

## Pharmacognostic Review on Datura

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### Review Article

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### Abstract

Datura, a wildy growing plant from Solanaceae family, is attributed with both poisonous and medicinal values. *Datura* spp. in Ayurveda, different parts of Datura is used for various human ailments when applied both locally and through oral administration. Several functional groups have been reported to be present in different parts of the plant. The plant shows various types of activities such as analgesic, anti-inflammatory, anti-viral, and anti-diarrheal that may be due to the presence of the active chemical constituents. especially in Ayurvedic medicine, *D. stramonium* has been used for curing various human ailments, including ulcers, wounds, inflammation, rheumatism and gout, sciatica, bruises and swellings, fever, asthma and bronchitis, and toothache. This comprehensive review of *D. stramonium* includes information on botany, phytochemistry, pharmacology, toxicology and ethnomedicinal uses.

**Keywords:** Datura stramonium; Pharmacological actions; Medicine; Traditional; Phytotherapy; Drug toxicity

**Abbreviations:** LD50: Lethal dose 50%; IP: Intraperitoneal; OP: Organophosphate; D. Stramonium: Datura Stramonium.

### Introduction

#### Herbal Plants

Plants have been used for health and medical purposes for several thousands of years. The use of herbal medicinal products and supplements has increased tremendously over the decades with not <80% of people worldwide relying on them for some part of primary health care. A majority of the world's population in developing countries still relies on herbal medicines to meet its health needs. Herbal medicines are often used to provide first-line and basic health service, both to people living in remote areas where it is the only available health service and to people

living in poor areas where it offers the only affordable remedy. Even in areas where modern medicine is available, the interest on herbal medicines and their utilization have been increasing rapidly in recent years [1].

#### Datura

#### Ancient Verse about Datura

!!! धत्तुरोमदवर्नाग्निवताक्रुदज्वरकुष्टनुत !!!

!!! कषायोमधुरस्तिक्तोयूकालीक्षावीनाशक !!!

!!! उष्णोगुरुर्वश्लेष्मकन्डूक्रिमीविषापह !!!

Datura is an herbaceous perennial plant from Solanaceae family is grown in temperate and tropical region of the globe. It has been used in traditional medicine to relieve pain, breathlessness, fevers, etc. It is a

powerful deliriant and hallucinogen. However, as the alkaloids are responsible for both the medicinal and hallucinogenic properties are toxic in higher amounts, and careless use often results in hospitalization and deaths. Considering this, the plant has been grouped under Schedule E-1 of Drugs and Cosmetics Act-1940 [2]. Even being a poisonous plant, it is being used since the ancient times by Ayurveda physicians for various purposes (Figure 1).

The therapeutic activities are due to the presence different active components and researches revealed the presence of saponins, tannins, steroids, alkaloids, polyphenols and glycosides in this plant [3].

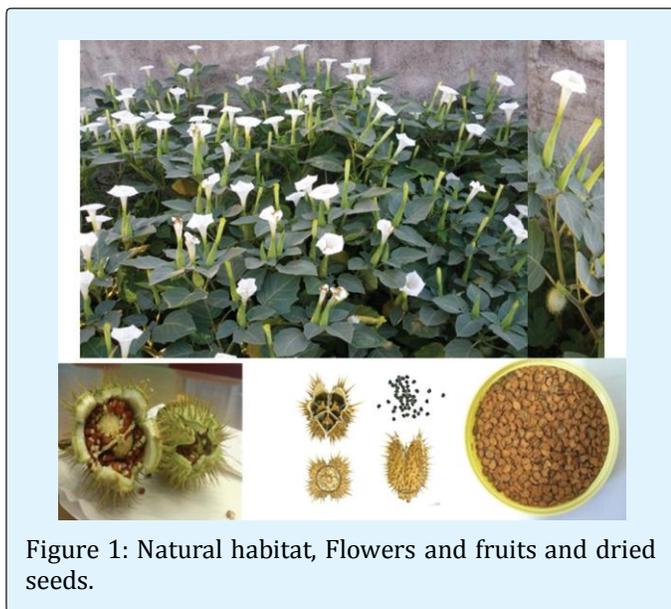


Figure 1: Natural habitat, Flowers and fruits and dried seeds.

### Various Species of Datura

1. Datura metal
2. Datura alba
3. Datura stramonium
4. Datura fastuosa
5. Datura candida (Pers) Saff.
6. Datura ceratocaula Ortega
7. Datura discolour Bernh.
8. Datura dolichocarpa (Lagerh) Saff
9. Datura ferox L.
10. Datura inoxia Mill.
11. Datura anoxia Mill.
12. Datura kymatocarpa Barclay
13. Datura leichhardtii Benth.
14. Datura reburra Barclay
15. Datura wrightii Regel

All these species belong to potato family Solanaceae. Several datura plants and species are used as drugs and many other species are treated as weeds [4].

### Common Species of Datura

#### Datura Alba (White datura)

Datura Alba bears white flowers and it grows naturally in Himalayas from Kashmir to Sikkim in India.

#### Datura Metal (Purple Datura)

Datura metal is used in ayurvedic medicine and religious purposes. It is widely used in asthma, persistence cough and pain disorders. Its effects are compared with codeine in persistent cough and all modern bronchodilators in asthma.

#### Datura Stramonium (Black Datura)

Datura stramonium is a source of a hypnotic drug known as stramonium. It has hypnotic and sedative effects (Figures 2-4).

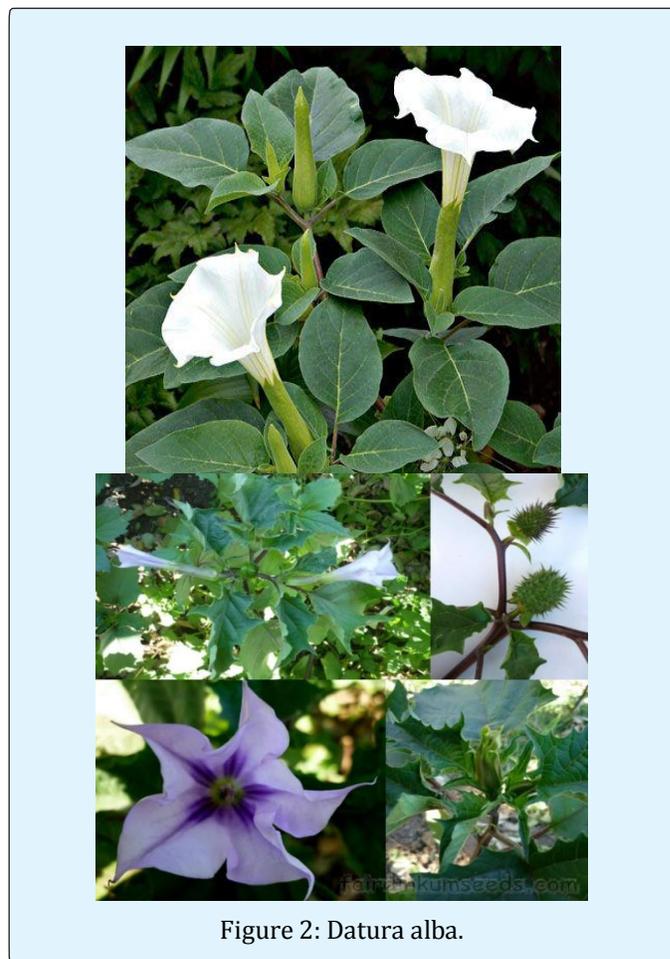


Figure 2: Datura alba.

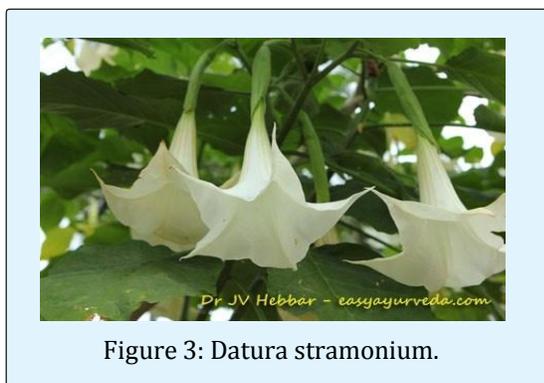


Figure 3: Datura stramonium.



Figure 4: Datura metel.

## Vernacular Names of Datura

### Classical Names

This plant is known with different names in Sanskrit. A few are Dhattura, Dhuttura, Dhustura, Kanaka, Unmatta, Matula, Shivapriya, Dhurta, Devata, Kitava, Toori, Mahamohi, Kanakahvaya, etc. Possible derivation for few such terms is provided in the below Tables 1 & 2 [5].

English	Thorn apple
Hindi	Dhattura, Kaladhattura
Bengali	Dhotra, Dhatura, Dhutura
Gujarati	Dhatura, Dhaturu, Dhanturo
Kannada	Unmatta, Unmatte-gida
Malayalam	Ummattu, Unmatta, Rotecubung, Ummam
Marathi	Dhotra, Dhatura
Punjabi	Dhattur, Dhattura
Tamil	Ummattai, Umate
Telugu	Ummetta, Ummatta
Bihari	Khunuk

Table 1: Different classical names in Sanskrit.

Unmatta	The drug that produces delirium
Kanaka/Kanakahva	The drug with synonyms of gold
Kitava Madana	That paralyses the function of the body parts
Shivapriya	Favourite of Lord Shiva
Dhustura	Drug causing giddiness and palpitation (with its delerient effect)
Dhattura	It destroys vitiated doshas and dhatus by its ushnaguna. Hence it cures diseases like vrana, sleshma vikaras, etc
Matula	No other drug is equal to its therapeutic effects or in other words there is no comparision of its efficacy with other drugs.

Table 2: Possible meanings synonyms of datura.

### Datura Stramonium

It is an herbaceous annual that grows from 0.3-1.5 m (1-5 ft.) tall. A single-stemmed plant can grow to cover an area up to 3 m (9.8 ft.) in diameter. The green to purplish stems of this plant are stout and hollow. The ovate to sub ovate leaves have long, stout petioles, a coarsely serrate margin, measure 5-20 cm (2-8 in.) long and are acuminate at their tips. The leaves have an unpleasant scent when

crushed or bruised [5].

### Description

Common as a weed growing in waste places and roadside throughout India, Sub-Himalayan tracts including North West Himalaya, Kashmir, Bihar, Orissa, West Bengal, Madhya Pradesh, open forests of Rajasthan, mountains of Deccan, Karnataka and Tamil Nadu [4].

## Ayurvedic Properties

Rasa, guna, virya, vipaka, prabhava, etc., of the plant are shown in Table 3.

Rasa	Tikta, Katu
Guna	Laghu, Ruksha, Vyavayi, Vikasi
Virya	Ushna
Vipaka	Katu Prabhava : Madaka
Doshaghnata	Kaphavatashamaka
Rogaghnata	Shotha, Vedana, Arsha, Vatavikara, Hridmandata, Nadimandata, Amlapitta, Parinamashoola, Pittashmari, Shwasa, Vrikkashoola, Ashmari, Shaiyyamootra, Rajahkrichchhra, Yuka, Liksha.
Karma	Jantughna, Vedanasthapana, Twagdosahara, Madaka, Antrashamaka, Shoolaprashamana, Hridayottejaka, Bastiavum Gavinisankochaka, Garbhashaya Prasaraka, Shukrastambhana, Swedavarodhaka

Table 3: Pharmacodynamics of Datura According to Ayurveda.

### Plant Parts Used

This plant is used as a whole in therapeutics. Its leaf, flower, and seed are also used individually for different purposes.

### Datura Seeds

Generally, datura seeds are used in Ayurveda, traditional Indian and alternative medicines. Before using datura in medicines, datura seeds require a series of detoxification and purification processes. These processes help to reduce the toxicity level in the human body and enhance medicinal value of datura. In raw form, datura seeds might be very dangerous and poisonous. The plant as a whole has anodyne, analgesic, sleep inducing and antispasmodic action.

### Datura Leaves

Datura leaves have bitter taste and similar characteristic odor like datura seeds. It is used in preparing herbal plasters. It is also used as anodyne and antispasmodic.

### Caution

Datura leaves are most poisonous part of datura plant. Leave contain high amount of poisonous alkaloids known as Daturine and albumen in addition to mucilage and ash. These alkaloids contain about 25% potassium nitrate.

Datura Parts used in medicines: Fresh Seeds, Fresh Leaves, Roots, Dried leaves, dried ripe seeds and Fruits. All parts have almost similar medicinal characteristics and same action in the body, but seeds are mostly commonly used in alternative and traditional medicines.

### Chemical Constituents

The plant contains different functional groups such as saponins, tannins, steroids, alkaloids, flavonoids, phenols and glycosides. Atropine and scopolamine are competitive antagonists of muscarinic cholinergic receptors and are central nervous system depressants. All parts of the plant are toxic but the highest amount of alkaloids is contained in the ripe seeds [6].

### Different Active Components at Different Parts of Datura Plant

- **Root:** 3 $\alpha$ , 6 $\beta$ -ditigloyloxytropine, 3 $\alpha$ , 6 $\beta$ -ditigloyloxytropan-7 $\beta$ -ol, tigloidine, apohyosine, hyosine, 3 $\alpha$ -tigloyloxytropan, norhyosine, meteloidine, hyosimine, cuscohygrine and tropine.
- **Pericarp:**  $\beta$ -sitosterol, scopolamine and fastusine.
- **Leaves:** Scopolamine and a mixture of two unidentified alkaloid.
- **Flower, leaves, aerial parts and roots:** Hyosine and hyoscyamine.
- **Fresh aerial parts:** With an olide, (17R, 20R 22R, 25R) -2125R-epoxy2-methoxy-1-oxowitha-2, 5-di enolide and hyosine and hyoscyamine.
- **Fruits:** Daturanolone and Daturadiol.
- **Seeds:** Scopolamine, atropine, fastunine, fastudine, fastusidine, daturanolone and fastusic acid.
- **Seedoil:** 4 $\alpha$  - methylsterols-31-nprlanost - 9(11) Enol.31 - norcrloartenol.Cycloeucaenol31- norlanost - 8 - enol. 31 - norlanosterol; obtusifoliol, 4 $\alpha$  - methyl cholesta - 8 - enol, lophenol.

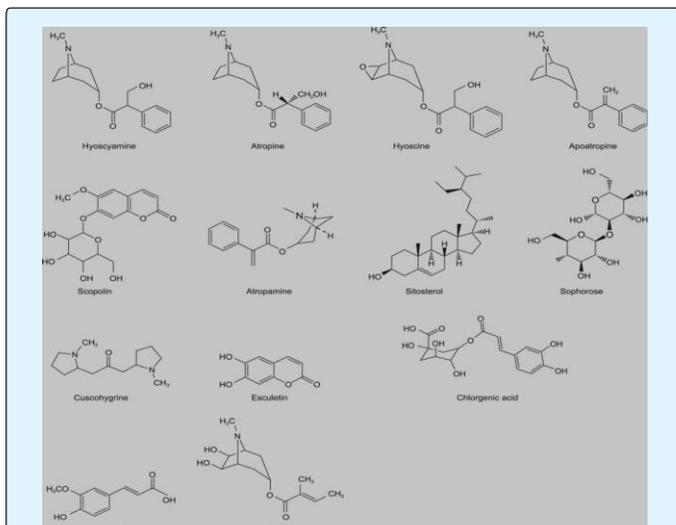


Figure 5: Active Components at Different Parts of Datura Plant.

- **Ingredients:** This mixture is given with cold water twice a day. This formulation is from the Sushruta samhita (Table 4).

Ingredients	Quantity
Datura root powder	125 mg
Punarnava Powder	5 grams

Table 4: The mixture of two Ingredients.

- **Alopecia Areata (Indralupta):** According to Vagbhata, datura leaves juice is applied on scalp in cases of alopecia areata.
- **Viral Conjunctivitis:** According to Harita samhita, datura root is crushed in water and strained the liquid. This datura water is used in instilling in eyes with viral conjunctivitis.
- **Intestinal Worms:** 5 to 6 drops of datura leaf juice is given to patients with buttermilk for getting rid of intestinal worms.
- **Breast Pain:** A paste is made from datura leaves and mixed with a small amount of turmeric. This paste is applied on the affect breast for relieving breast pain. Bhavamisra has described this remedy in his book bhavachikitsa.
- **Cracked Feet:** Make a paste of datura seeds and apply this paste on cracked feet. This application helps in treating cracked feet. Bhavamisra has also described this remedy in his book bhavachikista.
- **Schizophrenia:** Ayurvedic treatment of schizophrenia also includes the use of white datura root. Charkradatta

has described the following preparation in chapter Unmanda (Table 5).

Ingredients	Quantity
White datura root powder	125 mg
Milk	500 ml
Jaggery	5 grams
Ghee (clarified butter)	5 ml

Table 5: Mixture of components.

Take milk and add white datura root powder, jaggery and ghee. Boil the milk with all these ingredients and strain the milk in a glass. Give this mixture to patient suffering with schizophrenia.

- **Ear Infection with Pus:** Oil is prepared with various ingredients and datura leaf juice for ear infections. It works as antiseptic as well as antibiotic in ear infection.
- **Oil Ingredients:** (Table 6).

Ingredient	Quantity
Mustard oil	80 ml
Purified Sulphur/Gandaka	10 grams
Turmeric powder	10 grams
Datura leaf juice	320 ml

Table 6: Mixture of oil ingredients.

- 1) Take mustard oil and add all other three ingredients.
- 2) Simmer the mixture until oil remains.
- 3) Then strain the oil and discard residues.

This oil is instilled in ear with infections and pus. Ayurvedic scholar Charkradatta has given this formulation.

- **Filariasis or Elephantiasis (Elephant Feet Disease):** Datura seeds and Piper longum is used to treat filariasis.
- **Carbuncles:** Datura root paste is prepared with water and applied on the carbuncles. It helps to treat carbuncles and prevents scarring.
- **Rheumatoid Arthritis:** A juice prepared from datura, calotropis and castor leaves is applied on swelling and inflammation of joints due to rheumatoid arthritis.
- **Sciatica:** Hot paste of datura leaves is applied along the course of sciatica nerve to get rid of pain.
- **Asthma:** Datura seed oil is used for the treatment of asthma. Kanakasavam is prepared from datura, which is generally prescribed for asthma and productive cough in ayurvedic science.
- **Productive Cough:** The following formulation of datura is beneficial in cough (Table 7).

Ingredients	Quantity
Datura seed powder	50 mg
Long pepper	50 mg
Gum arabic (acacia gum)	Q.S.

Table 7: Mixture of Components Beneficial in Cough.

Tablets prepared in above ratio helps in relieving cough. This formulation is also used with honey without acacia gum. It is beneficial in productive cough.

**Epilepsy:** There are many formulation of datura used in ayurveda for epilepsy (Tables 8-12).

#### Datura Seeds with Saffron

Ingredients	Quantity
Datura seed powder	20 mg
Saffron	20 mg
Mishri	20 mg

Table 8: Seeds with Saffron.

#### Datura Seeds with Black Pepper

This mixture is given with butter in epilepsy.

Ingredients	Quantity
Datura seed powder	60 mg
Black pepper	60 mg

Table 9: Seeds with Black Pepper.

#### Diabetes Mellitus

This mixture is also beneficial in diabetes mellitus. In Diabetes mellitus, this mixture is given with Saunf ark.

Ingredients	Quantity
Datura seed powder	60 mg
Black pepper	60 mg

Table 10: Beneficial in diabetes mellitus.

#### Nightfall in Men

The tablets, prepared using following ingredients in given quantity are used to treat nightfall in men. Mix first three ingredients in powdered form and take this mixture with triphala water.

Ingredients	Quantity
Datura seed powder	30 mg
White cumin	30 mg
Coriander seeds	30 mg
Triphala water	Q.S.

Table 11: Ingredients in given quantities are used to treat nightfall in men.

#### Malaria Fever

Fresh Datura leaves are beneficial in malaria fever. A small amount of leaf paste is given with jaggery to lower the temperature in malaria.

#### Abdominal Pain

Abdominal pain may have many underlying causes. Some of these causes include gall bladder stone and kidney stone. In these conditions, datura and medicines containing datura are used to alleviate the pain.

#### Early Discharge in Men

The following formulation helps in early discharge in men.

Ingredients	Quantity
Datura seed powder	30 mg
Akarkara	30 mg
Clove	30 mg
This mixture is given with milk twice a day.	

Table 12: Formulation helps in early discharge in men.

#### Infertility in Women

Datura flowers are effective treatment of infertility in women. The dried powder of datura flowers in dosage of 120 mg is given with honey 10 days after menstruation. It is given for 5 to 7 days. This remedy is effective in infertility of unknown reason.

#### Excessive Sweating

Datura seed ash is given in dosage of one gram for seven days in patients complaining excessive sweating in hands and feet [7].

#### Toxicity of Datura

Administration of scopolamine in drinking water to pregnant rabbits on days 10-14 of gestation led to fetal deformities of eye. These malformations were observed in all living fetuses present in six different animals [4]. Lethal dose 50% (LD50) of petroleum ether extract was reported to be 5 times more potent than the aqueous extract. This difference in LD50 may be due to the presence of functional groups such as flavonoids, glycosides, and essential oil that are soluble in petroleum ether but insoluble in water [8].

The effects of acute, subacute and chronic administration of atropine and scopolamine were studied in male Albino-Wistar rats. After acute intraperitoneal (i.p.) administration of dose 100 mg/kg (1/4 DL50) of total alkaloids to the seeds of Datura, there were no remarkable changes in general appearance and no deaths occurred in any experimental groups. 24 h after total alkaloids of

seeds, a significant reduction in liver, spleen and brain was observed. Red blood cells, hematocrit, haemoglobin and white blood cells were significantly higher in the treated groups than the control group.

There were no statistical differences in glutamic-oxaloacetic transaminase, glutamic pyruvic transaminase and alkaline phosphatase observed between the groups. Histological examination of liver showed no histopathological changes. Subacute study for 4 weeks showed no resulting mortality or signs of toxicity [9]. Synthetic alkaloids in higher doses for prolonged periods are reported to be toxic [10].

Careful consideration of the toxicity of the plant is required before its use. Its ingestion induces characteristic symptoms such as dry mouth, intense thirst, blurred vision, mydriasis and increased heart rate followed by hallucinations, delirium and loss of motor coordination leading to comma and ultimately to death by respiratory failure [11]. Classics also considered this spp. under the category of Upavisha (semi-poisonous drugs) [12] and emphasized on different processing techniques (Shodhana) before their application in therapeutics to avoid possibilities of toxicity. By passing such classical guidelines will affect adversely and may even lead to death.

## Pharmacological Activities

### Antiasthmatic Activity

*D. stramonium* contains a variety of alkaloids, including atropine and scopolamine, having an anticholinergic and bronchodilating activity. Atropine and scopolamine act on the muscarinic receptors by blocking them (particularly the M2 receptors) on airway smooth muscle and submucosal gland cells, which dilate bronchial smooth muscle and ease asthmatic attacks. Charpin, et al. [13] reported that using *D. stramonium* as an antiasthmatic, cigarette is an effective bronchodilator in asthmatic patients with mild airway obstruction. However, the exposure of *D. stramonium* to the fetus when a mother uses it for asthma will cause a continuous release of acetylcholine, resulting in the desensitizing of nicotinic receptors, which could ultimately result in permanent damage to the fetus [14].

### Epilepsy

Though the antiepileptic activity of *D. stramonium* has not been reported yet, combination therapy with other herbs has the protective effect on status epilepticus. An experimental model of status epilepticus was induced in

male rats by a single systemic injection of lithium (3 mmol/kg) and pilocarpine (30 g/kg). Rats were then treated with herbal mixture containing *D. stramonium*. One week after the induction of status epilepticus, the rat group treated with extracts of *Scutellaria lateriflora* (Skullcap), *Gelsemium sempervirens* (Gelsemium) and *D. stramonium* (Jimson Weed) displayed no seizure during treatment.

The results of this experiment strongly suggest that the appropriate combination of herbs with *D. stramonium* may be helpful as adjunctive interventions to treat epilepsy [15].

### Organophosphate Poisoning

Since *D. stramonium* contains atropine and other anticholinergic compounds, it is a useful remedy for the central cholinergic symptoms of organophosphate (OP) poisoning. Bania, et al. [16] determined the beneficial effect of *Datura* seed extracts following a severe OP poisoning. According to their experiment, *D. stramonium* seeds were heated in water to make 2 mg/mL atropine solution and administered to male rats as a single intraperitoneal injection 5 min before the subcutaneous injection of 25 mg/kg of dichlorvos. Pretreatment with *Datura* seed extracts significantly increased survival in a rat model of severe OP poisoning.

### Antimicrobial Activity

The methanol extracts of aerial parts of *D. stramonium* showed the bactericidal activity against Gram-positive bacteria in a dose-dependent manner. However, little or no antibacterial activity was found against *Escherichia coli* and *Pseudomonas aeruginosa* [17]. Ethanol extract exhibited the highest inhibitory activity against *Klebsiella pneumonia* followed by *Staphylococcus aureus*, with the least activity against *Salmonella typhi*. The aqueous extract showed activity on only *S. aureus*, while *Neisseria gonorrhoea* was resistant to both extracts [18]. *D. Stramonium* was very effective as vibriocidal against various strains of *Vibrio cholera* and *Vibrio parahaemolyticus*. The minimum inhibitory concentration (MIC) value of acetone extracts of *D. stramonium* was in the range of 2.5 to 15 mg/mL serving as broad-spectrum vibriocidal agents [19].

### Antifungal Activity

Mdee LK, et al. [20] have been reported Acetone extracts of *D. stramonium* to have antifungal activity against several fungi including *Penicillium expansum*, *Aspergillus niger*, *Aspergillus parasiticus*, *Colletotrichum gloeosporioides*, *Fusarium oxysporum*, *Trichoderma*

harzianum, *Phytophthora nicotiana*, *Pythium ultimum* and *Rhizoctonia solani*. The MIC of *D. stramonium* extracts ranges from 1.25 to 2.5 mg/mL.

### Anti-Inflammatory Activity

The ethanolic extract of *D. stramonium* leaf showed significant anti-inflammatory activity against carrageenan induced paw edema in rats. In one experiment [21], 39.43% inhibition of the edema was observed after 3 h of oral administration of 200 mg/kg extracts. Maximum activity was observed when the extract was administered in doses of 3-hour intervals. Since the extract of *D. Stramonium* inhibited the carrageenan-induced edema that involves the release of histamine and serotonin in the first phase, release of histamine and serotonin in the first phase, the inhibitory effect of the extracts could be partly due to inhibition of mast cell mediator release [21].

### Acaricidal, Repellent and Oviposition Deterrent Properties

*Datura* plant generates a characteristic odor that acts as repellent for various insects and pests. Kurnal, et al. [22] have reported that the ethanol extracts of *D. stramonium* leaf and seed showed potent acaricidal, repellent, and oviposition deterrent activity against adult two-spotted spider mites (*Tetranychus urticae*) under laboratory conditions. Leaf and seed extracts which were applied in 167.25 and 145.75 g/L concentrations (using a Petri leaf disc-spray tower method), caused 98% and 25% mortality among spider mite adults after 48 h, respectively. These results suggest that *D. stramonium* could be used to manage the two-spotted spider mite.

### Other Activities

*D. stramonium* was reported to have anticancer effect against human epidermal carcinoma of the nasopharynx at a therapeutic dose of 0.05 to 0.1 g. However, precaution should be taken while using *Datura* as an anticancer agent since adverse anticholinergic effects may occur [23]. The half lethal dose (LD50) for ethanolic extracts of *D. stramonium* leaves showed potential larvicidal and mosquito repellent activities against *Aedes aegypti* (LD50: 86.25 mg/L), *Anopheles stephensi* (LD50: 16.07 mg/L) and *Culex quinquefasciatus* (LD50: 6.25 mg/L) [24].

### Few Formulations

A huge number of formulations with *Datura* as an ingredient have been mentioned in Ayurveda classics. It is not possible to enlist them in this attempt, but a few are enlisted in Table 13.

Kanakasava	Bhaishajya Ratnavali Hikkaswaschikitsa16/115-119
Pralapantaka Rasa	Bhaishajya Ratnavali 24/379-382
Unmadaganjakusha Rasa	Bhaishajya Ratnavali 24/383-385
Kanaka Sundararasa	Rasendra Sara Sangraha  Waratisara Chikitsa26-27
Lakshmi Vilasarasa	Rasendra Sara Sangraha Vatavyadhi Chikitsa 45-48
Unmattarasa	Sharangadhara Madhyama 12/135
Mahajwaran Kusharasa	Sharangadhara Madhyama 118/119
Bruhatkanaka Sundararasa	Rasendra Sara Sangraha Jwaratisara Chikitsa 34-35
Tribhuvana Kirtirasa	Yoga Ratnakara Jwarachikitsa
Kanaka Prabhavati	Rasendra Sara Sangraha Jwaratisara Chikitsa 28-29
Grantishothanivarikavarti	Rasa Tarangini 24/386-388 Datura taila Bhaishajya Ratnavali Shirorogdhikara/93

Table 13: Few formulations of *Datura*.

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