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MICROSCOPIC CHARACTERIZATION, TRADITIONAL USES, PHYTOCHEMISTRY AND PHARMACOLOGY OF *NYCTANTHES ARBOR-TRISTIS*: AN UPDATED SYSTEMATIC REVIEW

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Keywords:

Nyctanthes arbor-tristis, Phytoconstituents, Stem, Transverse section, Microscopy, Pharmacological activities

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ABSTRACT: Introduction: Being an Oleaceae family member, *Nyctanthes arbor-tristis*, known as Night jasmine or Harashingar, is a legendary plant with enormous therapeutic potential. Research on the different plant parts, such as the leaf, flower, fruit, seed, and bark revealed the phytochemicals that were responsible for the primary pharmacological activities. These phytochemicals included glucose, oleanic acid, glycosides, carotene, tannic acid, flavanoids, benzoic acid, and essential oils. The present article discusses the taxonomy, vernacular names, distribution, botanical description, habitat, cultivation and propagation, traditional uses, phytoconstituents, and pharmacological activities of the plant. The article also describes the study carried out on the characterization of microscopy of the stem transverse section. **Objective of the Study:** To investigate the microscopic characterization of the stem of *Nyctanthes arbor-tristis*. **Method:** The thin transverse section of the plant stem was treated with several chemicals like alcohol (10%, 30%, 50%, 90%, 100%) and with xylene (10%, 30%, 50%, 90%, 100%). The dyes, saffranine, and methylene blue were used to stain the stem sections. DPX assisted in making a permanent slide. **Result:** When viewed under the microscope, the thin transverse section of the stem displayed differentiation into various layers – the cuticle, epidermis, cortex, vascular system that consisted of primary xylem and phloem, secondary xylem and phloem, underdeveloped endodermis, and the pith – starting from outside towards the center.

INTRODUCTION: Bioactive chemicals can be found in natural products, which may also lead to the development of new medicinal agents. Plant-based medications have garnered increased attention in the past ten years, and they have established a significant class of medications for the treatment of disease.

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Worldwide, there is a revival of herbs and a comeback for them. These days, herbal goods stand for safety as opposed to synthetics, which are seen to be harmful to both people and the environment [1]. *Nyctanthes arbor-tristis*, also referred to as Night-flowering Jasmine or Parijat, is an intriguing species of plant native to the Indian subcontinent.

It has attracted notice for its beautiful white blossoms that open up at night and release a delightful scent that tantalises the senses [2]. Many places venerate this plant as a sacred symbol because of its deep cultural value and its involvement in many mythological stories [3]. Botanically, *Nyctanthes arbor-tristis* is a member

of the Oleaceae family and has unique physical properties. The plant has elliptical, opposing leaves with noticeable veins [4]. The tubular white flowers of *Nyctanthes arbor-tristis* have a fascinating orange or yellow core. To ensure effective reproduction, these aromatic blooms to attract nocturnal pollinators like moths and bees [5]. For millennia, Ayurvedic medicine has acknowledged the therapeutic benefits of *Nyctanthes arbor-tristis*, and this plant is widely used in the practice. The leaves, seeds, and flowers are among the plant parts used for their medicinal properties [6]. Traditionally used to reduce inflammation, relieve fever and pain, *Nyctanthes arbor-tristis* is well known for its anti-inflammatory, antipyretic and analgesic effects [5]. The plant's traditional uses have been validated by experimental research [7]. Studies on phytochemistry have provided insight into the components of *Nyctanthes arbortristis* that are responsible for its therapeutic effects. The plant's phenolic acids, essential oils, flavonoids, and iridoids all contribute to its medicinal properties [6]. Due to their antioxidant qualities, these bioactive substances guard against oxidative stress and related illnesses. Moreover, studies have demonstrated its hepatoprotective, anti-cancer, antidiabetic, and antimalarial qualities, demonstrating its adaptability in therapeutic settings [8]. This article describes the plant's taxonomy, common names, distribution, botanical description, habitat, cultivation and propagation, traditional applications, phytoconstituents, and pharmacological properties. The examination of the characterization of the stem transverse section's microscopy is also covered in the article.

Taxonomy:

TABLE 1: TAXONOMY [9]

S. no.	Taxonomy	
1	Kingdom	Plantae
2	Division	Magnoliophyta
3	Class	Magnoliopsida
4	Order	Lamiales
5	Family	Oleaceae
6	Genus	Nyctanthes
7	Species	Arbor-tristis

Vernacular Names:

TABLE 2: VERNACULAR NAMES [9]

S. no.		Vernacular names
1	English	Coral jasmine, Night jasmine
2	Kannada	Harashingar, Parijata
3	Tamil	Manja-pu, Pavazahamalligai, Pavilamalligai
4	Malayalam	Pavizhamalli, Pavilamalli, Parijatakam, Parijatam
5	Hindi	Shefali, Parja, Nibari, Har, seoli, Siharu, saherwa, Harsing har
6	Odia	Jharasephali, Shingadahar, Gangaseuli Harashingar
7	Telagu	Karuchiya, Paghada, Pagadammali, Karchia, Swetasarasa
8	Marathi	Parijataka, Khurasli, Purijat

Distribution:

Worldwide: *Nyctanthes arbor-tristis* is indigenous to Nepal and India's subtropical Himalayan regions. Geographically, the plant is dispersed throughout south-east Asian nations like Malaysia, Thailand and Indonesia, as well as north regions of Pakistan and south regions of India.

India: It spreads across the central regions of India all the way to the Godavari in the south. It distributes from east Assam to Nepal and also cover the regions of outer Himalayas and Jammu and Kashmir. It is also found to be localised in Tripura and Bengal [10, 11].

Botanical Description:

Height: *Nyctanthes arbor-tristis* is a terrestrial plant. This woody shrub having 5-20 years life span, attains height of up to 10 metres.

Stem and Bark: The branches of the plant are quadrangular. The grey coloured bark is rough and flaky.

Leaves: The simple, hairy, rough leaves measure 6–12 cm in length and 2–6.5 cm in width, with a complete margin. The arrangement of the leaves is decussate opposite [12].

Flowers: The fragrant, sessile flowers have a thin, campanulate shape and are longer than 13 mm. The flowers are hairy on the surface but glabrous from

inside, with a ciliated calyx and a 6-8 mm long tube. The white corolla has 5-8 unevenly cuneate and obcordate lobed white petals with orange red at the center.

The stigma is slightly bifid, and two stamens are placed close to the apex of the corolla tube. Flowers are grouped in clusters of two to seven at the tips of branches or in the axils of leaves.

Fruits: The green to brown colored fruits range from spherical to heart shape. The fruits are compressed, flat capsules with two parts, each holding one seed.

Seed: Exalbuminous seeds have flat cotyledons, thick testa and inferior radicle and contains highly vascularised outer layer consisting of huge transparent cells [11, 12].

FIG. 1 & 2: *NYCTANTHES ARBOR-TRISTIS* PLANT

FIG. 3: STEM

FIG. 4 & 5: LEAVES OF PLANT

FIG. 6: FRUIT OF PLANT

Habitat: In its natural habitat, the plant grows on rocky slopes in arid hillsides and also flourishes in dry deciduous forests as undergrowth. It can withstand mild shade and grows from sea level to a height of 1500 meters. It can tolerate broad variety of non-seasonal to seasonal rainfall patterns.

Microscopy of Stem: Materials used for microscopy of stem: Apparatus: Petri dish, watch glass, dropper, blade, brush.

Chemicals: Alcohol, water.

Dyes: Saffranine, methylene blue.

Mountant: DPX (dibutyl phthalate polystyrene xylene).

Method: The sample of the stem of plant *Nyctanthes arbor-tristis* was collected. A transverse thin section of the fresh stem was taken. It was treated with 10% alcohol (9 drops of water + 1 drop of alcohol) for 5-7 minutes, followed by 30% alcohol for 3-5 minutes, followed by 50% alcohol for 2-3 minutes, followed by 70% alcohol for 1-2 minutes, followed by 90% alcohol for 30 seconds to 1 minute. After that the sections were stained with saffranine dye (red dye) for few seconds followed by 2 washes with 100% alcohol. The sections are then treated with 10% xylene (9 drops of alcohol + 1 drop of xylene), followed by 30% xylene, 50% xylene, 70% xylene, and 90% xylene. Then the sections were stained with methylene blue dye followed by washing with 100% xylene. After that the sections are placed on the slide and mounting is done with the help of DPX (Dibutyl phthalate polystyrene xylene).

FIG. 7 & 8: MATERIALS USED FOR MICROSCOPY

RESULTS: The stem section that appeared quadrangular showed several tissues as follows: The single, layered epidermis consists of cells that seem rectangular. The epidermis consists of a continuous, thick cuticle with many multicellular hairs. Below the epidermis, the cortex was just a few layers deep in other locations, but it was numerous cells deep underneath the four protruding corners. The cortex has differentiation into parenchyma and collenchyma. There was the presence of several intercellular spaces. The extension of the cortex area was up to vascular tissue. Vascular bundles in the cortex were open, collateral, conjoint, and exarch. In every conical bundle, the pointed end of the xylem faces the outside. Microscopy showed that the endodermis was underdeveloped. Sclerenchymatous patches of the pericycle were present. The vascular system consists of primary and secondary phloem, cambium, and primary and secondary xylem. Under the pericycle, irregular patches of crushed primary phloem were seen. The secondary phloem was present as a continuous ring and was made up of companion cells, sieve tubes, and phloem parenchyma. In between the phloem and xylem, there was a continuous layer of cambium ranging in thickness from one to three cells. Inside the cambial ring, a secondary xylem was located. The secondary xylem was primarily made up of fibres, and the woody parenchyma had a thick wall. Additionally, vessels and tracheids were seen. Close to the pith, the primary xylem was located, with its protoxylem oriented towards the centre. The Pith was parenchymatous, having a thin wall.

FIG. 9: PERMANENT SLIDE OF TRANSVERSE SECTION OF STEM

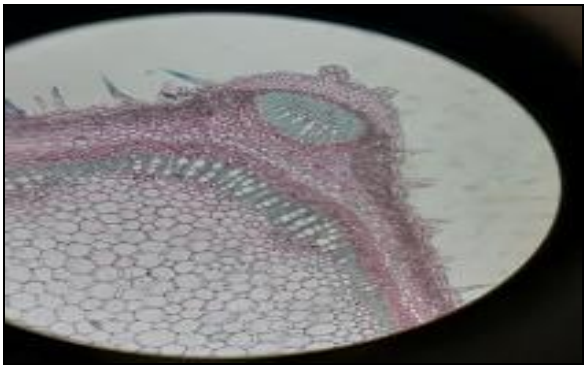

FIG. 10: MICROSCOPY OF THE TRANSVERSE SECTION OF STEM OF *NYCTANTHES ARBOR-TRISTIS*

Cultivation and Propagation: Around the world, the plant can be grown in tropical and subtropical climates. The plant flourishes well in a broad range of loamy soil types. In ordinary garden conditions, the plant thrives in soil with pH range of 5.6 to 7.5. The plant needs to be in a variety of lighting situations, from full sun to some shade, and it need frequent irrigation but not excessive watering. Typically, the blooming season lasts from late september to december. Flowers begin to open in the late evening. Across India, Malaysia, Sri Lanka and Indonesia, night jasmine is frequently grown next to Hindu temples and its flowers are used to worship. Propagation of plant can be carried out through plant part cuttings of semi-hardwood and seeds [11-14]. April-raised seedlings are transplanted in May or June. By August, it reaches a height of 2 meters, and that same year, in September or October, it begins to flower. Blooms can also be produced from rooted cuttings cultivated in containers. Other methods of propagation are budding and grafting [15].

Traditional Uses: In addition to being used in Ayurvedic, Siddha, and Unani medical systems, various portions of the plant *Nyctanthes arbor-tristis* are known to be used by tribal people in India, particularly in Orissa and Bihar, for the treatment of various maladies [16].

TABLE 3: TRADITIONAL USES OF *NYCTANTHES ARBOR-TRISTIS*

S. no.	Plant part	Preparation	Traditional use
1	Leaves	Entire leaf	Diuretic, skin fungal infection, laxative, colleague, dry cough, diaphoretic. Young leaves: to relieve gynecological issues and as female tonic
		Leaf juice	Antidote to reptile venoms, biliary disorders, rheumatism, in children for expelling threadworms and roundworms, as digestive, chronic fever, to treat appetite loss, obstinate sciatica, piles, as mild bitter tonic, malarial fever, liver disorders.
		Decoction	To treat malaria, liver disorders and arthritis.
		Leaves paste along with honey	Used to treat hypertension, fever, diabetes [17-18].
2	Flowers		Ophthalmic use, stomachic, piles, carminative, scabies and skin diseases treatment, to induce the menstrual cycle, antibilious, hair tonic, to treat mouth ulcers, astringent for bowel, expectorant, as sedative.
		Flower juice	As a hair tonic to combat baldness and hair graying.
		Decoction	Increase gastrointestinal secretions, to treat gout, enhance lung expectoration [15, 18-20.]
3	Seed	Seed powder	Expectorant, for treating skin conditions, scurvy, scurfy scalp ailments, alopecia, piles, as anthelmintic [21].
4	Stem bark		Bronchitis and snakebite treatment
		Bark powder	Rheumatic joint pain, as expectorant, anti-malarial.
		Paste (combined with Arjuna bark paste)	They are applied to the body to cure fractured bones in joints and internal injuries [22].
5	Root	Root	As anthelmintic [18].
		Root bark	Anti-bacterial activity [23].

Phyto-Constituents of *Nyctanthes arbor-tristis*:

TABLE 4: PHYTO-CONSTITUENTS OF *NYCTANTHES ARBOR-TRISTIS*

S. no.	Plant part	Phyto-constituents present
1	Leaf	β-sitosterole, ascorbic acid, iridoid glycosides, astragaline, methyl salicylate, benzoic acid derivative of carotene and kaempferol, nicotiflorin, volatile oil, fructose, oleanolic acid, friedeline, nyctanthic acid, lupeol, tannic acid, mannitol, D-mannitol, glucose [24-26].
2	Flower	Flavonoids, essential oil, diterpenoid nycanthin, β-monogentiobioside, anthocyanins, β-digentiobioside [27, 28].
3	Flower oil	Pcymene, methyl heptanone, quercetin, anisaldehyde, kaemferol, 1- decanol, α-pinene, 1-hexanol, apigenin, phenyl acetaldehyde, anthocyanin. [18]
4	Seed	Glycerides, myristic acids, Arbortristoside A & B, 3-4 secotriterpene acid, Lignoceric acid, D-glucose, Stearic acid, D-mannose, Palmitic acid.
5	Stem bark	phenylpropanoid, iridoid [29].

6	Stem	Naringenin-4'-Oβ-glucopyranosylα-xylopyranoside, β-sitosterol, Nyctanthine.
7	Root	Tannins, β-Sitosterol, alkaloids, oleanolic acid and glucosides. [18]

Pharmacological Activities of *Nyctanthes arbor-tristis*:

TABLE 5: PHARMACOLOGICAL ACTIVITIES OF *NYCTANTHES ARBOR-TRISTIS*

S. no.	Plant part	*In-vivo* / *in-vitro* model	Extract / fraction	Pharmacological activity	Study suggestions
1	Leaves	male Swiss albino mice (*in-vivo*)	Aqueous	Antiviral activity	Cellular and humoral immunity of mice was triggered by flavanol glycoside present in the extract [30].
		Swiss albino rats (*in-vivo*)	Ethanol	Antiviral activity	Humoral and cell-mediated immunity was triggered[31].
		Sprague-Dawley rats (*in-vivo*)	50% ethanolic	Antidiabetic activity	The extracts' antioxidant components, which counteract the oxidative stress associated with diabetes, may be the cause of the antidiabetic action[32].
		Rats (*in-vivo*)	90% ethanolic	Anti-inflammatory	Demonstrated a more encouraging outcome in the acute model than the chronic type[33].
		Albino mice and rats (*in-vivo*)	95 % ethanolic	Anti-inflammatory	justified its application in the Ayurvedic medical system for a range of inflammatory disorders[34] .
		Albino Wistar rats (*in-vivo*)	Methanolic	Hepatoprotection	Hepatoregenerative potential demonstrated by averting the deterioration of glutathione levels and guarding against deterioration of membrane[35].
		Male albino Wistar rats	90% ethanolic	Cognitive impairment	Inhibition of acetylcholinesterase[36].
		Sprague Dawley rats (*in-vivo*)	Ethyl acetate	Antiarthritic activity	Identification of the relevant phytoconstituents and validation of the antiarthritic action is needed[37].
		In-vitro	50% ethanol	Anti-fungal activity	Calceolarioside and β-sitosterol from the extract demonstrated strong anti-fungal properties against the fungi Malassezia[38].
		Albino rats (*in-vivo*)	Water soluble	Anti-ulcer activity	Mechanism of action not evaluated yet[34].
		Fish (*in-vivo*)	Aqueous	Immunostimulation	Immunity was found to be significantly enhanced in finfish. For long-term use at large-scale application, research on active chemical identification and suitable field trials must be identified[39].
		albino male Wistar rats *(in-vivo*)	Ethanolic	Immuno-modulatory activity	Mechanism of action to be evaluated[40].
		In-vitro	Ursolic acid	Antifilarial activity	Could be a viable medication to treat Bancroftian filariasis[41].
		Clinical trial (*in-vivo*)	Leaf paste	Anti-malarial activity	demonstrated strong anti-malarial effectiveness along with good tolerability. Preparing a standard formulation is necessary[42].
		Swiss mice (*in-vivo* and *in-vitro*)	50% ethanolic	Anti-trypanosomal activity	Considerable activity was seen[43].
		Adult albino rats (*in-vivo*)	50% ethanolic	Anxiolytic activity	Extract demonstrated dose-dependent anxiolytic effect[44].
		Mice (*in -vivo*)	Ethanoic	Wound healing activity	It may aid with issues related to exogenous TNF delivery in various

					carcinomas, as well as inflammatory rheumatoid arthritis, inflammatory bowel illness, and septic shock patients' improved cardiac function[24].
		Guinea Pigs (*in-vivo*)	80% ethanolic	Broncho dilatory effect	Demonstrated a clear broncho dilatory impact[45].
2	Flowers	Male adult mice (*in-vitro*)	Aqueous	Hypolipidemic and Hypoglycemic activity	Demonstrated to be risk-free when taken orally and to have encouraging hypolipidemic and hypoglycemic effects[46].
		In-vitro	Chloroform and Ethyl acetate extracts	Anti-bacterial activity	Gram-negative bacteria were more effectively treated by both extracts than gram-positive ones[47].
		Wistar rats (*in-vivo*)	Aqueous and ethanolic	Hepatoprotective activity	A likely mode of action against liver damage caused by CCL4 was suggested. It is necessary to separate and produce the active ingredient that provides hepatoprotection for medications[48].
3	Seeds	Swiss albino mice (*in-vivo* and *in-vitro*)	50% ethanolic extract's n-butanol fraction	Antiviral activity	antiviral properties possessed against enveloped viruses (V) by the Iridoid glycoside - arbortristoside A[49].
		Fish (*in-vivo*)	Chloroform	Immunomodulatory activity	Alkaloids and phytosterols from the chloroform extract responsible for the action[50].
		Male golden hamsters (*in-vivo*) and *in-vitro*	Iridoid glucosides	Anti-leishmanicidal activity	Demonstrated leishmanicidal effect[51].
4	Stem bark	*In-vitro*	80% methanolic	Antidiarrheal activity	Treatment for dysentery[52].
		adult albino rats (*in-vivo*)	methanolic	Anti-inflammatory activity	The nociceptive component, which may be the reason for the suppression of prostaglandins and associated products, is prevented by the extract. The precise mechanism of action needs to be investigated[53].
5	Fruit	*In-vitro*	Methanolic extracts and Petroleum ether	Antibacterial activity	The most effective antibacterial activity was displayed by the methanolic extract[54].
		Adult albino rats (*in-vivo*)	50% ethanolic extract's water-soluble portion	Antistress activity	It rectified the metabolic alterations brought on by stress[55].
6	Root bark	*In-vitro*	Aqueous, Ethanolic, Petroleum ether, and Chloroform extracts	Antibacterial activity	This study revealed notable antibacterial activity[56].

CONCLUSION: To sum up, *Nyctanthes arbor-tristis* is an extremely important and promising plant. Numerous studies have been conducted on its medicinal qualities, pharmacological activity, and aesthetic worth, indicating a wide range of uses and advantages. There are a ton of exciting opportunities for future study, such as focusing on certain substances, creating novel medicines, cultivating decorative variations, and incorporating cultural elements into landscape design. *Nyctanthes arbor-tristis* can enhance human well-being, environmental beauty, and cultural legacy with further scientific research and a comprehensive strategy.

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