

Heliotropium indicum L: An Ethnomedicinally Important plant of India

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Keywords: Ethnomedicinally Important, *Heliotropium indicum*, phytopharmacological activities, Medicinal Value.

Abstract:

This study attempted to summarise the existing data on the ethnomedicinal and phytopharmacological activities of *Heliotropium indicum* L., and it did so by using database reports as its primary source of information. In order to accomplish this goal, a search of the most recent relevant literature was carried out. Based on the data, it appears that the plant possesses a significant quantity of essential phytochemicals. In the plant family known as the Boraginaceae, *Heliotropium* is a sizable genus that spans both the tropical and temperate regions of the world. Because most of the alkaloids that can be isolated from *Heliotropium indicum* are toxic, this plant's use in treating internal conditions is not suggested. In order to provide light on potential directions for future research, the purpose of this review is to summarise the phytochemistry and pharmacological activity of the many species of *Heliotropium*.

Introduction:

New medicinal agents are frequently discovered using natural products. Traditional medicine has been the most logical and cost-effective form of care. From ancient time plant have been used as a source of therapy (Maiti et al., 2013; Sanyal, 2016). The medicinal plant plays a vital role in discovering new therapeutic agents (Banerjee et al., 2014; Bhattacharjee and Manna, 2016). Various phytochemicals like alkaloids, flavonoids, tannins, and phenols contribute to the medicinal property of medicinal plants. The medicinal use of herbs is deeply rooted in Indian culture (Maiti et al., 2010; Sarkar et al., 2016; Sarkar, 2017; Bhattacharjee, 2021). Traditional systems of medicine, along with homoeopathy and folklore medicine, both of which are practised in India, continue to play an essential part in the country's overall healthcare system for the general people (Sanyal et al., 2018; Erfani, 2021; Kundu, 2022; Kar et al., 2022).

Heliotropium indicum is locally known as Hatisur and gets its name from the Greek word “helios” meaning sun and “tropein” meaning to turn indicating that its flower turn towards the sun. This plant is distributed throughout Bangladesh, Sri Lanka, Thailand, Nepal, India, tropical

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Asia, and some parts of Africa. This plant is traditionally used against many pathological diseases (Sarkar, 2016; Chakraborty et al., 2019). In this chapter, the ethnomedicinal, phytochemical, and pharmacological profiles of *Heliotropium indicum* are intended to be reflected in the current context.

Plant Taxonomy:

Heliotropium indicum belongs to-

Domain: Eukaryota

Kingdom: Plantae

Phylum: Spermatophyta

Subphylum: Angiospermae

Class: Dicotyledonae

Order: Boraginales

Family: Boraginaceae

Genus: *Heliotropium*

Species: *indicum*

Plant Morphology:

Heliotropium indicum is an annual, perennial herb reaching a height of 20 to 50 cm (Dash and Abdullah, 2012). The stem is widely distributed, branched or unbranched. Long and heavily branched tap-roots make up the root system. The leaves are oval or ovate-oblong, simple alternate or sub-alternate, and have an undulate border. The undersides of the leaves are visibly covered in hair and nerve, which are found on both sides of the serrulate or cordate leaves. *Heliotropium indica* blooms all year long. Within the cymose, the flower grows apically. The fruit is referred to as a nutlet. They are 4-6 mm long, 2-4 lobed, and indehiscent. There are two cells and a beak on each nutlet. At the base of the flower, mature nutlets are visible. The flower is sessile, two-ranked pentamerous, and white or violet in colour. The sepals are five, evenly spaced with the hair outside, deep green in colour, irregular, and between three and five millimetres long.

Traditional and folk values:

Different traditional and folkloric medical systems have employed *Heliotropium indicum* to treat various ailments. *Heliotropium indicum* is a medication used to treat neurological problems, poison ivy, and skin conditions in Tamil Nadu, India. According to legend, the Malasar tribe used coconut oil and leaf juice boiled together to treat dandruff (Rahman et al., 2011). The root juice of *Heliotropium indicum* is used by some tribes in Assam, India, to treat ophthalmia.

When consumed orally, the dried flower is said to sterilize females permanently. Thailand is home to this practice. *Heliotropium indicum* is thought to be beneficial in treating dermatitis, stomach pain, and malaria in various African nations (Rahman et al., 2011). The flower is also infused and used to treat menorrhagia in Jamaica.

Several ailments have been treated using the entire plant in various traditional systems. In Bangladesh, the extract of *Heliotropium indicum* is used to cure chicken pox, allergies, knee swelling, and poisoning (Nawaz, 2009).

In the Philippines, dried root decoction is used to promote menstruation, flower infusion is used to cure kidney stones, and seeds are used to heal wounds, cholera, and malaria (Wiar, 2006). In Malaysia, the whole plant decoction is used to treat ringworm infection, whereas it is used to treat gonorrhoea in Burma (Wiar, 2006). Table 1 includes a list of the regional names and traditional uses of *Heliotropium indicum* in several nations.

Table 1. The use of *H.indicum* in traditional medicine

Country	Local name	Traditional use for	Plant parts used	Reference
Bangladesh	Hatisur	Antidote to poisoning	Leaves and stem	Nawaz, 2009
		Swelling of Knee, joint pain	Root	Nawaz, 2009
		Chicken pox, Allergy	leaves	Shahnaj et al., 2015
		Blood purification	Root	Akhter et al., 2021
Benin	Koklosouden	Psychosis	Leaf and root	Adjanohoun, 2011
		Leucorrhoea	Whole plant	Adjanohoun, 2011
Ghana	Komfemtikoro	Eye infection	leaves	Komlaga, 2017
India	Nakipoo	Snake and scorpion bite	leaves	Alagesaboopathi, 2009
	Indian heliotrope & Hatisur	Wound and skin infection	Whole plant	Muthu, 2006
		ophthalmia	root	Das et al., 2008
Indonasia	Bandotanlombok	Herpes & rheumatism	leaves	Togola, 2005
Jamaica	Turnsoles	Menorrhagia	flower	Asprey and Thornton, 1955
		Fever, ulcer, sore throat, Induced abortion, rectal sores	Whole plant	Asprey and Thornton, 1955
Mauritius	Herbepapillon	Renal colic	leaves	Suroowan and Mahomoodally, 2019
Mali	Bambara	Nausea & vomit-ing, high blood pressure	leaves	Nordeng et al., 2005

Nigeria	Akuko	Hepatitis and fever	leaves	Adjanohoun, 2014
		Gonorrhea	leaves	Ainslie et al., 1981
Philippines	Buntot-leon	Diuretic & kidney stone	Whole plant	Quisumbing, 1951
Senegal	Mandingbambaranagiku	Dermatitis	leaves	Kerharo and Adam, 1974
Taiwan	Gou Wei chungtsan	Hepatitis	Leaves and root	Lin and Kan,1990
West Indies		Head lice	Whole plant	Ayensu, 1981

Phytochemical Constituent

As *Heliotropium indicum* has been widely used in traditional and folk medicine since ancient times, researchers have made many efforts to identify the different phytochemicals and pharmacologically active compounds that contribute to the wide use of this plant in herbal medicine. Reports suggest that the areal part of *Heliotropium indicum* contains different alkaloids like helindicine, echinitine, europine, indicinine, heliotrine-N-oxide. The roots contains a high level of estradiol. *Helindicine* is a new pyrrolizidine alkaloid that has been isolated from the roots of *Heliotropium indicum* (Souza et al., 2005). The plant is reported to contain triterpenes like lupeol, rapone, rapanone, amines like putrescine, spermidine, spermine and sterols like astradiol, campesterol etc. (Wiert, 2006 ; Coe and Anderson,1996; Lin and Kan,1990). *Heliotropium indicum* also yields an essential oil that consists mainly of phytol, 1-dodecanol and beta-linalool. The different chemical compounds isolated from the plant are listed in **table 2**.

Table 2. Different Phytochemicals present *Heliotropium indicum*

Plant part	Phytochemicals	References
Seed	Alkaloids: Cynoglossine, Europine N-oxide, Heleurine N-oxide, Heliotridine N-oxide, Heliotrine N-oxide	Williaman and Schubert, 1962
Aerial part	Alkaloids: Echinatine, Heleurine, Heliotrine, Heliotridine, Indicine Aerial, Indicine N-oxide, Lasiocarpine,	Duke, 1994; Coe and Anderson,1996; Pandey et al.,1996
Leaves	Alkaloid: Trachelanth-amidine Amines: Putrescine, Spermidine, Spermine	Birecka et al., 1984
Whole plant	Sterols: β -Sitosterol, Estradiol, Chalinasterol, Campesterol ,Hexacosane-1-ol, Stigmasterol Volatile oils:1-Dodecanol, β -Linalool, Phytol	Andhiwal, 2013; Machan et al., 2005

Medicinal Importance:

Based on the data available on the presence of various phytochemicals in the different solvent extracts of *Heliotropium indicum* and its enormous use in folk medicine, many investigations have been conducted to look into the medicinal importance of the plant. The results have shown diverse biological effects described in this section.

Anti-microbial Activity:

The alcoholic extracts of the whole plant exhibited a dose-dependent anti-bacterial property. The extracts were effective against *Bacillus subtilis*, *Bacillus pumilus*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Proteus vulgaris* (Osungunna and Adediji, 2016; Rao et al., 2002). In another study, the petroleum ether, chloroform, aqueous and methanolic leaf extract of *Heliotropium indicum* has shown antibacterial effects against *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. (Oluwatoyin et al., 2011; Dash and Murthy, 2011). It has also been reported that the methanolic and aqueous leaf extracts mixed with simple ointment give promising results in *Staphylococcus aureus* induced wound infection model (Dash and Murthy, 2011). The volatile oils isolated from the aerial parts of the plant showed antituberculosis activity against *Mycobacterium tuberculosis* (Machan et al., 2005). The alcoholic extracts also possessed anti-fungal activity as tested against *Aspergillus niger*, *Aspergillus wentii*, *Rhizopus oryzae*, *Candida albicans* (Osungunna and Adediji, 2016; Rao et al., 2002). However, the anti-bacterial and antifungal effect of *Heliotropium indicum* high extract concentration is required. Therefore, the isolation and characterization of the active components and formulation based on those active components would increase the efficiency of this plant's antimicrobial properties.

Anti-inflammatory Activity:

The leaf extract of *Heliotropium indicum* has exhibited anti-inflammatory activity carrageenan-induced hind paw oedema and cotton pellet granulosa model of inflammation. The methanolic root extract of *Heliotropium indicum* showed a significant anti-inflammatory effect, with a 49% reduction in paw edema and a 55% reduction in granuloma formation (Srinivas et al., 2000). The ethanolic and petroleum ether extracts of *Heliotropium indicum* could successfully reduce the inflammation in egg white and induce acute paw oedema in a rat model (Shalini et al., 2010). Aqueous whole plant extract of *Heliotropium indicum* has also been reported to show anti-inflammatory effects in lipopolysaccharide-induced rabbit models. The extracts reduce inflammation and inflammatory cell infiltration (Kyeiet et al., 2016). It is noted that an oral pharmaceutical product obtained from *Heliotropium indicum* is used against inflammation, particularly against inflammatory diseases of the intestine (Pianowski et al., 2011).

Wound healing capacity:

Different *Heliotropium indicum* extracts have been shown to have wound-healing properties. In a rat model, the alcoholic extract of *Heliotropium indicum* demonstrated wound-healing efficacy. Topically, rats who received an extract demonstrated full wound healing (Reddy et al.,

2002). The alkaloids extracted from n-butanol crude extract display remarkable wound healing activity in human lung cell line H292.

Anticancer activity:

Heliotropium indicum possesses anticancer properties, as is evident from a study on HeLa cells using stem and leaf methanolic extract. Within 48 hours of treatment, both extracts demonstrated anti-proliferative effects (Sivajothi et al., 2015). On the SKBR3 human breast cancer cell line, an ethanolic extract of *Heliotropium indicum* demonstrated an anti-proliferative activity (Goyal and Sharma, 2014). The brine shrimp nauplii were cytotoxic to the *Heliotropium indicum* methanolic root extract, with an LC50 value ranging from 2.57 to 31.44 ug/ml (Rahman et al., 2011). Interestingly, the main pyrrolizidine alkaloid derived from the plant, indicine N-oxide, has entered phase-I clinical trials in patients with advanced cancer (Ohnuma et al., 1982).

Antifertility activity:

The ethnomedicinal use of *Heliotropium indicum* as an antifertility agent is supported by the plant's substantial antifertility and abortifacient action in the petroleum ether extract (Andhiwal et al., 2013). A study discovered that the n-hexane and benzene fractions of *Heliotropium indicum*'s ethanol extracts displayed antifertility effects in rat anti-implantation and abortifacient models (Savadi et al., 2009). The unfavourable impact of *Heliotropium indicum* extracts on sperm mortality was also demonstrated in the in-vitro study.

Anticataract effect:

Rats exhibit anticataract behaviour in response to the ethanolic leaf extract. According to the study, rats given extract treatment had much more water, soluble protein, and glutathione in their lenses (Veda et al., 2016). The aqueous extract of the entire plant *Heliotropium indicum* greatly reduced the occurrence of selenite-induced cataract (Kyei et al., 2015).

Anti helminthic effect:

On Indian adult earthworms, the leaf extracts of *Heliotropium indicum* in both methanol and water demonstrated an anti-helminthic activity. The effect of the methanolic extract was comparable to that of the reference medication, mebendazole. On the other hand, the aqueous extract had a significantly smaller and less potent effect on earthworms (Mahato et al., 2014).

Conclusion:

The conventional medical system makes extensive use of *Heliotropium indicum*. Numerous compounds with promising biological action may be obtained from the plant. Modern society is concerned about the overuse of medicinal plants for pharmacological purposes. According to reports, approximately 15000 plant species may go extinct as a result of overharvesting and habitat damage brought on by human activity. This should be considered while employing plants with medicinal value.

The use of herbal medicine has gained popularity recently, although there are still some questions about its effectiveness and safety. According to the article, *Heliotropium indicum* is used in several nations, but additional research is needed to identify the phytochemicals and therapeutic properties. The use of this plant in clinical practice is constrained because there have been relatively few investigations on its isolated ingredient, despite the fact that it can significantly progress medical treatment. Animal models for the toxicity of the extracts show contributions from heliotrine, lasiocarpine, and retrogressive presence. As a result, it is crucial to solve this issue. These problems can be solved with enough research, opening the door for this plant as a secure, efficient, and reasonably priced healthcare option.

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