



“FROM ANCIENT REMEDIES TO MODERN MARVELS: UNVEILING THE MEDICINAL SECRETS OF *NYCTANTHES ARBORTRISTIS* AND *PIPER BETLE LINN.* LEAVES - A COMPREHENSIVE REVIEW”

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Abstract:

Modern pharmacology has long drawn inspiration from the rich history of traditional medicinal herbs. The therapeutic potential of two such plants, *Nyctanthes arbortristis* and *Piper betel* Linn, is explored in depth in this review. These plant species continue to fascinate scientists in the modern scientific environment because of their numerous uses in traditional medical procedures. The 'Night-flowering Jasmine,' also known as *Nyctanthes arbortristis*, is filled with a wealth of bioactive substances. We examine its analgesic, immunomodulatory, and anti-inflammatory activities to provide light on its potential in the treatment of numerous diseases. We also look into the historical applications of *Nyctanthes arbortristis* and how well they align with current knowledge. The 'Betel Leaf' often referred to as *Piper betel* Linn, has a long history in traditional medicine, notably in Asia. The pharmacological effects of *Piper betel*, such as its antibacterial, antioxidant, and anticancer properties, are shown in this review. By bridging the gap between conventional wisdom and cutting-edge research, we demonstrate the medicinal use of this amazing plant. We also go through the difficulties and possibilities of utilizing the medical potential of *Nyctanthes arbortristis* and *Piper betel* Linn in the twenty-first century. This thorough investigation is a useful tool for academics, professionals, and amateurs who want to learn more about these botanical wonders and use them into contemporary medicine.

Keywords: Betel Leaf and Parijat

1. INTRODUCTION:

The World Health Organization (WHO) defines traditional medicine as "the sum of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illness," whether or not these practices are based on explicable theories, beliefs, or experiences. Indian Traditional Medicine, the world's oldest system of medicine, has contributed significantly to the care and wellbeing of people throughout its history.^[1] Ayurveda, Siddha, and Unani, Yoga, Naturopathy, and Homoeopathy are six of India's ancient

medical traditions. The most well-known of these ancient practices is Ayurveda. The ancient Ayurvedic remedies are used by over 70% of India's rural population.^[2] The use of plants for medicinal purposes has long been documented in ancient literary works. Such documents on the basic traditional knowledge of medicinal plants have provided many important drugs of the modern era. *Nyctanthes arbor-tristis* L. is an important medicinal plant with many medicinal uses since ancient times. Various parts of this plant have been used as local and traditional medicine.^[3] *Nyctanthes arbor-tristis* Linn. (Division: Magnoliophyta; Class: Magnoliopsida; Order: Lamiales; Family: Oleaceae), commonly known as Parijat and Night jasmine.^[4] *Nyctanthes arbor-tristis* (NAT) is commonly used traditionally for the treatment of Rheumatism and Inflammatory diseases.^[5] Different plant components, including seeds, leaves, flowers, bark, and fruit, have some medicinal value and are employed in traditional remedies.^[6] Scientific studies have historically shown that NAT can be used to treat conditions including persistent fever, biliary disease, liver disorder, rheumatism, intractable sciatica, malaria, bronchitis, wound healing, skin problems, stomachic, astringent, and menstruation.^[7] It is one of the most effective conventional medicinal plants in India. It is regarded as a significant plant that produces both distinctive medical medicines and essential industrial items.^[8] Higher plants such as NAT are referred to as "storehouses of chemo-therapeutants" because of their distinctive and extensive collection of biochemicals.^[9,10] Another well-known religious and traditional medicinal plant *Piper betel* Linn. an important species of the Piperaceae family is an evergreen and perennial creeper, with glossy heart-shaped leaves.^[11] There are more than 90 different types of betel vine in the globe, 45 of which are found in India and 30 in West Bengal itself.^[12] *Piper betle* leaf extracts have been found to be beneficial against a number of human diseases.^[13] The most prized part of the plant is the betle leaf, which has been chewed for centuries to prevent bad breath because it contains tannins, chavicol, phenyl, propane, sesquiterpene, cyneole, alkaloid, sugar, and some essential oils. These compounds have been found to have a variety of medicinal benefits, including those for digestion, appetizers, aromatics, expectorants, stimulants, antibacterial and many more.^[14]



Nyctanthes Arbor-tristis(Parijat)

Piper Betel Linn(Nagarbael)

2. DETAILED PLANT STUDIES:

[2.1] *Nyctanthes arbor-tristis*:

[2.1.1] Taxonomical Classification:^[15]

| | |
|----------------------|---------------------------------|
| <i>Kingdom</i> | <i>Plantae</i> |
| <i>Division</i> | <i>Magnoliophyta</i> |
| <i>Class</i> | <i>Magnoliopsida</i> |
| <i>Order</i> | <i>Lamiales</i> |
| <i>Family</i> | <i>Oleaceae</i> |
| <i>Genus</i> | <i>Nyctanthes</i> |
| <i>Species</i> | <i>arbor-tristis</i> |
| <i>Binomial Name</i> | <i>Nyctanthes arbor-tristis</i> |

[2.1.2] Vernacular Names of *Nyctanthes arbor-tristis*:^[15]

- Sanskrit: Parijata, Parijatah, Parijataka, Sephalika
- Hindi: Harsinghar, Harsingur, Seoli, Sheoli, Sihau
- Gujarati: Jayaparvati, Parijatak
- English: Coral Jasmine, Night Jasmine

[2.1.3] Geographical Distributions:

Nyctanthes arbor-tristis Linn is found on rocky ground in dry hillsides and as undergrowth in dry deciduous forests. *Nyctanthes arbor-tristis* Linn, native to Indo Pak subcontinent, grows naturally in Indo Malayan region, Burma, Thailand, Celon, South Asia and Southeast Asia. In India, it grows in the outer Himalayas and is found in tracts of Jammu and Kashmir, Nepal to East of Assam, Bengal, Tripura extended through the Central region up to Godavari in the South. It grows at sea level up to 1500 m altitude, within a wide range of rainfall patterns, from seasonal to non-seasonal and is tolerant to moderate shade. Himalayas and is found in tracts of Jammu and Kashmir, Nepal to East of Assam, Bengal, Tripura extended through the Central region up to Godavari in the South. Flowering usually occurs from July to October. *Nyctanthes* prefers a secluded and semi-shady place to grow.^[16]

[2.1.4] Botanical Description:

Nyctanthes Arbor-tristis is a shrub or small tree with stiff white hairs and grey or irregular bark that can reach heights of up to 10 meters. The young branches have a pronounced quadrangular shape.^[17]

Bark: The *Nyctanthes Arbor-tristis* Having quadrangular branches and rough, grey or greenish-white bark, the Linn tree is a deciduous tree that may reach a height of 10 meters. Scaling off of circular barks has left the bark surface dipped, and grayish-brown colour patches have caused it to be patchy. round flakes of scale are removed from the bark. The non-collapsed phloem zone of the inner bark is clearly apparent and is a creamy white, soft texture.^[18]

Leaves: The leaves are simple, opposite, 5-10 cm long, 2.5-6.3 cm broad, petiolate, ex-stipulate, intact or occasionally with uncommon gigantic distant teeth, oval, acuminate or pointed, curled with little bulbous hairs, or somewhat wedge-shaped. The broad extended blade is elliptical in shape with a dusky green top surface and a light green bottom surface covered with dotted glands and entire or serrated margins. Without including the midrib, the venation is unicostate, reticulate, and has roughly 12 lateral veins. Petioles of NAT leaves have been seen to have adaxial concavity as well. This plant drops its leaves once a year, from October to March.^[19]

Flowers: Small, delightfully fragrant, with 4-angled peduncles, 3-5 pedunculate bracteate fascicles, ovate or suborbicular attached modified leaf structures (bract), apiculate, hairy, 6–10 mm long, and most often seen in clusters of 2–7 flowers, the flowers are arranged on the tip of the main stem and its branches or in the axil of the leaves (solitary and axillary). Calyx has a fringe of fine hairs on the outside and is 6-8 mm long, campanulate, truncate, obscurely toothed, or lobed. The 13 mm long flower has 5-8 white lobes with a reddish orange core, is irregularly obcordate, and is wedge-shaped. On NAT, flowering typically happens from July through October.^[20,21]

Fruits: The fruit is a brown capsule that is 1-2 cm across. It is a long, two-celled, compressed, compressed, glabrous, obcordate structure that divides into two carpels, each bearing one seed. It bears a distinctive pattern of two locules, each of which contains two ovules, superior ovaries, and a bilobed stigma. Large elliptical, naturally occurring cavities that provide as anatomical indicators are common in NAT fruits. Fruit ripens in February and March.^[22]

Seeds: One brown, compressed seed is present in each cell. These are ex-albuminous, Testa thick, and have a strongly vascularized surface layer made up of large transparent cells. Typically, seed harvesting takes place between September and October.^[23]



Bark

Leaves

Flowers



Fruits

Seeds

[2.1.5] Phytochemical Profile:

Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek *phyto*, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators.

| Plant Parts | Chemical Constituents |
|----------------------------|---|
| Leaves ^[24,25] | D-mannitol, sitosterole, astragaline, nicotiflorin, oleanolic acid, nyctanthic acid, tannic acid, ascorbic acid, methyl salicylate, carotene, friedeline, lupeol, mannitol, glucose and fructose, iridoid glycosides, benzoic acid. |
| Flowers ^[26,27] | Essential oil, nyctanthin, d-mannitol, tannin and glucose, carotenoid, glycosides viz β -monogentiobioside ester of α -crocetin (or crocin-3), β -monogentiobioside- β -D monoglucoside ester of α -crocetin, β -digentiobioside ester of α -crocetin. |
| Seeds ^[28] | Arbortristoside A&B, Glycerides of linoleic oleic, lignoceric, stearic, palmitic and myristic acids, nyctanthic acid, 3-4 secotriterpene acid. |
| Stem ^[29] | Glycoside-naringenin-4'-O- β -glucapyranosyl- α -xylopyranoside and β -sitosterol. |
| Bark ^[30] | Glycosides and alkaloids. |

[2.1.6] Pharmacological Profile of *Nyctanthes Arbor-tristis*:



[I] Anticancer activity: *N. arbor-tristis* fruit, leaf, and stem methanol extracts were examined for in vitro anticancer properties. At 30mg/ml cans, moderate action was seen. The dried *N. arbor-tristis* leaf methanol extract was 71% inhibited, and 10 mg/ml cans showed the least amount of inhibitory efficacy. With about 86% inhibition of pathogen-free breast cancer cell lines. *N. arbor-tristis* dried fruit methanol was shown to be very effective against human breast cancer cell lines (MDA-MB 231), and the IC₅₀ values were determined to be 9.72 mg and 13.8 mg. The glycosides, tannins, phenols, and steroids found in the dried fruit methanol of *N. arbor-tristis* are anticipated to be the source of its anticancer action.^[31]

[II] Anti-Parasitic activity: A crude 50% ethanolic extract of the leaves has been reported to exhibit trypanocidal activity at 1000 g/ml concentration. Hamsters infected with *Leishmania donovani* have also shown that *N. arbor-tristis* extract has strong anti-leishmanial action. Infections caused by *Entamoeba histolytica* in the rat cecum have been reported to be cured by 50% ethanolic extracts of *N. arbor-tristis*' seeds, leaves, roots, flowers, and stem. But in vitro, the extracts exhibited no activity. The water-soluble parts of the ethanolic extract of the flowers, bark, seeds, and leaves of *N. arbor-tristis* were discovered to have anthelmintic effect, which is likely caused by the inhibition of motility by relaxing and depression in response to acetylcholine's contractile action.^[32,33,34]

[III] Antimalarial activity: There was a clinical investigation done with 120 malaria patients. Ninety-two (76.7%) of the patients were treated with a fresh paste made from five medium-sized leaves of *N. arbor-tristis* that was given three times daily for seven days. The eight patients who did not react to therapy were among the 20 patients who recovered within 10 days. No serious adverse effects were noticed, and the paste was well tolerated.^[35]

[IV] Anti-Diabetic Activity: Oral administration of chloroform and ethanolic leaf and flower extracts markedly increased superoxide dismutase (SOD) and catalase (CAT) levels and markedly decreased liver lacto peroxidase (LPO), serum SGPT, SGOT, and alkaline phosphatase, cholesterol, and triglyceride levels in diabetic controls. An ethanol extract of the stem bark showed notable anti-diabetic action when fed to diabetic rats receiving streptozotocin-nicotinamide treatment. Depending on the dosage, the extract reduces blood glucose levels.^[36]

[V] Anti-Allergy Activity: In guinea pigs exposed to histamine aerosol, pretreatment with a water soluble component of an alcoholic extract of NA leaves prevented asphyxia. In NA, arbortristosides A and C have been demonstrated to have anti-allergic properties.^[37]

[VI] Antianemic Activity: In a study on rats, the amount of haemoglobin and the number of red blood cells increased in a dose-dependent manner using ethanolic extracts of the plant's flowers, barks, seeds, and leaves. The extracts also stop the deterioration of the hemogram profiles in anemic rats.^[38,39]

[VII] Anti-Leishmanial Activity: Iridoid glucosides, arbortristosides A, B, and C, as well as 6-b-hydroxyloganin, have all been linked to *N. arbortristis* anti-leishmanial action. Both in vitro and in vivo anti-leishmanial efficacy was shown by the arbortristosides A, B, C, and 6-beta-hydroxy-loganin against amastigotes in macrophage cells and hamster test systems, respectively.^[40]

[VIII] Anti-Inflammatory activity: Acute and subacute anti-inflammatory action was found in the aqueous extract of the whole plant, the alcoholic extract of the stem and seeds, and the water-soluble component of the alcoholic extract of the leaves of *N. arbortristis*. In inflammatory models, the acute anti-inflammatory action is assessed in the rat hind paw using several phlogistic agents, including carrageenan, formalin, histamine, 5-hydroxytryptamine, and hyaluronidase. In both the granuloma pouch and the cotton pellet tests, it was discovered that *N. arbortristis* significantly inhibited the development of granulation tissue in the sub-acute animals. Additionally, it has been discovered that *N. arbortristis* inhibits the inflammation brought on by the immunological techniques Freund's adjuvant arthritis and pure tuberculin response.^[41]

[IX] Anti-Oxidant activity: Strong antioxidants are produced by plants, and *N. arbortristis* leaves are used as a decoction in Ayurvedic medicine to treat a variety of illnesses.^[42] the methanolic extract from the leaves of *N. arbortristis* on free radical induced lipid peroxidation using bovine brain phospholipid liposomes and found good activity with IC50 values of 20 mg/ml. It was originally discovered that the plant's leaves' aqueous extracts have anti-DPPH radical, anti-hydroxyl radical, and anti-lipid peroxidation properties.^[43]

[2.2] *Piper Betel* Linn:

[2.2.1] Taxonomical Classification:^[46]

| | |
|----------|----------------------------------|
| Synonyms | Chavica Beta, Arthanthe Hixagona |
| Kingdom | Plantae |
| Order | Piperales |
| Family | <i>Piperaceae</i> |
| Genus | <i>Piper</i> |
| Species | <i>P. Petle</i> |
| Taste | Pungent Taste |
| Division | Magnoliphyta |

[2.2.2] Vernacular Names of *Piper Betle* Linn:^[46]

- Sanskrit: Tambool, Mukhbhushan, Varnalata
- Hindi: Paan leaf
- Gujarati: Nagarbael, Paan
- English: Betle, Betle pepper, Betle-vine

[2.2.3] Geographical Distributions:

The Betel vine (usually the male plants) is believed to have originated in Malaysia. The plant is commonly cultivated in India and many other countries in South and South East Asia, including China and Vietnam, where the climate is hot and humid and the woods are typically damp. The piper beetle is said to have initially appeared in tropical Asia before migrating to Madagascar and East Africa. The

betel plant has a long history, with references to its presence dating back more than 2000 years in India, Sri Lanka, Bangladesh, Indonesia, Nepal, Pakistan, Vietnam, Thailand, Laos, Kampuchea, Philippine Islands, Burma, Malaysia, Taiwan, and many other countries in Southeast Asia.^[47] Bengal, Bihar, Orissa, Andhra Pradesh, Karnataka, Uttar Pradesh, and Tamil Nadu are among the Indian states where the plant is found.^[48,49,50] There are over 100 different types of betel plants, 40 of which are produced in India, along with another 30 in Bangladesh and West Bengal.^[51] Growing betel vines is a fairly common sort of farming. The best locations for betel cultivation are highlands, particularly fertile sandy, sandy clay, or sandy loam soil with good drainage and a pH range of 5.6-8.2. Saline and alkali soils where water logging is a problem are not suitable; suitable weather conditions include 2250-4750 mm of rainfall, relative humidity of 40-80%, and temperatures between 15 and 40°C.^[52]

[2.2.4] Botanical Description:

The plant is a dioecious root climber, and depending on the climbing infrastructure available, the shoots can grow as high as 3 to 10 meters. Along its whole length, the plant has lateral branches that sprout a few feet above the ground.

Stems: The stems have dichotomous branching and roots at the nodes, and they are large and articulate. When young, the stems are light green with short, elevated, white streaks and pinkish stripes along the node. They are thick, almost terete, and somewhat flattened. The internodes typically grow to a diameter of 1.2 cm and a length of around 12 cm.^[53,54]

Leaves: Simple blade, alternating, spiral, and exstipulate are the characteristics of the leaves, while the petioles are 2–5 mm long, hairy, and channelled. The leaf blades are whole, slightly recurved, glabrous, coriaceous, fleshy, green to yellowish, shiny, broadly ovate, width 7-8.5 cm, and length 9-11 cm. The venation is reticulate, with 7-9 veins in two or three pairs originating from the midrib and one pair raising from base.^[53,54]

Fruits: On the rachis of the mature flower are fruiting spikes that are 3-5 cm long, orange, and druping.^[53,54]



Stem

Leaves

Fruits

[2.2.5] Phytochemical Profile:

Phytochemicals are chemicals of plant origin. Phytochemicals (from Greek *phyto*, meaning "plant") are chemicals produced by plants through primary or secondary metabolism. They generally have biological activity in the plant host and play a role in plant growth or defense against competitors, pathogens, or predators.

| Chemical Compounds | Bioactive Constituents |
|--------------------|---|
| Phenolic | Chavicol, Hydroxychavicol, Chavibetol, Chavibetol Acetate and Eugenol. |
| Ethanolic | Steroids, Diterpenes, Tannin, Cardiac Glycosides, Flavonoids, Saponin, Phenols, Coumarin and Alkaloids. |
| Methanolic | Steroids, Diterpenes, Tannin, and Saponin |
| Butanolic | Steroids, Diterpenes, Tannin, Flavonoids, Emodins and Alkaloids. |
| Acetone | Steroids, Diterpenes, Tannin, Flavonoids, Saponin and Coumarin. |
| Aqueous | Steroids, Diterpenes, Tannin, Cardiac Glycosides, Flavonoids, Saponin, Phenols, Coumarin and Alkaloids. |

[2.1.6] Pharmacological Profile of *Piper Betle* Linn:

[I] Antioxidant activity: Due to its high phenolic content, an ethyl acetate extract demonstrated the strongest ferric reducing activity as well as radical scavenging capabilities against DPPH, superoxide anion, and NO radicals. Catechin, morin, and quercetin were found in the leaves through analyses. Additionally, the plant extract significantly reduced the growth of MCF-7 cells, whereas catalase and superoxide dismutase activity increased.^[55]

[II] Anticancer activity: Study evaluated an aqueous extract of leaves to cytotoxicity studies on Hep-2 cell line. The mean CTC50 was 96.25 ug/ml suggesting potent cytotoxicity and probable anticancer property. Piper betle leaf extract showed significant LC50 values of >100 µg/mL towards *A. salina*. The presence of cytotoxic compounds also suggests potential antitumor or anticancer property.^[56]

[III] Wound Healing: The study found that NSAID-induced peptic ulcers in albino rats significantly healed. The plant extract's capacity to scavenge free radicals was thought to be responsible for the therapeutic effect. In Sprague-Dawley rats, APC, one of the phenol's ingredients, significantly reduced the incidence of ulcers brought on by indomethacin. The antioxidative and mucin-protecting qualities were linked to the protection.^[57]

[IV] Antifungal activity: The antifungal activity of hydroxychavicol, which was obtained from the chloroform extraction of the aqueous extract of *P. Betle*, was examined against 124 strains of chosen fungi. Inhibitory effects of hydroxychavicol were seen in clinically significant fungi. Additionally, it demonstrated a prolonged post-antifungal action for species of *Candida* and the prevention of mutant emergence. The findings point to a possible topical antifungal drug and a gargle for oral candida infections.^[58]

[V] Anti-malaria activity: In comparison to the well-known mosquito repellent citronella oil, the essential oil of *Piper betle* offered superior protection against the bites of *Anopheles stephensi* and *Culex fatigans* mosquitoes. When sprayed at a rate of 20 µ/cm², piper betle oil offered protection against *Anopheles stephensi* and *Culex fatigans* for almost 4 hours, but citronella oil only offered 2.2 and 2.6 hours of protection, respectively. Thus, the plant's ability to repel mosquitoes was established.^[59]

[VI] Anti-allergic activity: The extracts dramatically reduced the levels of histamine and GM-CSF generated by an IgE-mediated hypersensitivity reaction as well as suppressed the release of exotoxin and IL-8 during an allergic reaction triggered by TNF- and IL-4. The findings indicated that *Piper betel* may provide a novel treatment strategy for the management of allergic illnesses by reducing the generation of allergic mediators.^[60]

3. CONCLUSION:

In conclusion, the comprehensive review of *Parijat* and *Betel* has unveiled a rich history of ancient remedies and their modern marvels. These plants, with their medicinal properties, have played a crucial role in traditional medicine for centuries. Today, their therapeutic potential is being explored through scientific research, offering hope for new treatments and insights into their health benefits. As we bridge the gap between ancient wisdom and modern science, the potential for these plants to contribute to the future of medicine remains promising, and further studies are needed to fully understand their true medicinal secrets.

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