

## A review on: *Nyctanthes arbortristis* Linn. Rejuvenating herbs

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### Abstract

Ayurveda is one of the oldest systems of medicine that uses plants and their extracts for treatment and management of various diseased states. *Nyctanthes arbortristis* Linn. (NAT) is well known Indian medicinal plant. Phytochemicals like flavanol glycoside, oleanic acid, essential oils, tannic acid, carotene, friedelene, lupeol, glucose, benzoic acid have been reported for significant, hepatoprotective, antileishmaniasis, antiviral, antifungal, antipyretic, antihistaminic, antimalarial, antibacterial, anti-inflammatory, antioxidant activities. Further investigations exploring possible use of these phytochemicals as pharmacological agents are warranted. Each part of the plant has some medicinal value and is thus commercially exploitable. It is now considered as a valuable source of several unique products for the medicines against various diseases and also for the development of some industrial products. The article reviews is an attempt to compile and documented information on different aspect of *Nyctanthes arbortristis* pharmacological properties and article published on this plant highlighted the need for research and their potential development.

**Keywords:** *Nyctanthes arbortristis*, Phytochemicals, Ayurveda, Harsingar

### Introduction

*Nyctanthes arbortristis* also called the “tree of sorrow”, because the flowers lose their brightness during daytime; the scientific name arbor-tristis also means “sad tree”. The flowers can be used as a source of yellow dye for clothing. The flower is the official flower of the state of West Bengal, India, and for Kanchanaburi province, Thailand. *Nyctanthes arbor-tristis* (sometimes incorrectly cited as *Nyctanthes arbortristis* or *Nyctanthes arbor-tristis*).



Fig 1: *Nyctanthes arbortristis* Linn.

### Vernacular names

**Family:** Oleaceae; Nyctanthaceae.

**Unani:** Harasingaar.

**Sanskrit:** Parijatha.

**Siddha:** Pavazha mattigai.

**Hindi:** Harsingar.

**Ayurvedic:** Paarijaata, Shephaali, Shephaalika, Mandaara.

**English:** Tree of Sorrow, Night Jasmine, Coral Jasmine.

**Marathi:** Parijathak.

**Kannada:** Parijatha.

Common name of *Nyctanthes arbortristis* (sad tree) <sup>[1]</sup>

Common name Area	Common name Area
Seri gading Malaysia	Seri gading Malaysia
Sheuli or Shefali West Bengal, Bangladesh	Sheuli or Shefali West Bengal, Bangladesh
Night-flowering Jasmine, Coral Jasmine English	Night-flowering Jasmine, Coral Jasmine English
Harashringara, Harsingar Hindi	Harashringara, Harsingar Hindi
Kannika Thailand	Kannika Thailand
Parijata, Paghala Nepal	Parijata, Paghala Nepal

### Taxonomical Classification

**Kingdom:** Plantae

**Division:** Magnoliophyta

**Class:** Magnoliopsida

**Order:** Lamiales

**Family:** Oleaceae

**Genus:** *Nyctanthes*

**Species:** *arbor-tristis*

**Binomial name:** *Nyctanthes arbor-tristis* <sup>[1]</sup>

### Distribution of the plant

*Nyctanthes arbor-tristis* Linn is native to India, distributed widely in sub-Himalayan regions and southward to Godavari. It is also widely distributed in Bangladesh, Indo-Pak subcontinent and South-East Asia, tropical and sub-tropical South East Asia. It grows in Indo-Malayan region and distributed across Terai tracts as well as Burma and Ceylon. It tolerates moderate shade and is often found as undergrowth in dry deciduous forests. It is also found in Thailand. <sup>[1, 2]</sup>

## Description of the plant

*Nyctanthes arbor-tristis* Linn is a large shrub growing to 10m tall, with flaky grey bark, stiff whitish hair, young branches and rough leaves. The flowers are fragrant, with a five to eightlobed white corolla with an orangecoloured centre; they are produced in clusters of two to seven together, with individual flowers opening at dusk and finishing at dawn. Calyx is 6-8mm long, narrowly campanulate, hairy outside, glabrous inside truncate or obscurely toothed or lobed, ciliated. Corolla glabrous and is more than 13 mm long; tube is 6-8 mm long, orange coloured, about equalling the limbs; lobes are white and unequally obcordate and cuneate. The leaves are opposite, simple, 6-12 cm long and 2-6.5 cm broad, with an entire margin. The fruit is a flat brown heart-shaped to round capsule 2 cm diameter, with two sections each containing a single seed. These are long and broad, obcordate or nearly orbicular, compressed, 2-celled. Seeds are exalbuminous, testa are thick, outer layer of large transparent cells is heavily vascularised. [1, 2]

## Uses of *Nyctanthes Arbor-tristis* Linn [1, 3]

### Traditional Uses

Traditionally the flowers are gathered for religious offerings and to make garlands. The orange heart is used for dyeing silk and cotton, a practice that started with Buddhist monks whose orange robes were given their colour by this flower. The Parijata is regarded in Hindu mythology as one of the five wish-granting trees of Devaloka. [1]

Different parts of *Nyctanthes arbor-tristis* Linn are known to possess various ailments by tribal people of Indian subcontinent with its use in Ayurveda, Sidha and Unani systems of medicines. [1]

### Flowers

The flowers are used as stomachic, carminative, astringent to bowel, antibilious, expectorant, hair tonic and in the treatment of piles and various skin diseases and in the treatment of ophthalmic purposes. The bright orange corolla tubes of the flowers contain a coloring substance nyctanthin, which is identical with  $\alpha$ -Crocetin from Saffron. The corolla tubes were formerly used for dyeing silk, sometimes together with Safflower or turmeric. [1]

### Stems

Traditionally the powdered stem bark is given in rheumatic joint pain, in treatment of malaria and also used as an expectorant. The bark is used for the treatment of snakebite and bronchitis. The stem bark pounded with *Zingiber officinale* and *Piper longum* is boiled in water and the resultant liquid is taken for two days for the treatment of malaria. The resulting paste on mixing with *Arjuna* bark is rubbed on the body to treat internal injury and for joint broken bones. [1]

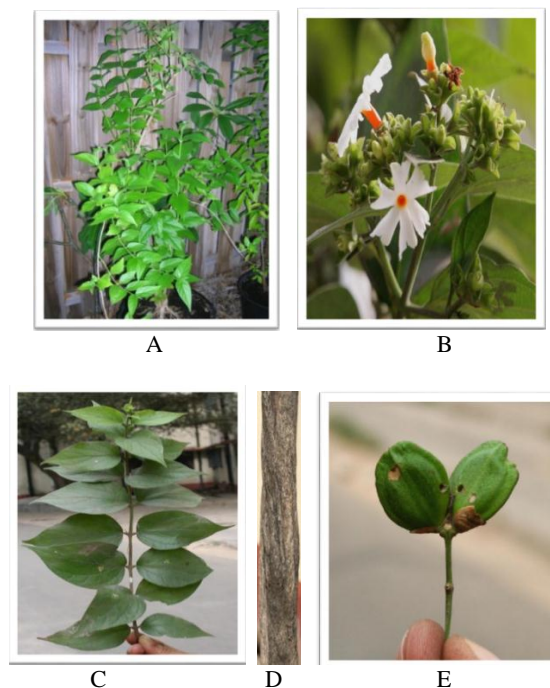
### Leaves

The leaves of *Nyctanthes arbor-tristis* Linn are used extensively in Ayurvedic medicine for the treatment of various diseases such as sciatica, chronic fever, rheumatism, and internal worm infections, and as a laxative, diaphoretic and diuretic. Leaves are used in cough reduction. Leaf juice is mixed in honey and given thrice daily for the treatment of cough. Paste of leaves is given with honey for the treatment

of fever, high blood pressure and diabetes. Juice 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. The leaf juice is used to treat loss of appetite, piles, liver disorders, biliary disorders, intestinal worms, chronic fever, obstinate sciatica, rheumatism and fever with rigors. The extracted juice of leaves acts as a cholagogue, laxative and mild bitter tonic. It is given with little sugar to children as a remedy for intestinal ailments. [1]

### Seeds

The seeds are used as anthelmintics and in alopecia. It is antibilious and an expectorant, and is also useful in bilious fevers. The powdered seeds are used to cure scurfy affections of scalp, piles and skin diseases. [1]



**Fig 2:** *Nyctanthes Arbor-tristis* Linn (A→ Whole plant, B→ Flowers, C→ Leaves, D→ Bark, E→Fruits)

## Chemical constituents of *Nyctanthes arbor-tristis* Linn: [3-6]

### Leaves

Leaves contain D-mannitol,  $\beta$ -sitosterole, Flavanol glycosides, Astragaline, Nicotiflorin, Oleanolic acid, Nyctanthic acid, Tannic acid, Ascorbic acid, Methyl salicylate, Amorphous glycoside, Amorphous resin, Trace of volatile oil, Carotene, Friedeline, Lupeol, Mannitol, Glucose, Fructose, Iridoid glycosides, Benzoic acid. [1]

### Flowers

Flowers contain Essential oil, Nyctanthin, d-mannitol, Tannin, Glucose, Carotenoid, Glycosides,  $\beta$ -monogentiobioside ester of  $\alpha$ -crocetin (or crocin-3),  $\beta$ -monogentiobioside,  $\beta$ -D monoglucoside ester of  $\alpha$ -crocetin,  $\beta$ -digentiobioside ester of  $\alpha$ -crocetin (or crocin-1). [1]

### Seeds

Seeds contain Arbortristoside A&B, Glycerides of linoleic acid, oleic acid, lignoceric acid, stearic acid, palmitic and

myristic acids, nycanthic acid, 3-4 secotriterpene acid, a water soluble polysaccharide composed of D-glucose and D mannose. [1]

### Bark

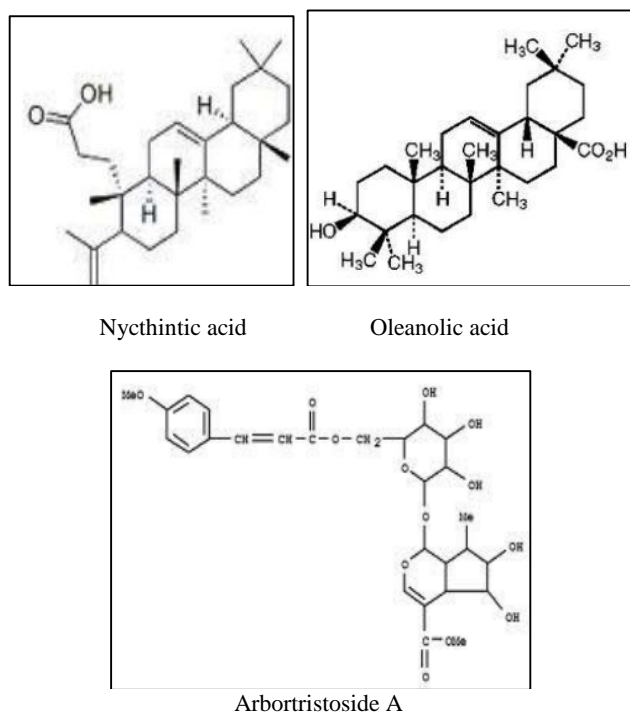
Bark contains Glycosides and alkaloids.

### Stem

Stem contains Glycoside-naringenin-4-O- $\beta$ -glucopyranosyl- $\alpha$ -xylopyranoside and  $\beta$ -sitosterol.

### Flower oil

Flower oil contains  $\alpha$ -pinene, p-cymene, 1- hexanol methyl heptanone, phenyl acetaldehyde, 1-deconol and anisaldehyde. [1]



**Fig 3:** Some chemical constituents of *Nyctanthes arbor-tristis* Linn with structure

### Review of literature on *Nyctanthes arbortristis*

Veeranki Nagavani, *et al.* (2210), In-vitro screening of nyctanthes arbor-tristis flowers for antioxidant activity and identification of polyphenols by Rp-hplc. Free radicals are highly reactive species produced in the body during normal metabolic functions or introduced from the environment, which are capable of causing tissue injury and have been implicated in the pathology of various human diseases. Antioxidants act as a major defense against radical-mediated toxicity by protecting against the damages caused by free radicals. A number of plants and plant isolates have been reported to protect free radical-induced damage in various experimental models. *Nyctanthes arbor-tristis* flowers were widely used for the treatment of Constipation, Intestinal worms, Piles. The different solvent extracts of the dry and fresh flowers were studied for its free radical scavenging activity with different methods viz lipid peroxidation assay, reducing activity and hydrogen peroxide scavenging assay. Along with these various levels of enzymatic and non-enzymatic antioxidants were also estimated. Further, polyph

enols were also identified by RP-HPLC. The results showed that methanol extracts of dry flowers exhibit high phenolic content and antioxidant activities, interestingly aqueous extracts showed high enzymatic antioxidants. [7]

Shalini Tripathi *et al.* (2010), was done the anxiolytic properties in experimental animals using various models such as elevated zero maze, elevated plus maze, open field exploratory behavior, novelty induced suppressed feeding test and social interaction test. Extract was given orally at different dose levels once daily for three consecutive days, while Lorazepam (Lor) (500 mg/kg i.p.) was administered as positive control. NAT (250 and 500mg/kg) showed significant anxiolytic effects on all the models of anxiety. The result reveals that NAT induced a promising increase in open field ambulation and slight increase in rearings and activity in center whereas grooming and fecal dropping remained unchanged. In elevated plus maze, open arm entries, open arm/closed arm entries ratio and the time spent on open arms was found to be increased. Both the NAT significantly produced the novelty induced increase in feeding latency test. NAT treated animals also showed increased social interaction in normal environment. The NAT observed under above parameters showed positive anxiolytic activity. [8]

Repon Kumer Saha, *et al.* (2012), investigated antibacterial assay by disk diffusion method. Cell surface receptor binding assay was performed by hemagglutination inhibition assay and hemolysis assay. Methanolic extract of the leaves of *Nyctanthes arbortristis* contains flavanoids and other biologically active compounds. The extract showed antioxidant, peroxide scavenging and total reducing activity. The extract also showed antibacterial activities against several strains of bacteria. It also showed hemagglutination inhibition activities and hydrogen peroxide induced hemolysis inhibition activity in human blood cells. [9]

R.S. Bhadouria, *et al.* (2012), was to isolate and characterize phytoconstituents from the ethanolic extract of *Nyctanthes arbor-tristis* L. leaves. By of the ethanolic extract of *Nyctanthes arbor-tristis* L., two alkaloidal compounds fractionated and isolated by column chromatography and further structures of these compounds were determined on the basis of spectral and chemical studies. It comprised two novel compounds i.e. 1- (8-Hydroxy-7-((4-nitrophenyl) (phenyl amino) methyl) quinoline-3-yl) propan-2-one and 2-(8-Hydroxy-7-((4-nitrophenyl) (phenyl amino) methyl) quinoline-3-yl) acetic acid. Structures of all the isolated compounds were elucidated by spectroscopic methods like IR, NMR and Mass spectrometry. [10]

P. Kannan. *et al.* (2009), was done Preliminary Characterization of Melanin Isolated from Fruits and Seeds of *Nyctanthes arbor-tristis*. Melanin from *Nyctanthes arbor-tristis* fruits and seeds was isolated and purified by alkaline extraction, acid hydrolysis and organic solvents. Each, fruit and seed yielded melanin 50 mg/100g tissue weight. The melanins of fruit and seeds were analyzed by UV-visible and infrared (IR) spectroscopy for characterization. The IR spectrum of fruit and seed melanins did not match with each other and the seed melanin could be distinguished by their sharp peak at 285 nm from the fruit melanin in IR spectrum. Two melanins have shown absorptions above and below 1600  $\text{cm}^{-1}$  in their respective IR spectrum. The melanins thus characterized were tested for their stability after incubating at different temperatures and in presence of oxidants ( $\text{KMnO}_4$

and  $K_2Cr_2O_7$ ) and metal ions ( $Mg^{++}$  and  $Zn^{++}$ ) for a specified period. The stability of the melanin was assessed by measuring changes in the absorbance at 285 nm. The results revealed that the fruit melanin was more stable at 50 °C while the seed melanin was quite stable at 25 °C. However, their stability was markedly affected by oxidants and metal ions. [11]

S. Bansal. *et al.* (2012), was done in vitro Regeneration of a Medicinal Plant Harsinghar (*Nyctanthes arbor-tristis* L.) In vitro propagation of *Nyctanthes arbor-tristis* L. has been successfully established from axillary bud explants on MS. Maximum number of multiple shoots was obtained on MS containing BAP (22.2  $\mu$ M). Half strength of MS (2% sucrose) supplemented with NAA (10.74  $\mu$ M) provided the maximum frequency of root initiation. The plantlets were successfully hardened. [12]

Prabodh Satyal. *et al.* (2012), was isolated essential oil from the leaves and barks of *Nyctanthes arbor-tristis*, collected from Biratnagar, Nepal, was hydrodistilled and analyzed by GC-MS. A total of 26 compounds were identified in the leaf oil, accounting for 100% of the oil while a total of 20 compounds were identified in the bark oil accounting for only 89.4% of the oil. Both the leaf and bark oil had similar quantities of hexadecanoic acid (26.4% and 34.3%, respectively) and octadecanoic acid (3.9 and 6.2%, respectively). However, the leaf oil also consisted of linalool (11.0%), (E)-phytol (13.6%) and (3 Z)-hexenyl benzoate (11.0%), which were absent in the bark oil. Besides fatty acids, the bark oil exhibited significantly different composition with mostly  $\beta$ -eudesmol and other eudesmol isomers (27.5%). The oil was screened for antimicrobial activity and showed marginal activity against *Bacillus cereus* and *Aspergillus niger* (MIC = 625  $\mu$ g/mL). *N. arbor-tristis* leaf oil was inactive in the brine shrimp lethality test (LC<sub>50</sub> > 100  $\mu$ g/mL). [13]

Manjulatha Khanapur. *et al.* (2014), was done in vitro Antioxidant, Antiproliferative, and Phytochemical Study in Different Extracts of *Nyctanthes arbor-tristis* Flowers. *Nyctanthes arbor-tristis* L. (Oleaceae) is widely used in the Indian system of traditional medicine and is reported to have various biological activities. The present study was intended to evaluate the antioxidant and antiproliferative activities of lower extracts of *Nyctanthes arbor-tristis*. The shade dried flowers were extracted with 95% ethanol under sonication and the antioxidant activities were investigated using in vitro assays along with the determination of phytochemical constituents (total polyphenol and total flavonoid). Arborescent C and-monogentiobioside ester of -Crocin were identified in crude active extracts through LCMS/MS analysis. The antiproliferative activity was carried out by MTT assay by employing different human cancer cell lines. The lowest IC<sub>50</sub> value of 24.56  $\pm$  6.63  $\mu$ g/mL was observed against Colo 205 cell line. The extract exhibited significant antioxidant and antiproliferative properties and the observed biological activities in this study provide scientific validation of ethnomedicinal use of this plant. [14]

Sonu Sharma, *et al.* (2012), was checked the antibacterial activity of the various extracts of bark of *Nyctanthes arbor-tristis* Linn. was evaluated by the filter paper disc method. This method is based on the diffusion of an antibiotic from a filter paper disc through the solidified culture media of a petri dish used for study. Growth of inoculated micro-

organism is inhibited entirely in a circular area "Zone", around the filter paper disc containing a solution of the antibiotic and the plant extract. [15]

Bibhuti Bhusan Kakoti. *et al.* (2013), was checked Analgesic and Anti-Inflammatory Activities of the Methanolic Stem Bark Extract of *Nyctanthes arbor-tristis* Linn. Stem bark of *Nyctanthes arbor-tristis* Linn. was extracted in methanol to evaluate their analgesic and anti-inflammatory activities. The analgesic activity was determined on Wistar albino rats by hot plate method, tail lick assay, and tail immersion method using Morphine sulphate as standard drug at a dose of 5 mg/kg of body weight and the results were expressed as mean increase in latency after drug administration  $\pm$  SEM. The anti-inflammatory activity was assessed by Carrageenan-induced rat paw oedema using diclofenac sodium as standard drug at a dose of 100 mg/kg of body weight and expressed in terms of mean increase in paw volume  $\pm$  SEM. Stem bark extract was given at a dose of 250 mg/kg and 500 mg/kg of body weight. Both standard drugs and extract were administered orally to the animals. Control received distilled water orally. Results showed that *Nyctanthes arbor-tristis* Linn. had potent analgesic and anti-inflammatory activities. [16]

Ravi Shankar Pandey. *et al.* (2012), was done Anti-oxidant activity of *Nyctanthes arbor-tristis* Linn. the flower of *Nyctanthes arbor-tristis* Linn was extracted with n-butanol. Total phenolic content of the extracts was determined by Prussian blue method was found to be 1220 mg catechin is equivalent to 100 g of flower powder. The antioxidant activity of the extracts was evaluated through in vitro model systems such as DPPH Radical scavenging, total anti-oxidant activity and reducing power. The % Inhibition by extract (86%) as well as BHT is comparable by considering I% of BHT is 100%. Total antioxidant activity was found to be 248mg/100g. Reducing power in terms of EC<sub>50</sub> value of the extract is excellent (12.10), which is comparable with that of BHT (12.26). The results of the present study indicate that *Nyctanthes arbor-tristis* Linn. Flower is a good source of antioxidant and phenolics. [17]

Shalini Tripathi. *et al.* (2012), evaluated Evaluation of Anxiolytic. Effect in Flowers of *Nyctanthes arbor-tristis*. Water soluble fraction of ethanolic extract of flowers of *Nyctanthes arbor-tristis* Linn (NATF) was Pharmacologically validated for its anxiolytic properties in experimental animals using various models such as elevated zero maze, elevated plus maze, open field exploratory behavior, novelty induced suppressed feeding test and social interaction test. Extract was given orally at different dose levels (250 and 500 mg/kg p.o.) once daily for three consecutive days, while Lorazepam (Lor) (0.5 mg/kg i.p.) was administered as positive control. NATF showed significant anxiolytic effects on all the models of anxiety. The result reveals that NATF induced a promising increase in open field ambulation and slight increase in rearings and activity in center whereas grooming and fecal dropping remained unchanged. In elevated plus maze, open arm entries and the time spent on open arms was found to be increased. Both the doses of NATF significantly produced the novelty induced increase in feeding latency test. NATF treated animals also showed increased social interaction in normal environment. The NATF observed under above parameters showed positive anxiolytic activity. [18]

A. K. Srivastava. *et al.* (1991), Evaluated some pharmacological studies on a flavone glycoside Of

nyctanthes arbortristis (harsinghar). A flavones glycoside isolated from the bark of ayurvedic plant, Nyctanthes arbortristis was subjected to various pharmacological studies. The glycoside was found to be effective on, cardiovascular system and smooth muscles of intestine but no significant effect was found on CNS. The glycoside exhibited promising anti-inflammatory activity.<sup>[19]</sup>

D. Sasmal. *et al.* (2007), checked Diuretic activity of Nyctanthes arbortristis Linn. the diuretic activity of the water-soluble portions of the ethanolic extracts of its flowers, barks, seeds and leaves. In toxicity study, the extracts were seen to be safe up to the dose of 2.0 gm/kg. For the estimation of diuretic activity, the parameters studied were total urine volume and urine concentration of Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup>. The ethanolic extracts of different plant parts of Nyctanthes arbortristis L. possess significant diuretic activity as reflected by rise in urine volume with cation excretion. The ethanolic extracts of the seeds and leaves at their higher doses exhibited higher electrolyte excretion.<sup>[20]</sup>

Pinky Kumari. *et al.* (2012), checked Bioactivity Guided Fractionation of Leaves Extract of Nyctanthes arbortristis (Harshringar) against *P. falciparum*. Crude ethanolic Harshringar leaves extract and its RPHPLC purified fractions were studied for anti-plasmodial potency against 3D7 (CQ sensitive) and Dd2 (CQ resistant) strains of *P. falciparum* and subsequently subjected to bioassay fractionation guided using reverse phase chromatography to pursue the isolation of active fractions.<sup>[21]</sup>

S. Meghashri. *et al.* (2012), was done Biochemical characterisation of radical scavenging polyphenols from Nyctanthes arbortristis. PE of *N. arbortristis* leaves was investigated for antioxidant activity employing various established *in vitro* systems, such as lipid peroxidation in liposome, DPPH and hydroxyl radical scavenging, reducing power assay, and iron ion chelation. Identification of active constituent in PE of *N. arbortristis* responsible for antioxidant activity by HPLC. Statistical analysis used: All experiments were carried out in triplicates. Data were shown as mean  $\pm$  standard deviation (SD). SPSS 10.0.5 version for windows (SPSS software Inc., USA) computer program was used for statistical analysis.<sup>[22]</sup>

**Ramadan B. Sopi. *et al.* (2013)**, was bronchodilatory effect of ethanolic extract of the *N. arbortristis* was investigated under *in vitro* conditions. The concentration–response curve of the tracheal smooth muscle (TSM) to histamine was recorded in presence or absence of ethanolic extract and N<sup>o</sup>-nitro-L-arginine methyl ester (L-NAME). Dose–response effect of ethanolic extract on pre-constricted tissues was investigated. The ethanolic extract inhibited the histamine-induced maximum contractile responses of TSM ( $P < 0.001$ ). Ethanolic extract also cause dose-dependent relaxation of TSM. These effects were reversed by L-NAME. Phytochemical analysis showed the presence of typical plant constituents. These results suggest the possible use of extract of the leaves of *N. arbortristis* as a bronchodilator in therapeutic treatment of asthma.<sup>[23]</sup>

Bhagyashree R Patil. *et al.* (2012), checked Activity of aqueous and ethanolic extract of nyctanthus arber tristis leaves using liver slice model. The differences in the biological activities of the aqueous and ethanolic extract of the Nyctanthes arbortristis leaves using the liver slice model.

To study the biological activity and cytoprotective potency associated with the Nyctanthes arbortristis leaf extract CCl<sub>4</sub> toxicity model was used. Rat liver slices were incubated *in vitro* in presence of CCl<sub>4</sub> and Nyctanthes arbortristis aqueous and ethanolic leaf extracts for one, two and three hours. The leakage of liver specific enzymes that is aspartate transaminase and alanine transaminase was assessed in the medium. After statistical analysis of the data showed that the leaves of Nyctanthes arbortristis possess hepatoprotective activity however some differences were noted in the activities of aqueous and ethanolic extract mediated protective efficacy.<sup>[24]</sup>

Sanjita Das. *et al.* (2008), was carried out with the water-soluble portion of the ethanol extracts of flowers, barks, seeds and leaves of *Nyctanthes arbortristis* Linn. to confirm their CNS depressant activity. The ethanol extracts of the plant parts were obtained by Soxhlet extraction. After performing the gross behavioral study, the CNS depressant activity was evaluated by observing the prolongation of sleeping time induced by pentobarbital sodium in mice. Attempts have been made to explore the possible mechanism behind this activity by determining their effect on brain monoamine neurotransmitters like dopamine and serotonin. The gross behavioral study showed that ethanol extracts of the leaves, flowers and seeds possess significant CNS depressant activity. The leaves, flowers, seeds and barks (600 mg/kg) showed significant and dose-dependent prolongation of onset and duration of sleep and so found to cause decrease dopamine and increase serotonin level. From which it can be concluded 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.<sup>[25]</sup>

Mohammad mizanur rahman. *et al.* (2011), was checked fatty acid composition of ripe seed oil of nyctanthes arbor-tristis L. The fatty acid composition of the ripe seed oil of Nyctanthes arbor-tristis L. (Bengali: Seuli) were determined by GLC. The major constituent of the oil was found to be stearic acid, 39.06%. The relative percentages of other major fatty acids were found to be lauric acid, (4.46); linoleic acid, (7.89); oleic acid, (7.97). The yield of the seed oil was found to be 7.29% on extraction with pet-ether (b. p. 40<sup>o</sup>C - 60<sup>o</sup>C). Acid value of seed oil was found to be 55.44 and suggests that this oil is inedible.<sup>[26]</sup>

Anowar Hussain. *et al.* (2012), evaluate the antioxidative activity of hydro-alcoholic extract of flower in the lymphocytes exposed to oxidative stress induced by H<sub>2</sub>O<sub>2</sub>. Isolated lymphocytes were treated *in vitro* with extract or extract + H<sub>2</sub>O<sub>2</sub> and the level of reduced glutathione (GSH) as well as the activity of glutathione-S-transferase (GST) and lactate dehydrogenase (LDH) were measured. Treatment of lymphocyte with flower extract (50, 100, and 200  $\mu$ g/ml) significantly increased the level of GSH and decreased the activity of GST. The LDH activity measured in the cell-free medium decreased significantly. Pre-treatment of lymphocyte with flower extract protects the lymphocyte from the H<sub>2</sub>O<sub>2</sub> induced oxidative stress by significantly increasing the levels of GSH as compared to the cells treated only with H<sub>2</sub>O<sub>2</sub>. Pre-treatment also reduced the activity of LDH significantly as compared to the cells treated only with H<sub>2</sub>O<sub>2</sub>. The LDH activity in cell-free medium is associated with membrane damage, the decreased levels of LDH activity reflects the reduced level of membrane damage due to H<sub>2</sub>O<sub>2</sub>.<sup>[27]</sup>

M. Balasubramanian. *et al.* (2012), investigate the antibacterial activity of *Nyctanthes arbor-tristis*. The seed and fruit extracts were used for their antibacterial screening. Melanin content and stability in fruits and seeds were studied with various factors like temperature, oxidants and metal ions. Chloroform and ethyl acetate extracts of fresh leaf, seeds and fruits were shown significant antibacterial activity against Gram negative bacteria (*E. coli* and *K. pneumoniae*) and Gram positive bacteria (*S. aureus*), whereas dried extracts of chloroform and ethyl acetate shown significant antibacterial activity against *Pseudomonas aeruginosa*. Phytochemical analysis shows the presence of phytosterols. Phenolics compounds, tannins, flavonoids, cardiac glycosides, saponins and alkaloids in leaf, fruit, seed content. Steroids were present only in seeds. UV spectral studies have shown high content of melanin in seeds. Melanin content was stabilized by  $\text{KMnO}_4$  than  $\text{K}_2\text{Cr}_2\text{O}_7$ . Melanin color was increased and preserved by metal ions like of  $\text{Fe}^{++}$ ,  $\text{Mg}^{++}$  and  $\text{Zn}^{++}$ .<sup>[28]</sup>

Vats Manisha. *et al.* (2009), was checked Antimicrobial Activity of Stem Bark Extracts of *Nyctanthes arbor-tristis* linn. (Oleaceae). The stem bark extracts of the plant were tested for their in vitro antimicrobial activity by cup plate method. The test organisms were *Staphylococcus aureus*, *Micrococcus luteus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans* and *Aspergillus niger*. The zone of inhibition and 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 activity whereas the petroleum ether and ethanol extracts possess only antibacterial activity.<sup>[29]</sup>

Sunil Ashokrao Nirmal. *et al.* (2012), was done Pharmacognostic evaluation of *Nyctanthes arbor-tristis* bark. Trunk bark consists of two distinct regions i.e. outer bark and inner bark. Outer bark consists of broad periderm of a wide phellem and inner phelloderm regions. Inner bark is broader than the outer part and it includes all the secondary phloem tissues. It can be distinguished into 2 zones viz. collapsed secondary phloem and non-collapsed secondary phloem regions. Collapsed secondary phloem region consist of thick blocks of phloem sclereids and radially oblique dark streaks of crushed sieve tubes and dilated axial parenchyma cells. Non-collapsed secondary phloem region is the conducting part of the phloem where the sieve elements are intact. It consists of intact sieve tube members, companion cells, axial parenchyma cells and narrow undilated ray. Calcium oxalate crystals are abundant in collapsed phloem region.<sup>[30]</sup>

Sanjita Das. *et al.* (2014), studied the effect of different parts of *Nyctanthes arbor-tristis* linn. on the hematological parameters of mice. Hematological effect of the ethanolic extracts of the flowers, barks, seeds and leaves of *Nyctanthes arbor-tristis* Linn were estimated at the dose levels of 200, 400 and 600 mg/kg body weight (I.P.), which were selected from the study of their LD50 value. From the overall study it was observed that the ethanolic extracts have antianemic, hematostatic effect and are hematologically nontoxic. Whereas the ethanolic extracts of the seeds and leaves at the dose of 600 mg/kg may possess immunostimulatory effect.<sup>[31]</sup>

Mayee R. *et al.* (2010), Evaluated of Hepatoprotective Activity of the Leaves of *Nyctanthes arbor-tristis* Linn. The decoction of the leaves of *Nyctanthes arbor-tristis* Linn. (Family- Oleaceae) is widely used in Ayurvedic system of

medicine for the treatment of sciatica, arthritis, fevers, various painful conditions, liver disorders and as laxative & diuretic. The aim of the present study was to evaluate the alcoholic and aqueous extracts of the leaves of *Nyctanthes arbor-tristis* for hepatoprotective effect against galactosamine-induced liver damage in rats. Administration of alcoholic and aqueous extracts of the leaves of *Nyctanthes arbor-tristis* was observed to protect the liver from toxic effects of galactosamine by reducing the elevated levels of Serum Glutamate Pyruvate Transaminase, Serum Glutamate Oxaloacetate Transaminase and serum Bilirubin (total). Liver section of standard treated and from *Nyctanthes arbor-tristis* treated groups show moderate protection in galactosamine-induced liver damage. Results revealed that both the alcoholic and aqueous extracts showed significant hepatoprotective activity by reducing the elevated levels of biochemical parameters at a dose of 500 mg/kg body weight.<sup>[32]</sup>

Ghiware Nitin B. *et al.* (2010), were prepared orally administrable dosage forms of fruits of *Piper nigrum* (Maricha) and leaves of *Nyctanthes arbor-tristis* (Parijataka), in combination, were developed. Tablet form of drugs from solid dosage form and two formulations from liquid class were designed and developed. By considering difficulty of solubility of herbal drugs in a vehicle, in one of the liquid class, decoction form of drugs in specific vehicle was used. This form of drugs hereafter considered as Liquid Oral Dosage Form of drugs. To prepare a liquid form with suspended particles of drugs, Suspension form was also designed. Formulated dosage forms then subjected to evaluation of production quality by different methods stated as per official compendia. Such evaluation has unique position in development of new formulations.<sup>[33]</sup>

Marikani Kannan. *et al.* (2010), was checked immunopharmacological properties of ethanolic extract of *Nyctanthes arbor-tristis* Linn. (NA) have been investigated. After administration of *Nyctanthes arbor-tristis* in doses of 0.25 and 0.5 g/kg bodyweight (BW) a significant increase in phagocytic index, leukocyte count and splenic antibody secreting cells were noticed. Stimulation of humoral immune response was further observed with hemagglutination antibody titer. This extract was further submitted to Thin Layer Chromatography (TLC) and High performance liquid chromatography (HPLC) and it confirmed the presence of methoxylated flavonoid quercetin-3,3'-dimethoxy-7-O-rhamnoglucopyranose. The results suggest that bio active compound flavonol glycoside of *Nyctanthes arbor-tristis* influences both humoral as well as cell mediated immune system.<sup>[34]</sup>

Chaitali Pattanayak. *et al.* (2013), was investigated the anti-inflammatory effect of leaves of *Nyctanthes arbor-tristis* linn in rodents. The leaf extract was prepared by "maceration" with 90% ethanol at room temperature, filtered and the filtrate evaporated to dryness. The extract was suspended in Tween 80 and used per orally in rodents. Acute anti-inflammatory activity of the extract at doses 200, 400 mg/kg was evaluated in rats using carrageenan induced paw edema. Chronic anti-inflammatory activity was tested using cotton pellet granuloma. The leaf extract of *Nyctanthes arbor-tristis* produced significant acute and chronic anti-inflammatory activity at 200mg/kg and 400 mg/kg doses. When compared to the standard drug Diclofenac sodium 10mg/kg the acute

effect of the extract was comparable but the chronic effect was significantly less at 400mg/kg dose. [35]

P.S. Smitha. *et al.* (2014), checked Stability & Fluorescent Studies of the Coloring Content of Flowers of *Nyctanthes Arbor Tristis*. Crocin is important commercially significant constituent of saffron, which is a Carotenoid glycoside (coloring compound). Crocin present in *Nyctanthes arbor-tristis* flowers will be of great significance. Herein, we studies to elucidate the stability and fluorescence property of Crocin by using different solvents including water extract of the flowers by spectroscopy and fluorimetry methods respectively. The compound seems to be fairly sensitive to sunlight, and ethanol /methanol extracts are more stable. [36]

Swapnil Goyal. *et al.* (2013), was carried out to evaluate anti-arthritis potential of *Nyctanthes arbor-tristis* and *Alstonia scholaris* extracts of leaves in Complete Freund's Adjuvant (CFA)-induced arthritis in rats. The anti -arthritis activity was evaluated by adjuvant -in duced arthritis at the dose of 200 and 400mg/kg body weight and the standard drug used was prednisolone in 10 mg/kg. The extracts administered in higher doses reduced the lesions to a greater extent showing a dose-dependent decrease in lesions comparable with standard drug prednisolone. The extracts of *Nyctanthes arbor-tristis* and *Alstonia scholaris* showed significant increase in body weight as compared to arthritic control group. The extracts of *Nyctanthes arbor-tristis* and *Alstonia scholaris* showed significant decrease ( $P < 0.001$ ) in WBC count, ESR, increase in hemoglobin contents, and RBC count as compared to control group. In conclusion, we demonstrate that, at 400mg/kg body weight, doses of *Nyctanthes arbor-tristis* and *Alstonia scholaris* extracts were highly effective in preventing and suppressing the development of adjuvant-induced arthritis. [37]

Abhijeet R. Bhalerao. *et al.* (2011), were studied a inflammation parameter using carrageenin induced hind paw edema and cotton pellet granuloma. The natural plant was screened for acute toxicity and it did not show any toxic or deleterious effects indicating low toxicity of the extract even at high doses at two different dose levels. In carrageenin induced hind paw edema a significant reduction in paw volume was observed as compared to control group whereas in cotton pellet granuloma model marked inhibition in granuloma formation, reduction in the elevated levels of serum lysosomal enzymes (SGPT, SGOT, and ALP) and lipid peroxidation was noted as compared to control group. The extracts exhibited profound anti-inflammatory activity in both acute and subacute animal models warranting further investigations to establish its anti-inflammatory potential. The activity was thought due to flavonoids which might be present in the formulation which could play a significant role in preventing the release of histamine, leukotrienes and prostaglandins. In future the extract needs to be studied for cellular line models of inflammation. [38]

R.S. Bhadouria. *et al.* (2012), was to isolated and characterize phytoconstituents from the ethanolic extract of *Nyctanthes arbor-tristis* L. leaves. By of the ethanolic extract of *Nyctanthes arbor-tristis* L., two alkaloidal compounds fractionated and isolated by column chromatography and further structures of these compounds were determined on the basis of spectral and chemical studies. It comprised two novel compounds i.e. 1- (8-Hydroxy-7-((4-nitrophenyl) (phenyl amino) methyl) quinoline-3-yl) propan-2-one and 2- (8-

Hydroxy-7-((4-nitrophenyl) (phenyl amino) methyl) quinoline-3-yl) acetic acid. Structures of all the isolated compounds were elucidated by spectroscopic methods like IR, NMR and Mass spectrometry. [39]

S. Bansal. *et al.* (2013) developed a protocol for callus induction from nodal explants of *N. arbor-tristis*. Among various PGRs 2,4-D shows maximum callus induction. Phytochemical analysis of natural and in vitro raised plants showed the presence of bioactive substances like flavonoids, alkaloids, terpenoids in different types of extracts. [40]

Shalini Tripathi. *et al.* (2011), was checked antiaggressive activity of *Nyctanthes arbor-tristis* leaves in rodents. Hydroalcoholic extract of leaves of *nyctanthes arbor-tristis* Linn (NATE) was pharmacologically validated for its antiaggressive properties in experimental animals using various models such as Foot shock-induced aggression, Isolation-induced aggression, Resident-intruder aggression and Water competition test. Extract was given orally at two different dose levels (250 and 500 mg/kg) once daily for three consecutive days, while Diazepam (2.5mg/kg), was administered as positive control. NATE. (250 and 500mg/kg) on all the models produced significant antiaggressive effects such as a reduction in vocalizations along with lowering of leaping, running, rearing and facing each other, increased latency time to first attack, reduced spout gaining frequency along with a reduction in time spent which was found to be statistically significant compared to the control. Results suggested that NATE showed significant antiaggressive activity. [41]

Shinde PR. *et al.* (2014), was checked Macroscopical, microscopical, physico-chemical evaluation, fluorescence analysis, behavior of seed powder, preliminary phytochemical analysis by chromatographic method and antibacterial potential of extract against *Bacillus subtilis* (NCIM 2079), *Escherichia coli* (NCIM 2065) and *Pseudomonasaeruginosa* (NCIM 2200) were determined of various extracts of *N. arbor-tristis*. Microscopic study shows the general characteristic of seed. Physico-chemical investigation shows the total ash, acid insoluble ash; water soluble ash and sulphated ash values were  $11.37 \pm 0.04\%$  w/w,  $2.16 \pm 0.02\%$  w/w,  $3.72 \pm 0.02\%$  w/w and  $5.56 \pm 0.04\%$  w/w respectively. Methanolic and petroleum ether extract exhibit significant inhibition of microorganism. [42]

Pinky Kumari. *et al.* (2012), were done Bioactivity Guided Fractionation of Leaves Extract of *Nyctanthes arbor tristis* (Harshringar) against *P. falciparum*. Crude ethanolic Harshringar leaves extract and its RPHPLC purified fractions were studied for antiplasmodial potency against 3D7 (CQ sensitive) and Dd2 (CQ resistant) strains of *P.falciparum* and subsequently subjected to bioassay guided fractionation using reverse phase chromatography to pursue the isolation of active fractions. [43]

Sunil Ashokrao Nirmal. *et al.* (2012), was checked Mast cell stabilizing and bronchodilatory activity of *Nyctanthes arbortristis* bark. Work was undertaken to check potential of the plant bark in the treatment of asthma. Petroleum ether, chloroform, ethyl acetate, ethanol and aqueous extracts of *N. arbortristis* bark (50 and 100 mg/kg, i.p.) were screened for mast cell stabilizing activity in mice and studies on smooth muscle preparation of guinea pig ileum (in vitro) for bronchodilation property. The petroleum ether extract of *N. arbortristis* bark showed maximum protection against mast

cell degranulation by clonidine and resisted contraction induced by histamine better than other extracts. All the results are dose dependant. So it can be concluded that petroleum ether extract of *N. arbortristis* bark have bronchodilation and mast cell stabilizing property and can be used in the treatment of asthma. <sup>[44]</sup>

G. R. Rout. *et al.* (2007), was checked In vitro clonal propagation of *Nyctanthes arbortristis* Linn. – A medicinal tree. Rapid shoot multiplication of *Nyctanthes arbortristis* was achieved from axillary meristems on Murashige and Skoog (MS) basal medium supplemented with 1.0–1.5 mg/l 6-benzyladenine (BA), 50 mg/l adenine sulfate (Ads) and 3% (m/v) sucrose. Inclusion of indole-3-acetic acid (IAA) in the culture medium along with BA + Ads promoted a higher rate of shoot multiplication. Maximum mean number of microshoots per explant (6.65) was achieved on the MS medium supplemented with 1.5 mg/l BA, 50 mg/l Ads and 0.1 mg/l IAA after 4 weeks of culture. The elongated Shoots rooted within 13 to 14 days on. Strength MS medium supplemented either with indole-3-butyric acid (IBA), IAA or naphthylacetic acid (NAA) with 2% sucrose. Maximum percentage of rooting was obtained on medium having 0.25 mg/l IBA, 0.1 mg/l IAA and 2% sucrose. About 70% of rooted plantlets survived in the greenhouse. The invitro raised plants were grown normally in the soil condition. This result will facilitate the conservation and propagation of the important medicinal plant. <sup>[45]</sup>

Anjali Deshmukh. *et al.* (2015), was prepared Natural yellow colour from Corolla of *Nyctanthes arbortristis* Linn. For dyeing and painting on cotton and silk for value addition. corolla of *Nyctanthes arbortristis* L. as a natural colour for dyeing and painting of cotton and silk with Kalamkari technique using bamboo stick. From the present work it can be concluded that cotton and silk painted and dyed with Corolla of *Nyctanthes arbortristis* Linn exhibited fair to excellent wash and sunlight fastness. Further four different dresses were designed and evaluated for fabric elements and colour which rated very good to excellent by the panel judges. Therefore the study suggest the use of *Nyctanthes arbortristis* Linn corolla extract as very good option for yellow, and yellow orange colour as a value addition to fashion fabric and ultimately in eco-friendly clothing. <sup>[46]</sup>

### Summary

The above work cited in the article of research work published, phytochemicals, promising pharmacological activities, are widely distributed in medicinal plant of *Nyctanthes arbortristis* and it revealed the importance of herbal and ayurvedic pathway for effective treatment of various diseases considering its tremendous potential pharmacological activities. *Nyctanthes arbortristis* is easily available plant and no special conditions are required for its collection and cultivation. It is a rich source of biologically active compounds, which would attract the attention of drug discovery groups to discover novel bioactive molecules for safer and effective treatment of various diseases.

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