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## LITERATURE REVIEW ON NYCTANTHES ARBOR TRISTIS

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### Abstract

*Nyctanthes Arbor Tristis* is one of the most useful traditional plants in India. It has high medicinal value in ayurveda. The various parts of plant like fruits, leaves, seeds, flowers, barks and stem have significant phytochemicals and have some medicinal value for treatment and management of various disease state. Phytochemicals like flavanol glycoside, oleanic acid, essential oils, tannic acid, carotene, friedeline, lupeol, glucose, benzoic acid present in various parts of plant which have significant hepatoprotective, antiviral, antifungal, antipyretic, antihistamine, anti-malarial, anti-bacterial, anti-inflammatory, antioxidant activities. The present review focus on Chemical constituents, Ecology And distribution, Biological activities of important compounds, pharmacological action, Medicinal application. This review beneficial for future research work and their Potential Development.

**Keywords:** *Nyctanthes Arbor Tristis*, Phytochemistry, Pharmacological Activities, Silver Nanoparticle, Traditional Uses, Toxicity.

### Introduction

*Nyctanthes arbor tristis* (NAT) Linn. Is one of the well known and most useful medicinal plant. It is commonly called "Night jasmine" [English], due to fact that its flowers emit a very strong and pleasant fragrance during whole night. The flowers start falling after midnight and by the day break, the plant appears dull. The generic name "Nyctanthes" has been coined from two Greek words 'Nykhtha' (night) and 'Anthos' (flowers). The specific name *arbortristis* means as it loses its brightness during daytime. NAT is a large shrub or a small tree widely cultivated in tropical and subtropical regions all over the world. leaves, fruits, flowers, stem and barks have pharmacological activity. NAT plant have been screened for anti-malarial anti-histaminic, activity, anti-arthritis activity, local anaesthetic, anti-hypnotic, analgesic, anti-ulcer, anti-pyretic, anti-depressant, anti-leishmaniasis, anti-cancer, anti-larvicidal, anti-allergic, anti-viral, Immunomodulatory, anti-helminthic, antioxidant, anti-diuretic, antioxidant, CNS modulators.

## **Taxonomical Classification**

Kingdom: Plantae

Order: Lamiales

Division: Magnoliophyt

Class: Magnoliopsida

Family: Oleaceae

Genus: Nyctanthes

Species: Arbortristis

## **Different Names of Plant ( pharmacognostic review)**

The plant is known by the following names in the languages Mentioned against.

Bengali: Harsinghar, Sephalika, Seoli, Sheoli.

English: Coral Jasmine, Night Jasmine.

Gujarati: Jayaparvati, Parijatak

Hindi: Harsinghar, Harsingur, Seoli, Sheoli, Sihau.

Kannada: Goli, Harsing, Parijata.

Konkani: Pardic, Parizatak, Parzonto, Parzot.

Malayalam: Mannapu, Pavizhamalli, Parijatakam

Marathi: Kharbadi, Kharassi, Khurasli, Parijatak.

Oriya: Godokodiko, Gunjoseyoli, Singaraharo.

Punjabi: Harsinghar.

Sanskrit: Parijata, Parijatah, Parijataka, Sephalika.

Tamil: Manjhapu, Pavala- Malligai, Pavazha-Malligai.

Telugu: Kapilanagadustu, Pagadamalle, Parijat, Sepali.

Urdu: Gulejafari, Harsingar.

Filipino: Coral Jasmine.

Indonesian: Srigading (Sundanese, Javanese)

Lao (Sino-Tibetan): Salikaa.

Malay: Seri Gading

Thai: Karanikaa.

Vietnamese: Iai Tau

**Ecology and Distribution:** *Nyctanthes arbor-tristis* is found on ground in dry hillsides and as undergrowth in dry deciduous forests. It is native to southern Asia, stretching across northern Pakistan and Nepal through Northern India to Southeast Thailand. 1500 m altitude required for growth, rainfall range from seasonal to non-seasonal and tolerant to moderate shade. In India, it grows in the outer Himalayas and 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.

### **Climate and soil**

Soil: loamy, pH :5.6–7.5. The plant requires conditions varying from full sunlight to partial shade and require to be watered regularly, but does not need overwatering.

### **Cultivation and collection:**

It is often cultivated in gardens due to its most agreeable and irregular aroma. The shrub can be propagated by cutting as well as by seeds. The seeds have been found to exhibit a poor germination rate because of phenolic compounds leaching out of the imbibed seeds. These inhibitory phenolic compounds were stored in the pericarp assisted by the seed coat. The speed of germination is improved by either removing both the treating seeds with a solution of antioxidants like polyvinylpyrrolidone (PVP) and polyvinylpolypyrrolidone (PVPP) prior to germination.<sup>2</sup>

Plantlets of NAT can be raised in vitro from isolated immature embryos using excised cotyledons, hypocotyls, roots, leaves and bases of internodes of plantlets that callused readily on culture. Calli from cotyledons, hypocotyls and root show faster growth as compared with those from leaves and internodal bases when cultured in Murashige and Skoog's (MS) medium with 2, 4-dichlorophenoxyacetic acid, naphthalene acetic acid (NAA) and coconut milk. Growth potential of the calli constant upon repeated subcultures upto twelve months.

The reproducible and an efficient plant regeneration protocol for NAT using excised cotyledonary node explants from 15 day old aseptic seedlings cultured in MS medium supplemented with thiaziduron (TDZ) and 6-benzyladenine (BA). Rooting is also achieved ex-vitro by plunging the basal cut ends of regenerated shoots in indole-3-butyric acid (IBA) followed by transplantation in sterile soil contained in plastic pots.

The plantlets with well developed shoots and roots can be successfully grown in garden soil in earthen pots with 85% survival rate. Inclusion of indole-3-acetic acid, 6-benzylaminopurine (BAP) and adenine sulphate (Ads) in the MS

culture medium promotes the rate of shoot multiplication. The elongated shoots root within 14 days that are successfully grown in greenhouse with 70% survival rate which are subsequently grown normally in the field.<sup>2s</sup>

### Pharmacognostic Description

*Nyctanthes arbor tristis* is a small tree upto 10m height with rough, rough and grey bark. It has rough, tetragonal and scabrous spreading branches.<sup>2</sup>

**Leaves:** Leaves are opposite, 5 -10 by 2.5 – 6.3 cm, ovate, acute or acuminate, entire or with a few large distant teeth, short bulbous hairs rounded or slightcuneate; main nerves few, conspicuous beneath; petiol 6cm long, hairy.<sup>2</sup> Leaves are simple, petiolate and exstipulate.<sup>9</sup> The lamina is ovate with acute or acuminate apex, the margin entire or serrated, somewhat undulated, particularly near the base, the upper surface dark green with dotted glands, and the lower surface pale green and softly pubescent. NAT 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 adaxial concavity.<sup>12</sup>



Figure 1: A photograph of NAT leaves showing morphological.

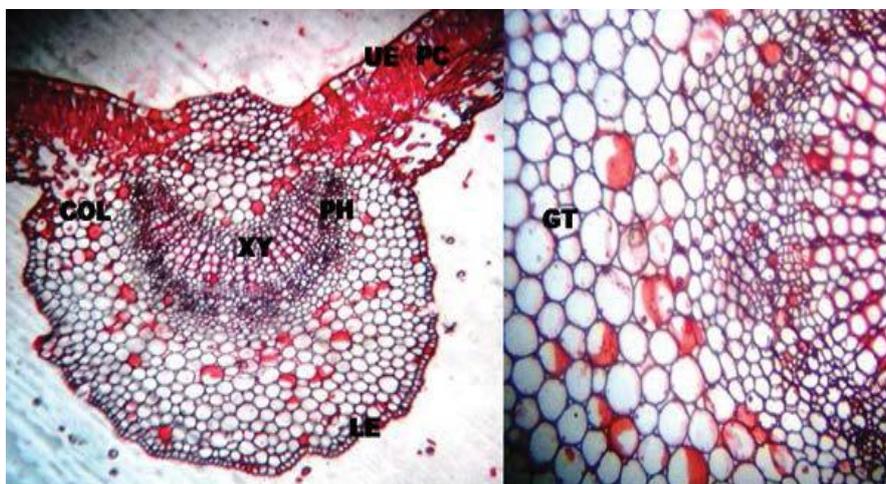


Figure 2: Microscopy of *Nyctanthes arbor-tristis* leaf. TS through midrib COL: Collenchyma, XY: Xylem, PH: Phloem, UE: Upper epidermis, PC: Palisadecells, LE: Lower epidermis,GT: Ground tissue.

**Flowers**

Flowers of NAT are small, delightfully fragrant, sessile in pedunculate bracteate fascicles of 3–5; peduncles 4-angled, slender, hairy, auxiliary and solitary and in terminal short trichotomous chymes; bracts broadly ovate or suborbicular, 6- 10 mm long, apiculate, hairy on both sides; Calyx 6-8 mm long, narrowly campanulate, hairy outside, glabrous inside, truncate or obscurely toothed or lobed, ciliated. Corolla globose rather more than 13 mm long; tube 6-8 mm long, orange colour, about equalling the limb; lobes white, unequally obcordate, cuneate.<sup>9</sup>



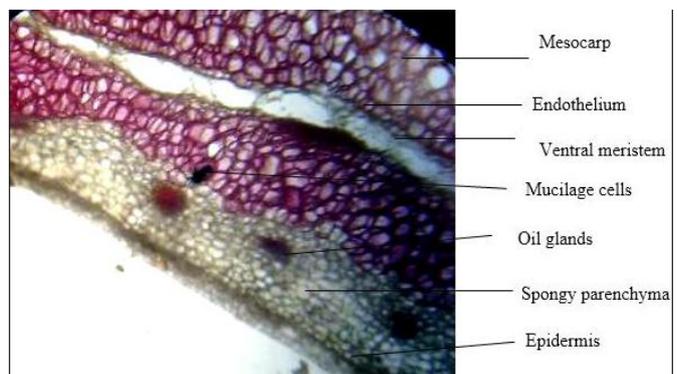
**Fig3. Flowers of *Nyctanthes Arbor Tristis*. Fig4. Various parts of *Nyctanthes Arbor Tristis* flower.**

**Fruits**

Fruits of NAT are acapsule of 1-2 cm diameter, long and broad, obcordate orbicular, compressed, 2-celled, separating into 2 flat 1-seeded carpels, reticularly veined, glabrous.<sup>9</sup> Macroscopic character of fruit: The fruit is flat, brown and heart cordate-shaped to rounded-capsule, around 2 cm in diameter with two celled opening transversely from the apex, each containing a single seed. Microscopically fruit showed typical character of fruit. In the epicarp epidermal cells were compactly arranged, polygonal cells with slightly anticlinal walls covered by a thin cuticle followed by 1-3 layers of collenchyma, Spongy parenchymatous tissue, sclerenchymatous sclerenchymatous fibres and oil gland.<sup>14</sup>



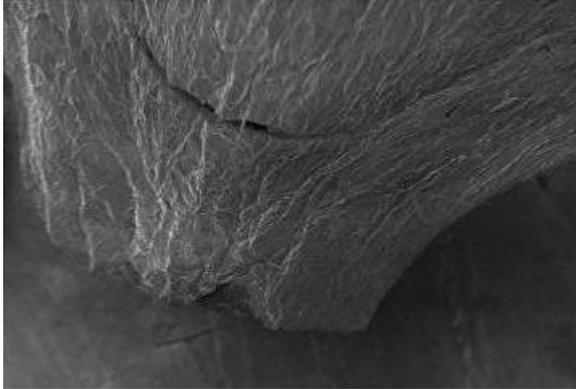
**Fig5:Shows Morphology of *Nyctanthes arbor tristis* Fruit**



**Fig6:Shows T.S fruit after treat with phloroglucinol- Conc. HCl (1:1)**

## Seed

The seed is compressed and is 1 per cell.<sup>2</sup> Seeds are exalbuminous, testa thick; the outer layer of large transparent cells and heavily vascularised.<sup>9</sup> phytosterols, phenolics compounds, tannins, flavonoids, cardiac glycosides, saponins and alkaloids all are found in seeds of *N.arbortristis*.<sup>15</sup>



**Fig-7:Seed and spermoderm patterns in *Nyctanthes arbor-tristis***



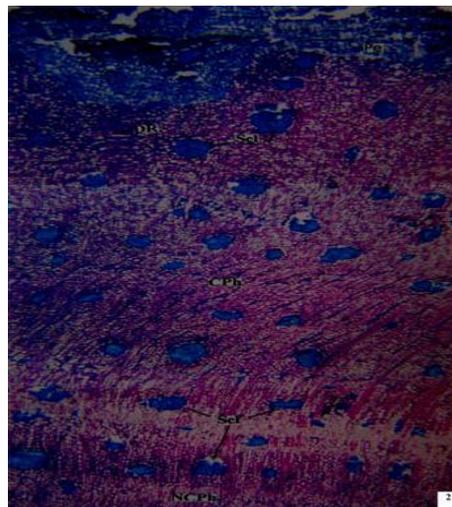
**Fig-8:Seeds of *Nyctanthes arbor-tristis***

## Bark

Bark of *N.arbortristis* plant is dark gray or brown in colour and rough and firm. Bark surface is dipped due to scaling off of circular barks and patchy due to gray brown colour regions. Scaling off the bark by circular flakes. Inner bark is creamy white, soft and collapsed and non-collapsed phloem zone distinctly visible<sup>11</sup>



**Fig9:Exomorphic features of young bark of *Nyctanthes arbour-tristis* Linn**



**Fig.10 T.S. of bark of *N. arbor-tristis* Linn entire view**

## Traditional Uses

CNS depressant activity showed in Seeds, leaves and flowers extract of plant (advance).The *Nyctanthes arbortristis* showed activity against Encephalomyocarditis virus (EMCV) and Semliki forest virus (SFV).

### **Leaves:**

Leaf is used for control fever, diabetes and as cholagogue, diaphoretic and anti-helminthic. Juice of the leaves is used as digestives, antidote to reptile venoms, mild bitter tonic, and diuretic. Leaves also used in treatment of the spleen disease.<sup>3</sup>The leaves have been used in ayurvedic medicine to treat sciatica, arthritis, and as laxative.<sup>6</sup> The leaf juice is also used to treat loss of appetite, piles, liver disorders, biliary disorders, malarial fever. Fresh leaf juice has been suggested to be safe purgative for infants when given with honey mixed with common salt. The Jayanti tribes (India) inhabiting regions close to Myanmar use the leaf juice or ally as an anthelmintic and the flower along with honey as an antispasmodic. Crushed fresh leaves are externally used for ulcers and sores to reduce inflammation.<sup>1</sup> *B-sitosterol* isolated from *N. arbor-tristis* leaves showed analgesic and anti-inflammatory activity. Leaves are responsible for some CNS activities like hypnotic, tranquilizing and local anaesthetic and antiasthmatic activity. (advance) leaves extracts was found to have antimicrobial activity.<sup>5</sup> The leaves are also used in fungal skin infection and in dry cough. The young leaves were used as female tonic and in alleviating gynaecological problems.<sup>2</sup>

### **Flowers:**

The flowers of *N. arbor-tristis* are used in India, Indonesia (Java) and Malaysia to provoke menstruation. The hot infusion of flowers is used by some elderly Sri Lankan Buddhist monks as a sedative. The inflorescence is used to treat scabies and other skin diseases. The flower helps in clearing out mouth ulcers. Oral administration of decoction of flowers ward off wind in the stomach, stimulate gastric secretions and improve expectoration from the lungs. The decoction is also used in treatment of gout. The flower juice is used as a hair tonic in preventing graying of hair and baldness.<sup>2</sup> Flower of NAT was shown to have antibacterial activity against many gram-positive and gram-negative microorganisms.<sup>6</sup> Flowers are bitter in taste and used as astringent, ophthalmic, stomachic and carminative.<sup>7</sup>

### **Stem And Bark:**

Traditionally the powdered stem bark is given in rheumatic joint pain, in treatment of malaria and is also used as expectorant.<sup>7</sup> stem bark of *Nyctanthes arbor-tristis* showed antimicrobial activity. Bark used for treatment of bronchitis and snakebite.<sup>1</sup> the paste of stem bark of *Nyctanthes arbor-tristis* along with Arjuna bark is rubbed on the body for the treatment of joint broken bones.<sup>11</sup>

### **Seeds:**

The seed powder is used for scalp scurvy, in alopecia and as anthelmintic.<sup>1</sup> It is antibilious and an expectorant and is used for the treatment of bilious fevers. The seeds are used to cure scurfy affections of scalp, piles and skin diseases.

The patients are suffering from piles are advised to apply fresh paste externally on piles, along with the internal use of the powdered seeds. The decoction of seeds is used as hair tonic and advised to wash the hair daily in order to get rid from dandruff and lice.<sup>11</sup>

**Roots:** Roots are traditionally used as antihelminthics.<sup>2</sup>

### Phytochemistry

Phytochemical analysis of leaf, fruit and seeds of *Nyctanthes arbor-tristis* revealed the presence of phytosterols, phenolics, tannins, flavonoids, glycosides and saponins. (table 1) The secondary metabolites such as glycosides and alkaloids are the largest groups of chemicals present in this plant. The stem of *N. Arbor-tristis* resulted in the isolation and identification of  $\beta$ -sitosterol a new glycoside naringenin-4'-O-e-glucopyranosyl-1-Z-xylopyranoside<sup>22</sup>. A phenyl propanoid glycoside, nyctoside-A23, water soluble glucomannan was found in its seeds. Seeds have been contain nyctanthoside, nyctanthic acid and an irridoid glycosides such as arbortristoside A,B,C and 6-*B*-hydroxyloganin.<sup>16</sup>

Rengyolone, a cyclohexylethanoid; and the irridoid<sup>24</sup> glucosides, 6-O-trans-cinnamoyl-7-O acetyl-6 $\beta$ -hydroxyloganin, arboroside C, 6 $\beta$ -hydroxyloganin and nyctanthoside, a phenylpropanoid glycoside, have been isolated from an ethanolic extract of the flowers, which possess anti-inflammatory and anti-pyretic activities. Flowers contain modified diterpenoid nyctanthin, flavonoids, anthocyanins and an essential oil which is similar to that of jasmine. 4-Hydroxy hexahydrobenzofuran-7-one has been isolated from the chloroform extract of the flowers. The orange tubular calyx of the flower contains carotenoids. Its flowers are known to contain an essential oil in 0.0045% quantity similar to that of jasmine, which is obtained by the water- distillation. The concrete obtained on steam distillation 10.0% of otto. The bright orange corolla tubes of its flowers contain a colouring matter nyctanthin, which is identical with alpha crocetin obtained from saffron. nyctanthin occurs in material in a concentration of about 0.1% probably as a glycoside. Beside the colouring matter, the flowers contain d-mannitol, tannin and glucose and bark of plant a glycoside and two alkaloids.<sup>17</sup> An alkaloid nyctanthine is also found in leaves of *Nyctanthes arbor-tristis*. Leaves were founds mannitol, astringent, resinous substances, ascorbic acid, coloring matters, sugar and traces of an oily substance, tannic acid, methyl salicylate, carotene, an amorphous resin and traces of volatile oil. Seed kernels give up 12-16% of the pale yellow brown fixed oil, which consists of glucosides of linoleic, oleic, lignoceric, stearic, palmitic acid and  $\beta$ -sitosterol. On keeping the oil for several weeks at 0°C, a tetracyclic triterpenoid acid named nyctanthic acid is deposited<sup>9</sup>. Some essential oils, coloring matter (nyctanthin), mannitol, tannin and glucose have also been obtained

from flowers and roots. The bark contains a glycoside and two alkaloids, one soluble in water and the other in chloroform. The amplitude of the frog's heart increase in small doses of glycoside, but in large doses diastolic period is decreased till the heart stops with A-V block.  $\beta$ -sitosterol and oleanolic acid were also reported from callus extracts of *Nyctanthes*.<sup>7</sup>

**Table No-1: Chemical constituent of night jasmine and its biological activity.**

Plant parts	Chemical activity	Biological activity
<b>Leaves</b>	D-mannitol, B-sitosterol, flavonoside glycoside-Astragaline, Nicotiflorin, Oleanolic acid, Nyctanthic acid, tannic acid, methyl salicylate, carotene, friedeline, lupeol, mannitol, Glucose and fructose, iridoid glycosides, benzoic acid.	Antibacterial,Anthelmintic,Anti-inflammatory,Hepatoprotective,Antipyretic,Antioxidant,Antifungal
<b>Flowers</b>	Essential oil, nyctanthin, d-mannitol,tannin and glucose, carotenoid, glycosides viz <i>B</i> --monogentiobioside ester of $\alpha$ -crocetin (or crocin-3), $\beta$ -monogentiobioside- $\beta$ -Dmonoglucoside ester of $\alpha$ -crocetin, <i>B</i> - digentiobioside ester of $\alpha$ -crocetin	Diuretic, Ant-bilious, Antioxidant, Anti-inflammatory, Sedative, Antifilarial
<b>Seeds</b>	Arbortristoside A&B, Glycerides of linoleic oleic, lignoceric, stearic, palmitic and myristic acids, nyctanthic acid, 3-4 secotriterpene acid.	Antibacterial, Antifungal, Immunomodulatory Antileishmania
<b>Bark</b>	Glycosides and alkaloids	Anti-microbial
<b>Stem</b>	Glycoside-naringenin-4'-0- $\beta$ -glucapyranosyl- $\alpha$ -xylopyranoside and $\beta$ -sitosterol	Antipyretic, Antioxidant
<b>Flower oil</b>	$\alpha$ -pinene, p-cymene, 1- hexanol methyl heptanone, phenyl acetaldehyde, 1-deconol and anisaldehyde	as perfume

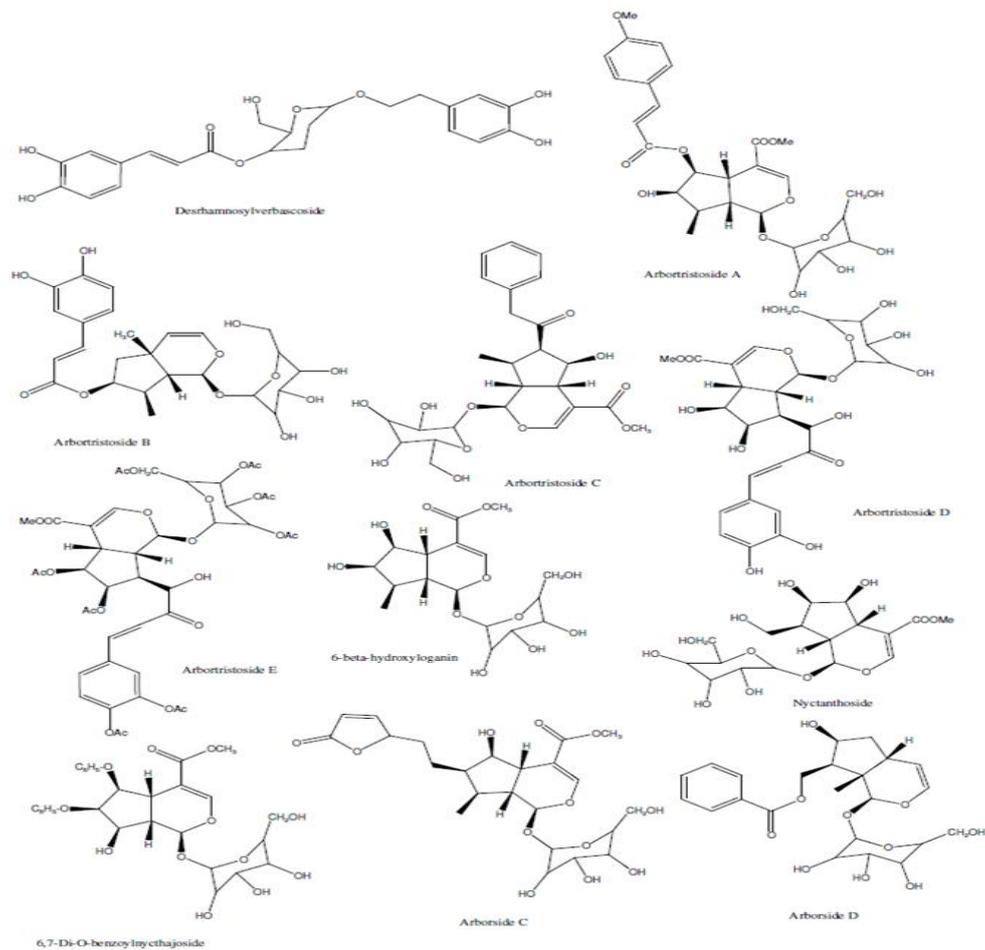


Fig no 11.Phytoconstituents of *Nyctanthes arbor tristis*.

## Pharmacological Activities:

### Analgesic and Anti-inflammatory activity

The analgesic activity of aqueous and ethanolic leaves extract of *Nyctanthes arbor tristis*, it was found from the percentage inhibition index that ethanolic extract shown better analgesic than aqueous extract when compared with standard drug aspirin. The methanolic extract of the stem bark of *Nyctanthes arbor tristis* shows statistically significant analgesic activity (by all four applied models) compared with control, standard, and MENA250. The results of treatment with the extracts of *Nyctanthes arbor-tristis* was similar with the standard and it showed significant analgesic activity.<sup>18</sup> Petroleum ether extract was found to be most active for analgesic activity and hence subjected to activity-guided fractionation.

The significant and dose-dependent activity showed by  $\beta$ -sitosterol (5, 10 and 20 mg/kg, i.p.) comparable with the standard extract.  $\beta$ -Sitosterol from *N. arbor tristis* leaves might be responsible for analgesic and anti-inflammatory activity.<sup>19</sup> The ethanolic extract obtained from the orange tubular of calyx of NAT and the isolated carotenoid (200 mg/kg, i.p.) possess significant inhibition of carangenan-induced rat paw oedema using diclofenac sodium as a standard drug. The anti-inflammatory activity against acute inflammatory oedema in rats using different phlogistic

agents like carrageenin, formalin, histamine, 5-hydroxytryptamine and hyaluronidase significantly showed by aqueous soluble fractions of NAT ethanolic extract.<sup>3</sup>

### **Antinociceptive and antipyretic activity**

The extract exhibited antipyretic effect against brewer's yeast-induced pyrexias in rats. When administered orally for six successive days in rats, it produced dose-dependent gastric ulcers.<sup>7</sup> The aqueous soluble fraction of ethanolic extract of the leaves exhibited significant aspirin-like antinociceptive activity which was evidenced by inhibition of acetic acid-induced writhing in albino mice but fails to elicit morphine-like analgesia which was tested via the rat tail flick and mouse tail-clip methods.

### **Hepatoprotective activity**

Administration of aqueous and alcoholic extracts of the leaves of *Nyctanthes arbor-tristis* protect the liver from toxic effects of carbontetrachloride by falling the elevated levels of Serum glutamate pyruvate transaminase, Serum glutamate oxaloacetate transaminase and serum bilirubin (total and direct). The results exposed that both an 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. The histopathological studies of liver samples which showed regeneration of hepatocytes by the extracts.<sup>21</sup> a possible mechanism of *Nyctanthes arbor-tristis* ethanol extract as hepatoprotective may be due to its antioxidant effect which impairs the activation of carbon tetrachloride into the reactive form. Since flavonoides have hepatoprotective activities. Tannins and carotenoids, both are known to be antioxidants with and hepatotoxic activity. It may be speculated that the constituents of *Nyctanthes arbor-tristis* especially the flavonoids, tannins and carotenoids were responsible for the observed protective effects.<sup>21</sup> The petroleum ether and methanol extracts (PeNa & MNa) of bark of *N. Arbostristis* have exhibited the hepatoprotective activity against carbontetrachloride (CCl<sub>4</sub>) induced hepatotoxicity and antipyretic activity against yeast induced pyrexia model in mice.<sup>23</sup>

### **Antibacterial Activity**

The flowers of *Nyctanthes arbor-tristis* show antibacterial activity against some gram-positive and gram-negative microorganisms in chloroform and ethyl acetate extracts. and significant cytotoxic activity in petroleum ether, chloroform and ethyl acetate extract.<sup>24</sup> The variation in the susceptibility of the organism could be attributed to the intrinsic properties of the organism. *Nyctanthes arbor-tristis* possessed a broad spectrum of activity against a panel of bacteria responsible for some common microbial disease in human and in plants.<sup>25</sup>

The stem bark extracts of NAT 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 hold only antibacterial activity.<sup>26</sup>

### **Antimalarial activity**

Karnik et al. have conducted a clinical study on 120 patients of malaria. Administration of fresh paste of medium sized 5 leaves of *N. Arborescens* thrice a day for 7-10 days has cured the disease in 92 (76.7%) patients within 7 days.

Other 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 larvicidal activity against 3 major mosquito vectors-*Aedes aegypti*, *Culex quinquefasciatus* and *Anopheles stephensi* has found the two extracts to kill larvae of *A. Stephensi* with LC50 values of 244.4 and 747.7 ppm, respectively.<sup>2</sup>

### **Anticancer activity**

Fruit, leaf and stem methanol extracts of *Nyctanthes arbor-tristis* were tested for in vitro anticancer activities. Moderate activity was observed at 30mg/ml conc. with 71% inhibition of dried NAT leaf methanol extract and least inhibitory activity was observed at 10mg/ml conc. With 86% inhibition of Breast Cancer Cell Lines free of pathogens. A high degree of activity against human breast cancer cell lines (MDA-MB 231) was observed with NAT dried fruit methanol and the IC50 values were calculated to be 9.72mg and 13.8mg. The phytochemicals isolated from NAT dried fruit methanol are glycosides, tannins, phenols and steroids and are predicted to be responsible for this anticancer activity.<sup>27</sup>

### **Antidiabetic activity**

*N. arborescens* ripe seeds and leaves extract show interesting possibilities as a source of oral hypoglycemic agents. The methanolic extract at 500 mg/kg dose level exhibited

Significant ( $p < 0.05$ ) hypoglycemic activity. The antidiabetic activity of methanol extract of root of *Nyctanthes arborescens* linn is comparable to that of diabetic control animals. It is concluded that methanol extract of root of

Nyctanthes arbour tristis linn possess safe and strong antidiabetic activity.<sup>28</sup> 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 homogenate (LPO), blood serum levels of SGPT, SGOT, Alk phos, cholesterol and triglyceride levels in comparison to the diabetic controls. Ethanol extract of the stem bark also possess significant anti-diabetic activity when treated in streptozotocin-nicotinamide induced diabetic rats. The extract lowers the blood glucose level in a dose-dependent manner.<sup>2</sup>

### **Antioxidant activity**

The acetone-soluble fraction of NATs ethyl acetate extract showed impressive antioxidant activity as revealed by several in vitro experiments, e.g., DPPH, hydroxyl and superoxide radicals, as well as H<sub>2</sub>O<sub>2</sub> scavenging assays. Its preventive capacity against Fe(II)-induced lipid peroxidation of liposomes and  $\gamma$ -ray-induced DNA damage confirmed. The strong reducing power and high phenolics and flavonoids contents could be responsible for the antioxidant activity.<sup>29</sup> leaf and stem of NAT is potential source of natural antioxidants. methanolic extract of stem and leaf NAT contain phenolic compound that have been perform as antioxidant agent which is act as free radical terminators. The encouraging results of NAT with the various in vitro antioxidant tests proved that plant as a reducing agent and effective as scavenger of free radicals and hydrogen peroxide.<sup>7</sup>

### **Anti-viral Activity:**

The ethanolic extract, n-butanol fractions and arbortristoside A and C, cut off from the NAT showed pronounced inhibitory activity against encephalomyocarditis virus (EMCV) and Semliki Forest Virus (SFV). In vivo, n-butanol fraction and ethanolic extract protected infected mice against EMCV and SFV by 40 and 60%, respectively.<sup>7</sup>

### **Anticholinesterase activity**

The aqueous extract of NAT stimulated the activity of acetylcholinesterase in mice and antagonize the inhibition of this enzyme by malathion. The higher effects were seen in the serum than in the brain. The low antimuscarinic activity against acetylcholine induced contractions of isolated rabbit ileum was already reported.<sup>3</sup>

### **Immunopotentiator activity**

The anti-immunosuppressive effect of an aqueous extract of NAT was determined in three to four week old swiss albino mice (20-25 g) which were exposed to the extract, malathion. An aqueous extract of NAT reverted non specific, humeral and cell - mediated immunological parameters to normalcy as the values of antibody titres of the non specific immune parameters and of cell mediated immune parameters were raised by extract. The Fc receptor

bearing cell counts, complement receptor, T-cell number, bearing Blymphocytes and IgG bearing B-cells of the extract-treated malathion mice were also increased towards normalcy while the phagocytic index was greater than in malathion mice not treated with the extract. The results showed that aqueous extract of leaf of NAT showed immunopotentiator activity with the effective capacity for potentiating both humoral as well as cell mediated immune responses.<sup>3</sup>

### **Antifilarial activity**

The chloroform extract of the flowers and a pure compound isolated from NAT plant exhibit larvicidal activity against *Culex quinquefasciatus* say, a common filarial vector.<sup>3</sup>

### **Antihistaminic and antitryptaminergic activity**

The alcoholic extract of NAT leaves (4.0 and 8.0g/kg oral) significantly shown antihistaminic activity in aerosol - induced asphyxia (2% at 300 mm Hg) guinea pigs. Arbortristosid A and arbortristosid C present in NAT was reported to be antiallergic. Antitryptaminergic activities against 5-HT induced rat paw oedema were also reported.<sup>3</sup>

### **Antileishmanial activity**

*Nyctanthes arbor tristis* was found its anti-leishmanial activity and mode of action of NAT for a potent chemotherapeutic agent against *Leishmania* pathogen. An aqueous extracts showed 100% inhibition in growth at a concentration of 6mg/ml. However at a lower concentration of 0.9 – 1.8 mg/ml, promastigote growth was inhibited by 60-80% with a IC50 of 0.6mg/ml. The action of *Nyctanthes arbor-tristis* as a chemotherapeutic agent is found to be mediated through inhibition of superoxide dismutase and simultaneous release of toxic superoxide radical. NAT may be considered as a prospective candidate to found a better line of therapeutic process against visceral leishmaniasis.<sup>30</sup>

### **Toxicity**

*Nyctanthes arbor-tristis* shown toxic effect of ethanolic extract of leaves in rats. The median lethal dose (LD) 16 gm/kg was observed in rats. No mortality was at 2.0 gm/kg while 75% mortality was seen at a 32 gm/kg dose. An administration of ethanol extract of the leaves (1, 2 and 4 gm/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 collagenous pasty stools in albino mice because of a purgative effect .when extract instilled into the rabbit's eye produced conjunctival congestion with oedema, while the person who grounded the dried leaves developed vesicles on both palms.<sup>7</sup>

**Green Synthesis of Silver Nanoparticles by Seeds and Leaves of NAT<sup>15</sup>**

The aqueous extract of the seeds of *Nyctanthes arbor-tristis* is very efficient for the synthesis of stable AgNPs from aqueous solution of AgNO<sub>3</sub>. The extract acts as both capping agent and reducing (from Ag<sup>+</sup> to Ag<sup>0</sup>) in the aqueous phase. The constituents in extract are mainly biomolecules like phenolic and carbohydrates compounds, which are responsible for the preparation of stable AgNPs within 20 min of reaction time at 25 C using without any severe conditions. The synthesized silver nanoparticles were evaluated with FT-IR, XRD ,UV–Visible spectroscopy and SEM. UV–Vis spectroscopy analysis showed peak at 420 nm, which corresponds to the surface Plasmon resonance of AgNPs. The face-centered cubic structure with presence of AgNPs confirmed by XRD results showed peaks at(111), (200), (220) . The size (between 50 and 80 nm) and uniform spherical nature of the AgNPs were further confirmed by SEM analysis.



**Fig: Freshly prepared AgNO<sub>3</sub> sol ( A), reaction mixture of AgNO<sub>3</sub>and seed extract after 20 min (B), reaction mixture of AgNO<sub>3</sub> and seed extract after 5 h (C).**

Anti-arthritic effect of silver nanoparticles synthesized from the leaves extract of *Nyctanthes arbor-tristis* was studied significantly by using in vitro inhibition of protein denaturation model. Silver nanoparticles at different concentrations provided significant protection against denaturation of proteins. Most of the investigators have reported that denaturation of protein is one of the cause of rheumatoid arthritis. Production of auto-antigens in certain rheumatic diseases maybe due to in vivo denaturation of proteins. Mechanism of denaturation probably involves alteration in electrostatic, hydrogen, hydrophobic and disulphide bonding. Silver nanoparticles from leaf extract of *Nyctanthes arbor-tristis* could be used as potent anti-arthritic agent.<sup>8</sup>

**Conclusions**

*Nyctanthes arbor tristis* widely used in traditional system of medicine for varied ailments are supported by various studies involving its pharmacological evaluations. The above article documented and revealed phytochemicals study and pharmacological activities of plants. *Nyctanthes arbor tristis* is unique source of metabolites such as alkaloids, phytosterols, phenolics, tannins, flavonoids, glycosides and saponins which is obtained from crude extracts of various

parts of plant and show effective treatment for various diseases. This review conclude that time has come to make good use of centuries old knowledge of *Nyctanthes arbor tristis* through modern approaches of drug development which is give encouragement among scientist in exploring more information about this medicinal plant.

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