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Summary on Phytochemistry, Pharmacology activity and Pharmacognosy of Frerea Indica plant: A review

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Abstract

This review investigates the potential of *Frerea indica*, a rare and endangered medicinal plant with a rich repository of bioactive compounds. Phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, and saponins, known for their therapeutic properties. The results demonstrated significant hypoglycemic effects, attributed to the synergistic action of the plant's bioactive constituents. The findings highlight *Frerea indica* as a potential source of natural antidiabetic agents and underscore its importance in drug development. However, the rarity of this species necessitates sustainable conservation strategies to enable further exploration of its medicinal properties.

Keywords: Frerea indica, phytochemical investigation, flavanoids, polyphenolic compounds, methanolic extract, anti diabetic activity.

INTRODUCTION

Frerea indica, belonging to the monotypic genus Frerea (Apocynaceae), is an attractive succulent herb with star-shaped flowers. This critically endangered plant is found on rocky cliffs and slopes at high altitudes, primarily in the northwestern region of the Western Ghats in Maharashtra, India. It is sporadically distributed across locations like Randha Falls in Ahmednagar, Shivneri Fort and Purandhar in Pune, Anjaneri Hills in Nasik, Shivthar Ghat in Raigad, and Kate's Point in Mahabaleshwar, Satara. Locally known as Shindal-Makadi, Shiv Suman, or Makad Meva, it is considered a 'living ancestor' of the stapeliads and shares morphological traits with genera such as Caralluma, Boucerosia, and Ceropegia.[1,2]

Frerea indica is closely related to the Indian Boucerosia group, which includes species like Caralluma diffusa, C. umbellata, and C. procumbens. These species are known for their various applications in food, cosmetics, and traditional medicine. Extracts from related Caralluma species have demonstrated diverse pharmacological properties, including cytotoxic, anti-inflammatory, hypoglycemic, antimicrobial, antioxidant, and anticancer activities. They are also used for their nephroprotective, insect-repellent, and anti-arthritic properties, among others.[2,3]

The whole plant of *Caralluma truncato-coronata* is recognized for its antioxidant and anti-angiogenic properties, while *Caralluma indica* exhibits strong antimicrobial activity. Similarly, *Caralluma pauciflora* has been found to possess cytotoxic, antimicrobial, and antioxidant properties. Indigenous communities consume the succulent stems and leaves of *Frerea indica* as vegetables, and its leaf paste is traditionally used to promote hair growth in certain tribal regions of Maharashtra, India.[4,5]

CHARACTARIZATION OF FREREA INDICA:

Frerea indica Dalz. (Apocynaceae) is a critically endangered, monotypic, and endemic genus of the Western Ghats of Maharashtra, India. Fleshy glabrous herb. Leaves 3-6 cm long. Flowers brick red, solitary or in pairs, pedicles arising from between the petioles. Corolla rotate, about 2.4 cm across, lobes valvate, deltoid, fringed with fine purple hairs, designed with a variety of striation and spots. Corona purple. Anthers red. Pollinia one in each cell. Style-apex pearly white.[6,7]

Many herbal plants have been described for the use of diabetes mellitus in ancient literature; herbal plant extracts, preparations alone or in combination with oral hypoglycemic agent sometimes produce a good therapeutic response in some resistant cases where in the allopathic drug alone has failed to produce the satisfactory results.[8,9]

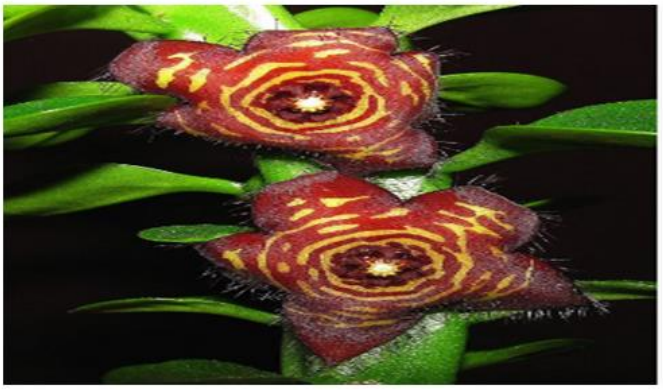

Figure: Frerea Indica

TAXONOMICAL NOMENCLATURE

- Kingdom: Plantae
- Subkingdom: Tracheobionta
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Gentianales
- Family: Apocynaceae
- Subfamily: Asclepiadoideae
- Genus: Frerea
- Species: *Frerea indica*

VERNACULAR NAMES

Marathi: Shindal Makudi
English: Indian Succulent or Frerea
Kannada: Tendlya-gida

Though the leaves powder of *Frerea Indica* may possess antidiabetic activity, their systematic investigation have not been carried out so far. Hence it was thought worthwhile to investigate the antidiabetic activity of leaves powder.[10,11]

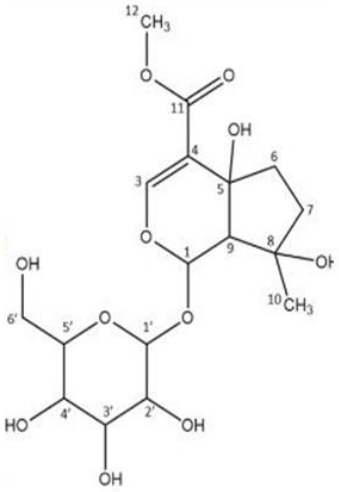

Figure 2 Chemical Structure of *Frerea Indica*

Proximate Components (%)	Root	Stem	Leaves
Moisture	69.42 ± 0.81c	78.83 ± 1.06b	8 7.45 ± 1.38a
Ash	23.8 ± 1.31b	26.8 ± 1.22a	20.9 ± 0.99c
Total Carbohydrates	11.46 ± 0.13b	13.2 ± 0.81a	6.53 ± 0.47c
Crude Proteins	1.43 ± 0.83a	1.75 ± 1.01a	1.54 ± 0.88a
Crude Fat	0.28 ± 0.02c	0.97 ± 0.01a	0.53 ± 0.02b

Table 1 Proximate composition content in various plant parts of Frerea indica.

CHEMICAL CONSTITUENTS

The plant contains carbohydrates like starch and reducing sugars in its tuberous roots, proteins in its leaves and stems, and essential fatty acids in its cuticle, which contribute to water retention. Among secondary metabolites, phenolic compounds and flavonoids, such as quercetin, kaempferol, and apigenin, stand out for their antioxidant, anti-inflammatory, and antimicrobial properties. Additionally, tannins, both condensed and hydrolyzable, are present in the stems and roots, enhancing the plant's astringent and antimicrobial capabilities.

Phytosterols like β-sitosterol and a variety of terpenoids, including monoterpenes, diterpenes, and triterpenes, have been identified, offering anti-inflammatory and antimicrobial benefits. The presence of cardiac glycosides in Frerea indica suggests potential applications in treating heart conditions, while saponins and essential oils extracted from the leaves and flowers contribute to its therapeutic and aromatic qualities.

The rich biochemical composition of Frerea indica supports its traditional uses, including wound healing and antimicrobial treatments. However, as the plant is critically endangered, further research and conservation efforts are essential to fully explore and utilize its medicinal potential while ensuring its survival in the wild.[12,13]

PHYTOCHEMICAL CONSTITUENTS

Phytochemical Constituents of ***Ferrea indica***

Ferrea indica, commonly known as the Indian fig or wild fig, is a plant rich in diverse phytochemical constituents that contribute to its medicinal properties. It contains bioactive compounds such as flavonoids, alkaloids, tannins, phenols, saponins, and glycosides. These phytochemicals exhibit antioxidant, anti-inflammatory, and antimicrobial properties, making the plant valuable in traditional medicine. The presence of

compounds like terpenoids and sterols further enhances its therapeutic potential, supporting its use in treating various ailments, including skin disorders, digestive issues, and infections[15,16,17]

Phytochemical Group	Examples/Properties	Potential Benefits
Flavonoids	Antioxidants, anti-inflammatory agents	Protect against oxidative stress, reduce inflammation
Alkaloids	Bioactive compounds with pharmacological effects	Pain relief, antimicrobial activity
Tannins	Polyphenolic compounds	Astringent properties, antimicrobial effects
Phenols	Antioxidant compounds	Neutralize free radicals, protect tissues
Saponins	Natural surfactants	Enhance immunity, reduce cholesterol levels
Glycosides	Bioactive sugar-linked compounds	Cardiotonic effects, detoxification
Terpenoids	Aromatic compounds	Anti-inflammatory, antimicrobial properties
Sterols	Structural components in cell membranes	Support hormone production, cholesterol regulation

PLANT DETAILS

The corolla is rotate, approximately 2.2 cm wide, 5-lobed, and fringed with fine deep purple hairs along the edges, exhibiting a purple colour with pale yellow spots. The outer corona is bowl-shaped, 1-2 mm long, and 5-lobed, while the inner corona is 1.5 mm long and also 5-lobed. The staminal column is short, with red anthers and one pollinium per cell. The style apex is flat and pearl white. Fruits are follicles, either paired or single, 6.3-8.2 cm long, terete, smooth, and curved at the apex. Seeds are numerous, approximately 8 mm by 3.5 mm, with silky white comas about 1.3 mm in length.[18,19,20]

It grows between 750-1350m above sea level on rock crevices and exposed hill slopes facing either south-east or northwest directions, forming large patches.[21]

Climate change poses a significant threat to the survival of Frerea indica, both directly and indirectly, by contributing to habitat loss, destruction, and shrinkage. Key factors include fire, grazing, and landslides, which have critically impacted this palaeoendemic genus. The plant suffers from poor flowering, limited seed production, and a lack of specific pollinators. Additionally, insect infestations by caterpillars and aphids, as well as local consumption of its succulent stems and leaves as vegetables, further contribute to its decline.[22]

Traditional use of the plant's leaf paste by tribal communities to promote hair growth also impacts its availability. Activities such as hiking and trekking in the Sahyadri ranges disrupt wildlife habitats and biodiversity. Unregulated tourism and anthropogenic activities in biodiversity hotspots like the Western Ghats exacerbate the issue. Moreover, the plant's striking star-shaped flowers make it susceptible to human interference, posing an additional threat to its conservation. Sustainable strategies and responsible ecotourism are crucial to minimize these impacts and protect this critically endangered species.[23].

CONCLUSION

The morphological diversity analysis of Boucerosia frerei revealed significant variation among the five accessions, offering substantial potential for selecting accessions suitable for use in hanging baskets. Key traits such as stem colour, plant height, root count, node count, leaf count, flower count, and flower diameter were identified as crucial for differentiating accessions. Cluster analysis grouped the five accessions into two distinct clusters based on shared characteristics, highlighting the Meruling Satara accession as particularly promising for hanging basket applications.

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