*Review*

# A Comprehensive Review of the Ethnopharmacology, Phytochemistry, and Therapeutic Medicinal Potential of *Nyctanthes arbortristis* L.

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**Abstract:** Ethnopharmacological, phytochemistry, therapeutic, and medicinal potential studies of Ayurvedic, Siddha, and Unani (ASU) medicinal natural single drugs/products are a significant and challenging task on a global level. There is a need for more advanced investigative research studies and screening of scientific research data to emphasize and explore the ethno-pharmacology, phytochemistry, and therapeutic medicinal potential values of ASU plants/products, including authentication, medicinal, and therapeutic aspects. *Nyctanthes arbortristis* L. is a tree used to treat various health and wellness issues and therapeutic illnesses in mankind since ancient times. This study aims to evaluate the ethno-pharmacological, phytochemistry, therapeutic, and medicinal potential values through a comprehensive review of the plant NAT. This comprehensive review gathered and analyzed studies, information on NAT from databases such as Web of Science, Scopus, Google Scholar, PubMed, ScienceDirect, Springer, and other scientific literature accessed from various electronic search engine databases. The review studies explored and authenticated the ethno-pharmacology, phytochemistry, and therapeutic medicinal potential values of NAT using standard review methods. The ethno-pharmacological, phytochemistry, and therapeutic medicinal potential values, along with the divine curative healing properties, have been found to be effective, consistent, and rich sources of novel bioactive compounds in the study medicinal plant. NAT has shown significant ethno-pharmacological, phytochemistry, biodiversity, and therapeutic medicinal potential activity. This study's herbal research data is helpful in confirming and revalidating the development of drug standards, pharmacovigilance, and research on therapeutic medicinal values that may be helpful to treat various conditions such as antiarthritic activity, antistress activity, anticancer activities, cytotoxic activities, anti-inflammatory, hypoglycemic and hypolipidemic activity, antiviral activity, antibacterial activity, antimicrobial activity, antifungal activity, antiulcer activity, antipyretic, analgesic activity, and obstinate sciatica disorder, among others.

**Keywords:** *Nyctanthes arbortristis* L.; ethno-pharmacological; phytochemistry, and therapeutic medicinal potential studies; electronic search engine databases

## 1. Introduction

*N. arbortristis* L. is a specie of plant commonly found in tropical Asia, as well as warm temperate regions of Asia, Europe and Africa. These glabrous twining shrubs are extensively cultivated in gardens in these areas. The plant is well-known for its aromatic white flowers and is referred to as "Night blooming Jasmine or Harsinghar" in Hindu mythology. The genus name "Nyctanthes" comes from the Greek words "Nykhta", meaning night, and "anther", meaning flower. Within the botanical family of Oleaceae, the Night Jasmine genus includes over 600 species of trees and vines. The plant is distributed in regions such as southern and northern regions of India, northern Pakistan, Thailand, Malaysia, and Indonesia, with its original habitat being the subtropical Himalayas of Nepal and India. In India, the species can be found in regions like the outer Himalayas, Jammu and Kashmir, East

Assam, Bengal, Tripura, and the central region extending to the Godavari River in the south. Night Jasmine thrives in reddish-black soil with a pH level between 5.6 and 7.5, making it suitable for dry and semi-arid conditions. According to the World Health Organization (WHO), herbal medicines can meet the health needs of approximately 80% of the global population, especially those in rural areas of developing countries. To ensure the acceptability of herbal crude drugs and formulated products in modern medicine, it is essential to conduct advanced research on drug standardization and product validation. Quality parameters for herbal drugs and raw plant materials need to be developed urgently, as emphasized by the WHO, to guarantee the quality of medicinal plant products using advanced controlled techniques [1–18].

*Traditional Uses of NAT by Traditional Healers*, *Tribes*, *Vedas*, *and Hakims*

Traditional medicine *N. arbortristis* L. is well recognized as a highly efficacious medicinal plant within Ayurveda, Homeopathy, Unani, and Siddha. In ethnomedicine, NAT therapy is beneficial in treating several disorders such as persistent fever, rheumatism, malaria, wound healing, skin problems, stomach issues, astringent effects, menstruation problems, wound healing, falij or lekba, paralysis, nervines disorders. The native inhabitants of the Chittoor region in Andhra Pradesh India and other southern and northern Asian regions, make considerable use of the entire plant for therapeutic purposes by traditional healers, tribes, vedas, and hakims from since ancient time. The root possesses therapeutic properties for managing fever, sciatica, and anorexia, while the bark is applied for its expectorant properties. An extract derived from the leaves has been administered to children to expel roundworms and threadworms. Fresh leaves have been utilized in the preparation of homeopathic remedies. The juice extracted from 3 to 7 leaves is employed by tribal communities in Orissa as a blood purifier, serving as a preventive measure against skin infections. The floral components of NAT are utilized in India, Indonesia (Java), and Malaysia as emmenagogues, stimulating menstrual flow. A heated concoction of these flowers is employed by a subset of elderly Buddhist monks in Sri Lanka for its sedative properties. The oral intake of a decoction derived from these flowers has been found to alleviate flatulence, stimulate gastric secretions, and enhance pulmonary expectoration. This decoction has also been used in the management of gout. Furthermore, the juice extracted from these flowers is applied as a hair tonic, preventing hair graying and baldness. Folk people of Tripura, a small state in Northeast India, rely on their traditional knowledge of phenological indicators for predicting the weather, to help plan their agro forestry activities and for disaster prevention. One such prediction relates to the phenology of NAT night-flowering jasmine, which helps them to forecast the onset of heavy rainfall. The NAT shrubs are found worldwide with rich biodiversity in the Asian region in India, Sri Lanka, Nepal and traditionally used by Vedas, traditional healers, and tribes since ancient times [6,16,17,19–22].

NAT Investigated herbasious medicinal plant investigated studies Graphical Illustration, investigated plant Ethnopharmacological and theraputic medicinal potency values, Bio-diversity, Natural Habitat, Worldwide Occurrences, Bioactive phytochemical compounds. Confirmation and identification authenticated research data's shown respectively in Figures 1 and 2 Graphical Illustrations of *Nyctanthes arbortristis* L. Pharmacological therapeutic medicinal properties and Biodiversity, Pharmacological activities medicinal properties, Bioactive phytochemical constituents.

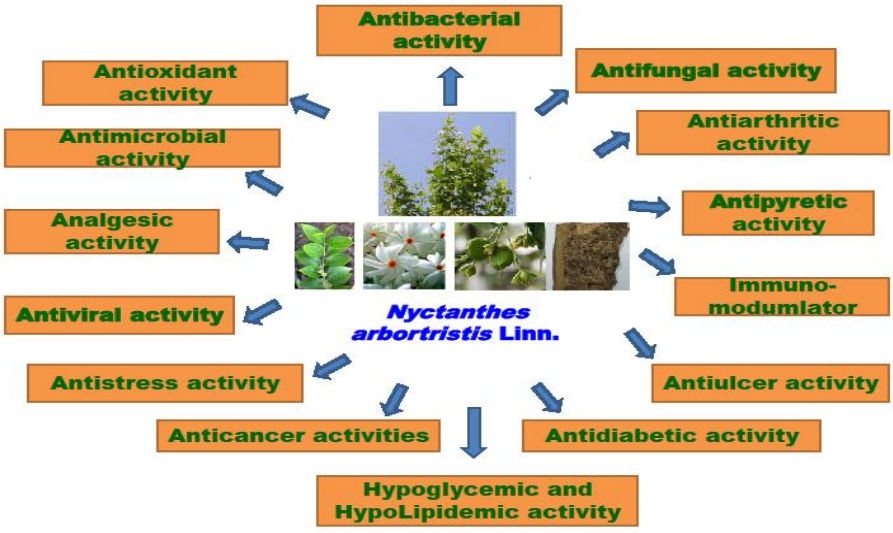



**Figure 1.** Graphical Illustration of *Nyctanthes arbortristis* L. Pharmacological therapeutic medicinal properties.

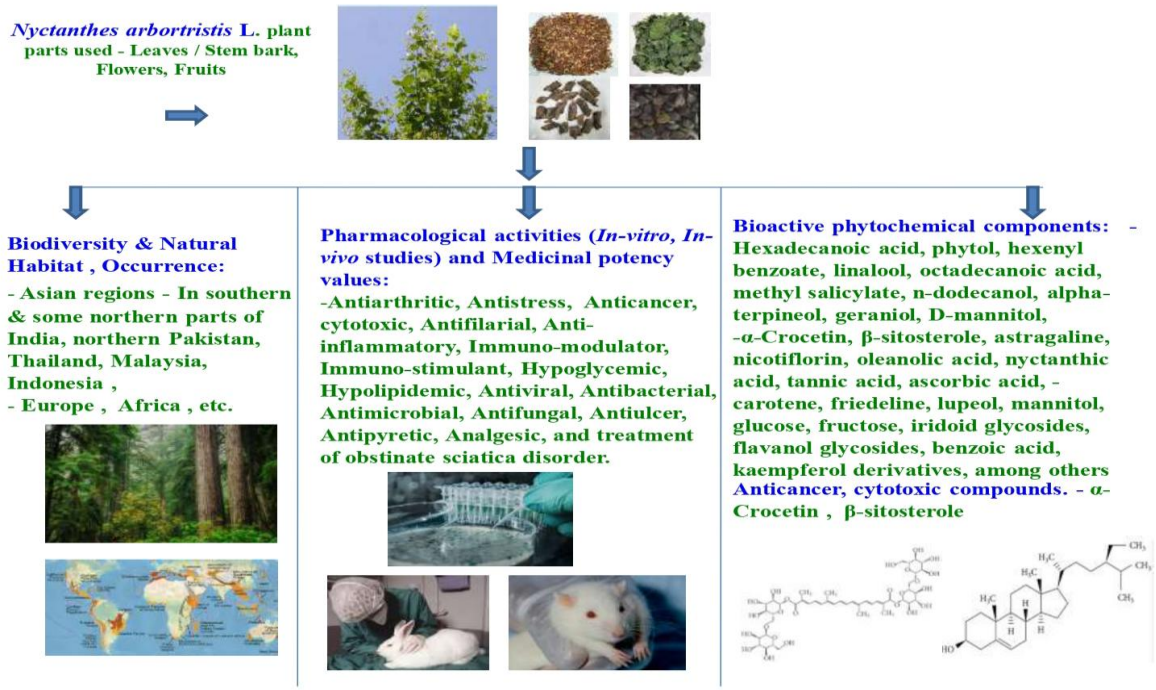



**Figure 2.** Graphical Illustration of *Nyctanthes arbortristis* L. Biodiversity, Pharmacological activities, medicinal properties, Bioactive phytochemical constituents.

## 2. Material and Methods

The sources of scientific literature were accessed from various electronic databases such as Pub Med, Google Scholar, Science Direct, Online Google Search Engine and library search, and other scientific literature accessed from various electronic search engine databases studies of drugs samples authenticated and confirmed of these botanical, scientific identification by our Experts botanist, pharmacognostical, Scientist and Researchers of CCRUM, New Delhi Council Research Institutes as Drug Standardization Research Institute, (NABL ISO/IEC-17025-2017), Ghaziabad UP., RRIUM, (NABL ISO/IEC-17025-2017), Chennai, T.N., India—SMPU and DSRU. Units, as well as NMPB, New Delhi under Ministry of AYUSH., Govt. of India and re-authenticated and reconfirmed by PCIM&H, (NABL ISO/IEC-17025-2017), Botany Department, Ghaziabad UP. India Govt. of India Organizations associated with Librarian harmony [1–13,23–35].

## 3. Result and Discussion

### *3.1. Ethnomedicinal Uses and Biodiversity of Investigated Plant NAT*

The herbaceous medicinal plant NAT that was investigated is found worldwide, with ethnomedicinal uses and geographical biodiversity present in tropical Asia and warm temperate regions of Europe and Africa. It is distributed across several regions, including southern India, northern Pakistan, Thailand, Malaysia, and Indonesia. In India, it is found in the outer Himalayas, Jammu and Kashmir, Andhra Pradesh, East Assam, Bengal, Tripura, Orissa, Burma, Central India such as Chhota Nagpur, Rajasthan, Madhya Pradesh, and southwards to Godavari River. It is also found in the Asian regions of Nepal and Sri Lanka, where it is used by tribal populations who have lived in these forest regions since ancient times.

The study plant is used at a broad level by these tribal populations, who have a wealth of knowledge about its therapeutic uses, medicinal efficacy, and values. They are well aware of its properties such as anti-inflammatory, anti-helminthic, antibilious, antibacterial, antifungal, and analgesic activities. It is also used for treating colds, joint pain, sciatica, and various other illnesses and disorders, showcasing its beneficial medicinal properties that have been developed since ancient times. The ethnobotanical, climatic, and biodiversity aspects of the investigated herbaceous medicinal plant NAT are rich and widespread worldwide (Table 1) [1,2,15,17,24,36–43].

**Table 1**. Investigated Major Active- Phyto-chemical Constituents in NAT.

| Plant | Part Used | Major Active-Phytochemical Constituents | References |
|---|---|---|---|
| *Nyctanthes arbortristis* Linn. (Night Jasmine) | Leaves | Hexadecanoic acid (26.4%), phytol (13.6%), Hexenyl benzoate (11%), Linalool (11.3%), Octadecanoic acid (6.2%), Methyl salicylate (5.6%), n-Dodecanol (5.5%), Alpha-Terpineol (4.7%), and Geraniol (3.7%), D-mannitol, β-sitosterole, astragaline, nicotiflorin, oleanolic acid, nyctanthic acid, tannic acid, ascorbic acid, methyl salicylate, carotene, friedeline, lupeol, mannitol, glucose and fructose, iridoid glycosides, Flavanol glycosides, benzoic acid, derivative of kaempferol, carotene. | [2,6,24,37,44,45] |
| | Stem Barks | Hexadecanoic acid (34.3%), Alpha-Eudesmol (8.7%), Beta-Eudesmol (17.1%), Elemol (5.8%), Cryptomeridiol (4.8%), Octadecanoic acid (3.9%), %), n-Dodecanol (6.8%), Methyl palmitate (1.8%), Methyl stearate (1.4%), and 1,8-Cineole (1.3%), Glycoside-naringenin-4‴-0-β-glucapyranosyl-α-xylopyranoside and β-sitosterol, Glycosides and alkaloids. | [2,6,24,37,44,46,47] |
| | Flowers | 1-octanol (74.81%), 2-hexadecen-1-ol, 3,7,11,15-tetra (6.8%), Bis (2-ethylhexyl) phthalate (5.88%), 2,4-cycloheptadiene-1-one, 2,6,6-trimethyl (4.23%), Hexadecanoic acid methyl ester (2.07%), and Benzoic acid (1.21%), Phytol (32.2%), Methyl palmitate (14.7%), *cis*-9-Tricosene (3.6%), Geranylgeraniol (2.7%), n-Nonadecene (2.2%), Phytone (1.4%), Methyl stearate (1.1%), n-Benzyl salicylate (1.1%), and Heptacosane (0.8%), Essential oil, Nyctanthin, D-mannitol, Tannin and Glucose, Carotenoid, glycosides viz β-monogentiobioside ester of α-crocetin (or crocin-3), β monogentiobioside-β-D monoglucoside ester of α-crocetin, β-digentiobioside ester of α-crocetin. (or crocin-1), 4-hydroxy hexahydrobenzofuran-7-one. | [2,6,24,37,48–50] |
| | Seeds | Arbortristoside AB&C Pale Yellow Brown Oil (15%), Arborside-A,B&D, Glycerides of linoleic oleic, Lignoceric, Stearic, Palmitic and Myristic acids, Nyctanthic acid, Nyctoside A, β-sitosterol, 3-4 secotriterpene acid and A water soluble polysaccharide composed of D-glucose and D-mannos. | [2,24,37,51] |
| | Roots | β-Sitosterol and Oleanolic acid | [2,24,52] |

### *3.2. Pharmacological and Therapeutics Medicinal Potential Values of NAT*

*Nyctanthes arbortristis* L. (NAT), also known as Harsinghar, Parijata, coral jasmine, or night blooming jasmine, is a plant that has gained attention for its therapeutic properties and medicinal applications. In traditional medicine, it has been used to manage various conditions such as sciatica, arthritis, intermittent fevers, inflammation, malaria, viral infections, and leishmaniasis [2,24]. The NAT plant contains bioactive phytoconstituents that possess pharmacological properties, including iridoid glycosides and other compounds that have demonstrated anticancer, anti-inflammatory, anti-allergic, immuno- modulator, and antiviral characteristics. Additionally, NAT has been found to have antibacterial and antifungal characteristics. Research has also explored the use of NAT as a natural pigment for dyeing textile fibers, showing promising results in terms of color yield, fastness properties, and functional properties of the dyed fabric. Overall, NAT is a plant with diverse therapeutic potential, and further research is needed to explore its full range of benefits [23,53]. Crocetin, a natural carotenoid compound found in various plant sources, has garnered significant attention due to its potential therapeutic properties. Among these sources, the seeds of NAT, a plant celebrated for its cultural and medicinal importance in South Asia, emerge as a particularly auspicious storehouse of α-crocetin as well as ß-sitosterol bioactive compounds [22,24]. Numerous pharmacological effects of a.-β-sitosterole-C20H24O4, b.-α-Crocetin-C20H24O4, c.-Carotenoids-C29H50O, d.-Nicotiflorin-C40H54O5, e.-Ascorbic acid-C6H8O6, f.-Benzoic acid-C6H5COOH, g.-Tannic acid-C76H52O46, h.-α-Eudesmol-C15H26O, i.-β-Eudesmol-C15H26O, j.-Elemol-C15H26O, k.-1,8 Cineile-C10H180, l.-Arborside-A-C31H34013, m.-Arborside-B-C24H30011, n.-Arborside-D-C24H30012, o.-Arbortristoside A-C27H34013, p.-Arbortristoside B-C27H32015, q.-Arbortristoside C-C26H32013, r.-Nyctanthoside-C17H26012 have been shown in various plant parts of NAT as Leaves, Stem Barks, Flowrrs, Seeds and Roots. NAT Bioactive major phytochemical constituents of compounds as Alkaloids, Glycosides, Flavonoids, Flavones, Polyphenols compounds, polyphenolic acids have been shown and demonstrated, including antioxidant, anti-inflammatory, anticancer, antitumor and cytotoxic activities, characteristics in various plant parts of NAT. Its molecular structures and their molecular formulas, characterized by a conjugated polyene system and functional groups, makes it an intriguing candidate for drug development [15,24].

The isolation of crocetin from NAT seeds presents an exciting opportunity to harness the bioactive potential of this compound. This endeavor aligns with the broader context of exploring natural compounds as potential therapeutic agents, given the growing demand for safer and more effective medicines [16,24]. *Nyctanthes arbortristis* L. (NAT) has been investigated in several studies, both in vitro and in vivo, which found remarkable medicinal properties present in all parts of the plant, including leaves, aerial leaves, stem barks, fruits, flowers,

and seeds. These properties include antibacterial, antifungal, antioxidant, analgesic, anti-inflammatory, hypoglycemic, hypolipidemic, hepatoprotective, larvicidal, antiviral, immunostimulatory, cognitive enhancement, ulcerogenic, antipyretic, immunomodulatory, antiarthritic, antidiabetic, antifilarial, antimalarial, wound healing, and hypoglycemic activities. Specifically, hypoglycemic activity has been investigated in the leaves of NAT [2,26,27,36,37]. Antioxidant activity, antibacterial activity, antiarthritic activity, antifungal activity, anti-proliferative activity, hypoglycemic and hypolipidemic activity, hepatoprotective activity, larvicidal activity, and antifilarial activity have been investigated in the flower parts of NAT [2,26,27]. The anti-diabetic, anti-inflammatory, analgesic, anti-arthritic, hepato-protective, antimalarial, antioxidant, and antibacterial activities of the stem bark of NAT have been investigated [2,26]. Research has been conducted on the antimalarial activity, antiviral activity, antiulcer activity, immuno-stimulatory activity, immuno-modulator/immuno-restorative activity, and anti-ulcerogenic activity/ulcer-healing properties found in the seed's kernel of NAT [2,26]. Anti-stress, antioxidant, and antibacterial activities have been investigated and found in various parts of the fruit of NAT. Additionally, antifilarial activity has been studied in both the leaves and fruit parts. Immuno-modulator/immune restorative activity has been observed in the fruits, seeds, and leaves of NAT. Antibacterial activity has also been discovered in the leaves and stem bark of NAT [54]. Furthermore, hepatoprotective and antibacterial activities have been identified in the leaves, flowers, fruits, and seeds of NAT [2,54]. Immuno-stimulant activity is found in the flowers, leaves, and seeds of NAT [2,24]. Antipyretic properties are present in the leaves, seeds, flowers, stem, and root of NAT [2,54]. The whole plant of NAT exhibits immuno-stimulatory and antibacterial activity [2,54]. Hepato-protective effects have been studied in the root bark of the NAT plant [2,54]. These findings are summarized in Table 2. Anticancer activities have been investigated in leaves, flowers, dried fruits, fruits, leaves, and stem bark parts of NAT [2,6,25,26,54–56]. Tumor necrosis factor depleting activity has been investigated in the leaves part of NAT [2,54]. Cytotoxic activities have been investigated in the flowers part of NAT [2,26,39,54,57]. Antiproliferative and anticancer activities in the flowers part of NAT have been studied [2,25], and cytotoxic activities have been investigated in leaves, stems, leaves, and fruits parts of NAT [2,54] respectively, as shown in Tables 2–5.

- This comprehensive review of NAT research profiling data's will be very supportive for advance review of Drug Standardization Research, development of advance Pharmacopeial monographs, research on Novel Drug discovery and development, profiling of data on Plant sustainability, propagation, and cultivation of new crops with rich therapeutic and medicinal potential for future advanced research purposes.
- Based on previous research, further exploration of necessary additional research is required. This includes In-*vivo* studies, clinical trials, secondary metabolites, and bioactive phytochemical constituents found in various parts of investigated plant NAT such as arial flowers, leaves, branches, roots, stems, and bark parts. This research is essential in order to fully understand the mechanisms of action that underlie the observed bioactivities from a human health and wellness perspective.
- While there is preliminary data available on the medicinal and nutritional value of NAT specie, this comprehensive review lacks information on parts such as arial parts, roots bark and stem bark. Future studies should explore these plant parts to uncover potential bioactive compounds for novel drug development and health benefits.

**Table 2**. Investigated Pharmacological Activities in In-vitro & In-vivo NAT studies.

| Investigated Plant Parts | Used in Studies Extracts | Study Plan | Pharmacological Activities | References |
|---|---|---|---|---|
| Leaves | Ethanolic extract | In-vivo | Hypoglycemic activity | [6,58] |
| Leaves | Aqueous extract | In-vitro | Antioxidant activity | [59,60] |
| Leaves, Stem | Ethanolic extract | In-vitro | Immuno-modulator/Immunorestorative activity | [2,59,61] |
| Leaves | Ethanolic extract | In vitro | Antibacterial activity | [59,62] |
| Leaves | Ethyl acetate extract | In-vitro | Anti-fungal activity | [6,63] |
| Leaves | Ethanolic extract | In-vitro | Antioxidant activity | [6,26] |
| Leaves | Aqueous extract | In-vitro | Antioxidant activity | [6,36] |
| Leaves | Petroleum ether extract | In-vitro | Antimicrobial activity | [6,64] |
| Leaves | Betulinic acid | In-vitro | Antioxidant activity | [6,56] |
| Leaves | Water-soluble extract | In-vivo | Ulcerogenic activity and Antipyretic | [59,65] |
| Leaves | Aqueous extract | In-vivo | Antipyretic | [57,59] |
| Leaves | 95% Ethanolic, 50% hydro-alcoholic | In-vivo | Immuno-modulator/Immunorestorative activity | [2,21,59] |
| Leaves | Petroleum ether extract | In-vivo | Hepatoprotective activity | [6,66] |
| Leaves | Methanol extract and Chloroform extract | In-vivo | Larvicidal activity | [6,64] |
| Leaves | Ethanolic Extract | In-vivo | Antiviral activity | [59,67] |
| Leaves | Aqueous Extract | In-vivo | Antiviral activity | [59,68] |
| Leaves | Water-soluble fraction | In-vivo | Immunostimulatory activity | [59,69] |
| Leaves | β-sitosterol isolated from petroleum ether extract | In-vivo | Immunostimulatory activity | [6,44,59] |
| Leaves | 95% ethanolic extract | In-vivo | Anti-inflammatory activity and Analgesic activity | [2,59,65] |
| Leaves | 90% ethanolic extract | In-vivo | Anti-inflammatory activity and Analgesic activity | [2,59,70] |
| Leaves | 90% ethanolic extract | In-vivo | Cognitive impairment | [59,71] |
| Leaves | 95% ethanolic extract | In-vivo | Antiarthritic activity | [59,72] |
| Leaves | Ethyl acetate extract | In-vivo | Antiarthritic activity | [59,73] |
| Leaves | Methanolic extract | In-vivo | Hepato-protective activity | [59,74] |
| Leaves | Methanolic extract | In-vivo | Hepato-protective activity | [59,75] |
| Leaves | Ethanolic extract | In-vivo | Hepato-protective activity | [59,76] |
| Leaves | 50% Ethanolic extract | In-vivo | Antidiabetic activity | [59,77] |
| Leaves | Ursolic acid | In-vitro | Antifilarial activity | [59,35] |
| Leaves | Herbal Formulation preparation (250mg powder/5 ml suspension | In- vivo | Antifilarial activity | [2,59,78] |
| Leaves | Fresh paste of leaves | In-vivo | Antifilarial activity | [59,79] |
| Leaves | Ethanolic extract | In-vitro | Antifilarial activity | [59,80] |
| Leaves | Fresh preparation of leaves paste | In-vivo | Antimalarial activity | [59,81] |
| Leaves | Methanolic extract | In-vivo | Wound healing activity | [59,82] |
| Leaves | β-sitosterol isolated from petroleum ether extract | In-vivo | Analgesic activity | [6,83] |
| Leaves | Petroleum ether extract | In-vivo | Anti-inflammatory activity | [6,83] |
| Leaves | Ethanolic extract | In-vivo | Hypoglycemic and hypolipidemic activity | [2,6,84] |
| Leaves | Ethanolic extract | In-vitro | Antibacterial activity | [2,6,26] |
| Leaves | Aqueous extract | In-vitro | Antibacterial activity | [6,36] |
| Leaves | Ethanolic, Methanolic, Petroleum ether, and Aqueous extracts | In vitro | Antibacterial activity | [2,59,85] |
| Flowers | Ethanolic extract | In vitro | Antibacterial activity | [59,86] |
| Flowers | Alcoholic extract utilized for the synthesis of silver nanoparticles | In vitro | Antibacterial activity | [2,59,87] |
| Stem Bark | Petroleum ether, Chloroform, and Ethanol extracts | In-vivo | Hepato-protective activity | [46,59] |
| Stem Bark | Ethanolic extract | In-vivo | Antibacterial activity | [59,88] |
| Stem Bark | Aqueous/Methanolic extract | | Antioxidant activity | [59,89] |
| Stem Bark | Ethanol extract | In-vivo | Anti-diabetic activity | [6,88] |
| Stem Bark | Methanolic extract | In-vivo | Anti-inflammatory activity and Analgesic activity | [2,59,90] |
| Stem Bark | Ethyl acetate extract | In-vivo | Anti-arthritic activity | [53,59] |
| Flowers | Aqueous extract | In-vitro | Hypoglycemic and Hypolipidemic activity | [2,6,91] |

| | | | | |
|---|---|---|---|---|
| Flowers | Aqueous extract | In-vitro | Hepato-protective activity | [6,77] |
| Flowers | Petroleum ether, Chloroform, and Ethyl acetate extracts | In vitro | Hepato-protective activity | [59,92] |
| Flowers | Chloroform extract | In-vitro | Larvicidal activity | [6,93] |
| Flowers | Ethanolic extracts, Rengyolone 1 and its acetate derivative | In-vitro | Antifilarial activity | [22,59] |
| Flowers | Zinc oxide nanoparticles synthesized using aqueous extract | In-vitro | Anti-fungal activity | [2,59,94] |
| Flowers | Aqueous extracts | In-vivo | Hypoglycemic and hypolipidemic activity | [6,59,91] |
| Flowers | Dry flower aqueous extract | In-vitro | Antioxidant activity | [59,95] |
| Flowers | Ethanolic, Ethyl acetate, and Aqueous extract | In-vitro | Antioxidant activity | [6,64] |
| Flowers | Ethanolic extract | In-vitro | Antibacterial activity | [6,26] |
| Flowers | Water-soluble fraction of 70% ethanolic extract | In-vivo | Antiarthritic activity | [59,96] |
| Flowers | Aqueous extract | In-vitro | Anti-fungal activity | [6,94] |
| Flowers | Crude aqueous extracts - Methanol fraction Hexane fraction | In-vitro | Anti-proliferative activity | [2,6,54] |
| Seed-kernel | Iridoid glucosides | In-vitro | Antimalarial activity | [59,97] |
| Seeds | n-Butanol fraction of 50% ethanolic extract, Arbortristoside-A, and Arbortristoside C | In-vivo | Antiviral activity | [2,6,59,98] |
| Seeds | Arbortristoside-A (AT) and 7-*O-trans*-cinnamoyl-6-hydroxyloganin (6-HL) ethanolic extract | In-vitro & In-vivo | Antiulcer activity | [2,6,90] |
| Seeds | Methanolic extract | In-vivo | Immunostimulatory activity | [6,59] |
| Seeds | Chloroform extract | In-vivo | Immuno-modulator/Immunorestorative activity | [2,6,59] |
| Seeds | Arbortristiside-A and 7-O-trans-cinnamoyl6β-hydroxyloganin | In-vivo | Anti-ulcerogenic activity/Ulcer healing property | [2,59,90] |
| Fruits | Water-soluble fraction of 50% ethanolic extract | In-vivo | Antistress activity, Anti-oxidant activity, Antibacterial activity | [2,59,99] |
| Fruits | Methanolic extract | In-vitro | Anti-oxidant activity | [59,80] |
| Fruits | Petroleum ether and Methanolic extracts | In-vitro | Antibacterial activity | [59,100] |
| Leaves and Fruits | 99% ethanolic extract | In-vitro | Antifilarial activity | [59,101] |
| Fruits, Seeds, and Leaves | Water-soluble ethanolic extract | In-vivo | Immuno-modulator/Immunorestorative activity | [2,59,102] |
| Leaves and Stem Bark | Hydro-alcoholic extract | In-vitro | Antibacterial activity | [44,59] |
| Leaves, Flower, Fruits, and Seeds | Ethyl acetate and Chloroform extract | In-vivo | Hepato-protective activity and Antibacterial activity | [2,59,103] |
| Flowers, leaves and Seeds | 50% ethanolic extract of seeds, flowers and leaves, aqueous fractions | In-vivo | Immuno-stimulant activity | [2,23,53] |
| Leaves, Seed, Flower, Stem, and Root | 50% ethanolic extract | In-vivo | Antipyretic | [2,59,104] |
| Whole plant | 80% methanolic extract | In-vivo | Immunostimulatory activity | [59,105] |
| Whole plant material | Aqueous, Ethanol, Benzene, Petroleum ether, and Chloroform extracts | In vitro | Antibacterial activity | [2,59,106] |
| Root barks | Aqueous, Ethanolic, Petroleum ether, and Chloroform extracts | In vitro | Hepato-protective activity | [2,59,107] |

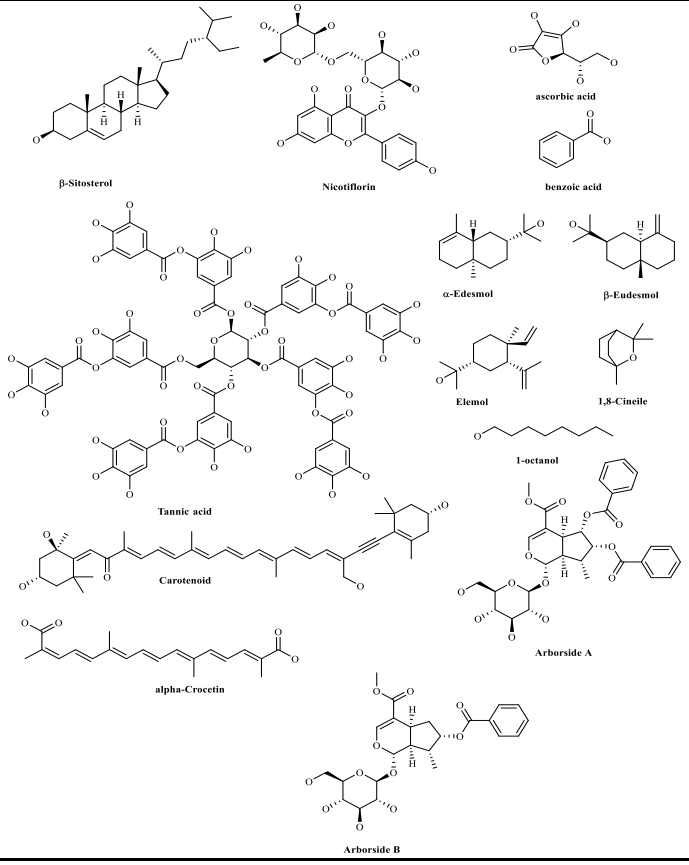
**Table 3**. Anticancer, Antitumor activities etc. details.

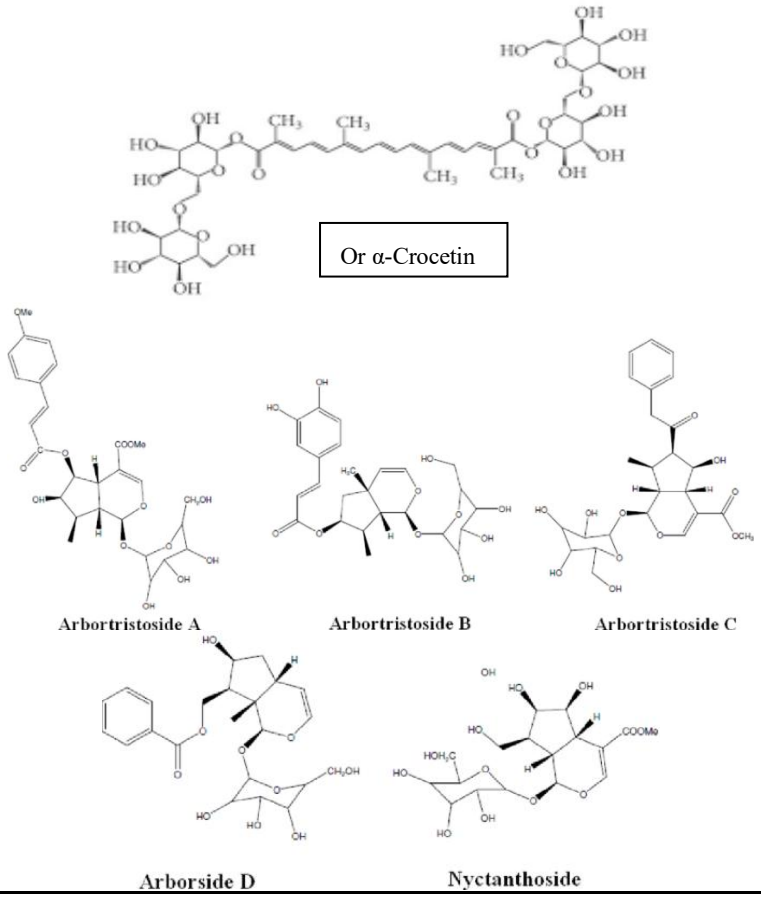
| Name of Medicinal Plants | Local Name | Part Used | Type of Anticancer, Antitumor Activities | Habitat Regions | Reference |
|---|---|---|---|---|---|
| *Nyctanthes arbortristis* L. | Harsingar/Siharu, Parijatha, Night Jasmine/Coral jasmine | Leaves/Stem bark, flowers | Inhibits, prevent and control growth Tumor, cancer, -Carcinoma cells growths | Europe and Africa, Asian region's Nilgiri Hill Southern, Northern India, Himalaya | [2,6,23–25] |

**Table 4**. Anticancer and Antitumor, Cytotoxic activity of flowers aqueous extract of NAT.

| Investigated Plant Parts | Used in Studies Extracts | Study Plan | Pharmacological Activities | References |
|---|---|---|---|---|
| Flowers | Flower extracts synthesized ZnO nanoparticle | In vitro | Anticancer activities | [2,24,25] |
| Flowers | Petroleum ether, Chloroform, and Ethyl acetate extracts | In vitro | Cytotoxic activities | [2,6,59,92] |
| Flowers | Ethyl acetate and ethanol extracts | In-vivo | Antiproliferative, Anticancer activities | [2,24,108,109] |
| Flowers | Crude aqueous extracts | In vitro | Cytotoxic activities | [2,92] |
| Flowers | Crude aqueous extracts-Chloroform fraction, Ethyl acetate fraction, Hexane fraction | In-vitro | Anticancer activities | [2,6,54] |
| Flowers | Ethyl acetate, Ethanolic and aqueous extracts | In-vitro | Anticancer activities | [2,59,108] |
| Leaves | Ethanolic extract | In-vivo | Tumour necrosis factor Depleting activity | [2,59,110] |
| Leaves | Methanolic extract | In-vitro, A-549 cancer cell line | Anticancer activities | [2,59,89] |
| Leaves and Stem | Successive extraction using hexane and ethanol | In-vitro | Cytotoxic activities | [2,59,111] |
| Fruits, leaves, and Stem barks | Methanol extract | In-vivo | Anticancer (human breast cancer) activities | [2,37,112] |
| Dried fruit | Methanol extract | In-vivo | Anticancer activities | [2,6,113] |
| Stem, leaves, and Fruits | Methanolic extract | In-vitro | Cytotoxic activities | [2,59,114] |

**Table 5**. NAT Shown Major Bioactive phytochemical constituents compound their Molecular Structure's with Molecular Formula's [2].

| NAT Shown Major Bioactive Phytochemical Constituents Compound Their Molecular Structure's | Molecular Formula's |
|---|---|
|  | a.-β-sitosterole-C20H24O4,<br>b.-α-Crocetin-C20H24O4<br>c.-Carotenoids-C29H50O,<br>d.-Nicotiflorin-C40H54O5,<br>e.-Ascorbic acid-C6H8O6,<br>f.-Benzoic acid-C6H5COOH,<br>g.-Tannic acid-C76H52O46,<br>h.-α-Eudesmol-C15H26O,<br>i.-β-Eudesmol-C15H26O,<br>j.-Elemol-C15H26O,<br>k.-1,8 Cineile-C10H180,<br>l.-Arborside-A-C31H34013,<br>m.-Arborside-B-C24H30011,<br>n.-Arborside-D-C24H30012,<br>o.-Arbortristoside A-C27H34013,<br>p.-Arbortristoside B-C27H32015,<br>q.-Arbortristoside C-C26H32013,<br>r.-Nyctanthoside-C17H26012 |




## 4. Conclusions and Future Prospective

*N. arbortristis* is a plant used in traditional systems of medicine in Asian, European and African countries regions. It holds a significant position in the medicine theory of these countries. The use of leaves, arial parts of NAT extracts and their active compounds in various folk remedies and herbal formulations highlights the plant's medicinal value's. NAT has been used therapeutically in various traditional and alternative medicines since ancient times. This study aims to comprehensively summarize relevant literature and initial identification and reconfirmation on ethno-botany, phytochemistry, important bioactive phytochemical constituents having antiarthritic, antistress, anticancer, cytotoxic, antiviral, antibacterial, antimicrobial, antifungal medicinal potential activities and evidence-based ethno-pharmacology, medicinal potential of NAT.

NAT is of considerable importance due to its broad range of pharmacological effects, including antiarthritic, antistress, anticancer, cytotoxic, antifilarial, anti-inflammatory, immuno-modulator, immuno-stimulant, hypoglycemic, hypolipidemic, antiviral, antibacterial, antimicrobial, antifungal, antiulcer, antipyretic, analgesic, and treatment of obstinate sciatica disorder. These effects are associated with its diverse phytochemical components and secondary metabolites, such as hexadecanoic acid, phytol, hexenyl benzoate, linalool, octadecanoic acid, methyl salicylate, n-dodecanol, alpha-terpineol, geraniol, D-mannitol, α-Crocetin, β-sitosterole, astragaline, nicotiflorin, oleanolic acid, nyctanthic acid, tannic acid, ascorbic acid, carotene, friedeline, lupeol, mannitol, glucose, fructose, iridoid glycosides, flavanol glycosides, benzoic acid, kaempferol derivatives, among others. Different parts of NAT, including leaves, stem bark, flowers, seeds, and roots, contain various bioactive compounds that have potential therapeutic benefits. Further research is needed to explore the medicinal and nutritional values of all parts of the plant to develop new unique herbal products. Additionally, identifying and isolating novel bioactive constituents through advanced techniques like GC-MS, LC-MS, XRD, SEM-EDX is crucial for understanding the mechanisms behind the health benefits of NAT. Preserving this valuable medicinal plant is essential for the health of future generations.

**Author Contributions:** S.P.K. performed Manuscript work designed and carried out review research data's profiling revalidation and Manuscript written and supervised. A.A. performed Manuscript rechecked and revised manuscript review. S.A., S.J.P., K.M., J.A., M.R., K.A.S. have been performed and carried out NAT whole plant initial plant authentication and identification, literature review of botanical, Pharmacognosy, taxonomy and biodiversity aspects, climatic occurrence, reconfirmation and reauthentication of works designed, literature review works, and Research Material's Collection etc. All authors have read and agreed to the published version of the manuscript.

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## Nomenclature

| Nomenclature | | | |
|---|---|---|---|
| Sanskrit: | Parijatha/Sephalika, Rajanikasa | Marathi: | Parijathak/Khurasli/Partaka |
| Hindi: | Harsingar/Siharu | Gujarathi: | Jayaparvati |
| English: | Night Jasmine/Coral jasmine/Weeping nyctanthes | Telugu: | Pagadamalle/Shwetasurasa |
| Bengali: | Sephalika/Singhar | Oriya: | Gangasiuli |
| Malayalam: | Parijatakam/Manpumaram | Kannada: | Parijatha. |
| Punjabi: | Kuri/Laduri | Tamil: | Pavalamalligai |
| Urdu: | Harsingar | | |
| Taxonomical Classification | | | |
| Kingdom: | Plantae | Division: | Magnoliophyta |
| Class: | Magnoliopsida | Order: | Lamiales |
| Family: | Oleaceae | Genus: | Nyctanthes |
| Species: | Arbortristis | Binomial Name: | Nyctanthes arbortristis Linn. |

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