

## Ethnobotanical, phytochemical, medicinal and clinical properties of *Nyctanthes Arbor-tristis* (nat) linn: A promising medicinal plant for drug discovery

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### ABSTRACT:

Small sacred ornamental tree, *Nyctanthes arbor-tristis*, is widely renowned for its exquisite aroma and white orange blossoms around the country. There are several uses for this plant in India's ethnomedicinal practices. It is often referred to as "Parijat", popularly known as Har-shinghar and is a critically endangered species in India. In the sub-Himalayan areas, it may be found all the way down to Godavari. Almost every aspect of the plant is being studied for its therapeutic potential. It has long been used to cure a wide range of diseases. There is a wealth of information in the Ayurvedic literatures on habitat, morphology, etymology, traditional pharmacological as well as medicinal uses, and more. An ethnobotanical research, pharmacological actions and chemical ingredients, cultivation and propagation are only a few of the topics covered in this literary analysis. More importantly, the ethnomedicinal uses reported in this study could be pathfinder for the research community about possible pharmaceutical applications of *Nyctanthes arbor-tristis* in the future.

**KEYWORDS:** Medicinal plant, *Nyctanthes arbor-tristis*, Ornamental, Traditional knowledge.

### I. INTRODUCTION:

Plants have been used for medicinal reasons in ancient texts for a long length of time. As a result of this recording of essential traditional knowledge about medicinal plants, many significant medicines have been developed in the contemporary age. The Acharyas of ancient India believed that each and every plant had immense healing potential if used judiciously. In many underdeveloped nations, herbal medicine is a vital component of the health care system.

The Kalpa-vrksha, the heavenly tree that represents the mind, is supposed to be the Parijata tree in the Matsya Purana list of items protected from the milky ocean's churning. In keeping with

its name, it is with us from birth and provides us with anything we wish for beneath its rays. Vaikuntha, Indra's pleasure garden, was given the Parijata tree that sprung from the ocean. In the Bhagavata Purana, it is stated that Narad took some blossoms from the tree and delivered them to Lord Krishna, who gave the flowers to his wife Rukmani. According to Narad's advice, the Parijata tree should be planted in Satyabhama (Krishna's second wife) garden. During this time, Satyabhama returned to Indralok to warn Indra that someone from the ground could try to take the tree from Indralok, which Narad did. Krishna was departing carrying a limb of the tree when an enraged Indra confronted him. Battle ensued, and Indra lost. Because of this, the branch has never produced any fruit, despite the fact that it has produced several blossoms. Satyabhama planted the tree in her yard in Dwaraka after transporting it there. Parijata is one of five wish-granting trees in Devaloka in Hindu mythology.

### Ethnobotanical properties:

In the Oleaceae family, *Nyctanthus arbor-tristis* Linn (Nyctaginaceae). This flower is known by a number of different names, including Hindi Harsinghar, Sanskrit Parijata and English Night Jasmine. *Nyctanthes arbor-tristis* 'a night blossoming sad tree' growing in tropical and subtropical climes worldwide, it is one of the most versatile therapeutic herbs, showing a wide range of biological action. It is a matter of fact considered to be one of the most versatile medicinal plants available. Flowers that bloom at night and fall off before morning create a beautiful combination of white and red on the ground below. As a result of this, the plant is referred to as "dark" during the day since it loses all of its colour "Tree of sadness" (*arbor-tristis*). Flowers are borne in clusters ranging from two to seven in number, each having a corolla that has five to eight lobes and an orange-red centre. Dew drops are sticking to the petals' powdery white hues. Rough and flaking grey or

greenish bark covers this little native tree. The shrub may reach a maximum height of ten metres. The opposite leaves are 6–12 cm in length and 2–6.5 cm in breadth, and they have a full edge on both sides. The fruit's flattened and brown heart-shaped to spherical capsule contains a single seed that is approximately 2 cm in diameter and has an oval shape. The seed is about 2 cm in diameter and has an oval shape. Night blossoming jasmine is used by the local people of Tripura to anticipate the weather and rainfall patterns, which they use to plan agroforestry operations and disaster mitigation. Because of its tolerance for shade, it may thrive on desert slopes, in dry deciduous woods, and even at sea level up to 1500 m above sea level, depending on the climate. In addition to seeds and cuttings, it is possible to reproduce the shrub from cuttings and seeds; however, the phenolic chemicals that have leached out of the seeds are thought to be responsible for the low germination rate.

**Scientific classification:**

Kingdom: Plant; Order: Lamiales; Family: Oleaceae; Genus: *Nyctanthus*; Species: *arbor-tristis*; Binomial name: *Nyctanthus arbor-tristis*.

**Stem bark****Leaves****Fruits****Flowers****Vernacular Names:**

English: Night jasmine, coral jasmine; Hindi: Parjat, Har, Siharu, Harsing har, saherwa, seoli, Nibari, Shefali; Sanskrit: Parijatha; Kannada: Parijata, harashingar; Odia: Shingadahar, harashingar, gangaseuli, jharasephali; Tamil: Pavilamalligai, manja-pu, pavazhamalligai; Telugu: Pagadammali, swetasarasa, paghada, karchia, karuchiya; Malayalam: Pavilamalli, parijatam, pavizhamalli, parijatakam; Marathi: Khurasli, Parijata, Purijat; Gujarathi: Jayaparvati; Bengali: Sephalika.

**Distribution and habitat:**

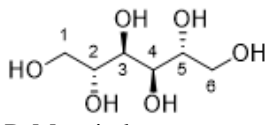
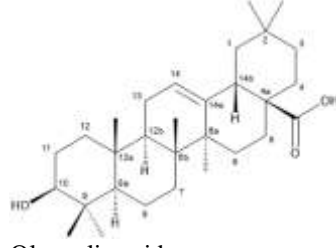
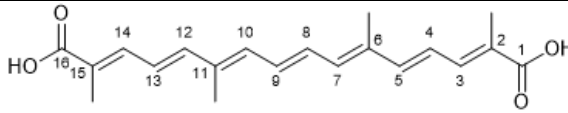
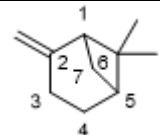
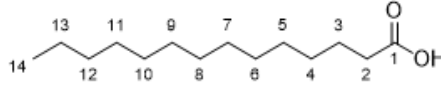
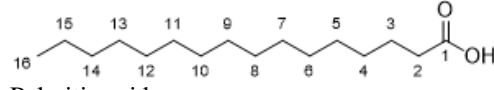
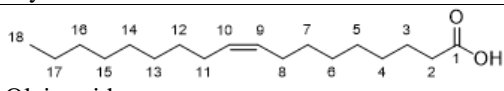
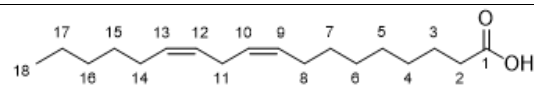
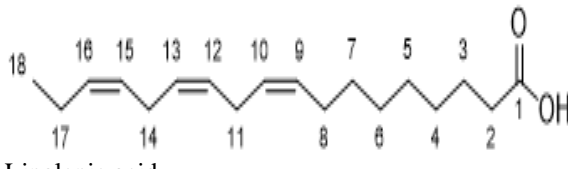
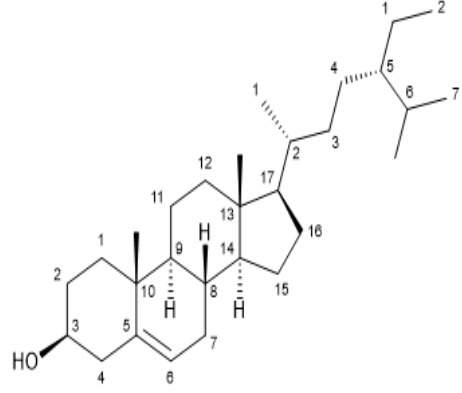
It is found in the region ranging from middle Kashmir to the Godavari River in the south is characterized by the presence of Himalayan rhododendrons and across northern Pakistan, as well as northern India. Subtropical Himalayas of Nepal and India, as well as South East Asian countries like Thailand, Malaysia, and Indonesia, are the natural habitats of night jasmine. Night jasmine grows wild in dry deciduous forests and on rocky slopes in its natural region. With a wide range of rainfall patterns, wherever there are tropical and subtropical climates, it may be cultivated from sea level to 1500 metres above sea level at the equator (at the equator). Seeds and cuttings can be used to propagate it. It does best on well-drained soil, but will not grow well in soggy conditions. It is a practice in India, Sri Lanka, and Indonesia to plant night jasmine around temples dedicated to Hindu deities.

**Botanical description:**

Massive, rough-barked *Nyctanthus arbor-tristis* linn ten-meters high, this shrub may reach a staggering ten metres in height. All that is necessary is a simple design that is 6 to 12-inches long with an edge that is 2- to 6-inches broad. The leaves are rough and hairy. The blooms are found in clusters of 2-7 on the tops of branches or in the axils of the leaves. With a white flower with an orange-red core, they are fragrant, sessile, and have campanulate calyxes and an 8-lobed corolla. The stigma, which seems to be bifid in appearance, is formed by the insertion of two stamens at the apex of the corolla tube into the stigma. Dewdrops sit on the petals, which are utilised in religious ceremonies. A single seed is found in each of the two portions of the flat, compressed, brown, heart-shaped to spherical capsule fruits. The outer layer of big transparent cells is extensively vascularized, and the seeds are ex albuminous with thick testa. A flat cotyledon and an inferior radicle characterise this plant.

**Phytochemical properties:**

Literature survey reveals that many phytochemicals were reported in *Nyctanthes arbor-tristis* Linn as discusses in the following Table 1.

 <p>D-Mannitol</p>	 <p>Oleanolic acid</p>
 <p>Corcetin</p>	 <p><math>\alpha</math> pinene</p>
 <p>Myristic Acid</p>	 <p>Palmitic acid</p>
 <p>Oleic acid</p>	 <p>Linoleic acid</p>
 <p>Linolenic acid</p>	 <p><math>\beta</math>-Sitosterol</p>

**Medicinal properties:**

Parajat has a variety of ethnomedicinal characteristics that have been linked with it for a long time, including rasa, guna, virya, and vipak, all of which have been used in traditional parijat formulations for a long time. It is a component in many chemical compositions. Parijata's leaves, roots, flowers, and seeds are used to cure a wide range of ailments in various dose forms, including juice, powder, and decoction. Vata and kapha vitiation-related disorders are the most commonly treated with it.

*N. arbortristis* has been reported for various pharmacological properties such as

anticancer, antiparasitic, antimalarial, hepatoprotective, immunostimulant, CNS depressant, antiviral, antidiabetic, anti-inflammatory etc. discussed as following under:

**Anticancer activity**

In 2003, **Khatune et al**, reported that petroleum ether, chloroform and ethyl acetate, methanolic extracts of *N. arbortristis* leaves has anticancer properties with a considerable effects on cancer.<sup>40</sup> When it came to treating Swiss albino rats for Dalton's ascitic lymphoma, 5-fluorouracil was shown to be less effective than methanolic extract of stem bark. Increased cytotoxicity of T-cell leukaemia cells was seen as the duration and

dosage of the leaf extracts are prolonged and increased. As the extracts were administered, they significantly reduced the typical cell toxicity. Swiss albino rats with Dalton's ascitic lymphoma were successfully treated with methanolic stem bark extract rather than 5-fluorouracil, according to the findings. With increasing time and dose, the T-cell leukaemia cell is killed by the ethanolic, methanolic, and aqueous leaf extracts. All dose and time intervals of extracts have showed a significant reduction in normal cell toxicity.

**In 2003, Khatune et al,** reported that *N. arbor-tristis*, methanol extracts of fruits, leaves, and stems were tested in vitro for their anticancer properties. *N. arbor-tristis* methanol extract at 30mg/ml conc. showed moderate effectiveness with 71 percent inhibition, whereas breast cancer cell lines devoid of pathogens were inhibited by 10mg/ml conc. at 30mg/ml conc. *N. arbor-tristis* dried phyto-chemicals extracted from the plant Glycosides, phenols, steroid and glycosides in fruit methanol are thought to be responsible for this anticancer action. A yellow formazan product is formed when spectrophotometry (max = 562 nm) and a chemical substance named 3-(4,5-dimethylthiazol-2-yl) 2, 5-diphenyl tetrazolium bromide (MTT) are used in an experiment. The MTT is less sensitive as a result of the fact that it is assessing mitochondrial respiratory activity. A total of 48 hours were spent treating cancer cells with various doses of the chemical (0, 10, 15, 20, 30 g) before the medium was aspirated and the cells were cultured for one hour at 37°C to see whether or not the molecule had any effect. 500 litres of Formazan DMSO were used to disintegrate the cells. The absorbance at 562 nm was measured with the use of an automated TECAN multimode reader. To compare the results with those from a control group that did not get any medicine, the experiment is carried out in multiples and triples.

**In 2003, Khatune et al,** reported that 5-fluorouracil was shown to be less effective than methanolic extract of stem bark of *N. arbor-tristis* when the treatment was given to Swiss albino rats for Dalton's ascitic lymphoma. Increased cytotoxicity of T-cell leukaemia cells was observed when duration and dosage of the leaf ethanolic extracts of *N. arbor-tristis* are prolonged and increased. As the extracts were administered, they significantly reduced the typical cell toxicity. As per the findings, Swiss albino rats with Dalton's ascitic lymphoma were successfully treated with methanolic stem bark extract rather than 5-fluorouracil. With increasing time and dose, the T-

cell leukaemia cell is killed by the ethanolic, methanolic, and aqueous leaf extracts. All dose and time intervals of extracts have showed a significant reduction in normal cell toxicity.

**In 2016, Desai et al,** reported that *N. arbor-tristis*, methanol extracts of fruits, leaves, and stems were tested in-vitro for their anticancer properties. *N. arbor-tristis* methanol extract at 30 mg/ml conc. showed moderate effectiveness with 71 percent inhibition, whereas breast cancer cell lines devoid of pathogens were inhibited by 10mg/ml conc. at 30mg/ml conc. Phytochemicals such as glycosides, phenolic and steroidal compounds isolated from the methanolic extract of *N. arbor-tristis* fruits were thought to be responsible for this anticancer action.

**In 2020, Parikh et al,** reported that that petroleum ether, chloroform and ethyl acetate, methanolic extracts of *N. arbor-tristis* leaves has anticancer properties with a considerable effects on cancer.

#### Antiparasitic activity

**In 2000, Talakal et al,** reported that at a concentration of 1000 Og/mL, a crude ethanolic extract of leaves containing 50 percent ethanol showed trypanocidal action. After being administered intravenously 300 mg/kg and 1000 mg/kg dosages extract demonstrated antitrypanosomal activity and increased the life span of mice infected with *Trypanosoma evansi* in in vivo trials. It has been shown that when the extract therapy is stopped, the parasitaemia increases, leading to the experimental animals' deaths. Hamsters infected with *Leishmania donovani* showed that *N. arbor-tristis* extract has anti-leishmanial properties. According to the researchers, an ethanolic extract of the seeds, leaves, roots, and flowers of *N. arbor-tristis* can be used to eradicate *Entamoeba histolytica* from rats' caecums. There was no activity seen in vitro with these preparations. This plant's contractile activity has been found to relax and reduce the cholinergic response to the water-soluble extracts of the ethanolic extracts of *N. arbor-tristis*' flowers, bark, seeds, and leaves' antihelminthic activities.

#### Antimalarial activity

**In 2012, Balasubramanian et al,** reported that a clinical study including 120 malaria patients was conducted. Three times daily for seven days, *N. arbor-tristis* leaves of medium-size were applied to 92 (76.7 percent) of the patients. The remaining 20 patients recovered within 10 days, whilst the other eight did not. As planned, there

were no significant negative effects from using the paste<sup>49</sup>. Leaf methanol and chloroform extracts had LC50 values of 244.4 and 747.7 ppm for mosquito larvicidal activity against *Aedes aegypti*, *Culex quinquefasciatus*, and *Anopheles stephensi*, respectively, when tested against these three mosquito species.

#### Immunostimulant activity

In 2011, Gupta et al, reported that NAT ethanolic extract was supplied at doses of 50, 100, 150, and 200 mg/kg following exposure to SRCs and Salmonella antigens, and the circulating antibody titres were considerably raised. The total WBC count was increased and the DTH response was greatly improved by long-term treatment. There were 21 immune-bioactive compounds detected in the extract. The immunomodulatory activities of plant extracts have been extensively studied<sup>55</sup>. NA leaf extracts have been proven to be immunomodulatory for both humoral and cell-mediated immune responses in laboratory animals. Floral immuno-stimulant effect has also been demonstrated via stimulating the cell-mediated immune system. It has also been shown that the ethanolic extracts from the seed and root of NA have anti-fungal properties. Arbortristoid C (5 mg/kg) was shown to be more protective than arbortristoid A (5 mg/kg) in terms of both iridoid glucosides extracted from the seeds. In both preventive and therapeutic regimens, arbortristoid A (5 mg/kg) proved to be more protective than arbortristoid C, according to the data. In addition to boosting humoral and delayed-type hypersensitivity to sheep red blood cells, extracts and arbortristoids A and C promoted macrophage migration in Balb/c mice. Floral immunostimulation has also been found to activate the cell-mediated immune system.

#### Hepatoprotective activity

In 2000, Lucas et al, reported that aqueous extracts of *Nyctanthes arbor-tristis* leaves and seeds were shown to have antihepatotoxic effects against CCl<sub>4</sub>-induced hepatotoxicity. Hepatic diseases have become significant roadblocks for medicine in the twenty-first century. Hepatic tissue has a high capacity for regeneration, and damage is typically substantial before it becomes apparent. Hepatic disorders develop itself when hepatocyte regeneration does not keep up with damage, resulting in hepatocellular failure. There is evidence that an alcoholic and aqueous extract from the leaves of *N. arbortristis* can

significantly reduce liver damage caused by exposure to carbon monoxide and the painkiller, aspirin. To protect the root from CTC-induced hepatotoxicity, NA leaf extract has been shown to be effective. Prior to administering a single subcutaneous dosage of CCl<sub>4</sub> (1.0ml/kg body weight) in this study, every day, a concentrated extract (1000mg/kg body weight) was administered to the roots via the Peroral (PO) route (SC). To obtain abdominal aorta blood samples 48 hours after CCl<sub>4</sub> therapy, For seven days, an intravenous anaesthetic containing pentobarbitone and silymarin (70mg/kg/day PO for seven days) was provided (9 days), p450 2E1 activity is reduced, which either prevents (CCl<sub>4</sub>) bioactivation or causes (CCl<sub>4</sub>) detoxification to occur more quickly (CCl<sub>4</sub>). Some of these advantages may be attributed to the presence of antioxidants in the plant. Animal models of (CCl<sub>4</sub>) hepatotoxicity were observed to benefit by extracts of the NA leaf (500mg/kg PO for 10 days), according to another investigation.

In 2000, Lucas et al, reported that Labs employ CCl<sub>4</sub> as one of the most common hepatotoxins to study liver disease<sup>64</sup>. Free radicals (•CCl<sub>3</sub> or CCl<sub>3</sub>COO) combine with lipids, proteins, and other tissue components to create CCl<sub>4</sub>'s toxicity. Poly-enoic endoplasmic reticulum (ER) lipids are peroxidized and secondary free radicals are generated as a result of the chain reaction triggered by the free radical. There is an increase in plasma enzyme levels due to the breakdown of membrane structure and function caused by this harmful lipid per oxidation process.

In 2000, Lucas et al, reported that the alcoholic and water-based extracts of the plant have been proven to have a high liver-protective effect, SGPT (Serum Glutamic Pyruvic Transaminase) and SGOT levels are reduced (Serum Glutamic Oxaloacetic Transamine), as well as lower levels of serum bilirubin (total and direct). Histopathological investigations on liver samples confirmed the findings, showing that the extracts regenerate hepatocytes.

#### CNS depressant action

In 2008, Das et al, reported that NAT (600 mg/kg) leaves, flowers, seeds, and bark prolonged sleep time and decreased dopamine levels while increasing serotonin levels. This suggests that NAT's depressant activity in the brain is caused by a drop in dopamine levels in the ethanol extracts of leaves, flowers, and seeds<sup>66</sup>. Many central nervous system illnesses can be treated using the leaves of *N. arbortristis*, an



ayurvedic medicinal plant. *N. arbortristis* leaves water-soluble extract was found to increase the sensitivity of rats to sleep deprivation following administration with the extract at dosages of 4.0 and 8.0 mg/kg. The screening of the same fraction for hypnotic, tranquilizing, local anaesthetic, hypothermic and anticonvulsant activities at varied doses. There is a significant amount of hypothermia-inducing activity in the percentage (which protected guinea pigs from histamine aerosol). Further research shows that the more extract is taken, the less effective it is in protecting against electrical injury. Anxiolytic effects of *N. arbortristis* hydroalcoholic extracts on many animal models, such as the raised zero maze, elevated plus-maze and open field exploration behaviour have been observed. It may possibly have antidepressant qualities because it reduces dopamine levels and increases serotonin levels in ethanol extract of flowers, bark, leaves, and seeds. A large amount of anticonvulsant activity may be obtained from ethanolic and watery leaf extracts. Maximal electroshock and pentylenetetrazole were used to generate tonic convulsions in the mice, and the extracts protected them from these seizures.

#### Anti-inflammatory activity

In 1984, Saxena et al, reported that the water-soluble, ethanolic extract of the NAT leaves was shown to have anti-inflammatory activities after conducting an experiment. Rat hind-paw oedema produced by carrageenin, formalin, histamine, 5-hydroxytryptamine and hyaluronidase was reduced by NAT treatment. Turpentine oil was shown to reduce rat knee joint inflammation, according to the results of a study<sup>68</sup>. However, analgesic activities have been detected in the water-soluble fractions of alcoholic extracts of the stems and seeds of leaves as well as in the aqueous extract of the plant. Carrageenan, formalin, histamine, 5-hydroxytryptamine, and hyaluronidase were administered to rats' hindpaws in order to examine the acute anti-inflammatory properties of several phlogistic medications. It was shown that *N. arbortristis* was effective in both the granuloma pouch and cotton pellet tests that it prevented the development of granulation tissue in subacute mice. Several immunological assays, including Freund's adjuvant arthritis and the pure tuberculin response, were shown to be inhibited by *N. arbortristis*, according to the research. It has been shown that ethanolic extracts of *N. arbortristis* seeds from Das and colleagues have anti-inflammatory properties with a significant strength

and dosage dependency. Harsingar's anti-inflammatory properties support its usage in Ayurvedic medicine for a variety of inflammatory diseases. Rats were inflamed by carrageenin, formalin, histamine, 5-hydroxytryptamine, and hyaluronidase; an ethanol extract of the water-soluble portion of the ethanol extract reduced this inflammation in male and female rats. After being injected with turpentine oil, the rats' knee joints experienced acute inflammation, which was decreased by the extract. When tested on mice, it was discovered that both leaf and fruit extracts have anti-inflammatory qualities. *Nyctanthes arbortristis* orange tubular calyx and carotenoid extracts (200 mg/kg) reduced carrageenan-induced paw oedema in rats. This was in contrast to the conventional therapy (Diclofenac sodium) and the untreated control group's results.

#### Antiviral Activity

In 2005, Gupta et al, reported that two identified arbortristiside C compounds found in the NA inhibit EMCV and SEV in a study including ethanolic extract, n-butanol fractions, and these two viruses (SFV). For 40 and 60 percent of their body weight, in-vivo doses of either the ethanolic extract or the n-butanol fraction of the ethanolic extract were effective at protecting mice infected with the EMCV from SFV.

#### Anti-Diabetic Activity

In 2005, Ratnasooriya et al, reported that the methanol extract from the root of *N. arbortristis* has anti-diabetic properties. Root powders of 50 grammes were extracted for 18 hours in a hot continuous extraction process using 400 millilitres of methanol. Using petroleum ether, the methanolic extract was filtered and partitioned to eliminate contaminants from the sample. Pressure and vacuum were used to evaporate the solvent. For testing hypoglycaemic action, the dried extract *N. arbortristis* was employed. Compared to a normal medication, The blood glucose levels of rats given 500 mg/kg of the medication dropped significantly after seven days. A methanolic extract of the roots of *N. arbortristis* was shown to be more effective than routinely recommended diabetic medications.

In 2011, Bharti et al, reported that Citrus leaf extracts in 50 percent chloroform and 50 percent ethanol significantly increased diabetic subjects' SOD and CAT activity while decreasing their LPO and cholesterol levels in comparison to the diabetic control group. Patients with diabetes were also affected by these negative effects. In diabetic rats caused by streptozotocin and

nicotinamide, an ethanol extract of the stem bark exhibited a significant anti-diabetic activity. The extract reduces blood glucose levels in a dose-dependent manner.

**In 2012, Pattanayak et al,** reported that ethylated plant extracts of chloroform and ethanol have been shown to have a considerable effect on diabetic control individuals' levels of superoxide dismutase (SOD), decreased liver lacto peroxide (LPO) levels in diabetic control subjects, and decreased triglyceride levels in diabetic control subjects; however, these effects were not observed in patients with diabetes. Researchers found that diabetic rats treated with strontozotocin and nicotinamide were significantly reduced in glucose levels when given an ethanol extract of the bark. Blood sugar levels are lowered in a dose-dependent manner by the extract.

#### **Anti-Allergy Activity**

**In 2007, Rathee et al,** reported that When exposed to histamine aerosol, guinea pigs that had been pre-treated with an alcoholic extract of NA leaves were able to survive. The anti-allergic properties of arbortristoid A and arbortristoid C in NA .

#### **Anti-Trypanosomal**

**In 2000, Talakal et al,** reported that The antitrypanosomal effects of an ethanolic extract were tested in vitro and in vivo using N. arbortristis leaves. At 1000 g/ml, a concentration of trypanocidal activity was detected during extraction.

#### **Sedative Effects**

**In 2005, Ratnasooriya et al,** reported that the hot infusion of N. arbo-tristis flowers may have sedative properties. A variety of concentrations of hot floral infusion were prepared and given orally. Two hours after treatment, the sedative potential was determined. Male rats had a modest dose-dependent conscious sedation effect from the injection, while female rats did not. Overt toxic effects, liver or kidney function, and any overt signs of reliance were all well tolerated even after subchronic treatment .

#### **Antianemic Activity**

**In 2016, Jain et al,** reported that when ethanolic extracts of plant floral components are fed to rats, the haemoglobin content and red blood cell count both increase significantly. Anaemic rats' hemograms are similarly protected against deterioration by extracts from the herb.

#### **Anti-Histaminic and Anti-Tryptaminergic activity**

**In 2002, Saxena et al,** reported that Hypoxia caused by histamine aerosol can be prevented by N. arbor-tristis leaves (4 and 8 g/kg oral) at 300 millimetres of mercury. As a result of this study, the anti-allergy effects of arbortristoid A and C were demonstrated in N. arbor-tristis .

#### **Anti-Filarial activity**

**In 2001, Khatu et al,** reported that Plant components from the genus N. arbortristis and a chloroform extract from the flowers of the genus Culex quinquefasciatus are both potent larvicidal agents.

#### **Anti-Leishmanial Activity**

**In 1992, Singh et al,** reported that 6-b-hydroxyloganin, arbortristoid A-C, and arbortristoid glucosides are all associated to the antileishmanial properties of N. arbortristis. Researchers found anti-leishmanial properties in macrophage cultures and hamster test systems for arbortristoides A, C, and 6-beta-hydroxy-loganin.

#### **Anti-arthritic activity**

**In 2007, Rathore et al,** reported that an arthritic disease begins with joint discomfort and worsens over time as the bones and joints wear away. The pathophysiology of rheumatoid arthritis is heavily influenced by cytokines. TNF-induced arthritis has previously been found to be associated with experimental animals with abnormal TNF-expression. There was a significant reduction in the development of arthritis with the lack of interleukin-1 (IL-1) (CIA). Antigens and collagen had no effect on the arthritis resistance of mice lacking the interleukin-6 (IL-6) gene. Rheumatoid arthritis may have therapeutic targets in the form of proinflammatory cytokines (TNF-, IL-1, and IL-6), as revealed in these research .

#### **Antioxidant activity**

**In 2010, Narendhirakannan et al,** reported that Free radicals are produced by the body's natural metabolic process in a live creature. For example, antioxidants protect the body from pathological illnesses including anaemia, angina pectoris, asthma and rheumatological diseases like rheumatoid arthritis and rheumatoid arthritis by neutralising free radicals. NAT's antioxidant activity has previously been assessed using the DPPH test, Total antioxidant capacity, free radical scavenging activity, and reducing power test. The plant has been found to have a high level of antioxidant activity in numerous investigations.

#### **Antimicrobial and antifungal activities**

**In 2014, Hirapure et al,** reported that Ethanolic leaf extract was shown to be effective

against *Staphylococcus aureus* and *Salmonella paratyphi* due to the presence of phenolic compounds. *Staphylococcus aureus* was shown to be killed by ethanolic leaf extract because of the presence of tannins and phenolic components. An antimicrobial study found that the aqueous extract was more efficient against *Micrococcus luteus* and *Streptococcus aureus* than the methanolic extract, but that the latter was less effective against *Salmonella*, *P. aeruginosa*, *E. coli*, *P. marginata*, and *Staphylococcus epidermis*. Phenols and tannins. The aqueous extract was more effective against *Micrococcus luteus* and *Streptococcus aureus* than the methanolic extract; *Salmonella*, *P. aeruginosa*, *E. coli*, *P. marginata*, and *Staphylococcus epidermis* were less effective against these pathogens, according to the results of an antimicrobial evaluation. It has been discovered that fresh and dried leaf, flower, fruit, and seed samples can reduce Gram-negative bacteria when they are extracted using chloroform or ethyl acetate, according to the research. Fresh plant parts appear to be more active than dried plant parts, according to preliminary research. Stem bark extracts (petroleum ether, chloroform and ethanol) are commonly used in the treatment of bacterial infections but have been proven to be resistant to bacteria such as *Micrococcus luteus*, *Bacillus subtilis*, *E. coli*, *P. aeruginosa* and *Candida albicans* in a research.

*Pyricularia oryzae*, *Cochliobolus miyabeanus*, and *Rhizotonia solani* are three rice fungal infections that leaf extract from *N. arbor-tristis* has been proven to effectively reduce radial growth.

#### Anticholinesterase Activity

In 2001, Verma et al, reported that Malathion inhibits acetylcholinesterase in mice, however the aqueous extract of NA enhanced its activity in those animals. There is no doubt that the brain is the most significant aspect. Previously conducted studies on isolated rabbit ileum contractions induced by acetylcholine found that they had very mild anti-muscarinic activity.

#### Anti-pyretic and Antinociceptive Activities

In 1987, Saxena et al, reported that the ethanolic extract of *Nyctanthes arbor-tristis* orange tubular calyx and the extracted carotenoid (200 mg/kg) was found to be more effective at reducing rat paw edema caused by carrageenan than the standard treatment (Diclofenac sodium) and the untreated control group when compared to the standard treatment (Diclofenac sodium) and the untreated control group<sup>73</sup>. It was shown that the

leaves' water-soluble component of an ethanol extract had considerable antinociceptive, antipyretic, and ulcerogenic effect, but that it did not generate morphine-like analgesia. When rats were administered the drug orally for six days in a row, antipyretic effects were observed, as well as dose-dependent stomach ulcers in the rats that received the treatment.

#### Anti-plasmodial activity

In 2000, Talakal et al, reported that An extract of the flowers of *Nyctanthes arbor-tristis* has been proven to inhibit the development of the parasite *Plasmodium falciparum* (K1, multidrug resistant strain). *Leishmania donovani* and *Entamoeba histolytica* were also shown to be effective in vitro by the extract.

#### Tranquilizing, Antistaminic and Purgative Activity

In 2016, Desai et al, reported that A water-soluble component of this plant's leaves has been studied for its antihistaminic and purgative properties on the central nervous system (CNS) in various studies (e.g. tranquilizing, local anaesthesia, hypothermic, anticonvulsant). The results confirmed the usage of the plant by Ayurvedic practitioners in the scenarios outlined above.

#### Anti-Anxiety

In 2012, Meshram et al, reported that Anxiolytic potential exists in *N. arbor-tristis* hydroalcoholic extracts. The plant material from *N. arbor-tristis* was dried, extracted using a hydro-alcoholic combination, concentrated by distillation to remove the solvent, before being kept in the refrigerator until required.

#### Clinical properties

One research looked at the possible impact of *Nyctanthes arbor-tristis* (Parijat) on malaria-related changes in health status as well as parasite and immune system changes. The study's findings suggest that NAT leaf extract has the potential to treat *Plasmodium falciparum*-induced malaria that is resistant to various drugs. In another trial, individuals with malaria were given oral doses of fresh five-leaf NAT every day for 7-10 days as part of a preventative treatment. The improvement in malaria symptoms and signs, as well as the characteristics of Visham jwara, were evaluated on a daily and weekly basis. Ninety-two patients (76.7%) demonstrated full clinical and parasite cure after seven days, out of 120 patients. Within 10 days, another 20 patients who had the same therapy



had recovered. Standard antimalarial medication was administered to individuals who did not react clinically or had parasites cleared. The amount of parasitemia at the beginning of treatment has a direct correlation to the rate of parasite clearance. Overall, there were no negative reactions to the paste, which is a good sign. NAT exhibited strong antimalarial effectiveness and acceptable tolerability at the dosage employed. NAT is safe.

#### Toxicological profile:

Acute toxicity of the water-soluble fraction of the ethanolic extract of various NAT components was tested using herbal extracts at dosages ranging from 400 mg/kg to 2000 mg/kg i.p.

#### Potential herbal-drug interaction:

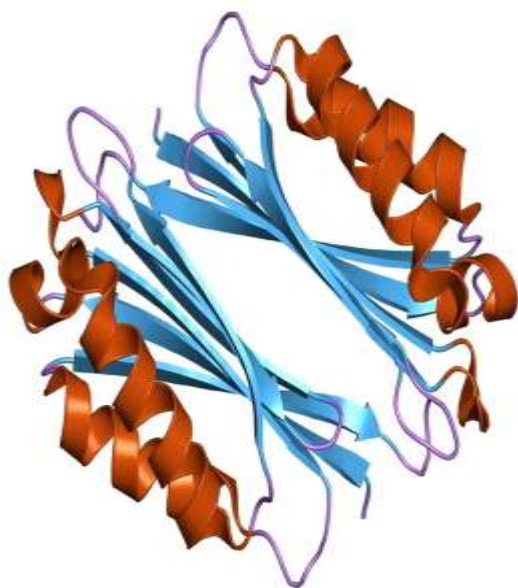
Antispasmodic efficacy has been linked to NAT's ability to decrease the contractile response of acetylcholine, which suggests that NAT has a variety of pharmacological effects<sup>12</sup> enhance the effect of some drugs like hyoscine and Propantheline and Oxyphenonium like Dicyclomine and Atropine According to a recent investigation, NAT has also been observed to lower blood serotonin levels when taken with MDMA, Mescaline or Amphetamine. The CNS depressive activity of the NAT was also discovered in a recent investigation Benzodiazepines, chlorpromazines, haloperidols, reserpine, and clozapine are just a few examples of medications that can be enhanced by this substance.

NAT has also been shown to have a hypolipidemic impact in pre-clinical studies a hypolipidemic drug such as Lovastatin or Atorvastatin may cause the non-alcoholic fatty liver, muscular weakness, irritability, nerve degeneration, or delayed nerve conduction owing to low blood total cholesterol.

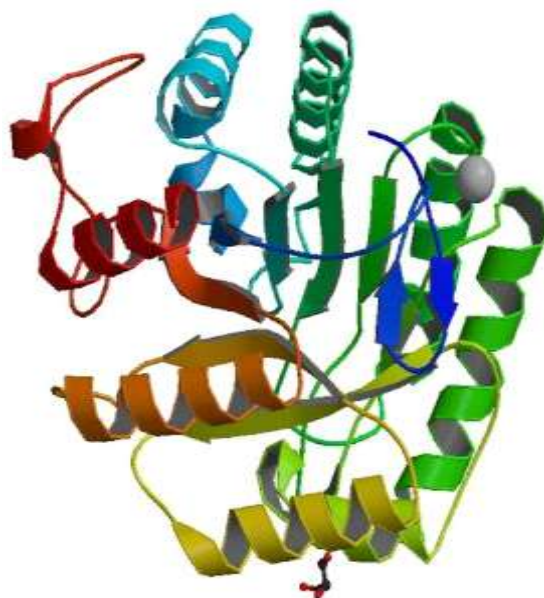
#### MOLECULAR TARGET

**Selection of enzymes with elevated activity during disease:** Liver cancer patients had higher levels of S-adenosyl-methionine decarboxylase activity than the general population<sup>11</sup>. So the anticancer activity of these five compounds with Sadenosyl-L-methionine decarboxylase was analysed with molecular docking study. The same compounds were used to study the fungicidal efficacy against the fungal pathogen *Puccinia triticina*, the causal organism of wheat leaf rust. As an obligate biotrophic parasite, this virus infects wheat, resulting in significant output losses across huge parts of the globe. Activity of one of the several pathogenesis related (PR) proteins,  $\beta$ -1,3-glucanase, is modulated due to *Puccinia* infection. So antifungal activity of the same five compounds isolated from *N. arbor-tristis* leaf was studied with this protein by utilizing molecular docking analysis.

**Protein preparation:** Using the Protein Data Bank, we were able to get the structures of the two proteins of interest, S-adenosyl-L-methionine decarboxylase and  $\beta$ -1,3-glucanase.



S-adenosyl-L-methionine decarboxylase



$\beta$ -1,3-glucanase

**Molecular docking analysis** The area of computer-based drug discovery, which screens small compounds by orienting and scoring them in the binding region of a protein, continues to hold considerable promise with molecular docking. Accelrys Discovery Studio's Ligand Fit software was used to conduct the interaction research. Receptor site prediction was carried out in a manner similar to that used to predict binding sites for proteins. An affinity for ligands was computed using dock scores; each ligand's Dock score is determined by the programme itself. Hydrogen bonds, amino acids involved, and the distance between hydrogen bonds were also determined using Ligand fit Accelrys Discovery Studio software. Five phytochemicals discovered in GC-MS analysis are docked with the target proteins S-adenosyl-L methionine decarboxylase and -1,3-glucanase.

Two molecules are docked together in three-dimensional space when they fit together. For many years, molecular docking has provided valuable contributions to the drug development process. S-adenosyl-L-methionine decarboxylase and -1,3-glucanase are docked with five phytochemicals discovered using GC-MS analysis. Predictions of binding energy between the docked ligand and the protein using different score determined using Discovery Studio are one element of the validation procedure, while hydrogen bond details of the top-ranked docked posture are the second component<sup>111</sup>. S-adenosyl Lmethionine decarboxylase and -1,3 glucanases are the two target proteins for which docking information is

summarised in Table 3 and Table 4 respectively. PLP1 and PLP2 (steric and H-bonding intermolecular functions) are included in the score values; higher PLP scores suggest greater receptor-ligand interaction, More stable docking is achieved when the internal energy of a system is reduced. All interatomic pairings of the receptor-ligand complex are summed to get a total score, which shows how strongly the receptor-ligand complex binds to each other (candidate ligand poses are evaluated and prioritised according to the Dock score function). S-adenosyl-L-methioninedecarboxylase ligands are ranked according to Dock score:

astragaline>nicotiflorin>nyctanthic acid >lupeol>friedeline; and that for  $\beta$ -1,3-glucanase is: friedeline >astragaline>nicotiflorin>nyctanthic acid >lupeol. Consequently, astragaline and friedeline were shown to have the highest molecular docking scores (45.87 and 48.65, respectively) with S-adenosyl-L methionine decarboxylase and -1,3-glucanase respectively. With the protein decarboxylase of S-adenosine, the docking model of the five ligands.

Astragaline was determined to be the best ligand for inhibiting S-adenosyl-L-methionine decarboxylase out of the five compounds studied, and as such, it might be considered a potential anticancer drug based on research into protein-ligand interactions and H-bond interactions. If you're looking for a fungicide to manage wheat leaf-rust, friedeline may be the best option because of its ability to interact with the protein to the largest extent feasible.

## Tables

<b>Table 1 – Phytochemicals present in the various parts of the <i>Nyctanthes arbor-tristis</i> linn.</b>	
<b>PLANT PARTS</b>	<b>CHEMICAL CONSTITUENTS</b>
<b>Leaves</b>	D-mannitol, -sitosterole, astragaline, nicotiflorin, oleanolic acid, nyctanthic acid, tannic acid, ascorbic acid, methyl salicylate, carotene, friedeline, lupeol, mannitol, glucose and fructose, iridoid glycosides, benzoic acid.
<b>Flowers</b>	$\alpha$ -crocetin (or crocin-3), $\beta$ -monogentiobioside- $\beta$ -D monoglucoside ester of $\alpha$ -crocetin, $\beta$ -digentiobioside ester of $\alpha$ -crocetin
<b>Flower oil</b>	$\alpha$ -pinene, p-cymene, 1- hexanol methyl heptanone, phenyl acetaldehyde, 1-deconol and anisaldehyde.
<b>Seeds</b>	Essential oil, nyctanthin, d-mannitol, tannin and glucose, carotenoid, glycosides viz $\beta$ -monogentiobioside ester of Arbortristoside A&B, Glycerides of linoleic oleic, lignoceric, stearic, palmitic and myristic acids, nyctanthic acid, 3-4 secotriterpene acid.
<b>Stem</b>	Glycoside-naringenin-4'-O- $\beta$ -glucapyranosyl- $\alpha$ -xylopyranoside and $\beta$ -sitosterol

<b>Bark</b>	Glycosides and alkaloids

**Table 2- Summary of docking information of the compound for S-adenosyl-L-methionine decarboxylase enzyme**

S. no.	Compound name	PLP1	PLP2	JAIN	Ligand internal energy	PMF	Dock score
1	Astragalín	40.81	40.53	1.83	-0.93	54.32	45.87
2	Nicotiflorin	48.47	59.27	2.65	-2.95	94.58	42.26
3	Nyctanthicacid	51.68	49.75	-1.74	-1.77	60.59	36.47
4	Friedeline	68.43	67.39	1.88	-1.83	74.28	26.85
5	Lupeol	31.28	37.74	-0.85	-0.89	37.71	29.04

**Table 3- Summary of docking information of the compound for  $\beta$ -1,3-glucanase**

S. no.	Compound name	PLP1	PLP2	JAIN	Ligand internal energy	PMF	Dock score
1	Astragalín	38.63	41.37	1.74	-0.91	56.47	43.565
2	Nicotiflorin	47.52	58.87	2.55	-2.76	92.63	41.226
3	Nyctanthicacid	52.49	48.56	-1.78	-1.83	61.46	37.276
4	Friedeline	67.34	66.59	1.72	-1.37	75.33	48.65
5	Lupeol	33.82	38.45	-0.83	-0.87	39.46	28.24

## II. CONCLUSION:

No particular conditions are needed to acquire or grow *Nyctanthes arbor-tristis*, a readily available plant. For drug development groups, it provides a rich source of biologically active chemicals that might lead to new bioactive molecules that are safer and more effective in treating a wide range of ailments. Studies on its pharmacological properties and its traditional medicinal usage in treating a variety of illnesses have been found to support its use as a traditional medicinal product; thus, further clinical study is urgently necessary. Pharmacological research has thus far been in its early stages. The bioactive chemical and the molecular mechanism of action must be found and explained in these investigations.

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