



## Review Article

ISSN 2320-480X

JPHYTO 2024; 13(4): 328-333

July- August

Received: 14-04-2024

Accepted: 10-08-2024

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doi: 10.31254/phyto.2024.13409

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## Harnessing the Power of Nature: *Nyctanthes arbortristis* as an Alternative Medicine

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### ABSTRACT

The *Nyctanthes arbortristis*, frequently referred to as Night-flowering Jasmine or Parijat, has a longstanding presence in traditional medicine. In this study, our objective was to assess its potential as an alternative therapy by analyzing its therapeutic uses and the scientific data that supports it. *Nyctanthes arbortristis*, a plant widely used in Ayurveda for its anti-inflammatory, antipyretic, and analgesic qualities, has shown promise in the treatment of several health disorders such as persistent fever, arthritis, parasite infections, and respiratory ailments. Recent studies have found several bioactive chemicals in this plant, including alkaloids, flavonoids, essential oils, and glycosides. These substances contribute to the pharmacological effects of the plant. This report consolidates current research results on the many health advantages of the plant and proposes potential topics for future investigations on the most effective ways to use it for therapeutic purposes. By incorporating *Nyctanthes arbortristis* into contemporary healthcare, it will be possible to create treatment plans that are both natural and sustainable, while also complementing current practices.

**Keywords:** Alternate medicine, Antiallergic, Antihistamine, Anticancer, *Nyctanthes arbortristis*.

### INTRODUCTION

The natural world contains a multitude of wonders. Ancient civilizations utilized conventional remedies and cultural customs to address ailments. The Rigveda has the oldest reference to traditional medicine. Ayurveda, originating from the Vedic comprehension of existence, subsequently evolved into the fundamental foundations for all medical disciplines. The traditional therapeutic method utilizes a wide array of herbs and medicinal plants that have shown to be advantageous to mankind for millennia. *Nyctanthes arbortristis*, also known as *N. arbortristis* (NAT), is a significant botanical specimen belonging to the Oleaceae family. It is predominantly distributed in tropical and subtropical areas. It is commonly known as Night jasmine, Harsinghar, and Parijat. The flowering season lasts from September to October. The blooms begin to descend around midnight and stop by daylight. The several parts of this plant are used in Indian medicine for various pharmacological effects, such as combating leishmaniasis, viruses, fungi, fever, histamine, malaria, oxidation, inflammation, and other activities [1]. Herbs have consistently been the predominant form of medicine in India throughout history, and their popularity has now extended globally. Furthermore, they provide not just conventional and cultural healing practices, but also ensuring the delivery of exceptionally potent novel bioactive substances. *N. arbortristis* contains various beneficial components like  $\beta$ -sitosterole, Oleanolic acid, Arbortristoside A & B,  $\alpha$ -crocetin (or crocin-1), 4-hydroxy hexahydrobenzofuran-7-one, and other chemicals [2]. These chemicals enhance the plant's appeal for therapeutic purposes. Gaining expertise in both historical and contemporary pharmacological systems can aid us in addressing chronic ailments.

### Plant description

*Nyctanthes arbortristis* L. is a shrub that can reach 10m in height and the tree has flaky grey bark, rigid white hair, underdeveloped branches, and coarse leaves. The flowers have a white corolla with five to eight lobes and an orange-red centre. They are fragrant and grow in clusters of two to seven. The petals of each flower open at night and close before daylight. The leaves exhibit an opposing arrangement and possess a basic structure, reaching 6-12 cm in length and 2-6.5 cm in width, with a smooth and unbroken margin. The fruit is a 2 cm diameter, flat, brown, heart-shaped to spherical capsule with two compartments, each containing a solitary seed. These objects are compressed, consisting of two cells, and have a long and wide shape. They are either obcordate or almost orbicular. Exalbuminous seeds, thick testa, and a strongly vascularised outer layer of big transparent cells [3].

**Distribution**

The plant's geographical distribution ranges from northern Pakistan and southern Nepal to northern India and southeast to Thailand [1].

**Taxonomical Classification**

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Lamiales

Family: Oleaceae

Genus: Nyctanthes

Species: arbortristis

**Traditional usage of *N. arbortristis***

The indigenous inhabitants of the Indian subcontinent have recognised specific therapeutic attributes in various parts of *N. arbortristis*. These qualities have been employed in the Ayurveda, Sidha, and Unani systems of medicine.

The leaf juice is employed for the eradication of roundworms and threadworms in children [4]. The leaf juice is additionally employed for the management of anorexia, haemorrhoids, liver disorders, biliary disorders, persistent fever, malaria, intractable sciatica, rheumatism, and as a diaphoretic [5]. There is a suggestion that a mixture of fresh leaf juice, honey, and common salt can serve as a harmless laxative for infants. When given as a two-ounce infusion, this substance has positive effects on fever and rheumatism by promoting sweating and enhancing urine production [6].

The native population in central India uses various parts of the *N. arbortristis* plant to relieve symptoms of cough, hiccup, diarrhoea, snakebite, and sores [7, 8]. The inflorescence is employed for the management of scabies and other comparable ailments [8]. Elderly Sri Lankan Buddhist monks use the hot infusion of flowers as a sedative [9]. The Jayantia tribes of India, who live in regions close to Myanmar, use the oral application of leaf juice as a treatment for worms, and they use the flower along with honey to relieve spasms [10]. The plant's flowers have long been acknowledged for their effectiveness in treating stomach issues, promote digestion, tighten tissues, reduce bile secretion, aid in cough relief, and promote hair health. They are also utilised in the piles therapy and numerous skin ailments. The bark is employed for the treatment of bronchitis and snakebite [11].

**Table 1:** Phytochemicals present in the *Nyctanthes arbortristis*

Plant Parts	Phytochemicals	Reference
Leaves	D-mannitol, β-sitosterole, Flavanol glycosides- Astragaline, Nicotiflorin, Oleanolic acid, Nyctanthic acid, tannic acid, ascorbic acid, methyl salicylate, volatile oil, carotene, friedeline, lupeol, mannitol, Glucose, fructose, iridoid glycosides, benzoic acid derivative of kaempferol, carotene	[12] [13] [14]
Flower	Nyctanthin, D-mannitol, Tannin, 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 (or crocin-1), 4- hydroxy hexahydrobenzofuran-7-one	[15] [2]
Seed	Pale Yellow Brown Oil (15%), Nyctanthic acid, Nyctoside A, β -sitosterol, Arbortristoside A & B, Glycerides of linoleic oleic, Lignoceric, Stearic, Palmitic and Myristic acids, 3-4 secotriterpene acid and A water soluble polysaccharide composed of D-glucose and D-mannose	[2]
Stem	Glycoside-naringenin-4'-O-β-glucopyranosyl-α- xylopyranoside , β-sitosterol	[2]
Root	β-Sitosterol and Oleanolic acid	[2]

### Scientific evidence supporting the therapeutic benefits of *N. arbortristis*

While NAT has been utilised since ancient times to treat many illnesses, there was a lack of scientific evidence at that era. Currently, we have scientific evidence regarding the therapeutic properties of NAT. Our scientists and researchers have made significant advancements in the field of healthcare by harnessing the therapeutic properties of NAT, enabling the effective treatment of many ailments.

#### Anti-inflammatory

Multiple investigations conducted on Harsingar, also known as night jasmine, have revealed its anti-inflammatory properties [16-18]. A study aimed to evaluate the anti-inflammatory activities of the aqueous component of an ethanol-based extract obtained from the leaves of NAT. The administration of NAT demonstrated efficient suppression of acute inflammatory edema in the hindpaw of rats, caused by diverse phlogistic agents such as carrageenin, formalin, histamine, 5-hydroxytryptamine, and hyaluronidase [19]. In a separate study, it was discovered that the leaf extract had notable acute and chronic anti-inflammatory effects when administered at doses of 200 mg/kg and 400 mg/kg, respectively. In comparison to the standard medicine diclofenac sodium at a dosage of 10mg/kg, the acute impact of the extract demonstrated similar results. However, when considering the chronic effect, the extract exhibited a much lower efficacy at a dosage of 400mg/kg in rats [20]. In a study it was discovered that an iridoid glycoside known as arbortristoside-A, which was isolated from the ethanolic extract of seeds, exhibited notable anti-inflammatory and antinociceptive activity [21, 22]. The observed effects were found to be considerable and dose-dependent, with doses of 50 and 75 mg/kg being particularly effective. The researchers hypothesised that these effects may be attributed to the inhibitory action of prostaglandins.

#### Anti-filarial and anti-malarial activity

Research successfully identified the anti-filarial activity present in Harsingar, with a specific focus on the molecule ursolic acid (UA). The crude extract and UA demonstrated notable micro- and macrofilaricidal effects on the egg, microfilaria, and adult stages of *Setaria cervi* (*S. cervi*), as evaluated using the colour exclusion test and MTT reduction assay. The effectiveness of UA in eradicating microfilariae of *Wuchereria bancrofti* was confirmed using a viability experiment, which showcased its significant microfilaricidal activity [23].

The efficiency of fresh leaf juice against chloroquine-resistant *Plasmodium falciparum* was examined, the *in-vitro* activity of the 50% ethanolic extract obtained from the root and seed is observed exclusively at a concentration of 100 mg/ml [24]. However, previous studies have indicated that leaf extracts exhibit antimalarial properties against both *Plasmodium falciparum* and *Plasmodium berghei* (NK65) in both laboratory and animal models [25]. The alcoholic extract obtained from the fruit and leaves has also exhibited efficacy against susceptible strains of the human malarial parasite *Plasmodium falciparum*, which is responsive to chloroquine. The inhibitory concentration (IC<sub>50</sub>) for these strains is determined to be 54 and 38 mg/ml, respectively [26].

#### Anti-allergic

An alcoholic extract comprising 50% of the flower, root, seed, and leaf of NAT exhibited significant inhibition of passive cutaneous anaphylaxis (PCA) in both mice and rats [27]. The inhibitory effect was observed at a dosage of 50mg/kg. These findings suggest that the extract has the potential to suppress anaphylactic reactions in the skin, comparable to the standard drug disodium cromoglycate (DSCG). Moreover, when Arbortristoside A and C were extracted from the seed and tested at doses of 25 and 50 mg/kg, they exhibited notable suppression of PCA at both doses. Additionally, these compounds demonstrated considerable protection against mast cell degranulation

generated by compound 48/80 at a dose of 10 mg/kg, which can be attributed to their mast cell stabilising effect in comparison to DSCG. Both compounds exhibited notable anti-PCA and mast cell stabilising activity in rats when administered orally [28]. Anti-histaminic action of the bark of the plant has also been examined. The researchers investigated various extracts of *Nyctanthes arbortristis* bark, including petroleum ether, chloroform, ethyl acetate, ethanol, and aqueous extracts. Among these, the petroleum ether extract at doses of 50 and 100 mg/kg demonstrated the highest level of protection against mast cell degranulation caused by clonidine, as well as resistance to contraction (bronchodilation) induced by histamine at the same doses. The researchers suggested that this enhanced activity might be attributed to the presence of  $\beta$ -sitosterol [29, 30].

#### Antioxidant

The study aimed to assess the impact of the methanolic extract derived from the leaves of *Nyctanthes* on lipid peroxidation generated by free radicals. This evaluation was carried out using bovine brain phospholipid liposomes. The results indicated a significant level of activity, with an IC<sub>50</sub> value of 20 mg/ml [31]. A report indicated that the aqueous extracts derived from the leaves of the plant exhibited DPPH (2, 2-diphenyl-1-picryl-hydrazyl-hydrate) radical scavenging activity, hydroxyl radical scavenging activity, and lipid peroxidation preventative property [32].

#### Anti-cancer

The consumption of dietary flavonoids and other polyphenols obtained from medicinal plants is thought to significantly contribute to the prevention of cancer. The anticancer capabilities of two iridoid glycosides, Arbortristosides A and B, obtained from *Nyctanthes arbortristis*, have been shown to be effective against methyl cholanthrene-induced fibrosarcoma in mice. The optimal dosage for these substances was found to be 2.5 mg/kg [33]. The research entailed the extraction of the chemical compound 4-hydroxyhexahydrobenzofuran-7-one from the leaves of NAT [15]. Subsequently, the chemical was administered to Ehrlich ascites carcinoma cells at a dosage of 20mg/kg for the purpose of experimental assessment. The chemical demonstrated a 43.27% suppression of cell growth and showed no detrimental effects. A recent study discovered that Nat-ZnO nanoparticles, which were created using the floral extract of the *Nyctanthes arbortristis* (NAT) plant, exhibited strong anti-cancer properties when tested on mice fibroblast cells and RBCs. These nanoparticles effectively triggered programmed cell death in cancer cells [34].

#### Anti-bacterial

Many research has been conducted to demonstrate Harsingar's antibacterial activity. The ethanol extracts from the leaves efficiently treated drug-resistant pathogens such as *Staphylococcus aureus* and *Salmonella paratyphi* [35]. An ethanol extract of the plant's stems and leaves was proven to suppress the growth of yeast, *Candida albicans*, *Staphylococcus aureus*, and *Staphylococcus epidermidis* [36]. However, there is some evidence that the water-based extract of the leaves can suppress the growth of *Pseudomonas testosteroni* [37]. A recent study discovered that zinc oxide nanoparticles, adorned with an extract from *Nyctanthes arbortristis* leaves, were highly effective in inhibiting the growth of *Staphylococcus aureus* and *Acinetobacter baumannii* [38]. The maximum zone of inhibition observed for *Staphylococcus aureus* was 7 ± 0.1 mm, while for *Acinetobacter baumannii* it was 0.5 ± 0.05 mm.

#### Anti-Viral

The ethanol-based extract, n-butanol fractions, extracted two pure compounds, Arbortristoside A and Arbortristoside C, derived from *N. arbortristis*, have notable inhibitory effectiveness against Encephalo Myocarditis Virus (EMCV) and Semliki Forest Virus (SFV).

The ethanolic extract and n-butanol fraction, administered at a daily dosage of 125 mg/kg body weight, provided a 40% and 60% protection against SFV in EMCV infected mice, respectively [39].

### Anti-fungal

The flower extract of *Nyctanthes arbortristis* was utilised to synthesise zinc oxide nanoparticles with a size range of 12–32 nm. The antifungal ability of nanoparticles was assessed, and they exhibited anti-fungal activity against all five tested phytopathogens, specifically *Alternaria alternata*, *Aspergillus niger*, *Botrytis cinerea*, *Fusarium oxysporum*, and *Penicillium expansum*. The lowest recorded minimum inhibitory concentration (MIC) value was 16 µg/mL [40].

### Anti-trypanosomal

The in-vitro assessment of the anti-trypanosomal potential of a crude 50% ethanol extract derived from the leaves of *Nyctanthes arbortristis* demonstrated trypanocidal activity at a concentration of 1000 mg/ml. *In-vivo* experiments shown that the extract exhibited anti-trypanosomal properties at dosages of 300 and 1000 mg/kg by increasing the lifespan of mice. Nevertheless, the cessation of medication resulted in the mortality of the experimental animals [12].

### Leishmanicidal activity

Leishmaniasis is a tropical disease caused by the protozoan parasite *Leishmania*. It is transmitted to humans through the bites of female sand flies belonging to the Phlebotomine species [41]. Visceral Leishmaniasis, commonly referred to as "Kala-azar," is a fatal illness caused by the parasites *Leishmania infantum* and *Leishmania donovani*. It is the most common form of the disease in India. Several iridoid glycosides were detected in *Nyctanthes* seeds, namely Arbortristiside A, B, and C, as well as 6-b-hydroxyloganin. The compounds exhibited significant efficacy against *Leishmania donovani* amastigotes in laboratory conditions, with concentrations ranging from 30 to 100 mg/ml. In animal studies, dosages of 10 to 100 mg/kg also demonstrated effectiveness [42]. A recent study suggests that green silver nanoparticles, synthesised using an aqueous leaf extract of *Nyctanthes arbortristis* (referred to as AgNPNAs), have both biocompatibility and efficacy in eradicating *L. donovani* promastigotes [43].

### Anti-nociceptive and antipyretic activity

The water-soluble portion of the ethanol extract from the leaves showed notable pain-relieving activity similar to aspirin. This was demonstrated by its ability to reduce acetic acid-induced writhing in albino mice. However, it did not produce pain relief similar to morphine, as tested using the rat tail-flick and mouse tail-clip methods. The extract had antipyretic activity in rats with pyrexias induced by brewer's yeast. When orally supplied to rats for six consecutive days, it caused stomach ulcers in a dose-dependent manner [44].

### Hepatoprotective activity

It was found that extracts from leaves, both alcoholic and aqueous, were beneficial in lowering the high levels of enzymes caused by liver damage induced by carbon tetrachloride [45]. Significant hepatoprotective effect was observed in both the alcoholic and aqueous extracts, as measured by the reduction in blood levels of serum glutamic pyruvic transaminase (SGPT), serum glutamic oxaloacetic transaminase (SGOT), and total and direct serum bilirubin. Histopathological analyses of liver tissue supported these findings by showing that the extracts could regenerate hepatocytes [46].

### Central nervous system modulatory activity

The aqueous extract obtained from the plant's leaves might mitigate the effects of malathion on acetylcholine esterase activity. Acetylcholinesterase plays a vital role in the breakdown of acetylcholine [47]. In a distinct experiment, the aqueous portion of the alcoholic extract obtained from the leaves exhibited no effect on the righting reflex. Nevertheless, when administered at doses of 4.0 and 8.0g/kg, it significantly prolonged the duration of pentobarbitone-induced sleep, with a significance level of  $p < 0.05$  and  $p < 0.01$ , respectively. The studies done to assess the sedative effects of the extract demonstrated a significant reduction in CAR activity at the same doses ( $p < 0.05$ ) [14]. The sedative properties of a hot floral infusion have also been examined for their sedative effects on rats. The infusion of the drug showed a dose-dependent effect on conscious sedation activity in male rats, with doses ranging from 3.7 to 18.7 mg/kg. Surprisingly, this effect was not observed in female rats. The infusion was well tolerated even after repeated treatments and did not exhibit any obvious signs of dependence [9].

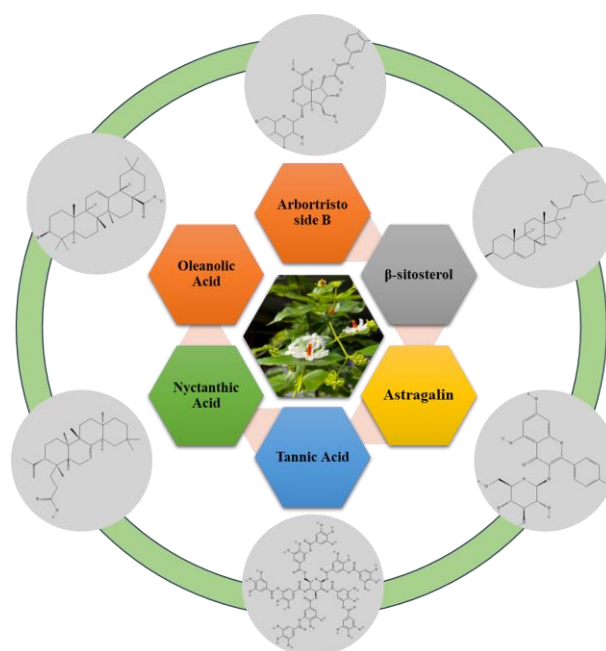


Figure 1: Some Phytochemicals of *Nyctanthes arbortristis* (<https://pubchem.ncbi.nlm.nih.gov/>)

## CONCLUSION

The medicinal plant *Nyctanthes arbortristis* has enormous pharmacological potential. It is an essential herbal and ayurvedic pathway for the effective treatment of a wide range of diseases. Studies on infectious disorders like malaria, trypanosomiasis, leishmaniasis, and microbial pathogens have demonstrated that the activities are more visible in crude extracts than in pure molecules. Considering the limited success of bioactivity-guided fractionation studies, it may be beneficial to explore combination treatment as a potential future approach. This would include mixing pharmacological agents that are susceptible to the development of resistance. Mechanism of action study would lend evidence to therapy claims. However, as stated in the traditional medical system, there is a gap in scientific research that must be filled in terms of valid studies. Introduction of advanced Bioinformatics and structural analogue docking and simulation models can bring a new direction. Certain validation studies have not been addressed; however, others have been indirectly associated with biological activities such as intestinal worms, gout, anxiety, and restlessness through the modulation of the central nervous system. Molecular metabolic profiling leads to identifying the crucial metabolites and its functional role. It has an outstanding pharmacological profile; nonetheless, more investigation is required to elucidate its specific modes of action. Therefore, it is essential to conduct thorough clinical trials and sophisticated pharmacokinetic research in order to ensure the safety and

effectiveness of this plant as a broadly applicable treatment. Ultimately, the effectiveness of Ayurvedic medicines is of utmost importance in incorporating ancient medicine into modern healthcare methods.

#### Conflict of interest

The authors declare that they have no conflict of interest.

#### Financial Support

None declared.

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#### HOW TO CITE THIS ARTICLE

Swain N, Sahoo RK, Parameswaran C, Singh NR, Behera B, Samantaray S. Harnessing the Power of Nature: *Nyctanthes arbor-tristis* as an Alternative Medicine. *J Phytopharmacol* 2024; 13(4):328-333. doi: 10.31254/phyto.2024.13409

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