

Antidiabetic Phytochemicals from Medicinal Plant of *Nyctanthes Arbor-Tristis* Linn: A Review

Research Scholar: Mr. M. RAJA, M. Pharm.,

Department of Pharmacognosy,
Padmavathi college of pharmacy,
Dharmapuri, Tamil Nadu.

Guide: Dr. R. MARGRET CHANDRA, M. Pharm., Ph.D.,

Professor cum HOD
Department of Pharmaceutics,
Vinayaka Misson's College of Pharmacy,
Salem, Tamil Nadu.

Co-Guide: Dr. D.C. PREM ANAND, M. Pharm., Ph.D.,

Professor cum Principal
Department of Pharmaceutical Analysis,
St. Peter's Pharmacy College and Research Institute,
Hosur, Tamil Nadu.

Abstract:

Nyctanthes Arbor-tristis Linn. is a traditional medicinal herb used in India, it belongs to Oleaceae family, having various uses such, as an anthelmintic, anti-inflammatory, antimalarial, anti-viral, anti-cancer, anti-leishmanial, anti-allergic, anti-pyretic, hepatoprotective, anti-histaminic, anti-tryptaminergic, anti-nociceptive, anti-choline esterase, bronchodilatory, pesticidal, anti-spermatogenic, purgative, CNS depressant, hypoglycaemic, hypolipidemic and immunomodulatory agent. The following study is to give comprehensive review on pharmacognostical, pharmacological and scientifically proved activities of *Nyctanthes Arbor-tristis*.

Keywords:

Nyctanthes Arbor-tristis Linn., therapeutic uses, pharmacognosy, pharmacological activity, phytoconstituents, comprehensive review.

Introduction:

Medicinal Herbs have been always the most important principle form of medicine since traditions and now a days it becoming most popular form of medicine throughout the world. Herbal medicines are not only providing traditional and ethnic medicine but also promising for highly efficient novel bioactive molecules.

Medicinal plants are a reservoir of various chemical compounds which serve as drugs and the potential source for newer lead molecule and clues for modern drug design by synthesis *Nyctanthes arbor-tristis* popularly known as Night jasmine or Parijata. Belongs to family Oleaceae.

The word *Nyctanthes* is derived from Latin, meaning 'night bloom' and the word *arbor-tristis* is derived from Greek, meaning 'sad tree', both of which refer to the fading of light during the day. This plant is well known for its fragrance and generally known as night flowering Jasmine or Parijata. It originates from South Asia.

The plant usually flowers at night time and liberates fragrant aroma. It is known as Parijata in Sanskrit, har singhar in Hindi and night jasmine in English. During the day the plant loses all its brightness and hence is called Tree of sadness or *arbor-tristis*.

Nyctanthes arbor-tristis is most commonly grown as a sacred tree in Maharashtra state. It is also known for its medicinal cure by the aboriginals residing in this region. Leaves and bark are said to be antibilious and expectorant. Bark in combination with *arjuna sadada* is considered to be useful in internal injuries and healing of wounds especially fractured bones.

The decoction of bark is most recommended for periodic infections. *Nyctanthes arbor-tristis* is one of the most valuable traditional medicinal plants in India Each part of the plant has some medicinal value and is thus commercially used.

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 drugs.

Every part of *Nyctanthes arbor-tristis* is used for medicinal purposes due to health benefitting properties. The present review includes comprehensive information on the chemical constituents, biological activities of important compounds, pharmacological therapeutic action such as anti-inflammatory, antibacterial, antispasmodic, antioxidant, antiarthritic, anthelmintic, antipyretic, antimicrobial, antiviral, antiallergic, as CNS depressant and immunostimulant.

Its use is also employed in Siddha and Unani system of medicine applications of Night jasmine and emphasizes the need for further exploring available information.

History:

It is mostly distributed in Himalayan regions and Southwards to Godavari (India). It is native to southern Asia and also found in other countries such as Nepal, Pakistan, and Thailand.

This is mostly found in the tropical and subtropical regions of the world. The flower of this plant is the official flower of the state of West Bengal, India and Kanchanaburi province of Thailand. Parijata is a small deciduous tree with dropping 4-angled branchlets.

The leaves shed in February or March and renewed in June-July. Flowering occurs in August with peaking in September-October. Fruit ripens in April-May



Fig.1: Nyctanthes Arbor-tristis Linn

Taxonomical classification:

Kingdom: Plantae

Division: Magnoliophytes

Class: Magnoliopsida

Order: Lamiales

Family: Oleaceae

Genus: Nyctanthes

Species: Arbor-tristis

Plant care:

Sunlight and temperature:

The plant usually needs hot climate and is habitat to tropical zone. Plant must be expose to sunlight for minimum 4 hours and maximum 8 hours.

Watering:

Clogging and standing of water must be avoided because excess water damages the root system. One should follow periodic deep watering for health growth of plant.

Soil:

Soil must be fertile, rich in organic content and well drained.

Fertilizer:

Plant must be supplied with well decomposed compost and vermicompost. For good flowering use natural fertilizers like banana and onion peel or use potassium-based fertilizers. If the flower does not bloom then use phosphorous rich or bonemeal fertilizer.

Pruning:

Regular trimming must be done as the shoots grow in different direction. The main advantage of pruning is it helps the plant to bloom.

Pest management:

Regular washing of the plant must be done using the strong water sprayer mist. The plant is usually attacked by mites, white flies and aphids. Use of natural pesticide such as neem oil keeps the pest free.

Cultivation:

Light preference: Full sun

Water preference: Moderate water

Pruning: Regular pruning is required.

CHARACTERISTIC FEATURES OF NYCTANTHES ARBORTRISTIS:

Nyctanthes Arbor-tristis is a small tree that can grow up to 10 meters in height 33 feet.

It has grey bark and opposite, simple leaves that are 6-12 cm (2.4-4.7 in) long and 2-6.5 cm (0.79-2.56 in) broad, with a smooth edge.

The Flowers are fragrant, with a white corolla that has five to eight lobes and an orange-red centre. They are produced in clusters of two to seven together, with individual flowers are opening at dusk and closing at dawn.

The fruit is a bilobed, flat brown heart-shaped to round capsule that is 2 cm in 0.79 diameter, and each lobe contains a one seed.

PHYTO-CHEMICAL CONSTITUENTS:

A various of chemical compounds such as terpenes, steroids, glycosides, flavonoids, alkaloids, and aliphatic compounds have been identified from different parts of the N. Arbor-tristis plant.

The plant primarily produces glycosides and alkaloids as secondary metabolites.

The glycosides belong to two groups: iridoid glycosides and phenylpropanoid glycosides.

Iridoid glucosides, specifically Arbor tristoside A, B, D, and E, are found in the seed and have been found to have immunomodulatory and anti-leishmanial properties

PLANT PART	PHYTO-CHEMICAL	MEDICINAL USES
BARK AND STEM	<p>ALKALOIDS AND GLYCOSIDES (6-β hydroxyloganin, Arbortristoside-A, Naringenin-4'-O-β-glucopyranosyl-α-xylopyranoside, Nyctoside A).</p> <p>STEROIDS (β-sitosterol).</p> <p>TERPENES (21α-Hydroxyfriedal-4-(23)-en-3-o, β-amyrin, friedal-1-ene-3-one, nyctantic acid, oleanolic acid).</p> <p>MISCELLANEOUS (1-Triacontanol, Lignoceric acid, Pelargonic acid).</p>	Bronchitis, Malaria, Rheumatic joint pain, Snakebite.
FLOWER	<p>ALKALOIDS AND GLYCOSIDES (2-phenylethyl-β-D-glucopyranoside, Arbortristoside C 6-β-hydroxy loganin, B-digentiobioside Cardiac glycoside-nymphalin, Irridoid glycosides-6-O-trans-cinnamoyl-7-O-acetyl-6-β-hydroxy loganin, Monogentiobioside-β-D, Nyctanthoside, n-tetradecyl-β-D-glucopyranoside).</p> <p>FLAVONOIDS (Anthocyanin, Apigenin, Kaemferol, Quercetin).</p> <p>STEROIDS (Stigmasterol).</p> <p>TERPENES (α-pinene, diterpene-Nyctanthin p-cymene).</p> <p>MISCELLANEOUS (Carotenoids, Crocetin, Crocin, D-Mannitol, Essential oil, Glucose, Rengylone, Tannin).</p>	Ant-Bilious, Ant filarial, Anti-inflammatory, Antioxidant, Astringent, Antibiotic, Carminative, Diuretic, Dyspepsia, Expectorant, Hair tonic, Ophthalmic, Sedative, stomach ache, Treatment of piles and various skin diseases
LEAVES	<p>ALKALOIDS AND GLYCOSIDES (6βhydroxyloganin, 6,7-Di-O-benzoylnycthanoside, Desrhamnosylverbacoside, Flavonol-Glycosidesastragaline, Irridoid glycosides-arborsides A,B,C, Nicotiflorine, Nyctanthine).</p> <p>FLAVONOIDS (Nicotiflorin).</p> <p>STEROIDS (β-sitosterol).</p> <p>TERPENES (Friedeline, lupeol, oleanolic acid, Triterpenes-βamyrin).</p> <p>MISCELLANEOUS (Ascorbic acid, Amorphous resin, Benzoic acid, Benzoic ester of logan in, Carotene, Fructose, Glucose, Hexatriacontane, Mannitol, Methyl salicylate, Tannic acid).</p>	Anthelmintic, Antibacterial, Antifungal, Anti-Inflammatory Antioxidant, Anti-Pyretic, Arthritis Asthma, Bronchitis, Cholecystagogue Constipation, Cough Dyspepsia, Flatulence, Heartburn, Hepatoprotective, Immunopotential, Nausea Reptile Venom, Rheumatism, Ringworm, Sciatica.
	ALKALOIDS AND GLYCOSIDES	Antibacterial, Antifungal, Alopecia, Antileishmanial,

SEED	(Irridoid glycosides-arbortristoides A,B,C,D and E, Phenyl propanoid glycoside-Nyctoside A). STEROIDS (β -sitosterol). TERPENES (4- secotriterpene acid, Nyctanthic acid, Triterpenes-3). MISCELLANEOUS (Glycerides of linoleic, Lignoceric, Myristic, oleic, Palmitic, Stearic acid. Polysaccharides composed of D-Glucose and D-Mannose, a pale yellow-brown	Hair Tonic, Immunomodulatory, Piles.
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PHYTOCHEMICAL ANALYSIS AND PHYSICAL CHARACTERISTICS OF NYCTANTHES ARBOR-TRISTIS BARK:

Pharmaceutical Analysis of the plant bark of *Nyctanthes Arbor tristis* revealed a various type of chemical components in several solvent extracts. A various of chemical compounds such as Alkaloids, steroids, triterpenes, tannins, glycosides, carbohydrates, and flavonoids were detected, while saponins, proteins, and amino acids are not found.

The investigation of insightful information about the chemical compound of *Nyctanthes arbortristis* bark, information that may be important for the future research into the plant's therapeutic and medicinal applications. The *Nyctanthes arbortristis* bark was studied and determine its phytochemical properties and quality parameters.

The total content of bark ash was found to be within acceptable limit of 9.16% w/w, while the acid insoluble ash was below the limit at 0.30% w/w. The water-soluble extractive content was also within the required range, not falling below 16.80% w/w. Moreover, the alcohol-soluble extractive content surpassed the minimum requirement at 9.40% w/w. These results indicate that *Nyctanthes arbortristis* bark has a high-quality phytochemical profile, making it a valuable resource for a variety of applications.

PHYTOCHEMICAL ANALYSIS AND PHYSICAL CHARACTERISTICS OF NYCTANTHES ARBOR-TRISTIS FLOWER:

The pharmaceutical analysis of *Nyctanthes Arbor tristis* flower have been chemical composition in different solvent extracts, revealing the presence of variety of chemical constituents. The flowers contain low sugars, alkaloids, tannins, cardiac glycosides, anthraquinone glycosides, proteins, terpenoids, and flavonoids, all of which have been identified through various chemical tests in both aqueous and alcohol extracts.

Interestingly, saponins were found to exhibit foam formation exclusively in the aqueous extract, while no starch was detected in any of the solvent extracts. This comprehensive analysis of *Nyctanthes Arbor tristis* flower was emphasizes the rich phytochemical content, highlighting their potential importance in several applications and traditional medicine.

Flowers' composition, notably their extractive and ash values, sheds light on their characteristics. Ash should not be more than 3.3% w/w, with water soluble ash being less than 1.9% w/w and acid-insoluble ash being less than 1.45% w/w. Aqueous extractive is not less than 22.5% w/w, alcohol extractive is not more than 15.5% w/w, and chloroform extractive is not less than 11.2% w/w. These extractive values show solubility.

Certain components of the corolla tubes and flower petals are different: tannin is only found in the corolla tube, whereas cellulose, pectin, lignin, lipids, oils, and proteins are present in both. Starch and mucilage are absent from both. The major components of Calcium oxalate crystals are absent in petals but found in the corolla tube, and suberin is absent in both, contributing to their unique characteristics

PHYTOCHEMICAL ANALYSIS AND PHYSICAL CHARACTERISTICS OF NYCTANTHES ARBOR-TRISTIS FRUIT:

The pharmaceutical analysis of *Nyctanthes Arbor tristis* fruit to determine its chemical make-up and how it reacts to different ratio solvents. The methanolic extract of the fruit contains alkaloids and glycosides, while the petroleum ether extract does not. Saponins are absent from both aqueous and solvent extracts.

The component of Carbohydrates, flavonoids and proteins with amino acids are found in the methanolic extract, but not in the petroleum ether extract. Tannins, phenolic compounds, and phytosterols are not present in both extracts.

The petroleum ether extract contains triterpenoids and fixed oils and fats, which are missing in the methanolic extract. Neither extract contains gums or mucilage.

This valuable information provides major insights into the composition of *Nyctanthes arbortristis* fruit, including its potential uses in various fields.

Nyctanthes arbortristis fruit has a moisture content of $8.70 \pm 0.01\%$ w/w and contains $11.7 \pm 0.04\%$ w/w of total ash, $2.16 \pm 0.02\%$ w/w of acid insoluble ash, and $3.72 \pm 0.02\%$ w/w of water-soluble ash, revealing its mineral content and solubility characteristics.

The *Nyctanthes arbortristis* fruit also has a sulphated ash content of $5.56 \pm 0.04\%$ w/w, indicating its sulfur content.

The both alcohol-soluble extractive content is $11.73 \pm 0.46\%$ w/w, while the water-soluble extractive content is $8.56 \pm 0.34\%$ w/w, contributing to the profile of these botanical specimens. This analysis provides a well understanding of the chemical composition of *Nyctanthes arbortristis* fruit, which has various practical applications.

PHYTOCHEMICAL CHARACTERISTICS OF NYCTANTHES ARBOR-TRISTIS LEAVES:

The physicochemical properties of *Nyctanthes arbortristis* leaves fats had been decided to be 2.10%. These leaves were found to be dark green colour and produced a viscous, semi-solid substance at room temperature. The acid value of *Nyctanthes arbortristis* leaves was found to be 76.27, indicating that oil is inedible due to a high acid supents.

The iodine values of *N. arbortristis* leaves were found to be 134.44, indicating that they are highly unsaturated. Furthermore, these *Nyctanthes arbortristis* leaves contained 50.01% moisture, 13.98% ash, 15.87% lignin, 9.41% crude fiber, 2.10% fat, 15.02% protein, and 9.48% carbohydrate.

ANALYTICAL EVALUATION AND PHYSICAL CHARACTERISTICS OF NYCTANTHES ARBOR-TRISTIS LEAVES

PHYTO-CHEMICAL	AQUEOUS EXTRACTS	CHLOROFORM EXTRACTS	ETHANOL EXTRACTS	ETHYL ACETATE EXTRACTS	PETROLEUM ETHER EXTRACTS
ALKALOIDS	+	-	+	-	+
ANTHRAQUINONE GLYCOSIDES	-	-	-	-	-
CARBOHYDRATES	+	+	+	+	+
FLAVONOIDS	+	+	-	+	-
GLYCOSIDES	+	-	+	+	+

PHENOLS	+	+	+	-	+
PROTEINS AND AMINO ACIDS	+	-	+	-	+
SAPONINS	+	-	-	-	+
TANNINS	+	-	+	-	+
STEROIDS	+	+	+	+	+

MEDICINAL VALUE OF NYCTANTHES ARBORTRISTIS PLANT:

1. ANTI-ALLERGY ACTIVITY:

The bark of the *Nyctanthus arbor-tristis* plant has additionally been identified for anti-histamine activity. The bark of *Nyctanthus arbor-tristis* was extracted using solvent of petroleum ether, chloroform, ethylacetate, ethanol, and water. Of these extracts, the petroleum ether extract at 50 and 100 mg/kg demonstrated the greatest protection against mast cell degranulation by clonidine and resisted contraction (bronchodilation) induced by histamine at 50 and 100 mg/kg more effectively than other extracts, which they suggested might be caused by betasitosterol.

The ability of extracts to inhibit histamine action launch appears glaring from the above paintings with the aid of using exclusive groups, with does below proper limits. Though the toxicity studies have not been reported in any of this work, but other reports of toxicity in similar extracts indicate a much safer level. The pre-treatment of guinea pigs uncovered to histamine aerosol with water-soluble part of the alcoholic extract of *N. arbor-tristis* leaves provided sizable safety towards the improvement of asphyxia. *Arbortristoside A* and *Arbortristoside C*, two anti-allergic chemicals, is reported to be present in *N. arbortristis*.

2. ANTI-ANXIETY ACTIVITY:

Hydroalcoholic extracts of *N. arbor-tristis* have anxiolytic potential. Dried plant parts of *N. arbortristis* were extracted using a hydro-alcoholic mixture. The extract was then concentrated by distilling of the solvent, evaporated to dryness on a water bath, and it stored in an air-tight container in a refrigerator until used [32].

3. ANTI-INFLAMMATORY ACTIVITY:

The extract obtained from the entire plant of *N. arbortristis*, as well as the alcoholic extract of its stem and seeds, and the water-soluble part of the alcoholic extract of its leaves, have demonstrated acute and sub-acute anti-inflammatory activity.

The acute anti-inflammatory activity was evaluated using various phlogistic agents such as Carrageenan, formalin, histamine, 5-hydroxytryptamine, and hyaluronidase in the hind paw of rats. In sub-acute models, *N. arbortristis* was found to significantly reduce granulation tissue formation in the granuloma pouch and cotton pellet test. Additionally, *N. arbortristis* was found to inhibit inflammation produced by immunological methods such as Freund's adjuvant arthritis and purified tuberculin reaction.

4. HEPATOPROTECTIVE ACTIVITY:

The investigated the protective effects of the alcoholic leaf extract of *Nyctanthes arbortristis* against carbon tetrachloride (CCl₄)-induced hepatotoxicity in rats. The rats were pre-treated with the alcoholic extract (1000mg/kg body weight/day, p.o. for 7 days) before receiving a single dose of CCl₄ (1.0ml/kg, SC). Blood samples were collected from the abdominal aorta of the rats 48 hours after CCl₄ administration (9th day) under pentobarbitone anesthesia (350mg/kg IP).

Silymarin (70mg/kg body weight/day, p.o. for 7 days) was used as a reference standard. The study found that both the leaf extract of *Nyctanthes arbortristis* and silymarin restored all serum and liver parameters to their normal levels, prevented loss of body weight, and protected against CCl₄-induced

increase in liver weight and volume. The mechanism of this protection may involve the inhibition of P 450 2E1 activity or acceleration of the detoxification of CCl₄. These effects may be mediated by the antioxidant present in the plant. In another investigation, the ethanolic and aqueous extract of the leaf of *Nyctanthes arbortristis* (500mg/kg oral route for 10 days) reversed the rise in serum AST and total bilirubin in CCl₄-induced hepatotoxicity in animal models.

The liver of mice was induced with hepatic toxicity by injecting CCl₄. To determine the function of the liver, the levels of Serum Glutamate Pyruvic Transaminase (SGPT), Serum Glutamate Oxaloacetic Transaminase (SGOT), Alkaline Phosphate (ALP), Direct Bilirubin (DB) and Total Bilirubin (TB) in the serum of mice were measured [34, 35].

5. ANTIVIRAL ACTIVITY:

The ethanolic extract, n-butanol fractions, and two pure compounds, arbortristoside A and arbortristoside C, which are derived from the *Nyctanthes arbortristis* plant, have been found to possess strong inhibitory activity against two viruses - the encephalomyocarditis virus (EMCV) and the Semliki Forest Virus (SFV). In laboratory evaluations, the *Nyctanthes arbor-tristis* Linn. Flower extract and its isolated compound have also been tested against the common floral vector, *Culex quinquefasciatus* say (dip).

The in-vivo ethanolic extract and the n-butanol fraction, when administered at daily doses of 125 mg/kg weight, have been shown to protect EMCV infected mice against SFV by 40% and 60% respectively. However, it should be noted that only two reports have been found on the anti-viral activity of the ethanolic extract, n-butanol fraction, and Arbortristoside A and C isolated from the seed of the plant against Encephalomyocarditis virus and Semlinki forest virus, both in vitro and in vivo. Furthermore, it has been reported that the antiviral activity of arbortristosides B, D, and E was not observed [36].

6. ANTIBACTERIAL ACTIVITY:

The various infectious diseases are responsible for the majority of premature deaths globally. Pathogens are increasingly developing resistance to antimicrobial agents, and multiple drug resistance is becoming more common. Organisms such as *Staphylococcus aureus*, *Staphylococcus epidermis*, *Salmonella typhi*, and *Salmonella paratyphi A* are among those that have developed resistance. However, a recent study found that the methanolic extract of leaves from *N. arbortristis* has significant antibacterial activity against these organisms, with the minimum inhibitory concentration (MIC) ranging between 1-8 mg/ml. The researchers compared the zone of inhibition and MIC of the extracts with those of standard drugs such as ciprofloxacin and fluconazole. They found that the chloroform extract had both antibacterial and antifungal activities, while the petroleum ether and ethanol extracts only had antibacterial activity [37].

7. ANTI-FILARIAL ACTIVITY:

The flowers chloroform extract and a compound from *N. arbortristis* plant possess larvicidal activity against *Culex quinquefasciatus*, a common filarial vector [38].

8. ANTIMALARIAL ACTIVITY:

A clinical study was conducted on 120 malaria patients. The study found that administering a fresh paste made from medium-sized five leaves of *N. arbortristis* thrice a day for a period of 7-10 days resulted in the cure of the disease in 92 patients (76.7%) within 7 days. An additional 20 patients were cured by day 10, while the remaining 8 patients did not respond to the treatment. The paste was well-tolerated, and no severe side effects were reported. The study also screened methanol and chloroform extracts of the leaves for mosquito larvicidal activity against three major mosquito vectors (*Aedesaegypti*, *Culex quinquefasciatus*, and *Anopheles stephensi*) and found that the two extracts killed larvae of Alexander Stephens with LC₅₀ values of 244.4 and 747.7 ppm, respectively [39].

9. ANTI-LEISHMANIAL ACTIVITY:

The anti-leishmanial activity of *N. arbor-tristis* can be attributed to the presence of iridoid glucosides, likes as arbortristosides A, B, and C and 6-b-hydroxyloganin. These medicinal compounds have demonstrated antileishmanial activity both *In-vitro* and *In-vivo* against amastigotes in macrophage cultures and hamsters test systems, respectively [40, 41].

10. ANTI-MICROBIAL ACTIVITY:

The oil extracted from the leaves, seeds, and bark of *N. arbor-tristis* have been found to possess a wide spectrum of antibacterial properties. It can effectively combat both gram-negative and gram-positive microorganisms, including streptomyces strains. The aqueous and methanol extracts of mature leaves from *N. arbor-tristis* were evaluated against *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Escherichia coli*, and *Staphylococcus aureus* to determine their bactericidal properties. The study results showed that both extracts were effective against most bacteria, except for *P. aeruginosa* which was resistant to the aqueous extract. Overall, it was discovered that the methanol extract outperformed the aqueous extract in terms of effectiveness. Additionally, it was discovered that the chloroform and ethyl acetate extract of the plant's flowers inhibited the growth of gram-positive (*B. subtilis*, *B. cereus*, *B. megaterium*, *Staphylococcus Aureus*, *Sarcinia lutea*, *Streptococcus sp*) and gram-negative (*E. coli*, *Shigella dysenteriae*, *Shigella shiga*, *Shigella boydii*, *Shigella sonnei*, *Pseudomonas aeruginosa*) bacteria. However, the petroleum ether extract did not show any inhibitory effect. Furthermore, the stem bark extracts of the plant were also tested for their antimicrobial activity against *Staphylococcus aureus*, *Micrococcus luteus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans*, and *Aspergillus niger* in vitro [42].

11. ANTI-PARASITIC ACTIVITY:

A study has reported that 50% ethanolic extract of leaves from *N. arbortristis*, a plant species, has trypanocidal activity at a concentration of 1000 g/mL. In vivo studies on mice have shown that doses (300 and 1000 mg/Kg) of the extract have anti-trypanosomal effects and can significantly prolong the survival period of *Trypanosoma evansi*-infected mice. However, it is important to note that once the treatment is discontinued, the parasitaemia increases and may lead to the death of the experimental animals. *N. arbortristis* extract has also demonstrated potential anti-leishmanial activity in *Leishmania donovani*-infected hamsters. The 50% ethanolic extracts of the seeds, leaves, roots, flowers, and stem of *N. Arbortristis* had been located to clean *Entamoeba histolytica* infections in rat caecum.

However, these extracts were not active *In-vitro*. Moreover, the water-soluble parts of the ethanolic extract of flowers, bark, seeds, and leaves of *N. arbortristis* have been found to possess anti-helminthic activity. This activity is suggested to be due to the inhibition of motility by relaxing and depressing the responsiveness to the contractile action of acetylcholine [43 ,44].

12. ANTI-AGGRESSIVE ACTIVITY:

It was discovered that the plant's fresh leaf juice had anti-malarial properties. It has been demonstrated that the plant's 50% ethanolic extract of the seeds, leaves, roots, flowers, and stem possesses ant amoebic and antiallergic qualities. The plant's leaf extract exhibited ulcerogenic, analgesic, antipyretic, and anti-inflammatory properties. It has been stated that the plant's leaves, seeds, and flowers have immunostimulant properties. It has been demonstrated that the water soluble portion of the ethanolic extract exhibits purgative, antihistaminic, calming, and tumor necrosis-depleting properties. Antitumor activity was discovered for the arbortristoside A that was separated from the seeds [45].

13. ANTIOXIDANT ACTIVITY:

In-vitro evaluation of the different *N. arbortristis* leaf extracts' capacity for unbound radical scavenging was conducted using the diphenyl-picryl-hydrazyl (DPPH) test technique. Plant extracts combined with the stable free radical DPPH to produce 1, 1-diphenyl-1, 2-picryl hydrazine, which had a wavelength of 517 nm. The following is a decrease in the DPPH radical scavenging effect of plant extracts and standard (ascorbic acid and BHT): (Ascorbic acid > Butanol > Ethyl acetate > BHT > Pet ether).

Ascorbic acid was discovered to be the most abundant substance at a concentration of 10 mg, followed by butanol, ethyl acetate, BHT, and pet ether, which were found to be the least abundant at a

concentration of 100 mg, 95.22%, 84.63%, and 82.04%, respectively. According to the results of this investigation, several *N. arbortristis* leaf extracts have concentration-dependent free radical scavenging activities. According to the results of this investigation, several *N. arbortristis* leaf extracts have concentration-dependent free radical scavenging activities [46].

14. CNS DEPRESSANT ACTION:

The water-soluble fractions of ethanol extracts of *N. arbortristis*'s flowers, bark, seeds, and leaves were used in a study to evaluate the plant's CNS depressing effect. Previous research has shown that the plant's flower has sedative qualities, while its leaves offer hypnotic and soothing effects. The ethanol of the plant was extracted using Soxhlet extraction, and the pharmacological effectiveness of the extract was evaluated in adult male Swiss mice. After giving mice pentobarbital sodium, the length of time they slept was used to measure the CNS depressant action. An investigation of the activity's potential mechanism was conducted by assessing the effects on brain monoamine neurotransmitters, such as dopamine and serotonin.

According to the research, *N. arbortristis* has considerable CNS depressive effect as well as some muscle relaxant activity in its ethanolic extract of leaves, flowers, seeds, and bark (600 mg/kg). Comparable to the standard medication chlorpromazine, the leaves, flowers, seeds, and bark all demonstrated a notable and dosedependent lengthening of the onset and duration of sleep. The leaves have been discovered to possess the highest level of CNS depressant interest. Furthermore, it is determined that the activity induced by the extract is most likely due to a decrease in dopamine and an increase in serotonin levels in the brain [47].

15. ANTI-PYRETIC ACTIVITY:

An enhance the prostaglandin E (2) concentration in specific brain regions causes a fever, a complex physiological reaction that raises body temperature in response to aseptic or infectious stimuli. This change in prostaglandin E (2) concentration also affects the rate at which neurons in the hypothalamus that regulate thermoregulation fire.

Antipyretics are medications that lower feverish body temperatures. In albino rats, the antipyretic effect of *N. arbortristis* was investigated for its potential to regulate both normal body temperature and pyrexia produced by yeast. At a dose of 200 mg/kg, the whole plant extract of *N. arbortristis* demonstrated strong antipyretic efficacy by lowering both baseline body temperature and increased temperature caused by yeast in a dose-dependent manner. Additionally, it was discovered that the effectiveness of the whole plant extract of *N. arbortristis* dosage was similar to that of the common antipyretic drug paracetamol (150 mg/kg). In another investigation, the antipyretic properties of *N. arbortristis* bark extracts in methanol and petroleum ether were investigated against mice who had pyrexia caused by yeast.

Aspirin (150 mg/kg) was the conventional medication, and mice's dorsum regions were subcutaneously injected with 20% aqueous solution (10 mg/kg) of Brewer's yeast to produce fever. It was discovered that both petroleum ether and methanol extract (100 mg/kg and 200 mg/kg) exhibited antipyretic effect by markedly lowering rectal temperature [48, 49].

16. ANTI-ANEMIC ACTIVITY:

Hematological research was conducted on ethanolic extracts of the plant parts likes as flowers, barks, seeds, and leaves, and it was observed that the concentration of red blood cells and hemoglobin in rats increased in a dose-dependent manner. Additionally, the extracts prevent the hemogram profile in anemic rats from declining [50].

17. HYPOGLYCEMIC AND HYPOLIPIDEMIC ACTIVITY:

Millions of individuals worldwide suffer with diabetes mellitus, a serious illness. Controlling blood lipid levels is crucial in diabetes since the disease tends to raise low-density lipoprotein cholesterol and lower high-density lipoprotein cholesterol levels, which can lead to coronary occlusions and blockages. Because it has been determined that the current method of treating diabetes with synthetic hypoglycemic medications may have unfavorable effects such as hypoglycemia, gastrointestinal problems, renal toxicity, and hepatotoxicity, plants are being explored as a potential substitute. The hypoglycemic and

hypolipidemic effects of various dosages of the boiled aqueous extract of fresh *N. arbortristis* flowers were investigated in mice. Mice were given extract at doses of 200, 500, and 750 mg/kg.

After that, random glucose concentration and fasting were measured. Following oral treatment of the extract, mice were used to investigate the extract's effects on blood lipid profile, in-vitro amylase assay, liver and skeletal muscle glycogen content, diaphragm uptake, and glucose tolerance. According to the experimental findings, 500 and 750 mg/kg of the extract significantly decreased the random blood glucose level by 32% after 4 hours post-treatment, while 500 mg/kg of the extract reduced fasting glucose levels by 49% and 39%, respectively. In addition, the extract dramatically reduced the amount of total cholesterol and triglycerides by 44.8% and 53%, respectively, and raised the level of high-density lipoprotein cholesterol by 57%. It also strongly restricted the absorption of glucose from the gut by 85% and increased the diaphragm's uptake of glucose by 64%. Additionally, it shows a 16.66% suppression of the activity of the α -amylase enzyme.

The extract's biochemical and toxicological effects did not reveal any deaths or indications of clinical toxicity, stress, or unpleasant behavior during the course of the treatment. Subsequent histopathological examination of the liver and kidney sections following extract therapy revealed no impact. According to the experimental results, the boiled aqueous extract of fresh *N. arbortristis* flowers has hypoglycaemic and hypolipidemic activity, making it a potentially useful alternative medication for the treatment of diabetes. The toxicological results also suggested that the extract is safe to take orally [51].

18. IMMUNO-STIMULANT ACTIVITY:

cell-mediated and Humoral responses demonstrate the powerful immunomodulatory properties of aqueous leaf extract of *N. arbortristis*. Additionally, flower has demonstrated immuno-stimulant action, which turns on the immune system through cells. The ethanolic extracts of *N. arbortristis* from the seeds and roots shown immunomodulator effect against systemic candidiasis in mice. Arbotristosides A and C, two iridoid glucosides, were extracted from the plant's seeds [55, 56].

19. ANTI-ULCEROGENIC AND ULCER-HEALING PROPERTY:

Gastrointestinal illnesses, peptic ulcer, is caused by an imbalance between defensive (primarily mucus-bicarbonate secretion and prostaglandin) and offensive (mostly acid, pepsin, *H. pylori*, and bile salts) components. The two main therapeutic strategies for gastric ulcer disorders are decreasing the production of stomach acid and protecting the gastric mucosa. It has been found that arbotristoside-A and 7-O-trans-cinnamoyl-6 β -hydroxyloganin from *N. arbortristis* exhibit anti-ulcerogenic and ulcer-healing properties. These two promote the healing of stomach ulcers and inhibit the development of irritant-induced ulcer.

20. ANTI-CANCER ACTIVITY:

The anticancer and antioxidant properties of the plant was investigated *In-vitro* using the methanolic crude extract of the leaves, fruits, and stem of *N. arbortristis*. The dried fruit methanol extract of *N. arbortristis* demonstrated a 93.8% scavenging effect of phenolic crude at 1000 mg/ml conc., dried stem methanolic extract showed a moderate value of 69.9% at 100 mg/ml conc., and the Least cost turned into 27.8% that turned into found with dried leaves methanol extract at 1.0 mg/ml conc. These results were obtained using the DPPH free radical scavenging assay, which was used to evaluate the antioxidant activity of the extract. Using MDB MB-231 cancer cell lines, the MTT test was used to assess the anti-cancer activity based on antioxidant activities. Dried fruit methanol extract was reported to have the highest degree of inhibition against human breast cancer cell lines (MDA-MB 231) of all the extracts.

The plant of *N. arbortristis* anticancer action was thought to be attributed to the phytochemical's glycosides, tannins, phenols, and steroids that were extracted from the *N. arbortristis* dried fruit methanol extract. In a different investigation, the anti-cancer potential of the methanolic extract of *N. arbortristis* leaves was tested against Ehrlich Ascites Carcinoma (EAC) cells (107 cells/mouse) by injecting the extract intraperitoneally (200 and 400 mg/kg body weight) into Swiss Albino mice.

Fluorouracil (20 mg/kg body weight) was administered intraperitoneally as a typical anti-cancer medication for the trial. The extract was assessed for anticancer efficacy based on its capacity to suppress

the growth of cancer cells in mouse ascitic fluid. The percentage suppression of the total cell count, tumor volume, viable and non-viable cell counts, percentage increase in life span, and hematological parameters were among the many metrics used to determine the strength of the anticancer property of the methanol extract of *N. arbortristis* leaves. The overall cell count and tumor volume were drastically reduced by the administration of extract at doses of 200 and 400 mg/kg b.w. 200 mg/kg conc. At 400 mg/kg conc., the percentages of total cell count inhibition and tumor volume inhibition were found to be 90.36% and 96.37%, respectively. The percentages of inhibition of total cell count and tumor volume were found to be 84.75% and 75.52%, respectively. When extract was administered at 200 and 400 mg/kg, it similarly markedly reduced the number of viable cells and WBC while increasing the number of non-viable cells, life span, and hemoglobin and RBC levels. The study's overall findings indicated that *N. arbortristis* leaves' methanol extract has anticancer properties [62, 63].

TOXICITY:

Rats exposed to an ethanolic leaf extract were proven to be poisonous by *N. arbortristis*. In rats, a median lethal dosage (LD) of 16 gm/kg was reported. At a dosage of 2.0 gm/kg, there was no death, but at 32 gm/kg, there was 75% mortality. Rats that receive an oral ethanol extract of the leaves (1, 2 and 4 gm/kg/day) for six days in a row develop stomach ulcers. Additionally, due to a purgative activity, this extract demonstrated dose-dependent irritating effects as well as the development of unformed semi-fluid collagenous pasty stools in albino mice. The person who ground the dried leaves had vesicles on both palms, whereas the extract that was injected into the rabbit's eye caused conjunctival congestion and oedema [70].

COMMERCIAL USE:

The orange heart is used to dye cotton and silk; this custom dates back to Buddhist monks who used the flower to dye their orange robes. The flowers are traditionally collected for garlands and religious offerings. Perfume is made from the essential oil of the aromatic blooms, which is comparable to that of *N. arbor-tristis*. The vivid orange corolla tubes of the flowers are filled with nyctanthin, a coloring agent that is the same as v-Crocetin found in saffron. In the past, the corolla tubes were occasionally used with safflower, turmeric, and indigo to dye fabric. The leaves can occasionally be used to polish ivory and wood, and the bark can be utilized as a tanning ingredient [70].

CONCLUSION:

The plant study, which is considerably presence in the composition on the pharmacological conditioning of *N. arbortristis* medicinal shops, demonstrated the significance of herbal and ayurvedic treatment protocols for the successful operation of a range of ails, given their immense pharmacological exertion eventuality. Research conducted on creatures sheds light on the colorful health benefits of phytochemicals, including their anti-inflammatory, anti-viral, anti-bacterial, anti-histaminic, anti-filarial, anti-oxidant, and vulnerable-boosting parcels. *N. arbortristis* shown a wide range of action against a variety of bacteria that beget a number of current microbiological conditions in both humans and shops. *N. arbortristis* is a shrub that grows extensively and is salutary in treating rheumatism, bronchitis, sciatica, dry cough, and fungal skin infections. Leaves have anthelmintic, antibacterial, and anti-inflammatory parcels. The flowers of *N. arbortristis* are carmi, ophthalmic, stomachic, and bitter-tangy. It has febrifuge, bitter, alcohol, expectorant, and mild purgative parcels.

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