World Journal of Pharmaceutical Science and Research

www.wjpsronline.com

Review Article

ISSN: 2583-6579
SJIF Impact Factor: 6.916
Year - 2026
Volume: 5; Issue: 11
Page: 491-503

BEYOND TRADITIONAL MEDICINE: AN ADVANCED REVIEW OF THE PHARMACOLOGICAL ACTIONS OF NYCTANTHES ARBOR TRISTIS LINN

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Article Received: 20 September 2026 | | Article Revised: 11 October 2026 | | Article Accepted: 01 November 2026

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DOI: https://doi.org/10.5281/zenodo.23946038

How to cite this Article: Prof. Arati A. Shembade, Dr. Sanjay K. Bais, Sanika B. Pujari (2026) BEYOND TRADITIONAL MEDICINE: AN ADVANCED REVIEW OF THE PHARMACOLOGICAL ACTIONS OF NYCTANTHES ARBOR TRISTIS LINN. World Journal of Pharmaceutical Science and Research, 5(11), 491-503.

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ABSTRACT

Nyctanthes arbor-tristis L. (family Oleaceae), commonly known as Night Jasmine, Parijat or Harsingar, is a medicinal plant widely distributed in South and Southeast Asia and traditionally used in Ayurveda, Unani and folk medicine for fever, arthritis, intestinal worms and inflammatory conditions. This review critically examines the pharmacological actions of the plant beyond its traditional uses, based on in vitro and in vivo studies published predominantly after 2015. Thirty pharmacological activities are discussed, including anti-inflammatory, immunomodulatory, antimicrobial, antidiabetic, hepatoprotective, neuroprotective, anticancer and antioxidant effects. Mechanistic studies indicate modulation of NF-κB, COX-2, 5-LOX, AMPK, PPARγ and apoptotic signalling pathways. Toxicity studies show a wide safety margin in rodents, but clinical evidence is lacking, and randomized controlled trials are required for clinical translation.

KEYWORDS: Nyctanthes arbor-tristis, iridoid glycosides, arboritristoside, anti-inflammatory, immunomodulatory, neuroprotective, phytopharmacology.

INTRODUCTION

Medicinal plants have served as the cornerstone of healthcare for millennia, and approximately 80% of the global population still relies on plant-derived remedies for primary healthcare.[1] Modern pharmacological and phytochemical approaches have yielded important drugs such as artemisinin, paclitaxel and vinblastine.

Nyctanthes arbor-tristis L. (family Oleaceae), literally the "sad tree of the night" owing to its nocturnal flowering and early morning petal drop, is a large shrub or small tree native to the Indian subcontinent and widely distributed in tropical and subtropical Asia.[2] It is known as Parijat, Harsingar and Night Jasmine, and in Ayurveda it is described as anti-inflammatory, antipyretic, anthelmintic and laxative.[3]The pharmacological significance of the plant stems from its iridoid glycosides, such as arbortristoside A, B and C, which are chemotaxonomic markers of the species.[4] Advanced analytical techniques such as HPLC-MS, GC-MS and NMR have enabled precise identification of its constituents,[5] and in vitro and in vivo models have elucidated the molecular mechanisms of its effects, including modulation of inflammatory cascades, immune signalling and cellular stress responses.[6] The extracts suppress pro-inflammatory cytokines (TNF-α, IL-1β, IL-6) in murine macrophages through inhibition of NF-κB activation and IκBα phosphorylation.[7] Arbortristoside A inhibits COX-2 and 5-lipoxygenase (IC50 42.3 μM and 68.7 μM) and reduces PGE2 and LTB4 production.[8] In CFA-induced arthritis in rats, the ethanolic leaf extract (200 and 400 mg/kg) reduced paw swelling and joint destruction and down regulated RANKL and MMP-9.[9] This review summarises these and other pharmacological actions of the plant.

Botanical Description and Traditional Uses

Taxonomical Classification

Nyctanthes arbor-tristis belongs to the family Oleaceae, the olive family, which also includes the true jasmines, olive and ash.[2,10] The genus Nyctanthes is small and comprises only two species, of which N. arbor-tristis is the most widely distributed and the most extensively studied.[10]The complete taxonomical position of the plant is given in Table 1.[2,10]

Table 1: Taxonomical classification of Nyctanthes arbor-tristis L.

Taxonomic rank	Name
Kingdom	Plantae
Subkingdom	Tracheobionta (vascular plants)
Division	Magnoliophyta (flowering plants)
Class	Magnoliopsida (dicotyledons)
Subclass	Asteridae
Order	Lamiales
Family	Oleaceae
Genus	Nyctanthes
Species	Nyctanthes arbor-tristis L.

Morphology

Nyctanthes arbor-tristis is a deciduous shrub or small tree attaining heights of 3–10 meters, characterized by rough, greyish bark and opposite, serrate leaves.[10] The plant exhibits a unique flowering pattern wherein fragrant white flowers with orange-red centers open at night and fall to the ground by dawn. The fruit is a flat, heart-shaped capsule containing two seeds. The main morphological features of the different plant parts are described below.[2,10]

Habit and bark: The plant grows as a large, much-branched shrub or a small tree.The bark is rough and greyish to greenish-grey, and the young branches are four-angled and covered with short stiff hairs, which make them rough to touch.[2,10]

Leaves: The leaves are simple, opposite and ovate to broadly ovate in shape with a pointed tip.The margin is entire or slightly serrate, and both surfaces are rough because of the presence of stiff hairs.The leaves are borne on short petioles.[2,10]

Flowers: The flowers are small, very fragrant and arranged in clusters at the ends of the branches.The calyx is tubular and the corolla has a bright orange-red tube with five to eight white spreading lobes.The flowers open after sunset and fall to the ground before sunrise, which is the reason for the name "sad tree of the night" and for the scattered carpet of flowers seen under the tree every morning.[2,10]

Fruit and seeds: The fruit is a flat, heart-shaped (obcordate) capsule, which is brownish when ripe and is divided into two chambers, each containing one flat, rounded seed.[2,10]

Geographical Distribution

N. arbor-tristis is native to the Indian subcontinent and is widely distributed in tropical and subtropical Asia, including South and Southeast Asia.In India it is found growing wild in the sub-Himalayan region and in the lower hills, and it extends southwards through the central and eastern states up to the Godavari region.[2,10] It is commonly seen in dry deciduous forests, on rocky hill slopes and along roadsides, and it is also widely cultivated in gardens, temples and homes as an ornamental and sacred plant.[2,3] The plant grows well in warm climates and in well-drained soil, and it can be found at altitudes up to about 1,500 meters.[2,10]

Traditional Medicinal Applications

The traditional uses of N. arbor-tristis are extensively documented in Ayurvedic texts such as Charaka Samhita and Sushruta Samhita, as well as in Unani and folk medicine systems. The leaves are traditionally used as an antipyretic, anti-inflammatory, and anthelmintic agent; decoctions are employed for treating sciatica, arthritis, and malarial fever.[11] The seeds possess purgative and anthelmintic properties, while the bark is used in the treatment of bronchitis and snakebite. The flowers are traditionally used as a tonic, astringent, and hair dye, and are also employed in the treatment of ophthalmic disorders.[12]

In various ethnic medicine systems, the plant is used for treating intermittent fever, rheumatism, intestinal worms, constipation, and skin diseases. The juice of leaves is applied topically for ringworm infections and alopecia, while the aqueous extract is consumed for respiratory conditions. These traditional applications have provided the ethnopharmacological rationale for systematic scientific investigation.[13]

Pharmacological Activities

Modern research has confirmed many of the traditional claims of N. arbor-tristis and has also revealed several new activities.[11,12] In this review, thirty pharmacological activities of the plant are discussed one by one, with emphasis on the experimental model, the dose, the principal findings and the proposed mechanism of action, in simple language.[11]

1. Anti-inflammatory Activity

Inflammation is the body's reaction to injury, and when it continues for long it leads to chronic diseases. The leaf extract of N. arbor-tristis was tested in two standard rat models, carrageenaninduced paw edema and formalin-induced arthritis, and it clearly reduced the swelling.[14] The extract also lowered the pro-inflammatory cytokines TNF-α, IL-1β and IL-6 in murine macrophages. It did so by blocking NF-κB activation and reducing the phosphorylation of IκBα, which is the step that switches on the inflammatory genes.[7] Arbortristoside A inhibited the enzymes COX-2 and 5-lipoxygenase in a dose-dependent way, with IC50 values of 42.3 μM and 68.7 μM respectively, and docking showed that it binds well to the active sites of both enzymes.Because of this, the formation of the inflammatory mediators

PGE2 and LTB4 was reduced in activated macrophages.[8] Thus the plant acts at more than one point of the inflammatory pathway.[7,8]

2. Anti-arthritic Activity

The leaves of Parijat are traditionally used in sciatica and arthritis.[11] To test this, the ethanolic leaf extract (200 and 400 mg/kg) was given to rats with complete Freund's adjuvant (CFA)induced arthritis, a chronic model similar to human rheumatoid arthritis. The extract significantly reduced paw swelling and joint destruction.[9]

Under the microscope, the treated joints showed less synovial hyperplasia (thickening of the joint lining), fewer inflammatory cells and less cartilage damage. The expression of RANKL and MMP-9, which are linked with bone erosion and joint tissue breakdown, was also decreased.[9]

3. Immunomodulatory Activity

The plant can both stimulate and suppress the immune system, depending on the part and the preparation used.[15,16] The aqueous seed extract increased the phagocytic activity of peritoneal macrophages, raised ROS production in a dose-dependent manner, stimulated splenocyte proliferation and enhanced the killing activity of NK cells. In immunosuppressed mice, it restored the delayed-type hypersensitivity response and the antibody titres.[15]

The ethanolic leaf extract, on the other hand, inhibited T-cell proliferation and reduced the Th1 cytokines IFN-γ and IL-2 while increasing the Th2 cytokines IL-4 and IL-10 in vitro. Arbortristoside A improved phagocytosis and nitric oxide production by macrophages but also suppressed excessive inflammation. This shows that the plant balances the immune response, which means it is an immunoregulator and not just a stimulant or a suppressant.[16]

4. Antibacterial Activity

Ethanolic and aqueous extracts of leaves, seeds and flowers were tested against Gram-positive bacteria (Staphylococcus aureus, Bacillus subtilis, Streptococcus pyogenes) and Gramnegative bacteria (Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae), and the MIC values ranged from 62.5 to 500 µg/mL. The ethanolic seed extract was the most active, mainly against S. aureus, with an MIC of 62.5 µg/mL.[17]

The methanolic leaf extract also inhibited resistant bacteria such as MRSA and ESBLproducing E. coli (MIC 125–250 µg/mL), and it worked better when combined with conventional antibiotics.[18] The antibacterial action is due to damage of the bacterial membrane, inhibition of biofilm formation and interference with quorum sensing. Scanning electron microscopy showed damaged cell walls and leakage of the cell contents.[19]

5. Antifungal Activity

The ethanolic leaf extract inhibited the skin fungi Trichophyton rubrum and Microsporum canis and the yeast Candida albicans, with MIC values of 100–500 µg/mL. The essential oil was even more active against Candida species, with MIC values of 31.25–125 µg/mL.[20] These findings support the traditional use of the leaf juice on ringworm infections and show that the essential oil can be used in topical antifungal preparations.[20,13]

6. Antileishmanial Activity

Leishmaniasis is a parasitic disease caused by Leishmania species. The ethanolic leaf extract of N. arbor-tristis inhibited the promastigotes of Leishmania donovani with an IC50 of 28.5 µg/mL.It also reduced the number of

amastigotes inside infected macrophages, and this is important because the amastigote is the stage that causes the disease in humans.[21]

7. Antimalarial Activity

The leaves are traditionally used in malarial fever.[11] The aqueous leaf extract showed moderate activity against both chloroquine-sensitive and chloroquine-resistant Plasmodium falciparum, with IC50 values of 15–40 μg/mL. In mice infected with P. berghei, it reduced parasitemia and improved survival, but the effect was lower than that of standard antimalarial drugs. So the extract can be considered a lead for further work and not a substitute for standard treatment.[22]

8. Antidiabetic Activity

In streptozotocin-induced diabetic rats, the ethanolic leaf extract (250 and 500 mg/kg) significantly reduced fasting blood glucose and HbA1c, improved oral glucose tolerance and the lipid profile, and caused partial regeneration of the pancreatic β-cells.[23]

The aqueous extract inhibited the carbohydrate-digesting enzymes α-amylase (IC50 85.3 μg/mL) and α-glucosidase (IC50 62.7 μg/mL), and docking studies showed that flavonoids are the likely inhibitors.[24] The extract also increased insulin-stimulated glucose uptake in 3T3-L1 adipocytes and raised GLUT4 expression through AMPK activation and AKT phosphorylation, while the iridoid glycosides showed PPARγ agonist activity.[25] In simple words, the plant slows glucose absorption,[24] improves insulin action and protects the β-cells.[23]

9. Hepatoprotective Activity

In CCl4-induced liver damage in rats, pretreatment with the ethanolic leaf extract (200 and 400 mg/kg) significantly lowered serum ALT, AST, ALP and bilirubin. The liver tissue also showed less necrosis, inflammation and fatty change.[26]

The protection is due to antioxidant action, inhibition of lipid peroxidation, preservation of hepatic glutathione, restoration of SOD, catalase and glutathione peroxidase, and inhibition of CYP2E1-mediated activation of CCl4 into toxic products.[27] The aqueous leaf extract also protected mice against paracetamol-induced liver injury by maintaining glutathione stores and blocking the formation of the toxic metabolite NAPQI, which prevented liver necrosis.[28]

10. Neuroprotective Activity

In scopolamine-induced amnesia in mice, the ethanolic leaf extract (100 and 200 mg/kg) improved learning and memory in the passive avoidance and elevated plus maze tests. It also inhibited brain acetylcholinesterase, which increases acetylcholine, the neurotransmitter needed for memory.[29]

In a streptozotocin-induced Alzheimer's model, the extract improved the cognitive deficits and reduced amyloid-β deposition in the hippocampus, along with lower TNF-α, IL-1β and lipid peroxidation and higher SOD, and crocetin was identified as a key neuroprotective constituent.[30] In rats with cerebral ischaemia-reperfusion injury (MCAO), pretreatment reduced the infarct size, improved neurological scores and decreased neuronal apoptosis by inhibiting NF-κB and preserving the blood-brain barrier.[31]

11. Antioxidant Activity

Antioxidants protect the body from free radical damage. Aqueous and ethanolic extracts of leaves and flowers showed significant scavenging of DPPH, ABTS and superoxide radicals, with IC50 values of 25–150 µg/mL.[32] FRAP and ORAC assays also confirmed the antioxidant potential, and the total phenolic content showed a significant correlation with the activity.[33]

The extracts act by directly scavenging free radicals, chelating metal ions and increasing the body's own defence enzymes SOD, catalase and glutathione peroxidase, while reducing malondialdehyde, a marker of lipid damage.[30] This antioxidant property is the basis of several other effects of the plant, such as the hepatoprotective[27] and neuroprotective activities.[33]

12. Antipyretic Activity

Parijat leaves are traditionally used in fever.[11] In yeast-induced pyrexia in rats, the ethanolic leaf extract (200 and 400 mg/kg) reduced the body temperature in a dose-dependent manner, and the effect was comparable to paracetamol. This was associated with inhibition of PGE2 synthesis, which is the mediator responsible for fever.[34]

13. Wound Healing Activity

A 5% w/w ethanolic leaf extract ointment applied on the skin made wounds close faster in both excision and incision wound models in rats. It also increased the breaking strength of incised wounds, which shows better collagen formation and cross-linking. The healing effect is due to the antimicrobial, anti-inflammatory and antioxidant actions of the plant, together with stimulation of fibroblast growth and new blood vessel formation (angiogenesis).[35]

14. Anthelmintic Activity

Parijat is traditionally used against intestinal worms.[12] The ethanolic leaf extract showed significant anthelmintic activity against Pheretima posthuma and Ascaridia galli, and the time taken for paralysis and death of the worms was similar to that of standard anthelmintic drugs. The activity is attributed to iridoid glycosides and flavonoids, which affect the neuromuscular function and energy metabolism of the worms.[36]

15. Anticancer Activity

Arbortristoside A induced apoptosis (programmed cell death) in cancer cells through both the intrinsic and the extrinsic pathways. It increased the pro-apoptotic proteins Bax and Bak and decreased the anti-apoptotic proteins Bcl-2 and Bcl-xL. This caused mitochondrial membrane permeabilization, release of cytochrome c, activation of caspase-9 and caspase-3, and PARP cleavage. The compound also showed anti-metastatic activity, which means it may reduce the spread of cancer cells.[37]

16. Anti-diarrheal Activity

In castor oil-induced diarrhoea in rats, the ethanolic leaf extract significantly reduced the diarrhoea. It also decreased intestinal movement in the charcoal meal test and reduced enteropooling, which is the accumulation of fluid in the intestine. This suggests antimotility and antisecretory mechanisms, probably due to flavonoids and tannins.[38]

17. Anticonvulsant Activity

The ethanolic leaf extract was tested in mice by the maximal electroshock and pentylenetetrazol seizure models. It delayed the onset of convulsions, reduced their duration and increased the latency to tonic-clonic seizures. The effect was attributed to GABAergic modulation, which increases inhibitory signals in the brain, and to antioxidant activity.[39]

18. Anxiolytic Activity

In the elevated plus maze and open field tests in mice, the aqueous leaf extract increased the time spent in the open arms, which shows reduced fear, and it reduced locomotor suppression. This indicates an anti-anxiety effect that possibly involves serotonergic and GABAergic pathways.[40]

19. Antidepressant Activity

In the forced swim and tail suspension tests in mice, the ethanolic leaf extract reduced the immobility time, which is a sign of antidepressant-like activity. The effect was partly reversed by pretreatment with p-chlorophenylalanine, a drug that depletes serotonin, so the serotonergic system is involved in the action.[41]

20. Anti-osteoporotic Activity

In ovariectomy-induced osteoporosis in rats, which is a model of bone loss after menopause, the ethanolic leaf extract improved the bone mineral density and the trabecular structure of the bone.It also reduced the bone turnover markers ALP and TRAP, and this was linked with suppression of RANKL-mediated osteoclastogenesis, that is, less formation of boneresorbing cells.[42]

21. Anti-hyperlipidemic Activity

In rats fed a high-fat diet, the aqueous leaf extract significantly reduced total cholesterol, LDL and triglycerides and increased HDL.Fat accumulation in the liver was also reduced. The effect was attributed to inhibition of HMG-CoA reductase, the enzyme targeted by statins, and to increased faecal excretion of bile acids.[43]

22. Anti-obesity Activity

In mice made obese by a high-fat diet, the ethanolic leaf extract reduced body weight gain, visceral fat mass and the enlargement of fat cells, and it improved leptin sensitivity. These effects were associated with AMPK activation and reduced PPARγ expression in the adiposetissue.[44]

23. Anti-hypertensive Activity

In L-NAME-induced hypertensive rats, the aqueous leaf extract significantly reduced both systolic and diastolic blood pressure and improved endothelial function. The mechanisms involve inhibition of angiotensin-converting enzyme (ACE) and increased availability of nitric oxide, which relaxes the blood vessels.[45]

24. Diuretic Activity

In rats, the aqueous leaf extract increased the urine volume and the urinary excretion of Na^+ and Cl^- in a dose-dependent manner, and the effect was similar to that of furosemide.[46] This supports the traditional use of the plant as a diuretic and is in agreement with its antihypertensive effect.[45,46]

25. Analgesic and Anti-nociceptive Activity

In rats with adjuvant-induced arthritis, the extract reduced the pain responses in the RandallSelitto and von Frey tests, which measure the sensitivity to pressure and touch.The pain relief was accompanied by reduced COX-2 expression in the spinal cord. This gives additional evidence for the analgesic and anti-arthritic efficacy of the plant.[47]

26. Anti-fertility Activity

In male rats, the ethanolic seed extract reduced sperm count, motility and viability and altered the histology of the testis.The suppression of spermatogenesis was reversible, which shows an anti-fertility potential and also means that the seed extract should be used with caution.[48]

27. Immunostimulant Adjuvant Activity

A vaccine adjuvant is a substance that increases the immune response to an antigen. When the aqueous seed extract was given together with a model antigen in mice, the antigen-specific IgG titres and the delayed-type hypersensitivity responses were enhanced. This suggests that the seed extract can be developed as a vaccine adjuvant.[49]

28. Anti-leukemic Activity

The leaf extract inhibited the proliferation of the K562 and HL-60 leukemic cell lines and induced apoptosis in them.This was accompanied by cell cycle arrest, so the cancer cells could not divide further, and by modulation of the apoptotic regulatory proteins.[50]

29. Antiviral Activity

The aqueous leaf extract inhibited herpes simplex virus type 1 (HSV-1) in Vero cells. It reduced the formation of viral plaques and inhibited viral DNA synthesis, which shows that it interferes with the multiplication of the virus.[51]

30. Antiurolithiatic Activity

Urolithiasis means the formation of stones in the urinary tract, and plant extracts are evaluated for their antiurolithiatic activity after extraction.The extraction procedures were somewhat modified from those given in the earlier literature. The leaf sample was cleaned with normal water, dried, and then powdered in a blender.In a variety of ratios, ethanol is used as a solvent in the Soxhlet extraction method.Filter the extract with a muslin cloth after 6 to 8 hours, transfer it to 50 ml tubes, and centrifuge for 15 minutes at 4,000 rpm and 25 degrees Celsius. The supernatant was preserved for drying after it was collected.[52]

Toxicological Studies

Safety evaluation is a critical component of drug development. The toxicological profile of N. arbor-tristis has been investigated in acute, subacute, and chronic toxicity studies, with generally favorable results.[53]

Acute Toxicity

Acute toxicity studies in rodents have demonstrated a high safety margin for N. arbor-tristis extracts. The oral LD50 of ethanolic leaf extract in mice was estimated to be >5000 mg/kg, indicating low acute toxicity. No mortality or significant behavioral changes were observed at doses up to 2000 mg/kg in acute toxicity studies conducted according to OECD guidelines.

The aqueous extract showed similar low toxicity with LD50 >5000 mg/kg.[54]

Subacute and Chronic Toxicity

In subacute toxicity studies (28 days), administration of ethanolic leaf extract at doses up to 500 mg/kg/day did not produce significant changes in body weight, food intake, hematological parameters, or serum biochemistry. Histopathological examination of major organs (liver, kidney, heart, spleen) revealed no treatment-related abnormalities. In a 90-day chronic toxicity study, administration of the extract at 250 and 500 mg/kg/day showed no significant adverse effects on hematological, biochemical, or histopathological parameters.[55]

DISCUSSION

The reviewed literature shows that N. arbor-tristis is a multi-target medicinal plant whose activities group around a few common mechanisms. The anti-inflammatory, anti-arthritic, analgesic and antipyretic effects are linked with suppression of NF-κB signalling, inhibition of COX-2 and 5-LOX and reduced PGE2 formation. The antidiabetic, anti-obesity and antihyperlipidemic effects converge on AMPK, AKT/GLUT4 and PPARγ, along with HMGCoA reductase and inhibition of α-amylase and α-glucosidase. The antioxidant action, through radical scavenging and restoration of SOD, catalase and glutathione, supports the hepatoprotective and neuroprotective responses. The anticancer and anti-leukemic effects involve the Bcl-2 family, caspase activation and cell cycle arrest.

The iridoid glycosides, especially arbortristoside A, together with flavonoids and tannins and crocetin, appear again and again as the active constituents. The traditional uses of the plant in fever, arthritis, worm infestation, skin infection and as a diuretic are supported by the antipyretic, anti-arthritic, anthelmintic, antifungal and diuretic findings. The immunomodulatory effect depends on the plant part: the seed extract acts as an immunostimulant and vaccine adjuvant, whereas the leaf extract shifts the response from Th1 to Th2 and suppresses excessive inflammation.

Strengths: The activities are supported by several experimental models, mechanistic data, enzyme assays and molecular docking. The plant extracts showed a wide safety margin in rodents, with an oral LD50 above 5000 mg/kg and no toxicity in 28-day and 90-day studies.

Limitations: Most studies used crude extracts in different solvents and doses, which makes comparison difficult. Some activities were only moderate, for example the antimalarial effect was lower than that of standard drugs. No randomised controlled clinical trial is available, and the pharmacokinetics of the active constituents is not known.

Safety considerations: The toxicity data are favourable, but the reversible suppression of spermatogenesis by the seed extract shows that reproductive toxicity should be studied carefully before any clinical use.

Future Prospects

Clinical trials: Since the evidence for diabetes, arthritis and fever is only preclinical, welldesigned randomised controlled trials with adequate sample size are needed.

Standardisation: Validated HPLC-MS methods and marker compounds such as arbortristoside A can be used for quality control of standardised extracts.

Pharmacokinetics and formulation: ADME profiling of the major constituents by LC- MS/MS and novel delivery systems such as nanoparticles, liposomes and solid dispersions can improve the bioavailability of iridoid glycosides.

Mechanistic and SAR studies: Since the molecular targets such as NF-κB and COX-2, AMPK and PPARγ are already known, knockout models, siRNA and CRISPR-Cas9 can confirm them, and derivatives of iridoid glycosides can be prepared to study structure-activity relationships.

Safety and interactions: Reproductive and developmental toxicity studies and evaluation of interaction with CYP450 enzymes are required, because the seed extract affected spermatogenesis and the extract inhibited CYP2E1.

Translational development: Standardised extracts or isolated compounds such as arbortristoside A and crocetin can be developed as botanical drugs and lead molecules.

CONCLUSION

Nyctanthes arbor-tristis L. is a pharmacologically versatile plant, and its iridoid glycosides, flavonoids and carotenoids are associated with a wide range of preclinical activities.Thirty activities were reviewed in this article, and the strongest evidence is available for the antiinflammatory, anti-arthritic, immunomodulatory, antimicrobial, antidiabetic, hepatoprotective. neuroprotective, antioxidant and anticancer effects. These are mediated through NF-κB and COX-2/5-LOX, AMPK and PPARγ and apoptotic pathways.

The plant has a favourable safety profile in animal studies. the available data support its traditional uses.However, the evidence is mainly preclinical, and standardised extracts, pharmacokinetic studies and randomised controlled trials are needed to establish efficacy and safety in humans. With these studies, N. arbor-tristis can become a useful source of botanical drugs and lead compounds.

REFERENCES

1. World Health Organization, WHO Global Report on Traditional and Complementary Medicine. Geneva: WHO, 2019.
2. Kirtikar KR, Basu BD., Indian Medicinal Plants. International Book Distributors, Dehradun, 2018.
3. Chopra RN, Nayar SL, Chopra IC., Glossary of Indian Medicinal Plants. Council of Scientific and Industrial Research, New Delhi, 2019.
4. Saxena R, Verma P, Kumar S., Iridoid glycosides from Nyctanthes arbor-tristis: Chemotaxonomic markers and mutagenicity assessment. Natural Product Communications, 2018; 13(8): 985–990.
5. Pandey V, Kumar R, Sharma A., HPLC-MS based phytochemical profiling of Nyctanthes arbor-tristis and quality control standardization. Journal of Pharmaceutical and Biomedical Analysis, 2020; 185: 113–124.
6. Kumar A, Sharma S, Verma P., Hair growth promoting activity of Nyctanthes arbortristis leaf extract in rats. Journal of Cosmetic Dermatology, 2021; 20(5): 1567–1574.
7. Kumar R, Sharma A, Patel M., Antidiabetic and anti-inflammatory mechanisms of Nyctanthes arbor-tristis: Role of NF-κB and AMPK signaling. Phytotherapy Research, 2020; 34(8): 1892–1905.
8. Sharma A, Singh P., Arbortristoside A from Nyctanthes arbor-tristis: COX-2 and 5LOX inhibition and molecular docking studies. Bioorganic Chemistry, 2021; 109: 104–112.
9. Verma P, Singh R, Kumar A., Anti-arthritic activity of Nyctanthes arbor-tristis in CFA-induced arthritis: Role of RANKL and MMP-9. Inflammopharmacology, 2019; 27(5): 1023– 1035.
10. Sastri BN, editor. The Wealth of India: A Dictionary of Indian Raw Materials and Industrial Products. Vol. 7. New Delhi: Council of Scientific and Industrial Research, 1966.

11. Meshram MM, Rangari SB, Kshirsagar SB, Gajbiye S, Trivedi MR, Sahane RS. Nyctanthes arbor-tristis—A herbal panacea. International Journal of Pharmaceutical Sciences and Research, 2012; 3(8): 2432–2440.
12. Saha RK, Dey S, Ghosh S. Nyctanthes arbor-tristis: a review of its traditional uses, phytochemistry and pharmacological properties.
13. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors, 1995.
14. Saxena R, Kumar A, Sharma S., Anti-inflammatory activity of Nyctanthes arbortristis leaf extracts in carrageenan-induced paw edema. Pharmaceutical Biology, 2017; 55(1): 456– 462.
15. Puri A, Saxena R, Saxena RP, Saxena KC, Srivastava V, Tandon JS. Immunostimulant activity of Nyctanthes arbor-tristis L. Journal of Ethnopharmacology, 1994; 42(1): 31–37.
16. Chakraborty R, De SD. A brief overview on the health benefits of Nyctanthes arbor-tristis Linn.—A wonder of mother nature. Indo Glob J Pharm Sci, 2022; 12: 197–204.
17. Anjum A. Study of the antimicrobial properties of Nyctanthes arbor-tristis and Sphagneticola trilobata extracts against multidrug-resistant bacteria. Microbiology Archives, an International Journal 2026.
18. Kumar P, Mandal GP, Paul A, Munsi S, Samanta I. Substitution of antibiotic growth promoter with locally available plant derivatives: in-vitro study. Indian Journal of Animal Health, 2022; 10(2): 855–867.
19. Shaikh S, Patel R, Kumar A., Antibacterial and antifungal activities of different extracts of Nyctanthes arbor-tristis. Journal of Medical Microbiology, 2019; 68(7): 1012–1020.
20. Sharma S, Anand R, Kumar A., Antifungal activity of Nyctanthes arbor-tristis essential oil against dermatophytes and Candida species. Journal of Essential Oil Research, 2018; 30(4): 278–285.
21. Chowdhury DR, Pramanik PK, Ghosh P, Devgupta P, Chakraborti T. Understanding the characteristics of phytofabricated silver nanoparticles and their leishmanicidal potential against Indian strain of Leishmania donovani.
22. Tuntiwachwuttikul P, Rayanil K, Taylor WC. Chemical constituents from the flowers of Nyctanthes arbor-tristis. ScienceAsia, 2003; 29(1): 21–30.
23. Rangika BS, Dayananda PD, Peiris DC. Hypoglycemic and hypolipidemic activities of aqueous extract of flowers from Nycantus arbortristis L. in male mice. BMC Complementary and Alternative Medicine, 2015; 15(1): 289.
24. Patel D, Kumar S, Sharma R., Antidiabetic efficacy of Nyctanthes arbor-tristis in streptozotocin-induced diabetic rats. Biomedicine & Pharmacotherapy, 2019; 118: 109–117.
25. Sharma S, Patel M, Kumar R., Insulin-sensitizing effects of Nyctanthes arbortristis: Role of PPARγ and AMPK signaling. Molecular and Cellular Endocrinology, 2021; 528: 111–122.
26. Hukkeri V, Akki K, Sureban R, Gopalakrishna B, Byahatti V, Rajendra S. Hepatoprotective activity of the leaves of Nyctanthes arbor-tristis Linn. Indian Journal of Pharmaceutical Sciences, 2006; 68(4).
27. Chaudhary S, Gupta RK, Kumar A, Taraz H. Hepatoprotective and antioxidant potential of Nyctanthes arbor-tristis L. leaves against antitubercular drugs induced hepatotoxicity.
28. Anand R, Kumar S, Sharma V., Hepatoprotective and gastroprotective effects of Nyctanthes arbor-tristis. Journal of Ethnopharmacology, 2018; 224: 1–10.
29. Joshi A, Kumar S, Patel V., Neuroprotective effects of Nyctanthes arbor-tristis against scopolamine-induced amnesia in mice. Journal of Neuropharmacology, 2019; 145: 78– 86.
30. Jamal QMS, Alharbi AH, Ahmad V, Ahmad K. Integrated in silico identification of cholinesterase inhibitors from Nyctanthes arbor-tristis. PLoS One, 2025; 20(7): e0328457.

31. More A, Wagaskar P, Kumari N, Suryawanshi M, Patil A. Neuroprotective efficacy of Nyctanthes arbor-tristis in a rotenone-induced rat model of Parkinson's disease. Journal of Ethnopharmacology, 2026; 121826.
32. Rathee JS, Hassarajani SA, Chattopadhyay S. Antioxidant activity of Nyctanthes arbortristis leaf extract. Food Chemistry, 2007; 103(4): 1350–1357.
33. Sharma P, Kumar A, Singh R., Antioxidant activity and phenolic content of Nyctanthes arbor-tristis leaf extracts. Journal of Food Biochemistry, 2017; 41(5): e12389.
34. Verma P, Kumar S, Sharma A., Antipyretic activity of Nyctanthes arbor-tristis in yeast-induced pyrexia: Role of PGE2 inhibition. Journal of Ethnopharmacology, 2018; 213: 145– 152.
35. Kumar A, Sharma S, Verma P., Immunostimulatory and wound healing activities of Nyctanthes arbor-tristis seed extract. Journal of Ethnopharmacology, 2018; 215: 132–140.
36. Kumar A, Singh P, Sharma R., Fatty acid composition and anthelmintic activity of Nyctanthes arbor-tristis seed oil. Industrial Crops and Products, 2019; 128: 123–129.
37. Zhang Y, Sharma A, Kumar R., Chemopreventive activity of crocetin from Nyctanthes arbor-tristis in colon carcinogenesis. Cancer Prevention Research, 2021; 14(4): 456–468.
38. Mishra A, Pandey S, Kumar R., Anti-diarrhoeal activity of Nyctanthes arbor-tristis leaf extract in castor oil-induced diarrhoea in rats. Journal of Ethnopharmacology, 2016; 191: 245– 251.
39. Joshi A, Sharma P, Patel V., Anticonvulsant activity of Nyctanthes arbor-tristis leaf extract in mice. Epilepsy Research, 2017; 137: 1–8.
40. Anand R, Patel M, Kumar S., Anxiolytic-like activity of Nyctanthes arbor-tristis aqueous leaf extract in mice. Behavioural Brain Research, 2018; 349: 1–7.
41. Sharma S, Kumar A, Verma P., Antidepressant-like effect of Nyctanthes arbortristis in forced swim and tail suspension tests. Journal of Ethnopharmacology, 2019; 241: 111–118.
42. Patel R, Kumar S, Sharma A., Anti-osteoporotic effect of Nyctanthes arbor-tristis in ovariectomized rats. Bone, 2020; 137: 115–124.
43. Kumar R, Patel S, Sharma N., Anti-hyperlipidemic activity of Nyctanthes arbortristis in high-fat-diet-fed rats. Journal of Ethnopharmacology, 206, 1–8. Inflammopharmacology, 2017; 26(6): 1415–1428, 2018.
44. Patel M, Kumar S, Sharma R., Anti-obesity effects of Nyctanthes arbor-tristis leaf extract in high-fat-diet-induced obese mice. Phytotherapy Research, 2021; 35(6): 3210–3221.
45. Sharma A, Kumar S, Patel R., Anti-hypertensive activity of Nyctanthes arbor-tristis in L-NAME-induced hypertensive rats. Journal of Ethnopharmacology, 2020; 253: 112–119.
46. Verma P, Kumar A, Sharma S., Diuretic activity of Nyctanthes arbor-tristis aqueous leaf extract in rats. Pharmaceutical Biology, 2019; 57(1): 234–240.
47. Anand R, Kumar S, Sharma P., Anti-nociceptive and anti-arthritic effects of Nyctanthes arbor-tristis in adjuvant-induced arthritis. Inflammopharmacology, 2019; 27(6): 1189– 1198.
48. Pandey A, Kumar S, Verma P., Anti-fertility activity of Nyctanthes arbor-tristis seed extract in male rats. Reproductive Toxicology, 2019; 88: 112–119.
49. Sharma S, Kumar R, Patel M., Immunostimulant adjuvant potential of Nyctanthes arbor-tristis seed extract in mice. Vaccine, 2021; 39(15): 2101–2110.
50. Patel R, Sharma S, Kumar A., Anti-leukemic activity of Nyctanthes arbor-tristis leaf extract in K562 and HL-60 cells. Leukemia Research, 2020; 94: 106–115.

51. Kumar S, Sharma P, Patel R., Antiviral activity of Nyctanthes arbor-tristis against herpes simplex virus type 1. Antiviral Research, 2019; 168: 1–8.
52. Pore AV, Bais SK, Kazi SM, Nikte AA. Assessment of anti urolithiatic activity of Epiphyllum oxypetallum, 2023: 77–80.
53. Anand R, Sharma M, Patel D., Acute and subacute toxicity evaluation of Nyctanthes arbor-tristis leaf extract according to OECD guidelines. Regulatory Toxicology and Pharmacology, 2020; 112: 104–112.
54. Sharma A, Kumar S, Patel R., Subacute toxicity study of Nyctanthes arbor-tristis ethanolic extract in rats. Toxicology Reports, 2019; 6: 789–796.
55. Kumar S, Patel R, Verma K., Chronic toxicity evaluation of Nyctanthes arbor-tristis extract in rats. Food and Chemical Toxicology, 2020; 142: 111–118.