World Journal of Pharmaceutical Sciences
ISSN (Print): 2321-3310; ISSN (Online): 2321-3086
Available online at: http://www.wjpsonline.org/
Review Article

A Review on *Nyctanthes arbortristis Linn* an important traditional Plant of Herbal Medications

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Received: 13-01-2021 / Revised Accepted: 10-02-2021 / Published: 27-02-2021

ABSTRACT

The *Nyctanthes arbortristis Linn* is one of the most useful traditional plants in India it is distributed widely in sub-Himalayan regions and southwards to Godavari Nyctanthes arbortristis is commonly known as night jasmine or Harshringar is an important medicinal plant mainly used in Ayurveda? One of the oldest systems is ayurveda that uses plants and their extracts for treatment and management of various diseases. It has been reported as useful in sciatica, arthritis, fever, asthma, anti-viral, antifungal, anti-pyretic, anti-histaminic, diabetes, cancer, etc. Diversity of plant part like seeds, leaves, flowers, bark and fruits have been investigated for their major pharmacological activity and Phytochemicals and revealed the presence of flavanoid, glycoside, oleanic acid, essential oils, tannic acid, carotene, fraudulent, lapel, glucose.

Keywords: *Nyctanthes arbortristis Linn*, Phytoconstituents, pharmacological action, flavanoid.

INTRODUCTION

Nyctanthes arbortristis Linn is commonly known as Harshringar belonging to the family Oleaceae. The name Nyctanthes means "Night Flowering" is a shrub or small tree growing to 10 m tall flaky grey bark. The flowers start falling after midnight and by the day break, the plant appears dull. *Nyctanthes arbortristis Linn* is a small divine ornamental tree used to pray the God according to Indian mythology known across the country for its fragrant white flowers. Use of the medicinal plants for curing diseases has been documented in history of all civilizations. Various parts of the plant like seeds, leaves, flowers, bark and fruits have been investigated for their significant pharmacological activity. Every part of the tree has been used as traditional medicine for household remedies against various human ailments from antiquity. Phytochemicals like flavanoid glycoside, oleanic acid, essential oils, tannic acid, carotene, fried line, lapel, glucose, benzoic acid have been reported for significant hair tonic, hepatoprotective, anti-leishmaniasis, antiviral, antifungal, anti-pyretic,

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How to Cite this Article: Garima Gupta, Dr. Ajit Kiran Kaur, Anil Kumar. A Review on *Nyctanthes arbortristis Linn* an important traditional Plant of Herbal Medications. World J Pharm Sci 2021; 9(3): 160-169.

anti-histaminic, anti-malarial, antibacterial, anti-inflammatory and anti-oxidant activities [4,5]. The various parts of Nyctanthes arbortristis are illustrated.

Vernacular classification

Sanskrit : Parianth
Bengali : Harsinghar, Sephalika, Seoli, Sheoli**.**
Ayurvedic : Paarijaata, Shephaali, Shephaalikaa, Mandaara.
Unani : Harasingaar.
English : Coral Jasmine, Night Jasmine
Gujarati : Jayaparvati, Parijatak.
Hindi : Harsinghar, Harsingur, Seoli, Sheoli, Sihau.
Kannada : Goli, Harsing, Parijatak.
Konkani : Pardic, Parizatak, Parzonto, Parzot.
Malayalam : Mannapu, Pavizhamalli, Parijatakom.
Marathi: Kharbadi, Kharassi, Khurasli, Parijatak.
Sanskrit : Parijatak, Parijatah, Parijataka, Sephalika.
Tamil : Manjhapu, Pavala-Malligai.
Telugu : Kapilanagadustu, Pagadamalle, Parijat.
Siddha : Pavazha motif.

Taxonomical classification

Kingdom : Plantae
Division: Magnoliophyta
Class : Magnoliopsida
Order : Lamiales
Family : Oleaceae
Genus : Nyctanthes
Species : arbor-tristis
Binomial name: *Nyctanthes arbortristis Linn*

Overview of Family Oleaceae: Oleaceae is a family containing 24 extant genera and around 600 species of helophytic shrubs, trees and occasionally twines. As shrubs, members of this family may be twine climbers, or scramblers.

Table 1: Some genera with common names of Oleaceae family

Genera Forsythia	Common name
Abeliophyllum	White Forsythia
Chionanthus	Fringetree
Forester	Swamp-privet
Forsythia	Forsythia
Fraxinus	Ash
Jasminum	Jasmine
Ligustrum	Privet
Osmanthus	Osmanthus
Olea	Olive
Failure	Mock-privet
Syringa	Lilac

Geographical distributions: In its native habitat, *Nyctanthes arbortristis Linn* is found on rocky ground in dry hillsides and as undergrowth in dry deciduous forests. *Nyctanthes arbortristis 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 [9].

Botanical descriptions

Bark: *Nyctanthes arbortristis Linn* is a deciduous tree grows up to 10 m tall, with quadrangular branches and grey or greenish-white rough bark [6]. Bark surface is dip pled due to scaling off of circular barks and patchy due to gray brown colour regions. Scaling off the bark by circular flakes. The inner bark is creamy white, soft and collapsed and non-collapsed phloem zone distinctly visible.

Leaves: Leaves are simple petiolate and estipulate, opposite, 3-10 by 4- 6.3 cm ovate, acute or acuminate, bears distant teeth on entire, short bulbous hairs rounded or slight cuneate, petiole 6cm long hairy. *Nyctanthes arbortristis Linn*

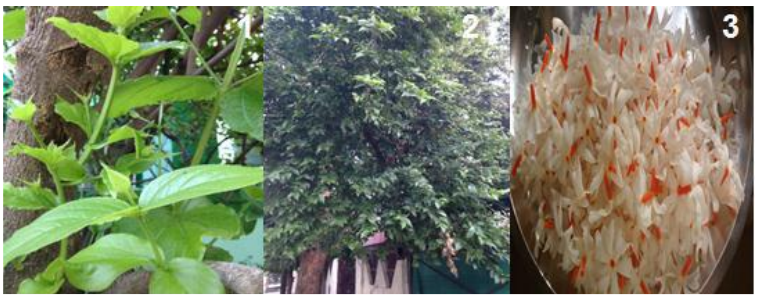
venation is unicostate, reticulate with an average of 12 lateral veins leaving the midrib. The petioles are about 5-7, 7-10 mm long with ad axial concavity.

Flower: The flowers are originated at the tips of branches in the axils of leaves are small in clusters of 5-7 fragrant delightfully, peduncles of 4 angled, slender, calyx are 6-8 mm long, narrow campanulas, hairy glabrous inside, trunctate toothed or lobed, ciliated and Corolla are glabrous more than 13mm long, 6-8 mm long tube, orange colour, equalling limb, white lobes corolla with an orange red center, unequally obcordate.

Fruits: Fruits of Nyctanthes *arbortristis Linn* are a capsule of 1-2 cm diameter, long and broad, obcordate Orbicular, compressed, 2-celled, separating into 2 flat 1- seeded carpels, reticularly veined, glabrous. It grows well in loamy soils. The plant requires conditions varying from full sunlight to partial shade and needs to be watered regularly Flowering usually occurs from July to October. The macroscopic character of the fruit: The fruit is flat, brown and heart cordite-shaped to rounded-capsule, around 2 cm in diameter with two celled opening transversely from the apex, each containing a single seed. Microscopically fruit shows typical character of the fruit. In the epicarp epidermal cells are compactly arranged, polygonal cells with slightly anticlinal walls covered by a thin cuticle followed by l, 3 layers of collenchymas, Spongy parenchymatous tissue, sclerenchymatous fibres and oil gland.

Seed: The seed is compressed and is 1 per cell [4] Seeds is exalbuminous, testa thick; the outer layer of large transparent cells and heavily vascularised. Phytosterols, phenolic compounds, tannins, flavonoids, cardiac glycosides, saponins and alkaloids all are found in seeds of *Nyctanthes arbortristis Linn.*

Fig 1: Parts of Plant**;**



1) Leaves, 2) Matured Plant, 3) Flowers

Significance of plant in mythology: The orange heart is used for dyeing silk and cotton, this practice was started with Buddhist monks whose orange robes were given their colour by this flower. The Parijatak is regarded in Hindu mythology as one of the five wish-granting trees of Devaloka.

Significance of various parts of plant in Ayurveda: Different parts of *Nyctanthes arbortristis Linn* are known to own for treatment of various ailments by tribal people of India esp. Orissa and Bihar along with its use in Ayurveda, Siddha and Unani systems of medicines [3, 11, 13]. The seeds are used as antihelmintic and in alopecia. It is ant bilious and an expectorant, and is also useful in bilious pyrexia [14]. The powdered seeds are used to cure scurfy affections of scalp, piles and skin diseases [11]. The powdered stem bark is given in rheumatic joint pain, in treatment of malaria and also used as an expectorant [4]. The bark is used for the treatment of snakebite and bronchitis [6, 15]. The leaves of *Nyctanthes arbortristis Linn* are used extensively in Ayurvedic medicine for the treatment of various diseases such as sciatica, chronic pyrexia, rheumatism, and internal worm infections, and as a laxative, diaphoretic and diuretic [16]. Leaves are effective in cough. Leaf succulent is mixed in honey and given thrice daily for the treatment of cough. Paste of leaves is given with honey for the treatment of pyrexia, high blood pressure and diabetes [17]. Succulent of the leaves is used as digestives, antidote to reptile venoms, mild bitter tonic, laxative, diaphoretic and diuretic. Leaves are also used in the enlargement of spleen [3, 4]. The leaf succulent is used to treat anorexia, haemorrhoid, liver disorders, biliary disorders, intestinal worms, chronic pyrexia, obstinate sciatica, rheumatism and pyrexia with rigors [14]. The extracted succulent of leaves acts as a cholagogue, laxative and mild bitter tonic. The rural people of Chittoor district Andhra Pradesh (India) widely use the whole plant for treatment of cancer, root for pyrexia, sciatica, anorexia; bark as expectorant. The flowers are used as stomachic, carminative, astringent to bowel, ant bilious, expectorant, hair tonic and in the treatment of haemorrhoid and various skin diseases 6 and for ophthalmic purposes.

Phytoconstituents: The plant *Nyctanthes arbortristis Linn* contains high amount of alkaloids especially in leaves and roots. The important active principle of this plant is iridoid arbortristoside. The whole plant and leaves also contains many important useful Phytochemicals like β- sitosterol, nyctanthic acid, olenoic acid, ascorbic acid, saponins, flavonoids, tannins and also many glycosides like D-mannitol, flavonoglycosides, Astragaline, Nicotiflorine.

Phytoconstituents from leaves: Leaves contain D-mannitol, β-sitosterole, Flavanol glycosides, Astragaline, Nicotiflorin, Oleanolic acid, Nyctanthic acid, Tannic acid, Ascorbic acid, Methyl salicylate, resinous substances, Amorphous glycoside, Amorphous resin, Trace of volatile oil, Carotene, Friedeline, Lupeol, Mannitol, Glucose, Fructose, Iridoid glycosides, Benzoic acid. All the important Phytoconstituents are being used in Ayurvedic medication and reported for sciatica, arthritis, fevers, and various painful conditions and as a laxative.

Phytoconstituents from flowers: Flowers contain modified diterpenoid nyctanthic, flavonoids, anthocyanins and an essential oil which is related to that of jasmine .Flowers have modified essential oil, Nyctanthin, d-mannitol, Tannin, Glucose, Carotenoid, Glycosides, β-monogentiobioside ester of α-crocetin (orcrossing-3), β-monogentiobioside, β-D monoglucoside ester of α-Christian, β-digentiobioside ester of α-crocetin (or crossing-1) 1, anthocyanins and essential oil which is similar to jasmine. It also contain an antiplasmodial cyclohexylethanoid, rengyolone, a new iridoid glucoside 6-O -trans-cinnamoyl-7- O-acetyl-6-β-hydroxyloganin and three known iridoidglucosides, arborside-C, 6-β-hydroxyloganin and nyctanthoside. Rengyolone was first isolated from Forsythia suspense (Oleaceae), an important plant of the crude drug "rengyo". It was also reported that Halleridone from the African medicinal plant Hallerialucida (Scrophulariaceae) and as a cytotoxic constituent from Cornuscontroversa (cornaceae). It was establish that after several months the mix abused-C has changed in the isomeric structure with the benzene group shifted to C-6-OH. This construction is named as isoarborside-C.

Phytoconstituents from seeds: Seeds contain Arbortristoside A&B, Glycerides of linoleic acid, oleic acid, lignoceric acid, stearicpolysaccharide tranquil of D-glucose and D mannose. The seed of Nyctanthes arbortristis contains 15% of pale yellow brown oil, nyctanthic acid, nyctoside A, b-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 mammals and used as an immunostimulant and hepatoprotective [20].

Bark: The bark contains glycosides and alkaloids.

Phytoconstituents from stem: Stem contain β-sitosterol, Glycoside-naringenin-4-0-β-glucapyranosyl-αxylopyranoside and
Flower oil Flower oil contains p-cymene α-pinene, 1-hexanol methyl heptanone, phenyl acetaldehyde, 1-deconol and anisaldehyde. β- Amyrin, arbortristoside-A, oleanolic acid, nyctoside-a, nyctantic acid and 6- β- hydroxyloganin.

Phytoconstituents from the Roots: The root part of the plant composed of alkaloids, tannins and glycosides. From the chloroform extract of the root β-Sitosterol and oleanolic acid has been isolated.

Table 2: Phytoconstituents from *Nyctanthes arbortristis Linn*

Chemical Class	Phytoconstituents				
	Steam	**Flower oil**	**Flower**	**Seed**	**Leaf**
Flavonoids		Quercetin, Kaempferol, Apigenin, Anthocyanins			Nicotiflorin
Steroids	β-sitosterol			β-sitosterol	β-sitosterol, D-mannitol β-sitosterole, Astragaline, Nicotiflorin, Oleanolic acid, Nyctanthic acid, Tannic acid, Ascorbic acid Methyl salicylate, Volatile oil, Mannitol, Glucose
Glycosides	Naringenin-4'-Oβ-glucopyranosylα-xylopyranoside		Cardiac glycosideny phalanx	Phenylpropanoid Glycosidenyctoside	Flavonol Glycosidesastragaline, Nicotiflorine

Alkaloids	Nyctanthin				
Terpenes		α-pinene, pcymene	Diterpene-Nyctanthin	Triterpenes-3, 4-Secotriterpene acid, nyctanthic acid	Triterpenes ,β-amyrin, oleanolic acid, friedeline, lupeol

The studies revealed the presence of tertiary alkaloids mainly 7-(α -anilino-p-nitro benzyl)-8-quinolinol and quaternary alkaloids belonging to protoberberines and aporphines 21, 22.The leaves have been found to contain tannic acid, methyl salicylate, amorphous glycosides, mannitol, resin, ascorbic acid, carotene, and traces of a volatile oil. Flowers contain essential oils, colouring matter (nyctanthin), mannitol, tannin and glucose. Its roots are composed of alkaloids, tannins and glycosides 15, 23, 24, 25 are summarised in Table 2.

Table 3: Various Chemicals Isolated From the Parts of Nat and Reported Pharmacological Activity:

Parts of plant	Chemical constituents	Pharmacological activity
Seed	Nytoside A11	Under investigation
Flower	4-hydroxy hexahydrobenzofuran-7-one Rengyalane16	Antibacterial ,Antimalarial
Leaves	Friedelin26	Antihistaminic
Corolla tube	Arbortristoside A11 Arbortristoside B11 Arbortristoside C11	Antihistaminic
Steam	β-sitosterol Nyctanthin	Antioxidant Antipyretic Bronchitis Snakebite

Medicinal Usage

Virtually all parts of the plant have been used in different diseases and in different indications. By and large, different parts have following activities like:

- **Leaves –**antibacterial, anti-inflammatory, anti-fungal, anti-pyretic
- **Flowers –** anti-filarial, antioxidant, diuretic
- **Seed –** antifungal, antibacterial, antileishmanial, immunomodulatory
- **Stem –** antipyretic and antioxidant
- **Bark** – anti-microbial
- **Flower oil –** as perfume

Pharmacologic activities-

Antioxidant activity: The free radical scavenging potential of the different extracts of leaves of *Nyctanthes arbortristis Linn* was evaluated. The scavenging effect of plant extracts and standard on the DPPH radical decreases in the following manner: Ascorbic acid > Butanol > Ethyl acetate >BHT > Pet ether, and it was found to be 93.88% for ascorbic acid at concentration of 10 mg, for BHT, Butanol, Ethyl acetate and Pet ether was found to be 97.42 %, 95.22%, 84.63% and 82.04% at concentration of 100 mg respectively. In this investigation different extract of *Nyctanthes arbortristis Linn* leaves possess concentration dependant free radical scavenging activity19. Nyctanthes arbor-tristis revealed the presence of flavonoids, tannins, saponins, glycosides, alkaloids, steroids, and phenolic compounds. Phenolic compounds have been recognized as antioxidant agents, which act as free radical terminators 56, 57 and have been known to show medicinal activity. The overall antioxidant activity of Nyctanthes arbor-tristis might be attributed to its polyphenol content and other phytochemical constituents [26].

Toxicity: *Nyctanthes arbortristis Linn* showed the toxic effect of ethanol extract of leaves in rats. The median lethal dose (LD) 16 mg/kg was observed in rats. No mortality was at 2.0 mg/kg, while 75% mortality was seen at a 32 mg/kg dose. An administration of ethanol extract of the leaves (1, 2 and 4 mg/kg/day) orally for 6 consecutive days is produced gastric ulcers in rats. This extract also showed irritant effects as it, dose-dependently, the formation of unformed semi-fluid collagens pasty stools in albino mice because of a purgative effect. When extract installed into the rabbit‘s eye produced conjunctival congestion with edema, while the person who grounded the dried leaves developed vesicles on both palms.

Hepatoprotective activity: The aqueous extracts of the leaves and seeds of *Nyctanthes arbortristis Linn* were found to have hepatoprotective activity against carbon tetrachloride (CCl_4) induced hepatotoxicity. The alcoholic and aqueous extracts showed significant hepatoprotective activity by reducing the levels of SGPT (serum glutamic pyruvic transaminase), SGOT (serum glutamic oxaloacetic transaminase) and serum bilirubin (total and direct). The results were supported by histopathological studies of liver samples which showed regeneration of hepatocytes by the extracts. In this study the leaf extract of *Nyctanthes arbortristis Linn* and silymarin restored all serum

and liver parameters which were altered by (CCl_4) from the normal level, also prevent loss of body weight; both candidates are also protected against (CCl_4) induced increase in liver weight and volume. The mechanism involves the blockade of deactivation of (CCl_4) through inhibition of P 450 2E1 activity and or to accelerate the detoxification of (CCl_4). These effects may be mediated by the antioxidant present in the plant. In another investigation, the ethanolic and aqueous extract of the leaf of *Nyctanthes arbortristis Linn* (500mg/kg PO for 10 days) reversed the rise in serum AST and total bilirubin in (CCl_4) induced hepatotoxicity in animal model [30].

Anti-diabetic activity: The anti-diabetic activity of methanol extract of root of *Nyctanthes arbortristis Linn* is comparable to that of diabetic control animals. The extract poses safe and strong anti-diabetic activity. The extract was prepared by extracting 50g root powders with 400mL of methanol for 18 hours by hot continuous extraction method. The methanolic extract was filtered and partitioned by using petroleum ether to remove impurities. The solvent was evaporated under pressure and dried in a vacuum. The dried extract of N. arbortristis thus obtained was used for the assessment of hypoglycaemic activity Methanol extract of root of *Nyctanthes arbortristis Linn* poses safe and strong anti-diabetic activity. It reduces blood glucose level after seven days at the 500 mg/Kg in rats compare with standard drug. It was found that methanolic extract of *Nyctanthes arbortristis Linn* roots were more effective in reducing the blood glucose level compare to the standard drug. Oral administration of chloroform extracts of leaf and flower and 50% ethanolic extract of leaves significantly increase superoxide dismutase (SOD) and catalase (CAT) levels and cause a significant reduction in liver lacto peroxidase (LPO), serum levels of SGPT , SGOT , alkaline phosphatise, cholesterol and triglyceride levels in comparison to the diabetic controls

Anti-inflammatory activity

The aqueous extract of the whole plant, alcoholic extract of stem and seeds and water soluble portion of the alcoholic extract of leaves of N. arbortristis were reported to have acute and sub-acute anti-inflammatory activity. In the sub-acute models, *Nyctanthes arbortristis Linn* was found to check granulation tissue formation significantly in the granulomapouch and cotton pellet test. N. arbortristis is also found to inhibit the inflammation produced by immunological methods that are Freud's adjuvant arthritis and purified tuberculin reaction.

Sedative Activity: Sedative potential of a hot infusion of the flowers was examined in rats 25. In this test, male rats exhibited a dose-dependent conscious sedative activity while female rats remained unaffected. At these doses, muscle strength and coordination were not affected nor was blood glucose levels affected even at the highest dose. However, glucose absorption from the small intestine was significantly reduced. The sedation was attributed, in part, to the antioxidant and membrane stabilizing activity of the extract.

Anti Anxiety: Hydroalcoholic extracts of *Nyctanthes arbortristis Linn* have anxiolytic potential. Using hydro-alcoholic mixture, dried plant parts of N. arbortristis was extracted, concentrated by distilling off the solvent and then evaporated to dryness on the water bath and then stored in an airtight container in are frigerator till used.

Antibacterial activity: Infectious diseases are the world's leading cause of premature death. Resistance to antimicrobial agents is conferred in a wide variety of pathogens and multiple drug resistance is becoming more common in diverse organisms such as Staphylococcus aureus, Staphylococcus epidermis, Salmonella typhi, Salmonella paratyphoid. In a study, it was reported that methanolic extract of leaves of *Nyctanthes arbortristis Linn* exhibited significant antibacterial activity against Staphylococcus aureus, Staphylococcus epidermis, Salmonella typhi, Salmonella paratyphoid A with MIC value ranging between 1-8 mg/ml. The zone of inhibition and the Minimum Inhibitory Concentration (MIC) of the extracts were determined and compared with the standard drugs ciprofloxacin and fluconazole. The chloroform extract was found to have both antibacterial and antifungal activities, whereas the petroleum ether and ethanol extracts hold only antibacterial activity.

Anti-malarial activity: Administration of fresh paste of medium sized 5 leaves of *Nyctanthes arbortristis Linn* thrice a day for 7-10 days has cured the disease in 92 (76.7%) patients within 7 days. Another 20 patients were cured by 10 days while the remaining 8 patients did not respond to the treatment. The paste was well tolerated and no severe side effects were reported. Screening of methanol and chloroform extract of leaves for mosquito parricidal activity against 3 major mosquito vectors-aedesaegypti, Culex quinquefasciatus and Anopheles stephensihas found the two extracts to kill larvae of A. Stephens with LC_{50} values of 244.4 and 747.7 ppm, respectively.

CNS depressant activity: It was reported that the leaves, flowers, seeds and barks (600 mg/kg) of N. arbortristis exhibited significant and dose dependent prolongation of onset and duration of

sleep and found to cause a decrease in dopamine and increase serotonin level from which it can be resolved that the CNS depressant activity of the ethanol extracts of seeds, leaves and flowers may be due to the decrease in dopamine and increase in serotonin level.

Treatment of Piles, Gout, And Dry Cough: The seeds of *Nyctanthes arbortristis Linn* are used in the treatment of piles. The decoction of *Nyctanthes arbortristis Linn* Flowers are used in the treatment of gout. Leaves are used against dry cough. The aqueous paste of the leaves is used externally in the treatment of skin related troubles specifically in the treatment of ringworm. The young leaves are used as a female tonic. N. arbortristis also has hypoglycaemic effect, potentiating action of exogenous insulin and streptozotocin- induced diabetic rat model.

Anti-allergy Activity: The pre-treatment of guinea pigs exposed to histamine aerosol with a water soluble portion of the alcoholic extract of *Nyctanthes arbortristis Linn* leaves offered significant protection against the development of asphyxia70. Arbortristoside A and arbortristoside C present in N. arbor-tristis was reported to be anti-allergic.

Anti-plasmodia activity: Rengyolone, a cyclohexylethanoid isolated from the ethanolic extract of *Nyctanthes arbortristis Linn* flowers and its acetate showed in vitro antiplasmodial activity against Plasmodium falciparum (K1, multidrug resistant strain). The extract also showed in vitro efficacy against Leishmaniasis Donovani and Entamoeba histolytica.

Anti-arthritic activity: Arthritis is a disease manifested by joint pain followed by bone and joint destruction. Cytokines play a major role in arthritis. In the previous study it was reported that the irregular expression of tumour necrosis factor-α (TNF-α) in experimental animals has been shown to cause destructive arthritis. The development of arthritis was markedly suppressed in interleukin-β (IL-1β) deficient collagen-induced arthritis (CIA). Interleukin-6 (IL-6) gene disrupted mice were resistant to antigen and collagen-induced arthritis. These studies indicated that pro-inflammatory cytokines (TNF-α, IL-1β, and IL-6) play a role in arthritis and are potential targets for therapy.

Immunostimulant activity: In a study, it was reported that oral administration of ethanolic extract of NAT at dose of 50, 100, 150, 200 mg/kg significantly enhanced circulating antibody titre when challenged with SRCs and heat-killed Salmonella antigens. The chronic administration significantly enhanced total WBC count and potentiated DTH reaction. Flowers have also been shown to possess immuno-stimulant activity by activating the cell mediated immune system [28]. The ethanolic seed and root extracts of NA also showed immunomodulatory activity against systemic candidiasis.

Antispasmodic activity: In this study it was reported that ethanolic extract of fresh flowers and dried leaves and stem and bark of NAT tested for its antispasmodic activity using guinea pig ileum. It was found to inhibit contractile response of acetylcholine.

Anti-Anaemic Activity: A research was performed as a haematological study on the ethanolic extracts of the flowers, barks, seeds and leaves of the plant and noticed the dose dependent rise in haemoglobin content and red blood cells count in rats. The extracts also protect the decline of hemogram profile in anemic rats.

Anti-Cholinesterase activity: The aqueous extract of *Nyctanthes arbortristis Linn* stimulated the activity of acetyl chorine esterase in mice; it antagonizes the inhibition of this enzyme by Malathion. The higher effects were seen in the serum than in the brain. The low anti muscarinic activity against acetylcholine induced contractions of isolated rabbit ileum was already reported

Anticancer activity: Fruit, leaf and stem methanol extracts of *Nyctanthes arbortristis Linn* were tested for in vitro anticancer activities. Moderate activity was observed at 30mg/ml cans. With 71% inhibition of dried N. arbortristis leaf methanol extract and least inhibitory activity was observed at 10mg/ml cans. With 86% inhibition of breast cancer cell lines free of pathogens. A high degree of against human breast cancer cell lines (MDA-MB 231) was observed with N. arbortristis dried fruit methanol.

Anti-Parasitic activity: A crude 50% ethanolic extract of the leaves has been reported to exhibit trypanocidal activity at1000 g/ml concentration. In vivo studies revealed that the extract exerted antitrypanosomal effects at doses of 300 and 1000 mg/Kg, significantly prolonged the survival period of Trypanosomaevansi infected mice. However, it is also reported that as soon as the treatment with the extract is discontinued, the parasitaemia increases and results in the death of the experimental animals. N. arbortristis extract has also exhibited potent anti-leishmanial activity in Leishmanial donovani infected hamsters.

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inhibition of this enzyme by Malathion. The higher effects were seen in the serum than in the brain. The low anti muscarinic activity against acetylcholine induced contractions of isolated rabbit ileum was already reported.

Anti-viral Activity: The ethanolic extract, n-butanol fractions and two pure compounds, arbortristoside A and arbortristoside C, isolated from the N. Arbortristis showed pronounced inhibitory activity against encephalomyocarditis virus (EMCV) and Semliki Forest Virus (SFV). In vivo, the ethanolic extract and the n-butanol fraction protected infected mice against EMCV and SFV by 40 and 60%, respectively 31.

Anti-leishmanial Activity: The anti-leishmanial activity of *Nyctanthes arbortristis Linn* has been attributed to iridoid glycosides, arbortristoside A, B, and C and of Night jasmine; a few reports are available on clinical studies with the extracts or the compounds and their medicinal applications.

Anti-Cholinesterase activity: The aqueous extract of *Nyctanthes arbortristis Linn* stimulated the activity of acetylcholine esterase in mice; it antagonizes the inhibition of this enzyme by Malathion. The higher effects were seen in the serum than in the brain. The low anti muscarinic activity against acetylcholine induced contractions of isolated rabbit ileum was already reported.

Anti-Histaminic and Anti-Tryptaminergic activity: The aqueous solubility of the alcoholic extract of *Nyctanthes arbortristis Linn* leaves (4.0 and 8.0g/kg oral) Significantly protect against histamine aerosol - induced asphyxia (2% at 300 mm Hg) in guinea pigs. Arbortristoside A and arbortristoside C present in N. arbortristis was reported to be anti-allergic activity.

Antimicrobial and antifungal activities: Phenolic compounds and tannins in ethanolic extract of leaves are found to be active against Staphylococcus aureus and Salmonella paratyphoid. Antimicrobial evaluation of aqueous and alcoholic extract of leaves against numerous Grams positive and Gram negative strains revealed that Salmonella typhimurium; Pseudomonas aeruginosa, Klebsiella pneumonia, E. coli, P. marginata and Staphylococcus epidermis were found more susceptible to the aqueous extract where as Micrococcus luteus, Staphylococcus aureus, Sterptococcus pyogenes and Baccilus subtilis were more sensitive to methanolic extract. Chloroform and ethyl acetate extracts of fresh and dried leaf, flowers, fruits and seeds are also reported to have a dose dependent antibacterial activity against Gram negative bacteria. The activity has been found significant for fresh plant materials than the dried plant parts. The stem bark extracts (petroleum ether, chloroform and ethanol) are found to have potential antimicrobial activity against S.aureus, Micrococcus luteus, B. subtilis, E. coli, P. aeruginosa, Candida albicans and Aspergillums Niger [47-51]. Leaf extract of N. arbortristis are found effective in reducing radial growth of 3 fungal pathogens of rice viz. Pyricularia oryzae, Cochliobolus miyabeanus and Rhizotonia solania.

Miscellaneous Activities: Acetone extract of the seeds exhibit ovicidal effect on the eggs of rice moth, Corcyra cephalonica. The inhibition of egg hatching increased with increase in concentration of plant extracts in contact toxicity test. 80-73% ovicidal action was observed at 100% concentration of the extract. Petroleum ether extract of NA also exhibits insecticidal activity against Bagradacruciferarum. The ethanolic extract of NA leaves, seed and roots were scanned portion of an ethanol extract of the leaves exhibit significant aspirin like antinociceptive activity but failed to produce morphine like analgesia.

Conclusion

Nyctanthes arbortristis Linn easily available and no special conditions are required for its collection and cultivation. It is a valuable medicinal plant and a unique source of useful metabolites such as alkaloids, phytosterols, phenolics, tannins, flavonoids, glycosides and saponins. For the last few years, there has been an increasing awareness for N. arbortristis research. Several therapeutically and industrially useful preparations and compounds have also been marketed, which generates enough encouragement among the scientists in exploring more information about their medicinal plant. Potential of this plant in management of various diseases makes it a plant of clinical interest. Though plant has been found to be safe but the potent curvature effects of the plant against particular human ailment need to be verified by more controlled and exhaustive clinical trials.

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