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A REVIEW ON PHARMACOGNOSTIC AND PHYTOCHEMICAL ASPECTS OF TABERNAEMONTANA DIVARICATA

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ABSTRACT

The escalating global crisis of antibiotic resistance has prompted a fervent quest for alternative antimicrobial agents. This study conducts an in-depth exploration of the antibacterial potential residing within the stem extract of Tabernaemontana divaricata, a shrub deeply rooted in traditional medicine. The investigation aspires to solve the complex interplay of phytochemicals present in this plant, shedding light on its efficacy against bacterial pathogens and contributing to the growing arsenal of natural remedies.

Keywords: Tabernaemontana divaricata, Extractive solvents, Phytochemical, Antimicrobial.

INTRODUCTION

Infectious diseases caused by bacteria pose an enduring challenge to public health, accentuated by the emergence of antibiotic resistant strains. This necessitates a paradigm shift in our approach to combating bacterial infections. Tabernaemontana divaricata, has not only adorned gardens with its exquisite blooms but has also been employed in traditional medicinal practices across diverse cultures. Utilising the potential of this plant stem extract for its antibacterial properties holds promise as a sustainable and effective alternative to conventional antibiotics. The abundant diversity of medicinal plants in nature indeed offers a vast array of beneficial properties. While around 80% of people tend to rely on conventional medicine, there's been a growing resurgence in trust and interest in natural remedies derived from plants. Natural antioxidants, antibacterial, cytotoxic, antiviral, fungicidal agents, and nutrients have gained popularity due to their perceived positive impact on health.

Tabernaemontana divaricata, with its glossy deep green leaves and a rich profile of phytochemical constituents including alkaloids, steroids, flavonoids, phenolic acids, and enzymes exhibits an extensive range of pharmacological activities.

Various important phytoconstituents which are present in the above-mentioned plant encompass anti-inflammatory, anti-cancer, and analgesic properties, contributing to its potential as a valuable natural resource in medicinal applications. The increasing recognition and utilization of such plant-derived remedies reflect a broader shift toward embracing nature's offerings for health and well-being.

Fig: Entire plant with different parts of Tabernaemontana divaricata

(leaves, barks, stem, flowers, fruits, and seeds).

TABLE 1:

Taxonomical description of Tabernaemontana divaricata

Kingdom	plantae
phylum	Tracheophyta
Class	Magnolipsida
Order	Gentianales
Family	Apocynaceae
Genus	Tabernaemontana
Species	divaricata
Botanical name	Tabernaemontana divaricata

TABLE 2:

Vernacular names

English	Crepe jasmine, pinwheel flower
Sanskrit	Nandivarsha
Hindi	Chandni, Tagar, Tagari
Assamese	Kathanda
Kannada	Nandibattalu Nanjubattalu, nadyaavarta
Mizo	Par-arsi, kelte-benbeh Battalu
Gujarathi	Sagar
Bengali	Tagar, kath Mallika
Marathi	Ananta, Tagar
Malayalam	Kuntampale
Bangladesh	Dundhful/ Kath-Mallika

DESCRIPTION:

The pinwheel flower also called as crape jasmine sounds absolutely stunning with its waxy white flowers and glossy dark green leaves. Its fragrance must be enchanting, especially in the night! The description of its leaves with the glossy, leathery texture and intricate shape adds to its appeal.

Leaves:

These plants often exhibit leaves arranged in whorls of three, with elliptic to lanceolate or obovate shapes, bright green on the upper side and pale green on the underside, along with an acute or acuminate tip and a slender, tapering base.

Dorsal leaf

Ventral leaf

Stem:

The plant often shows thick and erect stems that produce a milky latex when cut and can have a silvery-grey appearance.

Bark:

It is also dichotomously branched. Additionally, it may clump or be multi-trunked.

Root:

The taproot system of Tabernaemontana divaricata comprises hard, branching roots with a silvery brownish appearance. Interestingly, despite its hard and branching nature, this root doesn't possess any distinct taste or smell**.**

Flowers:

The flowers showcase distinct carpels, each with a long style and an oblong stigma, along with numerous ovules. The calyx consists of five imbricate lobes forming a bell shape, while the corolla takes on a salver-shaped structure with a dilated tube below the top and five ovate lobes.

These small, trumpet-shaped flowers are milky white, actinomorphic (radially symmetrical), emit a sweet fragrance, and typically appear either solitarily or in small, few-flowered cymes in axils or terminals. Their petal arrangement resembles a pinwheel, adding to their visual appeal and charm.

PHYTO CHEMISTRY OF TABERNAEMONTANA DIVARICATA

- It's fascinating how comprehensive the phytochemical analysis of Tabernaemontana divaricata has been.
- The plant indeed showcases a rich array of bioactive compounds like proteins, carbohydrates, cardiac glycosides, alkaloids, terpenoids, steroids, flavonoids, phenylpropanoids, phenolic acids, saponins, and various enzymes.
- Specifically, the ethanolic extracts highlight a concentration of proteins and notably high levels of flavonoids.
- The leaves contain substantial phenols, estimated at 47.1 mg GAE/g, total flavonoids at 19.6 mg QE/g, and total protein at 18 mg/g.
- Additionally, the flower displays significant flavonoid content (15.4 mg QE/g), total phenols (6.2 mg GAE/g), and total protein (2 mg/g).
- These findings underscore the plant's richness in bioactive components, potentially contributing to its pharmacological properties**.**

Table1:

Presence of various phytoconstituents present in different parts of Tabernaemontana divaricata plant.

S.no	Chemical class	leaves	Flowers	Fruits	Stem	Roots	Aerial parts
1	Alkaloids	+	+	-	++	+	+
2	Carbohydrates	-	+	-	++	-	-
3	Glycosides	+	+	-	++	+	-
4	Flavanoids	+	+	-	++	+	-
5	Amino acids	+	+	-	++	-	-
6	Tannins	+	+	-	-	-	-
7	Steroids	+	+	-	+	-	+
8	Saponins	+	-	-	-	-	-
9	Proteins/Terpenoids	+	-	-	+	-	+
10	Fixed oils	+	-	-	-	-	-
11	Resins	+	-	-	-	-	-
12	Reducing sugars	-	-	-	-	-	-

Slightly present ++ Present + Absent -

DESCRIPTION OF TABERNAEMONTANA DIVARICATA

Tabernaemontana divaricata belongs to the Apocynaceae family and is native to the Indian subcontinent. Its aesthetic appeal has made it a popular ornamental shrub, but beyond its visual allure lies a rich reservoir of bioactive compounds. The focus of this study is chosen for its potential medicinal properties.

Leaves	These plants often exhibit leaves arranged in whorls of three, with elliptic to lanceolate or obovate shapes, bright green on the upper side and pale green on the underside, along with an acute or acuminate tip and a slender, tapering base.
Stem	Tabernaemontana divaricata often has a smooth stem. The stem texture is generally smooth, contributing to the overall appearance of the plant. This smoothness is a characteristic feature of its stem structure.
Flower	the flowers of Tabernaemontana divaricata. The bisexual flowers typically have a diameter of 6-12 cm, with slender, pubescent pedicels measuring around 1-1.5 cm in length. The jointed apex and hairy underside are distinctive features of these flowers.
Calyx	the calyx of Tabernaemontana divaricata typically consists of five lobes, and it's stellate or star-shaped, covered with glandular hairs on the outside. This characteristic helps distinguish it within its botanical features.
Corolla	Tabernaemontana divaricata indeed boasts a striking corolla that can be quite eye-catching. The base of the corolla comes in various colors like yellow, white, orange, or purple, and its overall structure is typically bell-shaped or campanulate, contributing to its allure and appeal as an ornamental plant.
Fruit	the ovary of Tabernaemontana divaricata matures into a capsule-a dry, dehiscent fruit that opens up to release numerous small seeds. This capsule structure and seed dispersal mechanism are common among various plants and contribute to the propagation and spread of Tabernaemontana divaricata.
Inflorescence	The inflorescence of Tabernaemontana divaricata commonly takes the form of a cyme, more specifically a dichasial cyme. This type of inflorescence is determinate, meaning its growth is restricted and concludes with the development of a flower or bud at its terminal point. This structure defines the arrangement and growth pattern of the flowers in this plant species.
Root	The roots of Tabernaemontana divaricata are typically tuberous and exhibit a pale brown coloration. These tuberous roots play a role in the plant's nutrient storage and absorption, aiding its growth and development.

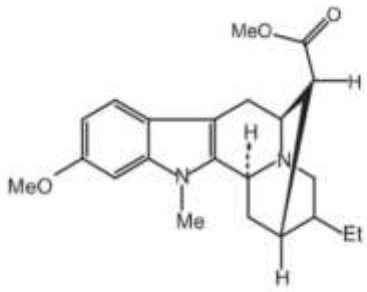
GROWTH AND CULTIVATION

Tabernaemontana divaricata, known by various names like pinwheel flower, crape jasmine, East India rosebay, and Nero's crown, is indeed a captivating evergreen shrub or small tree native to South and Southeast Asia, including China. Its ornamental value as a house or glasshouse plant owes much to its beautiful flowers and foliage. The milky latex from its stem, often referred to as the milk flower, is a distinctive feature of this plant. With dichotomously branched growth, it can grow to a height of 1.5-1.8m (5-6 ft). The large, glossy leaves are about 15cm (6in) in length and 5cm (2in) in width, and the plant produces tiny clusters of waxy blossoms at the tips of its stems.

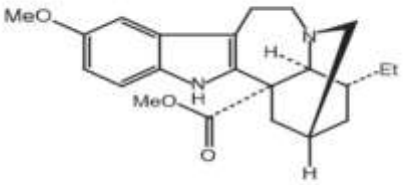
STRUCTURES

The stem extract of Tabernaemontana divaricata comprises a diverse array of phytochemicals, including alkaloids, flavonoids, tannins, and other secondary metabolites. Alkaloids, such as cornaridine and ibogaine, have been previously identified in the plant and are recognized for their pharmacological activities. The structural complexity of these compounds suggests a multifaceted approach in targeting bacterial pathogens, making the stem extract a promising reservoir for novel antibacterial agents.

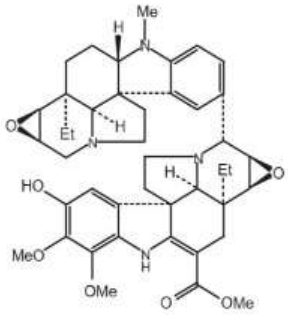
Structure of important chemical constituents (Alkaloids)



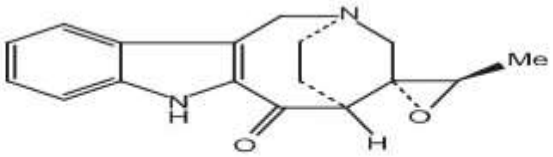
11-Methoxy-N-methyldihydropericyclivine **(1)**



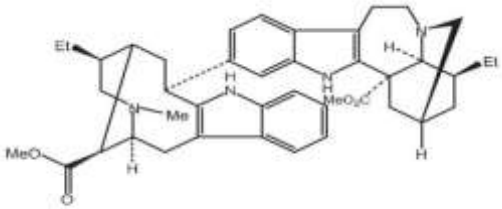
19-Epivoacangine**(5)**



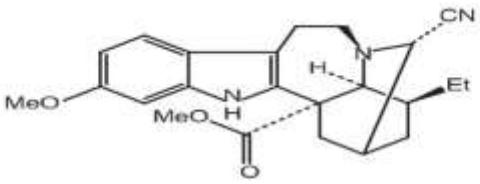
Conofoline



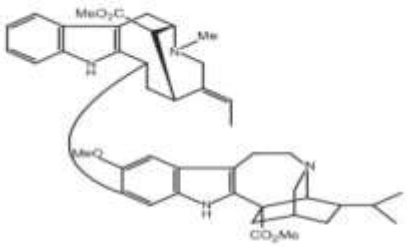
Conolobine A



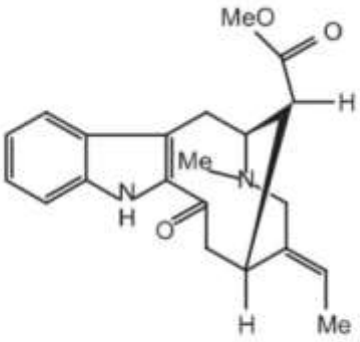
19,20-Dihydroervahanine A



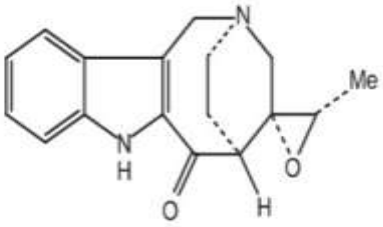
3S-Cyanoisovoacangine



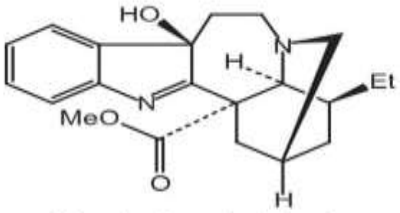
Voacamine



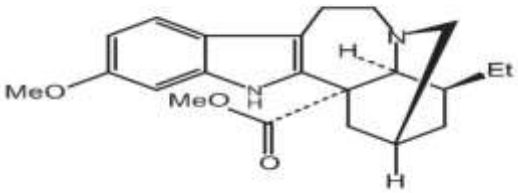
Vobasine



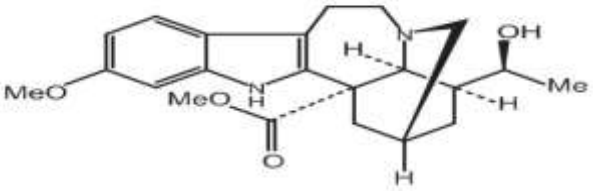
Conolobine B



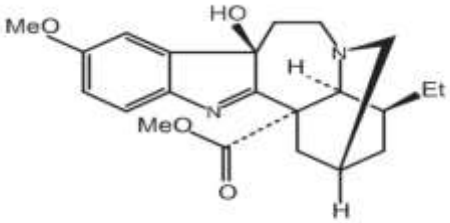
Coronaridine hydroxyindolenine



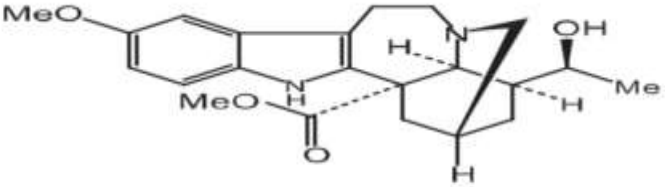
Isovoacangine **(37)**



Isovoacristine **(38)**



Voacangine hydroxyindolenine **(57)**



Voacristine **(58)**

Summary of Non alkaloids isolated from Tabernaemontana stem part.

Non alkaloids	Plant part	Specimen from	Reference
Enzyme: Anthranilate synthase	Cell culture	Netherlands	poulsen et al, 1991
Tryptophan decarboxylase Strictosidine synthase Strictosidane glucosidase Isopentenyl Pyrophosphate isomerase Geratinol 10-hydroxylase	Cell culture	Netherlands	Dagnino et al, 1995
Strictosidine beta glucosidase Squalene synthase Isopentenyl diphosphate Isomerase Farnesyl diphosphate synthase	Cell culture	Netherlands	Luijendijk et al, 1996
Superoxide dismutase catalase Ascorbate peroxidase Glutathione reductase Phenolic peroxidase	Whole plant	India	Mandal and Mukherji, 2001
Pyrolytic oil and solid char	Stem, leaves	India	Sharma and prasad, 1996
Hydrocarbon Other (terpenoid and phenolic acid):	Leaves, ,roots flowers, stems	India	Behera et al
Alpha-amyrin acetate Lupeol acetate Alpha-amyrin lupeol cycloartenol Beta-sitosterol campesterol benzoic acid Aurantiamide acetate	Root bark	India	Rastogi et al, 1980 Dagnino et al, 1994 Van der heijden et al, 1989

CONCLUSION

The potential of Tabernaemontana divaricata as shown a formidable natural antibacterial agent with different extracts (like flowers, leaves, fruits, bark aerial parts and roots). This is because of rich presence of alkaloids and flavonoids. As a value we have given more concentrations on the selection of stem part for preparing various extracts to detect the antimicrobial results. Since the earlier results already shown the good antimicrobial activity with different parts. Hence the further research is imperative to elucidate the specific mechanisms of action, conduct in in-vivo studies and asses the extracts efficacy against a broader spectrum of clinically relevant bacterial strains. Tabernaemontana divaricata stands as a beacon of hope, bridging the traditional and scientific realms in the pursuit of innovative antibacterial solutions.

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