



“A Systematic Review Of : *Nyctanthes Arbor-Tristis*: A Conventional Herbal Remedy With Remarkable Medicinal Potential”

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ABSTRACT :

In recent years, research on medicinal plants using traditional medical systems has drawn attention from all across the world. Many therapeutic herbs that have been used for thousands of years are present on our planet. *Nyctanthes arbor-tristis* Linn, also referred to as Parijat or night jasmine, is one such plant. This plant, which belongs to the Oleaceae family, grows natively in tropical and subtropical climates across the globe. It has several therapeutic and pharmacological qualities, although being mainly valued for its aesthetic qualities. Each portion of this significant traditional plant from India has therapeutic significance and a variety of pharmacological effects, including antibacterial, antifungal, antipyretic, antihistaminic, antimalarial, anti-inflammatory, and antioxidant properties. It is utilized in Ayurveda, Siddha, and Unani medicine. Phytochemicals such as flavanol glycoside, oleanic acid, tannic acid, carotene, friedelene, lupeol, glucose, and benzoic acid compounds are found in *Nyctanthes arbor-tristis*. *Nyctanthes arbor-tristis* may be a less expensive and potentially harmful substitute for pharmaceutical medications.

Keywords: *Nyctanthes arbor-tristis*, Phytochemicals, Ayurveda, Harsingar, glycosides, herbals, infusion, clinical trials, cannabinoids, and alkaloids.

INTRODUCTION:

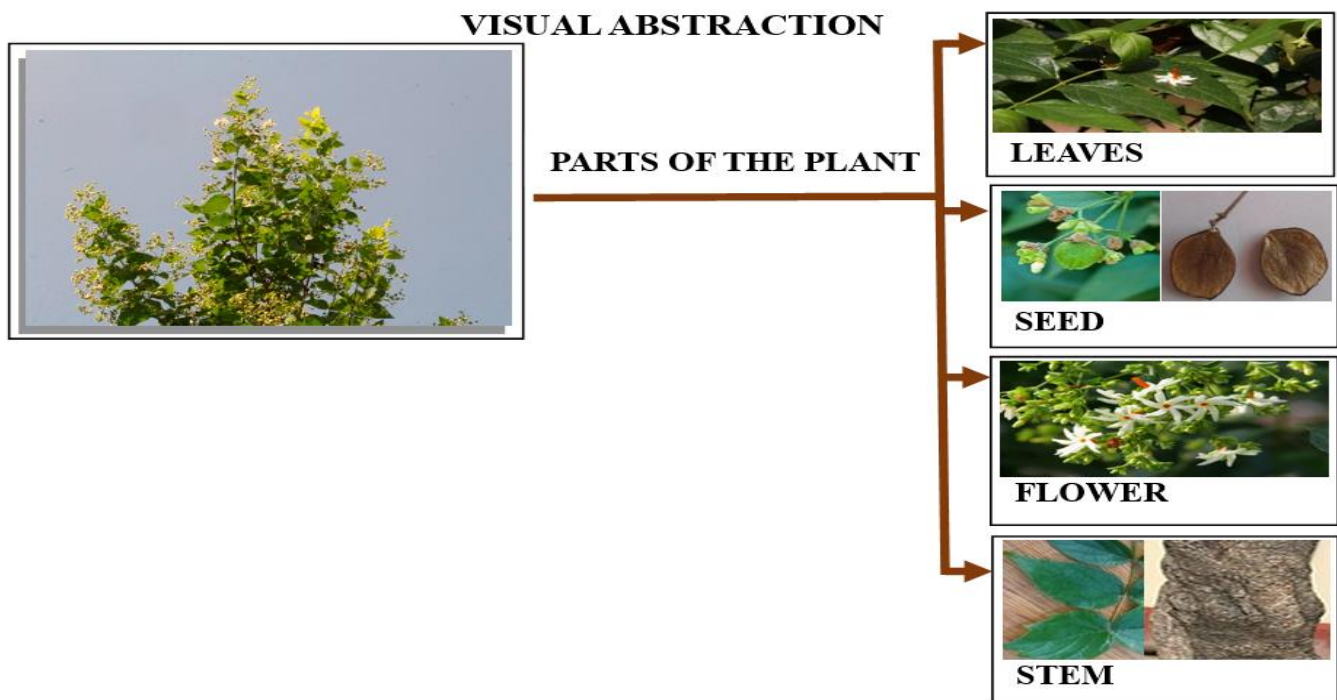
Nyctanthes arbortristis, often known as *N. Arbortristis*, is a valuable medicinal plant that is a member of the Oleaceae family. Tropical and subtropical regions are typical habitats for this plant. *N. arbortristis* is also referred to as Parijat, Harsinghar, and Night Jasmine. The plants start to wither after midnight and appear lifeless when they use the daylight break. Nykhta (night) and anthos (flower) are the Greek words that gave rise to the common name *Nyctanthes*^[1, 2]. *Arbor-tristis*, sometimes known as the "Tree of Sadness," is a plant that is typically a tiny tree or shrub that has extremely fragrant blossoms. These blooms create a stunning combination of red and white on the ground when they bloom at night and fade before the morning rises. The plant loses all of its brightness during the day. Other names for it include Coral Jasmine, Parijat, Queen of the Night, Harsinghar, and Night-flowering Jasmine^[3]. India is the native habitat of *Nyctanthes arbortristis*. It grows in the sub-Himalayan region and is a common ornamental plant in Indian gardens. The plant may grow on rocky terrain in dry hill shadows, dry deciduous forests, and at sea level up to 1500 meters in elevation. It can even withstand light shade. It is also resilient to mild shade and can tolerate a broad range of rainfall patterns, from seasonal to non-seasonal. It is frequently grown in gardens because of its delightful and distinctive aroma^[4, 5]. A species of plant known as *N. arbortristis* can be found in India's outer Himalayas, Jammu & Kashmir, Nepal, Bengal, and Tripura. It is also prevalent in the Central area, extending as far south as Godavari. The plant likes to thrive in a semi-shaded, secluded area and flowers from July to October^[6]. One well-known medicinal plant, *N. arbortristis*, is a big, hardy, wild shrub or small tree that is common in the wild. They have been used as a hair tonic, to cure skin infections, and to start the menstrual cycle, among other things. Herbal medications contain very effective bioactive molecules in addition to traditional and ethnic therapies. People have been using *N. arbortristis* to treat a variety of physical ailments for decades. Different plant parts have been used for pain relief, suffering control, and illness prevention since ancient times. The majority of the medications utilized in traditional medicine were derived from plants, which are the oldest and primary source of medicinal materials. Different parts of this plant have been used in Indian systems of medicine due to their various pharmacological actions, such as anti-leishmaniasis, anti-viral, anti-fungal, anti-pyretic, anti-histaminic, anti-malarial, and anti-oxidant properties, anti-inflammatory and many more activities^[7,8].

GROWING SEASON AND TYPE ^[9]:

This particular tree can thrive in a range of loamy soils found in average garden scenarios with a pH level between 5.6 to 7.5. The plant can grow in both full sunlight or partial shade and requires regular watering without overwatering.

□ TAXONOMICAL CLASSIFICATION ^[9, 10] :

- **Kingdom** : Plantae
- **Subkingdom** : Viridiplantae
- **Infrakingdom** : Streptophyta
- **Superdivision** : Embryophyta
- **Division** : Tracheophyta
- **Subdivision** : Spermatophytina
- **Class** : Magnoliopsida
- **Order** : Lamiales
- **Genus** : *Nyctanthes*
- **Species** : *N. arbor-tristis*
- **Binomial name** : *Nyctanthes arbor-tristis*
- **Family** : Oleaceae



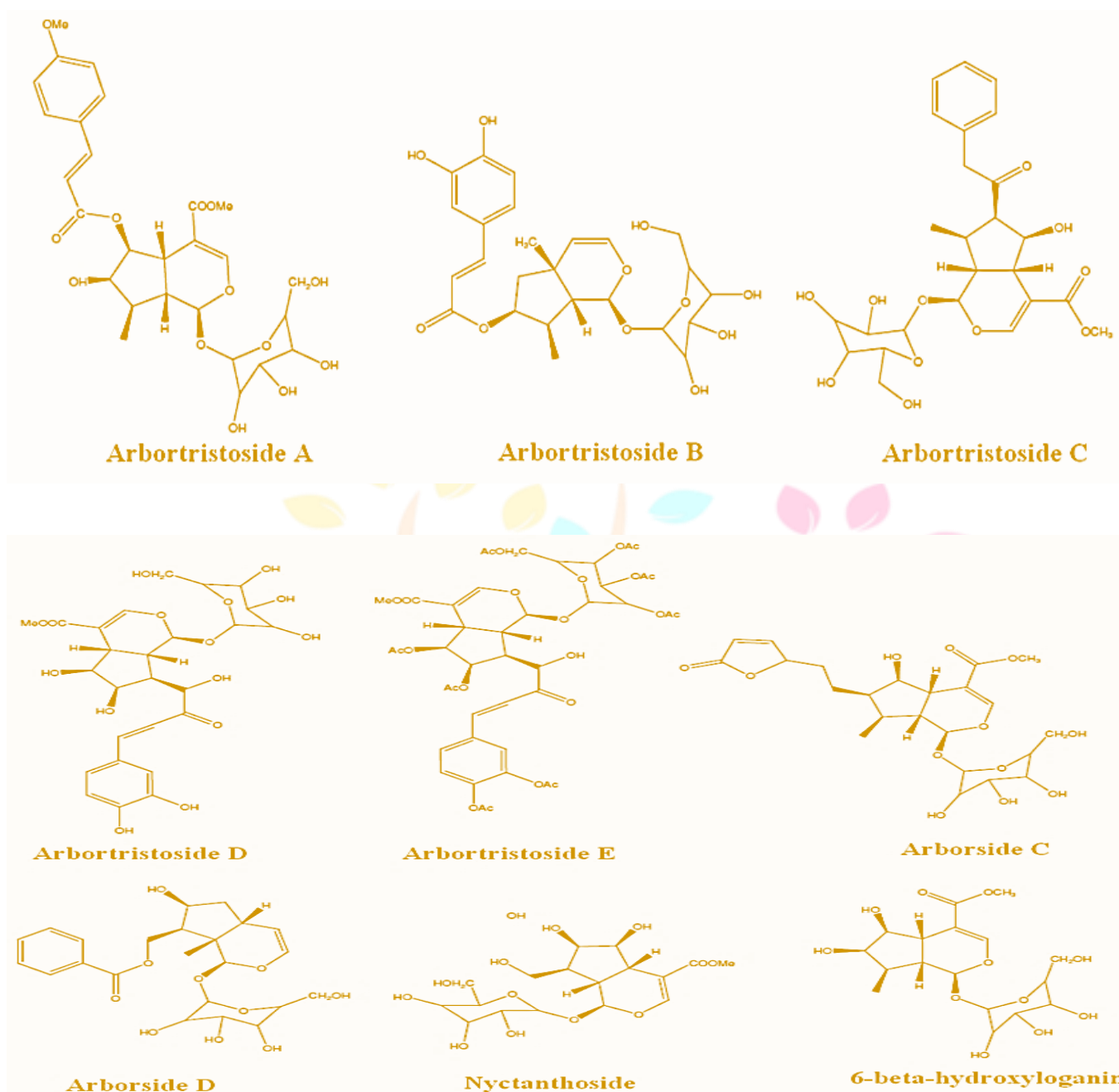
CHARACTERISTIC FEATURES OF *NYCTANTHES ARBORTRISTIS*:

Nyctanthes arbor-tristis is a shrub or small tree that can grow up to 10 meters (33 feet) in height. It has flaky 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 center. They are produced in clusters of two to seven together, with individual flowers opening at dusk and closing at dawn. The fruit is a bilobed, flat brown heart-shaped to round capsule that is 2 cm (0.79 in) in diameter, and each lobe contains a single seed ^[11, 12].

PHYTO-CHEMICAL CONSTITUENTS:

A variety 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 arbortristoside A, B, D, and E, are found in the seed and have been found to have immunomodulatory and anti-leishmanial properties ^[13, 14].

VARIOUS PARTS OF PLANTS CONTAIN PHYTO-CONSTITUENTS [15, 16, 17, 18, 19, 20, 21, 22] :



PLANT PART	PHYTO-CHEMICAL	MEDICINAL USES
BARK AND STEM	<p>ALKALOIDS AND GLYCOSIDES (6-β-hydroxyloganin, Arbotristoside-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, Arbotristoside C 6-β-hydroxy loganin, B-digentiobioside Cardiac glycoside-nymphalin, Iridoid glycosides-6-O-trans-</p>	Ant-Bilious, Antifilarial, Anti-Inflammatory, Antioxidant, Astringent, Antibiotic, Carminative, Diuretic, Dyspepsia,

	<p>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>	Expectorant, Hair tonic, Ophthalmic, Sedative, stomach ache, Treatment of piles and various skin diseases.
LEAVES	<p>ALKALOIDS AND GLYCOSIDES (6β-hydroxyloganin, 6,7-Di-O-benzoylnycthanoside, Desrhamnosylverbacoside, Flavonol-Glycosides-astragaline, 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-β-amyrin).</p> <p>MISCELLANEOUS (Ascorbic acid, Amorphous resin, Benzoic acid, Benzoic ester of loganin, 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.
SEED	<p>ALKALOIDS AND GLYCOSIDES (Irridoid glycosides-arbortristosides A,B,C,D and E, Phenyl propanoid glycoside-Nyctoside A).</p> <p>STEROIDS (β-sitosterol).</p> <p>TERPENES (4- secotriterpene acid, Nyctanthic acid, Triterpenes-3).</p> <p>MISCELLANEOUS (Glycerides of linoleic, Lignoceric, Myristic, oleic, Palmitic, Stearic acid. Polysaccharides composed of D-Glucose and D-Mannose, a pale yellow-brown oil).</p>	Antibacterial, Antifungal, Alopecia, Antileishmanial, Hair Tonic, Immunomodulatory, Piles.

PHYTOCHEMICAL ANALYSIS AND PHYSICAL CHARACTERISTICS OF *NYCTANTHES ARBOR-TRISTIS* BARK :

Analysis of the bark of *Nyctanthes arbortristis* revealed a wide variety of chemical components in several solvent extracts. Alkaloids, steroids, triterpenes, tannins, glycosides, carbohydrates, and flavonoids were detected, while saponins, proteins, and amino acids were not found. This investigation offers insightful information about the chemical makeup of *Nyctanthes arbortristis* bark, information that may be important for future research into the plant's therapeutic and medical applications.^[23] The bark of *Nyctanthes arbortristis* was studied to determine its phytochemical properties and quality parameters. The total ash content was found to be within the acceptable limit of 9.16% w/w, while the acid insoluble ash was well 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^[24].

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

The flowers of *Nyctanthes arbortristis* have been analyzed for their chemical composition in different solvent extracts, revealing the presence of various chemical constituents. The flowers contain reducing sugars, alkaloids, tannins, cardiac glycosides, anthraquinone glycosides, proteins, terpenoids, and flavonoids, all of which have been confirmed 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 emphasizes the rich phytochemical content of *Nyctanthes*

arbortristis flowers, 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 overall, with water-soluble ash being less than 1.9% w/w and acid-insoluble ash being less than 1.45% w/w. Water 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. Calcium oxalate crystals are absent in petals but found in the corolla tube, and suberin is absent in both, contributing to their unique characteristics [25, 26].

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

The fruit of *Nyctanthes arbortristis* has been analyzed to determine its chemical makeup and how it reacts to different solvents. The methanolic extract of the fruit contains alkaloids and glycosides, while the petroleum ether extract does not. Saponins are absent from both extracts. 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 either extract. 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 information provides valuable 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 fruit also has a sulphated ash content of $5.56 \pm 0.04\%$ w/w, indicating its sulfur content. The 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 comprehensive profile of these botanical specimens. This analysis provides a deeper understanding of the chemical composition of *Nyctanthes arbortristis* fruit, which has various practical applications [27, 28].

ANALYTICAL EVALUATION AND PHYSICAL CHARACTERISTICS OF *NYCTANTHES ARBOR-TRISTIS* LEAVES [28, 29]

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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	+	-	+	-	+
TERPENOID AND STEROIDS	+	+	+	+	+

PHYTOCHEMICAL CHARACTERISTICS OF *NYCTANTHES ARBOR-TRISTIS* LEAVES:

The physico-chemical properties of *N. arbortristis* leaves fats had been decided to be 2.10%. These leaves were found to be of dark green color and produced a viscous, semi-solid substance at room temperature. The acid value of *N. arbortristis* leaves was found to be 76.27, indicating that this oil is inedible due to a high acid content. The iodine values of *N. arbortristis* leaves were found to be 134.44, indicating that they are highly unsaturated. Furthermore, these 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 [30].

□ PHARMACOLOGICAL APPLICATIONS OF *NYCTANTHES ARBOR-TRISTIS* :

1. ANTI-ALLERGY ACTIVITY:

The bark of the plant has additionally been checked for anti-histamine activity. The bark of *Nyctanthus arbor-tristis* was extracted using 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 beta-sitosterol. The ability of extracts to inhibit histamine 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 pretreatment of guinea pigs uncovered to histamine aerosol with a 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, have been reported to be present in *N. arbortristis* [31].

2. ANTI-ANXIETY ACTIVITY:

Hydroalcoholic extracts of *N. arbor-tristis* have anxiolytic potential. First, dried plant parts of *N. arbor-tristis* were extracted using a hydro-alcoholic mixture. The extract was then concentrated by distilling off the solvent, evaporated to dryness on a water bath, and stored in an airtight 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 different 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 [33].

4. HEPATOPROTECTIVE ACTIVITY:

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

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 (*Aedes aegypti*, *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, namely arbortristosides A, B, and C and 6-b-hydroxyloganin. These 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* has been found to possess a wide spectrum of antibacterial properties. It can effectively combat both gram-negative and gram-positive microorganisms, including streptomycetes 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. 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 extracts 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 a 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 of 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 antiamoebic 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 arbortristosome 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:

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 dose-dependent 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 increase in 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 a 20% aqueous solution (10 mg/kg) of Brewer's yeast to produce fever. Following delivery, 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's 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. ANTIHISTAMINIC AND ANTI-ASTHMATIC ACTIVITY:

When limbs are in catalepsy, they stay in that position no matter what. It can be brought on by neuroleptic medications and is characterized by a rigidity of the muscles and a lack of reaction to external stimuli. The findings of the experiments demonstrated that the petroleum ether extract of the bark of *N. arbortristis* can suppress the clonidine-induced catalepsy. After examining the effects of clonidine-induced catalepsy in Albino mice, researchers found that histamine from mast cells mediates the cataleptic effect of clonidine in mice. As a result, *N. arbortristis* extract was able to inhibit the catalepsy caused by clonidine because it stabilizes mast cells. The results of this investigation suggested that the bark of *N. arbortristis* had antihistaminic activity and that it might be helpful in the management of asthma. Breathing is impacted by the chronic inflammatory condition known as allergic asthma. Airway inflammation, bronchial blockage reactions, and hyper-reactivity to a range of stimuli, including allergens, histamine, methacholine, etc., are its defining characteristics. It was determined that in asthmatic conditions, the bronchial obstruction reaction and airway hyper-sensitivity are associated with the deficiency of nitric oxide production, which is crucial for maintaining airway balance. When exposed to allergen, bronchoconstriction is the main component of the early asthmatic reaction. The histamine-induced dose-dependent contraction of tracheal smooth muscles was tested with an ethanolic extract of *N. arbortristis* leaves. The results showed that the extract could inhibit the histamine-induced contractile responses, confirming the ethanolic extract's bronchodilatory action on airway smooth muscles. The experiment's findings demonstrated that the extract works by increasing the formation of nitrogen oxide, or NO. Additionally, it has been determined that the presence of β -sitosterol in *N. arbortristis* leaves is responsible for their anti-allergic and anti-asthmatic properties [52, 53].

19. WOUND HEALING ACTIVITY :

For 16 days, Wistar albino rats were given a 2% w/w *N. arbortristis* methanolic extract to investigate the efficacy of *N. arbortristis* in healing wounds. It was discovered that both excision and incision wounds need roughly 16 days to fully epithelize before they healed. It was determined that *N. arbortristis* extract at a dose of 300 mg/kg would be a good way to treat both kinds of wounds [54].

20. IMMUNO-STIMULANT ACTIVITY:

Humoral and cell-mediated 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].

21. ANTI-ULCEROGENIC AND ULCER-HEALING PROPERTY:

One of the main 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 ulcers ^[57].

22. ANTI-ARTHRITIC ACTIVITY:

The autoimmune disease known as arthritis affects the synovial joints and is typically brought on by inflammatory mediators and infections. It is characterized by persistent inflammation that causes pain, inflammation of the synovial joints, creation of pannuses, rupture of cartilage, reduced mobility, and disability. Biological therapies, such as inhibitors of IL-6, IL-1, and TNF- α , glucocorticoids, such as methyl prednisolone and triamcinolone, and nonbiologic disease-modifying antirheumatic drugs (DMARD) like methotrexate and piroxicam, are currently used for the treatment of arthritis. Although NSAIDs are seen to be the best treatment for rheumatoid arthritis since they successfully reduce pain, swelling, and stiffness in the joints, they also have negative side effects that include bleeding, dyspepsia, ulcers in the stomach, and an increased risk of cardiovascular issues. When non-biologic DMARDs are used for treatment, side effects include rash, nausea, vomiting, diarrhea, injection site reaction, cellulitis, and respiratory tract infections; on the other hand, anti-TNFs therapy is linked to side effects like headache, abdominal pain, bruising, bleeding, rash, vomiting, diarrhea, and mouth ulcers. Reversible alopecia can also result from non-biologic DMARDs. In addition to these negative consequences, long-term glucocorticoid treatment increases the risk of osteoporosis, diabetes mellitus, peptic ulcers, gastrointestinal bleeding, cataracts, and infections. Due to all the side effects of the current treatment options, a growing number of people with rheumatoid arthritis are turning to alternative medications. The anti-arthritis efficacy of methyl, ethyl acetate, and n-hexane extracts of mature leaves of *N. arbortristis* was investigated using a rat model of FCA-induced arthritis. The ethyl acetate extract of *N. arbortristis* leaves was the most promising extract, according to the comparative analysis of extracts. When paw edema was compared to the other two extracts, the ethyl acetate extract demonstrated the greatest suppression. When compared to the other two and the reference medication, piroxicam, it more dramatically reduced bone degradation, the total leukocyte count, and the infiltration of inflammatory cells in the ankle joint. The ethyl acetate extract's phytochemical investigation revealed the presence of α -terpineol, eugenol, and phytol. Eugenol has anti-inflammatory properties by controlling redox reaction, whereas phytol reduces oxidative stress and cytokine production. While terpenoids control inflammatory and immunological responses by blocking nuclear factor kappa B, α -terpineol is also well-known for its anti-inflammatory properties, which include decreasing proinflammatory IL-6 receptor gene expression levels. These terpenes and terpenoids were thought to be responsible for the extract's antiarthritic properties. The hepatotoxic and nephrotoxic effects of *N. arbortristis* extracts were assessed; the group of animals treated with the extracts did not exhibit any of these symptoms, and the extracts were deemed safe ^[58].

23. SEDATIVE ACTIVITY:

A hot infusion of the flowers was used to investigate the sedative effects on rats. Male rats in this experiment exhibited a dose-dependent conscious sedative activity, but female rats showed no effects at all. Blood glucose levels were unaffected by these dosages, even at the maximum dosage, nor were muscular strength or coordination *Nyctanthes arbortristis*ion. However, there was a discernible drop in the amount of glucose absorbed by the small intestine. The sedative effect was partially attributed to the antioxidant and membrane-stabilizing activities of the extract ^[59].

24. ANTI-AMNESIC ACTIVITY:

In people between the ages of 18 and 60, neurological disorders are more prevalent. They are typified by a range of mental conditions, including depression, panic attacks, phobias, generalized anxiety, obsessive-compulsive disorder, and post-traumatic stress disorder. The most prevalent degenerative illness among them is Alzheimer's disease, which is characterized by inflammation, loss of neurons, memory loss, and an age-related reduction in cognitive and learning difficulties. Increased oxidative stress in the hippocampus, a region of the brain, and cholinergic system malfunction are the causes of Alzheimer's disease pathogenesis. Using adult male Wistar rats, the ethanolic flower extract of *N. arbortristis* was tested for its anti-amnesic and anti-memory impairment properties. The results of these tests included the Morris water maze (MWM), the elevated plus maze (EPM), and passive avoidance (PA). According to the study's findings, ethanolic extract from *N. arbortristis* flowers enhances memory via lowering oxidative stress in the brain tissue and blocking acetylcholinesterase activity. Utilizing GC-MS and UPLC-Q-TOF-MS/MS, the physiologically active ingredient in the extract that controls brain activity was identified. While UPLC-Q-TOF-MS/MS analysis was used to identify four chemicals in the extract—4-coumaric acid, chalcone, melatonin, and chlorogenic acid hemihydrate—GC-MS analysis was used to identify phytol and oliolide. The active chemicals found in *N. arbortristis* flowers were initially identified, and several studies have reported on the neuroprotective properties of these compounds. These findings suggest that the extract may have potential applications in the management of various neurological illnesses. The impact of *N. arbortristis* leaf hydroalcoholic extract on scopolamine-induced amnesia in male Albino Swiss rats was examined in a different investigation employing the Morris water maze test. After receiving a 0.4 mg/kg scopolamine injection, rats' memory was impaired in comparison to the control group, which had no alterations in their escape latency time to reach the hidden platform. The index of retrieval was determined by measuring the reduction in the rats' escape

latency time to locate the hidden platform and the amount of time they spent in the target quadrant after receiving varying doses of plant extract. Using the elevated plus maze to determine transfer latency time, it was discovered that the extract lengthened the time required for transfer, suggesting that the plant exhibited nootropic properties. Moreover, the hydroalcoholic extract of *N. arbortristis* leaves was found to enhance learning and memory in an in-vivo study of *N. arbortristis* that was backed by the determination of biochemical parameters such as brain acetyl cholinesterase activity, glutathione, malondialdehyde, and nitric oxide [60, 61].

25. ANTI-CANCER ACTIVITY:

The antioxidant and anticancer properties of the plant were 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's anticancer action was thought to be attributed to the phytochemicals 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].

26. MEMBRANE STABILIZING ACTIVITY:

A carotenoid aglycone, Ag-NY1, was extracted from the orange-colored tubular calyx of flowers through study conducted by *N. arbortristis*. Crocetin, the main aglycone found in the stigma of *Crocus sativus*, was identified as the carotenoid molecule when the structure was clarified. When compared to the equivalent glycoside, crocin, the molecule demonstrated good membrane stabilizing action [64].

27. ANTI-CHOLINESTERASE ACTIVITY:

In mice, *N. arbortristis* aqueous extract increased acetylcholine esterase activity, counteracting malathion's suppression of the enzyme. The serum exhibited more effects than the brain. The isolated rabbit ileum's weak anti-muscarinic effect against acetylcholine-induced contractions has previously been documented [65].

28. TREATMENT OF PILES, GOUT, DRY COUGH:

When treating piles, *N. arbortristis* seeds are utilized. Gout is treated using the flower decoction of *N. arbortristis*. Leaf tea is used to treat dry cough. The leaf paste used in its watery form is applied externally to treat skin conditions, particularly ringworm. Young leaves are used as a tonic for women. Moreover, *N. arbortristis* has a hypoglycemic impact, enhancing the effects of exogenous insulin and a diabetic rat model generated by streptozotocin [66].

29. OTHER ACTIVITIES:

The seeds' acetone extract has ovicidal effects on *Corcyra cephalonica* rice moth eggs. With the increased knowledge of plant extracts in contact toxicity testing, the inhibition of egg hatching increased. At 100% concentration of the extract, 80.73% ovicidalaction was noted. Moreover, *N. arbortristis* petroleum ether extract has insecticidal effects on *Bagradacruiferarum*. In order to test the ethanolic extract of *N. arbortristis* leaves, seeds, and roots for humoral and cell-mediated immune responses against *Salmonella* and *Candida albicans* antigens. The extracts' protective effects were attributed to irridoidglucosides, or arbortristosides A and C. Although it was unable to generate analgesia akin to morphine, the water soluble fraction of an ethanol extract of the leaves shows notable anti-nociceptive effects similar to aspirin. Additionally, it was discovered to have anti-pyretic properties against rats that had pyrexia caused by brewer's yeast. In rats, the extract also caused stomach ulcers after oral treatment for six days in a row. The whole plant's ethanolic extract is used to treat alopecia, a dermatological condition where it has been reported to stimulate hair growth. It supports the traditional application of the herb as a hair loss treatment. It has been observed that alcohol extracts from several *N. arbortristis* sections have antiallergic properties. Arbortristosides A and C have been shown to significantly reduce mast cell stability and cause antipassive cutaneous anaphylaxis in rats that are separated from the plant. Disodium cromoglycate is analogous to this activity. Two pure substances, arbortristoside A and arbortristoside C, obtained from *N. arbortristis*, as well as the n-butanol fraction of the ethanolic extract, have been evaluated against the Semliki Forest Virus (SFV) and the Encephalomyocarditis virus (EMCV) [67, 68, 69].

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 nycanthin, 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 forenamed study, which is considerably available 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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