pharmacological activities, particularly the methanolic leaf extract, which demonstrated a wide range of therapeutic effects. Ethnobotanical reports also highlight its traditional applications in treating kidney stone problems, as an antiseptic, and as an antidiabetic remedy. This review emphasizes the value of

Ravenala madagascariensis and its bioactive components, which hold strong potential for the development of both clinical and pharmacological applications, thereby supporting its integration into modern therapeutic practices.

Keywords: antioxidant, antithyrosine, antidiabetic, antibacterial, antithrombolytic, anticholinesterase

INTRODUCTION

Ravenala madagascariensis, popularly known as the Traveler's tree, is the national tree of Madagascar. these trees are primarily found on the eastern side of the island. In the local Malagasy language, they are called *ravinala*, which translates to "leaf of the forest". **[1]** the plant belongs to a member of the Strelitziaceae family, is widely cultivated as an ornamental plant and grows well in tropical and subtropical climates. In Madagascar, it holds significant ethnobotanical value, with its trunk used for construction, tools, utensils**,** and even as food, since the boiled trunk heart is locally consumed. Traditionally, it has been employed to treat coughs, stomach pain, urinary retention, diabetes, diarrhea, swelling, kidney stones, and hypertension **[2]**. *Ravenala madagascariensis* is closely related to Musa species found in parts of Africa, where traditional treatments are widely practiced. Among them, Musa acuminata considered the ancestor of commercial bananas is of particular importance **[3]**. In both rural and urban settings, people often rely on traditional treatments for several reasons: limited geographic or financial access to orthodox antidiabetic medicines, inadequacies in the healthcare system, the widespread availability of traditional medicine, the preservation of indigenous knowledge within communities, and the central role of traditional healers **[4]**. Mature trees of *Ravenala madagascariensis* reach 9–18 m in height. The plant has large green oblong leaves with thick pinnate margins and evergreen venation, extending over 36 inches. Its flowers feature a perianth of three sepals and three petals, two of which are fused to enclose the stamens, while the third remains free. The six free stamens and a style equal in length to the perianth help distinguish the species. The plant produces a tough, three-chambered fruit that dehisces naturally. The seeds, surrounded by a fatty blue aril ranging from ultramarine to pale blue, contrast with the orange arils of related genera such as *Phenakospermum* and *Strelitzia* **[5]**.

The plant's anatomy shows small cells with wide intercellular spaces. Its long, thin stomatal guard cells have a dumbbell-shaped lumen, with undulated anticlinal walls in the inner tepals. Raphide sacs occur in the leaf sheath, bract, bracteole, and inner tepals. The inner tepal epidermis is papillose, with two tepals interlocking to form a tube around the anthers that separates explosively upon dehiscence, dispersing pollen to pollinators **[6]**.

Recent studies reveal that *Ravenala madagascariensis* comprises at least four distinct variants, differing in leaf structure, growth habit, and habitat preference. This diversity highlights the need for systematic screening to validate its traditional medicinal uses and discover novel bioactive compounds. The plant is easily recognized by its paddle-shaped leaves arranged in a fan-like pattern resembling a peacock feather **[7]**.

TAXONOMICAL CLASSIFICATION [8]

Botanical name:

Ravenela madagascariensis sonn

Family:Sterlitziaceae

Kingdom: Plantae

Subkingdom: Viridae plantae

Phyllum:Tracheophyta

Subphyllum:Euphyllophytina

Intraphyllum:Radiotopses

Class:Liliopsida

Subclass:Commelinidae

Superorder:Zingiberanae

Order:Musales

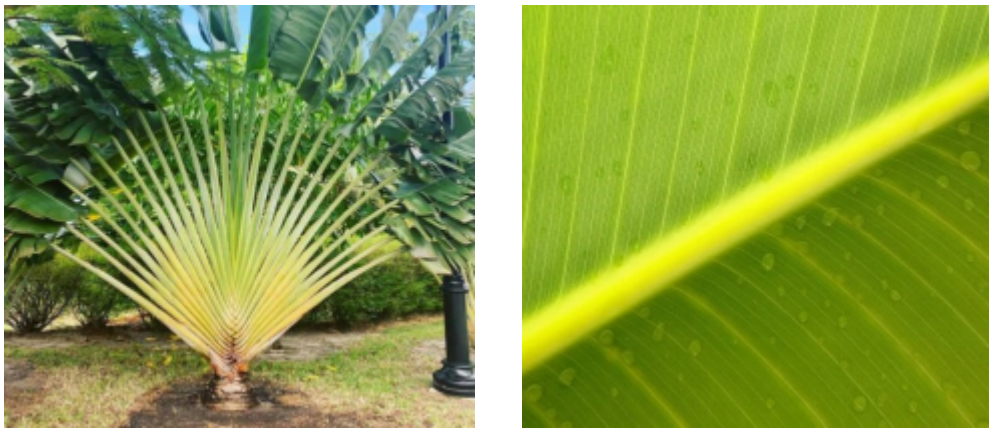
Suborder: Sterlitziinae

Subfamily:Ranunculoideae

Tribe:Anemoneae

Genus: *Ravenala*

Specific epithet: *madagascariensis* – Sonnerat



(A) **(B)**

Figure 1: (A) Plant of *ravenela madagascareinsis* and (B) Leaf of *ravenela madagascareinsis*

ETHANOBOTANICAL SURVEY [9][10]

Plant Name: *Ravenala madagascariensis* Sonn., **Common name:** Traveller's tree,

Traveller's palm. **Family:** Sterlitziaceae. **Vernacular name; Tamil**: Visiri vazhai, Pyanihallpanai**. Telugu**: Kiritaarati, Pankaarati. **English**: Traveller's Palm**. Bengali:** panthopadoo

DISTRIBUTION AND HABITAT [11][12]

Native to Madagascar and known for its adaptability, it is cultivated across tropical and subtropical regions, particularly in South Indian gardens. It is a striking, elegant, palm-like tree with a fan-shaped crown, developing a distinct trunk as it matures

PLANT DESCRIPTION

Ravenala madagascariensis is a palm-like, clump-forming tree that can exceed 10 meters in height and develops a distinct trunk with age. It is simple, alternate leaves are arranged in two ranks, forming a fan-shaped crown. Each paddle-like leaf (1.5–3 × 0.6–1 m) has a grey-green surface and often split margins. The plant flowers intermittently year-round, producing clusters of 7–12 large**,** green, boat-shaped bracts that enclose white to yellowish blossoms. The woody, oblong fruits (≈8 cm long) contain numerous seeds surrounded by bright blue arils. Traditionally, the species has been used in ethnomedicine to manage kidney stones, diabetes, and for its antiseptic properties

PHYTOCONTIUENTS OF *RAVENELA MADAGASCARIENSIS* [13][14]

Ravenala madagascariensis is a unique plant containing various constituents identified from different parts, namely the leaves, bark, flowers, seeds, and arils. Its fatty acid profile includes palmitic acid (C16:0), stearic acid (C18:0), oleic acid (C18:1 ω9) primarily in the trans form (elaidic acid), and approximately 7% linoleic acid (C18:2 ω6) **[15]**. It also contains lipids, carbohydrates, and proteins. Furthermore, the plant is rich in several bioactive compounds, such as anthraquinones, cardiac and cyanogenic glycosides, flavonoids, phlobatannins, saponins, steroids, tannins, terpenoids, and triterpenoids. **[16]** Bio-guided extraction of *Ravenala madagascariensis inflorescences* led to the first isolation of cycloartanol triterpene, (2E,7R,11R)-phytyl-3,7,11,15-tetramethylhexadec-2-enyl pentadecanoate, (24S,31S)-cycloartan-31,32-diol, and androsta-1,4-dien-3,16-dione from its ethanolic extract. These compounds, along with others, have been successfully isolated from the plant **[17] [18] [19]**.

PHARMACOLOGICAL ACTIVITY

Different parts of *Ravenala madagascariensis*, such as the leaves, bark, roots, flowers, fruits, and seed arils, are traditionally utilized by communities in Madagascar and South Africa. Several research and review studies have investigated

its pharmacological potential using both in vitro and in vivo models, mainly with methanolic, ethanolic, ethyl acetate, and n-hexane extracts of various plant parts

Antimicrobial studies

The antimicrobial activity of *Ravenala madagascariensis* has been evaluated against various bacterial and fungal strains. Both antibacterial and antifungal activities have been reported, as summarized in the table below. Different experimental techniques were employed, including disc diffusion and microdilution methods for antibacterial activity, and the agar diffusion method for antifungal activity. The results showed that methanolic extracts of the pericarp, leaves, and arils were bactericidal against strains, while n-hexane leaf extracts exhibited significant antifungal activity without causing hematological toxicity in experimental animals. These findings indicate that *Ravenala madagascariensis* possesses strong antimicrobial potential, supporting its traditional therapeutic use **[20][21][22]**.

Antioxidant activity

The antioxidant potential of *Ravenala madagascariensis* was assessed using multiple assays, including DPPH, FRAP, CUPRAC, metal chelating, phosphomolybdenum, and ABTS. The aqueous extract showed the highest overall antioxidant activity in the DPPH (154.08 ± 2.43 mg TE/g), FRAP (249.40 ± 3.01 mg TE/g), CUPRAC (384.57 ± 1.99 mg TE/g), metal chelating (29.68 ± 0.74 mg EDTAE/g), and phosphomolybdenum (2.38 ± 0.07 mmol TE/g) assays, while the methanolic extract exhibited the strongest activity in the ABTS assay (438.46 ± 1.69 mg TE/g) **[23]**.

Anticholinesterase activity

To evaluate cation channel activity, DTNB method employed here. The mixture was transferred to a 96-well microplate containing Tris-HCl buffer and incubated at 25 °C for 15 minutes. It began with by adding 25 µL of either butyrylthiocholine chloride or acetylthiocholine iodide. A blank was prepared by adding the sample solution to the reaction mixture without the enzyme. After 10 minutes of incubation at 25 °C, absorbance was measured at 405 nm for both the sample and the blank, and the blank's absorbance was used for comparison. At end result the methanolic extract showed the strongest activity against the acetylcholinesterase enzyme **[24]**.

Antidiabetic activity

The different leaf extracts of *Ravenala madagascariensis* were assesed at a concentration of 50 g/L by method of an in vitro approach to evaluate their impact on

glucose transport in the gastrointestinal tract, relative to a control lacking the extracts. The extracts expressed significant inhibition of glucose diffusion in vitro and were further tested in vivo at doses of different body weight rats.by comparing with reference standard drug. Both extracts demonstrated strong antidiabetic activity, with the ethanolic extract being more potent in reducing blood glucose levels during both short-term and long-term treatment, supporting the traditional use of the plant **[25]**.

Antithrombolytic activity

Antithrombolytic activities in which the aqueous-soluble fractions of carbon tetrachloride, chloroform, crude methanolic, and hexane extracts were evaluated for Anti thrombolytic and membrane-stabilizing activities. The results demonstrated inhibition of RBC hemolysis induced by hypotonic solution and heat **[26]**.

Antityrosine activity

To evaluate cation channel activity, DTNB method was used here. The mixture was placed in a 96-well microplate and incubated at 25 °C for 15 minutes. A blank was prepared by adding the enzyme-free reaction mixture to the reagents. After 10 minutes of incubation at 25 °C, the absorbance of both the sample and blank was measured at 492 nm. The blank absorbance was used for baseline correction, and tyrosinase inhibitory activity was expressed as mg kojic acid equivalents per gram of extract (mg KAE/g). Among the extracts tested, the methanolic and ethyl acetate fractions exhibited comparable tyrosinase inhibition, with the ethyl acetate extract showing the highest activity **[24]**.

Insulin secretagogue study

The viability of RIN5F (rat insulinoma) cell lines during treatment with the plant extract was assessed using the MTT assay. and enzyme-linked immunosorbent assay (ELISA) on RIN5F cells. The ethanolic root extract of *R. madagascariensis* Sonn. exhibited minimal cytotoxicity at concentrations of 20–40 μg/mL; therefore, doses up to 40 μg/mL were used for the insulin secretion assay. At 20 and 40 μg/mL, the extract significantly ($p < 0.05$ vs. control) stimulated insulin release in a dose-dependent manner, both under low (5 mM) and high (10 mM) glucose conditions **[27]**.

Anticancer activity

The study mainly focused on the pancreatic region. Leaf extracts of *Ravenala madagascariensis* exhibited cytotoxic activity against PANC-1 and SW1990 pancreatic cancer cell lines, as evaluated using the MTT assay. The results demonstrated significant cytotoxic effects on

both cell lines, indicating the presence of bioactive constituents with potential anticancer activity and validating the plant's promising anticancer potential **[28]**.

Antiuroliathiatic activity

Urolithiasis is a condition that affects the urinary tract, and several extracts from the leaves of *Ravenala madagascariensis* have been used in its management. The extraction methods employed included methanolic, hydro-methanolic, and decoction techniques. The decoction demonstrated the superior antiurolithiatic effect (IC_{50} = 188.65 µg/mL) compared with the methanolic and hydro-methanolic extracts, highlighting the potential role of water-soluble phytoconstituents. These findings provide experimental support for the traditional use of the plant in urolithiasis management and warrant further formulation and development studies **[29]**.

Table 1: Pharmacological activity

S. No.	EXTRACT (PLANT PART)	THERAPEUTIC EFFECT	METHOD	RESULT	REFERENCE
1	Methanolic extract (Pericarp, leaves, aril)	Antibacterial	Discdiffusion and microdilution	All three extracts were bactericidal against the tested strains.	[20][21]
2	n-hexane extract (leaves)	Antifungal	Agarwell diffusion method	Leaf extract was nothematologically toxic and exhibited antifungal activity against human pathogenic fungi	[22]
3	Methanolic Extract (leaves)	Anticholineterase	Colorimetric assay based on the Ellman's reagent (DTNB)	methanolic extract showed the strongest activity against the acetylcholinesterase enzyme.	[24]
4	Methanolic extract (seed,arils leaves)	Antioxidant	DPPH, FRAP, CUPRAC, metal chelating, phosphomolybdenum, and ABTS assays	The aqueous extract showed the highest antioxidant activity across most assays, while the methanolic extract was most effective in the ABTS assay.	[23]
5	Methanolic Extract (Leaves)	Antityrosine	Tyrosinase Inhibition Assay and DTNB method	The extracts of anti-tyrosinase activity showed that the methanolic and ethyl acetate extracts were almost equally good at stopping the tyrosinase enzyme,	[24]
6	Methanolic Extract (leaves,bark)	Antithrombolytic	In vitro clot lysis assay and erythrocyte membrane stabilization assay	The chloroform fraction of the leaf extract inhibited RBC hemolysis by 28.72 ± 0.61% (hypotonic) and 39.97 ± 0.39% (heat-induced), while the hexane fraction of the bark extract showed 53.78 ± 0.17% and 41.83 ± 0.61% inhibition, respectively	[26]
7	n-hexane, ethanol,ethyl -acetate extract(leaves)	Antidiabetic	In vitro glucose diffusion inhibition assay also called glucose uptake/diffusion inhibition method using dialysis membrane	In conclusion, the ethanolic and aqueous extracts of *Ravenala madagascariensis* exhibited significant	[25]

				antidiabetic activity, with the ethanolic extract showing superior efficacy. These results substantiate the plant's traditional use in diabetes management and highlight its potential for further pharmacological development	
8	**Ethanolic extract (leaves)**	**Insulin Secretatagogue effect**	**MTT assay and enzyme-linked immunosorbent assay (ELISA)**	**The ethanolic root extract of *R. madagascariensis* Sonn. exhibited minimal cytotoxicity at concentrations of 20–40 µg/mL; therefore, doses up to 40 µg/mL were used for the insulin secretion assay. At 20 and 40 µg/mL, the extract significantly ($p < 0.05$ vs. control) stimulated insulin release in a dose-dependent manner, both under low (5 mM) and high (10 mM) glucose conditions**	**[27]**
9	**n-hexane extract, ethyl acetate extract, ethanol extract (leaves)**	**Anticancer**	**MTT assay**	**The results demonstrated significant cytotoxic effects on both cell lines, indicating the presence of bioactive constituents with potential anticancer activity and validating the plant's promising anticancer potential**	**[28]**
10	**Methanolic Extract (leaves)**	**Antiurolitheatic**	**The extraction methods employed included methanolic, hydro-methanolic, and decoction techniques**	**The decoction demonstrated the superior antiurolithiatic effect (IC_{50} = 188.65 µg/mL) compared with the methanolic and hydro-methanolic extracts, highlighting the potential role of water-soluble phytoconstituents**	**[29]**

CONCLUSION

Ravenala madagascariensis is a well-known ornamental plant with numerous traditional uses among the native people of Madagascar and South Africa. It contains various bioactive components and has been traditionally used in the treatment of many illnesses. Numerous studies have investigated its pharmacological potential, demonstrating a wide range of biological activities.This comprehensive review highlights its ethnobotanical description, traditional uses, phytoconstituents (including phlobatannins, saponins, steroids, tannins, terpenoids, and triterpenoids), and geographical distribution. It further emphasizes the various pharmacological and therapeutic effects of the plant. Ravenala madagascariensis holds significant potential for clinical exploration, and further pharmacological studies are needed to support its development into therapeutic application.

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