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NYCTANTHES ARBOR-TRISTIS A HERBAL PANACEA

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ABSTRACT

Nyctanthes arbor-tristis Linn. (NAT) is well known Indian medicinal plant. The plant is used in Ayurveda for various pharmacological actions such as anti-arthritic, antispasmodic, antibacterial, anti-inflammatory, immunostimulant, antidiabetic, hepatoprotective, antiarthritic, antioxidant, antimicrobial, antihelmintic, antileishmanial, antiviral, CNS depressant. The present review discusses pharmacology of the herb, its pre-clinical and clinical studies, safety and herbal drug interaction which is a need of the hour.

INTRODUCTION: *Nyctanthes arbor-tristis* Linn.(NAT) is a small divine ornamental tree used to pray the God according to Indian mythology known across the country for its fragrant white flowers [1, 2]. NAT is commonly known as night flowering Jasmine [3, 4] or Parijata [5]. It is indigenous to India, disseminated wild in northern part of India and southwards to Godavari. It is also disseminated in Bangladesh, Indo-Pak subcontinent and South-East Asia [6], tropical and sub-tropical South East Asia [7].

It grows in Indo-Malayan region and disseminated across Terai tracts as well as Burma and Ceylon [8]. Wherever the elevation is above 1500 feet from sea level as a shrub but at 3000 feet it is a well formed tree called cow by the natives. The wood is chiefly used for handles of axes koolharees for turning purposes and as firewood. It constitutes a little of the jungle on the highest part of the low ranges of hills forming the main part of that on the salt range [9].

Description of plant: NAT is a large shrub with flaky grey bark [10] and height up to 10 m tall , stiff whitish hair, young branches [11] and rough leaves [8]. It has fragrant flowers with five to eight lobes which are white in colour, and corolla is orange coloured centrically they are produced in clusters of two to seven together, with individual flowers opening at dusk and finishing at dawn [10].

Calyx is 6-8 mm long, narrowly campanulate, hairy outside, glabrous inside truncate or obscurely toothed or lobed, ciliated. Corolla is glabrous and more than 13 mm long; tube is 6-8 mm long, orange coloured, about equalling the limbs; lobes are white and unequally obcordate and cuneate [11]. The leaves are opposite, simple, 6–12 cm long and 2–6.5 cm broad, with an entire margin. The fruit is a flat brown heart-shaped to round capsule 2 cm diameter, with two sections each containing a single seed [10]. These are long and broad, obcordate or nearly orbicular, compressed, 2-celled.

Seeds are exalbuminous, testae are thick, and outer layer of large transparent cells is heavily vascularised [11].

Significance of plant in mythology: The orange heart is used for dyeing silk and cotton, this practice was started with Buddhist monks whose orange robes were given their colour by this flower. The Parijata is regarded in Hindu mythology as one of the five wish-granting trees of Devaloka [12].

Significance of various parts of plant in Ayurveda: Different parts of NAT are known to own for treatment of various ailments by tribal people of India esp. Orissa and Bihar along with its use in Ayurveda, Siddha and Unani systems of medicines [3, 11, 13]. The seeds are used as antihelmintic and in alopecia. It is antibilious and an expectorant, and is also useful in bilious pyrexia [14]. The powdered seeds are used to cure scurfy affections of scalp, piles and skin diseases [11]. The powdered stem bark is given in rheumatic joint pain, in treatment of malaria and also used as an expectorant [4]. The bark is used for the treatment of snakebite and bronchitis [6, 15].

The stem bark pounded with *Zingiber officinale* and *Piper longum* is boiled in water and the resultant liquid is taken for two days for the treatment of malaria in Orissa. The resulting paste on mixing with Arjuna bark is rubbed on the body to treat internal injury and for joint broken bones [11]. The leaves of NAT are used extensively in Ayurvedic medicine for the treatment of various diseases such as sciatica, chronic pyrexia, rheumatism, and internal worm infections, and as a laxative, diaphoretic and diuretic [16].

Leaves are effective in cough. Leaf succulent is mixed in honey and given thrice daily for the treatment of cough. Paste of leaves is given with honey for the treatment of pyrexia, high blood pressure and diabetes [17]. Succulent of the leaves is used as digestives, antidote to reptile venoms, mild bitter tonic, laxative, diaphoretic and diuretic. Leaves are also used in the enlargement of spleen [3, 4].

The leaf succulent is used to treat anorexia, hemorrhoid, liver disorders, biliary disorders, intestinal worms, chronic pyrexia, obstinate sciatica, rheumatism and pyrexia with rigors [14]. The extracted succulent of leaves acts as a cholagogue, laxative and mild bitter tonic. It is given with little sugar to children as a remedy for intestinal ailments. In several cases, it has also been found to act efficaciously for malarial pyrexia [2].

The decoction of leaves is extensively used by Ayurvedic physicians for the treatment of arthritis, obstinate sciatica, malaria, intestinal worms and as a tonic, cholagogue and laxative [18]. The expressed succulent of leaves (10ml BD X 5days) is a traditional remedy for intermittent pyrexia [12]. The flowers are used as stomachic, carminative, astringent to bowel, antibilious, expectorant, hair tonic and in the treatment of hemorrhoid and various skin diseases [6] and for ophthalmic purposes [11].

The bright orange corolla tubes of the flowers contain a colouring substance nyctanthin, which is identical with α-Crocetin ($C_{20}H_{24}O_4$) from Saffron. The corolla tubes were formerly used for dyeing silk, sometimes together with Safflower or turmeric [2]. The rural people of Chittoor district Andhra Pradesh (India) widely use the whole plant for treatment of cancer, root for pyrexia, sciatica, anorexia; bark as expectorant [19].

Chemical constituents: In previous studies, it was reported the isolation of polysaccharides, iridoid glycosides, henylpropanoid glycoside, ß-sitosterol, ß-amyrin, hentri-acontane, benzoic acid, glycosides, nyctanthoside-a iridoid, nyctanthic acid, Friedelin and lupeol and oleanolic acid and 6-ß-hydroxylonganin and iridoid glucosidesarborsides A, B and C, alkaloids, Phlobatanins, terpenoids and cardiac glycosides. Iridoid glucosides (arbortristosides- A, B, C) and 6-ß-hydroxyloganin has also been isolated from this plant [20].

Phytochemical studies revealed the presence of tertiary alkaloids mainly 7-(α -anilino-p-nitrobenzyl)-8-quinolinol and quaternary alkaloids belonging to protoberberines and aporphines [21, 22].The leaves have been found to contain tannic acid, methyl salicylate, amorphous glucosides, mannitol, resin, ascorbic acid, carotene, and traces of a volatile oil. Flowers contain essential oils, coloring matter (nyctanthin), mannitol, tannin and glucose. Its roots are composed of alkaloids, tannins and glucosides [15, 23, 24, 25] are summarised in **Table 1**.

TABLE 1: VARIOUS CHEMICALS ISOLATED FROM THE PARTS OF NAT AND REPORTED PHARMACOLOGICAL ACTIVITY:

Parts of the plant	Reported chemicals	Reported pharmacological activity
Flower	4-hydroxy hexahydrobenzofuran-7-one Rengyolone[16]	Antibacterial, larvicidal, Antimalarial
Orange colored tubular calyx	Carotenoid aglycone Ag-NY1	Good membrane stabilising agent
Corolla tubule	Arbortristoside-A[11] Arbortristoside-B[11] Arbortristoside-C[11]	Antileishmanial, Antihistaminic
Seed	Nyctoside A[11]	Under investigation
Leaves	Friedelin[26]	Antihistaminic

Reported pharmacological activities:

Pre-clinical study:

Anti-arthritic activity: Arthritis is a disease manifested by joint pain followed by bone and joint destruction. Cytokines play a major role in arthritis. In the previous study it was reported that the irregular expression of tumor necrosis factor-α (TNF-α) in experimental animals has been shown to cause destructive arthritis. The development of arthritis was markedly suppressed in interleukin-β (IL-1β) deficient collagen-induced arthritis (CIA). Interleukin-6 (IL-6) gene disrupted mice were resistant to antigen and collagen-induced arthritis. These studies indicated that pro-inflammatory cytokines (TNF-α, IL-1β, and IL-6) play a role in arthritis and are potential targets for therapy [20].

Adjuvant induced arthritic model was used to test the efficacy of seed, leaves and fruit extract of NAT. The results resolved that the mice receiving two doses of FCA (Freud's complete adjuvant): one on 0th day and other on 12th day. Daily treatment with extracts of leaves and fruit reduced TNF α, IL-1, IL-6 from 14th day; while the seed extract was found to be pathetic. A shift in balance between pro-inflammatory and anti-inflammatory cytokines was observed in adjuvant-induced mice thus favouring inflammation. The extract of leaves and fruit was found to possess anti-arthritic properties [20] are summarised in **Table 2**.

Antidiabetic activity: In a study, it was reported that the ethanol extract of stem bark of NAT exhibited dose-dependent antidiabetic property. The levels of serum cholesterol and triglycerides were raised in diabetic rats but which were lowered significantly with the treatment of stem bark of NAT. It indicated that the ethanol extract of stem bark of NAT was more useful in the treatment of diabetes as it has hypolipidemic effect [4].

Ethanolic extract of NAT significantly subdued TBARS in liver. It was found to possess antioxidant and antidiabetic effect [27]. Administration of NAT leaves and flower chloroform extracts (50, 100 and 200 mg/kg) orally for 27 days caused a significant reduction in LPO, SGPT, SGOT, Alk Phos, cholesterol and triglyceride levels on extracts treated STZ diabetic rats, compared to diabetic control rats. Furthermore, NAT extract treated diabetic rats showed significant increase in SOD and CAT enzymatic antioxidant activity when compared to diabetic control rats. The administration of the extracts and Glibenclamide (10 mg/kg) improved the activity of both enzymatic and non-enzymatic antioxidants and lipid profile in STZ-induced diabetic rats [20] are summarised in Table 2.

Antibacterial activity: Infectious diseases are world's leading cause of premature death. Resistance to antimicrobial agents is conferring in a wide variety of pathogens and multiple drug resistance is becoming common in diverse organisms such as *Staphylococcus aureus, Staphylococcus epidermis, Salmonella typhi, Salmonella paratyphi A.* In a study, it was reported that methanolic extract of leaves of NAT exhibited significant antibacterial activity against *Staphylococcus aureus, Staphylococcus epidermis, Salmonella typhi, Salmonella paratyphi A* with MIC value ranging between 1-8 mg/ml [28] is summarised in Table 2.

Antihelmintic activity: In the previous study, it was mentioned that ethanolic extract of fresh flowers and dried leaves, stem and bark of NAT were tested for its antihelmintic activity using piperazine citrate as a standard. The antihelmintic activity was studied on the basis of inhibition of contractile effect of acetylcholine by various dilutions of this extract. It was found that ethanolic extract of seeds and a flower owned more potent antihelmintic activity than that of bark and leaves but were less than that of piperazine citrate.

Also, these extracts potentiated the anthelmintic activity of atropine, which might be due to the inhibition of motility by relaxing and depressing responsiveness to contractile action of acetylcholine [29] is summarised in **Table 6**.

Anti-inflammatory activity: In a study it was mentioned that the water soluble ethanolic extract of the leaves of NAT was screened for the presence of anti-inflammatory activity. NAT subdued the acute inflammatory edema produced by different phlogistic agents, viz. carrageenin, formalin, histamine, 5-hydroxytryptamine and hyaluronidase in the hind paw of rats. The acute inflammatory edema in the knee joint of rats induced by turpentine oil was also significantly reduced [48].

In another study, it was reported that in sub-acute models, NAT was found to check granulation tissue formation significantly in the granuloma pouch and cotton pellet test. Acute and chronic phases of formaldehyde induced arthritis were significantly subdued. NAT was also found to inhibit the inflammation produced by immunological methods, viz. Freund's adjuvant arthritis and PPD induced tuberculin reaction [32]. Also in a previous study it was reported that water- soluble fraction of ethanolic extract of leaves of NAT has been screened for the anti-inflammatory activity.

It was found to significantly inhibit acute inflammatory edema produced by carrageenan, formalin, histamine, 5-hydroxytryptamine and hyalouronidase in hind paw of rats. It also reduced acute inflammatory swelling in the knee joint induced by turpentine oil [30].

Arbortristoside-A was found to possess significant and dose-dependent anti-inflammatory and anti-nociceptive activity. It seems arbortristoside- A subdued the histamine, serotonin and carrageenan-induced edema suggesting its inhibiting effect on carrageenan, arachidonic acid, histamine and serotonin-induced edema suggesting its anti-inflammatory activity may be due to the inhibiting effect of prostaglandin, histamine and serotonin. The analgesic activity of arbortristoside- A may be due to the inhibition of the action of prostaglandin [31] are summarised in **Table 3**.

Antimicrobial activity: The frequency of life-threatening infections caused by pathogenic microorganisms has risen worldwide and is becoming an important cause of morbidity and mortality in immune compromised patients in developing countries and many infectious microorganisms are resistant to synthetic drugs. A study was conducted and it was reported that the stem bark extracts of the plant were capable to exhibit *in vitro* antimicrobial activity by cup plate method.

The test organisms were *Staphylococcus aureus*, *Micrococcus luteus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans* and *Aspergillus niger*. The zone of inhibition and Minimum Inhibitory Concentration (MIC) of the extracts were ascertained and compared with the standard drugs ciprofloxacin and fluconazole. The chloroform extract was found to have both antibacterial and antifungal activity whereas the petroleum ether and ethanol extracts possess only antibacterial activity [3].

Antioxidant activity: In living body, free radicals are generated as part of the body's normal metabolic process. Antioxidants are radical scavengers which shield the human body against free radicals that may cause pathological conditions such as ischemia, anaemia, asthma, arthritis, inflammation, neurodegeneration, Parkinson's diseases, mongolism, ageing process and perhaps dementias [18]. In the previous study it was mention that an antioxidant activity of NAT was carried out by DPPH assay, free radical scavenging activity, reducing power assay, total antioxidant capacity. It was resolved that the plant owned strong antioxidant activity [18].

NAT leaf extracts are extensively used in Indian traditional medicine. The acetone-soluble fraction of its ethyl acetate extract showed impressive antioxidant activity as revealed by several in vitro experiments, e.g., DPPH, hydroxyl and superoxide radicals, as well as H_2O_2 scavenging assays. In addition to that, its preventive capacity against Fe (II)-induced lipid peroxidation of liposomes and γ-ray-induced DNA damage also confirmed this. The strong reducing power and high phenolic and flavonoids contents could be responsible for the antioxidant activity [32] are summarised in **Table 4**.

Antileishmanial activity: In a study, it was reported that iridoid glucosides (arbortristosides A, B, C and 6-β-hydroxy-loganin) isolated from NAT possess antileishmanial activity by assessing in vitro (against amastigotes in macrophage cultures) and in vivo (in hamsters) test systems [33]. In another study, it was mentioned that calceolarioside A from the methanolic extract of NAT leaves by bioactivity-guided fractionation and ascertained its in-vitro antileishmanial study, which (IC_{50}) was found to be =20µg/ml.

Its *in vivo* efficacy was noted at 20 mg/kg body weight when it reduced the hepatic and splenic parasite burden by 79 and 84 %, respectively, in an established model of *L. donovani* Ag83 infected golden hamster. This was the first report describing the isolation of compound calceolarioside A from NAT and the first demonstration of its potent activity against visceral leishmaniasis [34].

Iridoid glycosides isolated from NAT have been found to be potential source as novel drugs against this disease [35]. In another study it was reported that the chloroform extract and the isolated compound (NCS-2) from its flowers were found to have larvicidal activity against common filarial vector, *Culex quinquefasciatus*. The results were also showed that the late instar larvae were more resistant to the extracts than the early instars [36] are summarised in Table 4.

Antispasmodic activity: I the previous study it was reported that ethanolic extract of fresh flowers and dried leaves and stem and bark of NAT tested for its antispasmodic activity using guinea pig ileum. It was found to inhibit contractile response of acetylcholine [29] is summarised in Table 4.

Antiviral activity: It was reported that the ethanolic extracts, various fractions and two pure compounds isolated from NAT were tested against *Encephalomyocarditis Virus* (EMCV) and *Semliki Forest Virus* (SFV). There was prominent in-vitro virus inhibitory activity with the ethanolic and n-butanol fractions as well as with the pure compounds arbortristoside A and arbortristoside C. In addition, ethanolic extracts and n-butanol fraction protected EMCV infected mice to the extent of 40 and 60% respectively against SFV at a daily dose of 125 mg/kg body weight [37] is summarised in Table 4.

CNS depressant action: In the earlier study, it was reported that the leaves, flowers, seeds and barks (600 mg/kg) of NAT exhibited significant and dose-dependent prolongation of onset and duration of sleep and found to cause decrease in dopamine and increase serotonin level from which it can be resolved that the CNS depressant activity of the ethanol extracts of seeds, leaves and flowers may be due to the decrease in dopamine and increase in serotonin level [38] is summarised in **Table 5**.

Cytotoxic evaluation: In a study, it was mentioned that 4-hydroxy hexahydrobenzofuran-7-one isolated from chloroform extract of flowers of NAT was not carcinogenic as it inhibited EAC cell growth only by 43.27 %. Also it was found that this compound possesses no adverse effect on central nervous system [39] is summarised in Table 5.

Hepatoprotective activity: Hepatic disorders have become major stumbling blocks to twentieth century medicine. Capacity for regeneration of the hepatic tissue is considerable and damage is usually extensive before it is evident. The effects of hepatic diseases are manifested when; regeneration of hepatocytes does not keep pace with damage leading to hepatocellular failure [40].

In a previous study, it was reported that administration of alcoholic and aqueous extracts of the leaves of NAT protected the liver from toxic effects of CCl_4 by reducing the elevated levels of SGPT, SGOT and serum bilirubin (total and direct). Results explained that both the alcoholic and aqueous extracts showed significant hepatoprotective activity by reducing the elevated levels of biochemical parameters at a dose of 500 mg/kg body weight [41].

In another study, it was mentioned that methanolic extract of leaves of NAT exhibited significant hepatoregenerative potential in acetaminophen-induced hepatic damage. It acted by defending against membrane fragility and by preventing decline in glutathione levels [40]. Another study mentioned that the aqueous extracts of the leaves and seeds were proved to have antihepatotoxic activity against CCl_4 induced hepatotoxicity [42, 43].

Also in a study, it was mentioned that the ethanolic and aqueous extract of leaves of NAT has been found to be hepatoprotective at a dose of 500 mg/kg [44] are summarised in Table 5.

Immunostimulant activity: In a study, it was reported that oral administration of ethanolic extract of NAT at dose of 50, 100, 150, 200 mg/kg significantly enhanced circulating antibody titre when challenged with SRCs and heat-killed Salmonella antigens. The chronic administration significantly enhanced total WBC count and potentiated DTH reaction. It was resolved that the extract possesses immune-bioactive [21, 22] are summarised in **Table 6.**

Lung protective activity: In the previous study, it was mentioned that the pulmonary injury was induced in Swiss mice through inhalation exposure to silica particles (< 5 mu) using a Flow Past Nose Only Inhalation Chamber at the rate of -10 mg/m3 respirable mass for 5 h.

Inhalation of silica raised the level of tumor necrosis factor-alpha (TNF-α), and of the 66 and 63 kDa peptides in the BAL fluid in comparison to sham-treated control. Pre-treatment of silica exposed mice with NAT leaf extract significantly prevented the accumulation of TNF- α in the BAL fluid, but the 66 and 63 kDa peptides remained unchanged.

The extract was also found to be effective in the prevention of silica-induced early fibrogenic reactions like congestion, edema and infiltration of nucleated cells in the interstitial alveolar spaces, and thickening of alveolar septa in mice lungs [45].

Clinical study:

Antimalarial activity: A study was conducted to explore and putative effects of Nyctanthes arbor-tristis (Parijat) in malaria clinical, metabolic, parasitic and immune changes [46].

Conclusion of the study revealed that the leaf extract of the NAT has a potential to cure the multiple drug resistant malaria caused by *Plasmodium falciparum*.

In another study patients with malaria were treated with fresh five leaves of NAT given orally t.i.d for 7-10 days. The relief of symptoms and signs of malaria and the features of *Visham jwara* were graded basally and daily. Among 120 patients, ninety two (76.7%) showed complete clinical and parasitic cure within 7 days. Other 20 patients, who then continued on same treatment, were cured by 10 days. Those patients who did not respond clinically and by parasitic clearance were treated with standard antimalarial therapy.

Parasitic clearance was gradual and showed a direct temporal relationship with the level of initial parasitemia. The paste was well tolerated and no severe side effects were reported. NAT with the dose used showed significant antimalarial activity and good tolerability [47].

Toxicological profile: Herbal extract was screen for acute toxicity of the water soluble fraction of ethanolic extract of different parts of NAT at doses of 400 mg/kg to 2000 mg/kg i.p. [38].

Potential herbal-drug interaction: NAT has been reported with variety of pharmacological actions such as antispasmodic activity which indicated that inhibition of contractile response of acetylcholine [29] might potentiate the action of certain drug like Dicyclomine, Atropine, Hyoscine, Propantheline, Oxyphenonium etc.

It has also been reported that NAT claimed to reduce the blood serotonin level, if it is taken with the methylenedioxymethamphetamine, or MDMA, Mescaline, Amphetamine. Recent study also indicated that the NAT has CNS depressant action [38], so it can potentiate the action of certain drugs like benzodiazepine, Chlorpromazine, Haloperidol, Reserpine, Clozapine etc.

Pre-clinical research also revealed that NAT has hypolipidemic effect [4] this might lead to the non-alcoholic fatty liver, muscle weakness, irritability, nerve degeneration or delayed nerve conduction due to low serum total cholesterol if it is taken with hypolipidemic agent such as Lovastatin, Atorvastatin, Clofibrate, Nicotinic acid.

TABLE 2: PARTS OF THE NAT REPORTED FOR VARIOUS PHARMACOLOGICAL ACTIVITIES:

Reported activity	Part used	Extract	Illation
Anti-arthritic	Seeds, leaves and fruits whole plant	Ethanolic	Seed extract ineffective; Leaves and fruits extracts reduced TNF α, IL-1, IL-6. Extract of leaves and fruit possess anti-arthritic properties [20].
Antibacterial	Leaves	Methanolic	Antibacterial activity against *Staphylococcus aureus, Staphylococcus epidermis, Salmonella typhi, Salmonella paratyphi A* [28].
Antidiabetic	Stem Bark	Ethanolic	Serum cholesterol and triglycerides get lowered; Antidiabetic[4].
	Whole plant	Ethanolic	Subdued TBARS; Antidiabetic + antioxidant [31].
	Leaves and flowers	Chloroform	Increase in SOD and CAT enzymatic antioxidant action [20].

TABLE 3: PARTS OF THE NAT REPORTED FOR VARIOUS PHARMACOLOGICAL ACTIVITIES:

Reported activity	Part used	Extract	Illation
Anti-inflammatory	Leaves	Ethanolic	Inhibit inflammation produced by Freund's adjuvant arthritis and PPD induced tuberculin reaction [32].
		Ethanolic	Inhibit acute inflammatory edema produced by carrageenan, formalin, histamine, 5-hydroxytryptamine and hyalouronidase in hind paw of rats. It also reduced acute inflammatory swelling in the knee joint induced by turpentine oil [47].
	Seeds	Ethanolic	Isolated arbortristoside-A subdued the histamine, serotonin and carrageenan-induced edema [30].

TABLE 4: PARTS OF THE NAT REPORTED FOR VARIOUS PHARMACOLOGICAL ACTIVITIES

Reported activity	Part used	Extract	Illation
Antileishmanial	Leaves	Methanolic	Isolated calceolarioside A which seemed to be potent against visceral leishmaniasis [34].
	Flowers	Chloroform	Larvicidal against *Culex quinquefasciatus* [36].
Antioxidant	Leaves	Ethanolic	DPPH assay, free radical scavenging activity, reducing power assay, total antioxidant capacity resolved it to strongly possess antioxidant [18].
	Leaves	Ethyl-acetate	Potent antioxidant [32].
Antispasmodic	Fresh flowers, Dried leaves, stem, bark	Ethanolic	Inhibit contractile response of acetylcholine [29].

TABLE 5: PARTS OF THE NAT REPORTED FOR VARIOUS PHARMACOLOGICAL ACTIVITIES

Reported activity	Part used	Extract	Illation
Antiviral	Whole plant	Ethanolic extract; n-butanol fraction	Ethanolic extracts and n-butanol fraction protected EMCV infected mice to the extent of 40 and 60% respectively against SFV [37].
Cytoprotective	Flowers	Chloroform	No adverse effects on central nervous system [39].
CNS depressant	Seeds, leaves, Flowers, Bark	Ethanolic	Dose-dependent action [38].
Hepatoprotective	Leaves	Alcoholic, Aqueous	Significant hepatoprotective activity by reducing the elevated levels of biochemical parameters [40].
		Methanolic	Hepatoregenerative potential in acetaminophen-induced hepatic damage [40].
	Seed	Aqueous	Hepatoprotective against CCl_4 induced hepatotoxicity [42, 43].

TABLE 6: PARTS OF THE NAT REPORTED FOR VARIOUS PHARMACOLOGICAL ACTIVITIES:

Reported activity	Part used	Extraction	Illation
Immunostimulant	Whole plant	Ethanolic	Enhanced total WBC count and DTH reaction [21, 22].
Antihelmintic	Fresh flowers, dried leaves, stem, bark	Ethanolic	Seeds and flowers possess more potent activity than bark and leaves. Also potentiated antihelmintic activity of atropine [29].

Marketed formulations:

1. Hersingar herbal memory nectar, by Chandi, LLC, USA
2. Jasmine- enchanting light massage oil, by Sadatan Pure Ayurveda Pvt. Ltd, India

CONCLUSION: Plant has got wide range of pharmacological actions, which may be therapeutically beneficial for overall health and wellness of population, the need of the hour to further research in clinical aspect. Since the plant is easily available and no special conditions are required to cultivate and collect the plant, it could be a better choice to treat the ailments. Simultaneously, safety evaluations of plant need to be carried out carefully with its interactions along with various synthetic medication, which is a totally an unexplored area and very much a need of the hour.

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