



Datura Stramonium (*Dhatura*) - Pharmacological Actions, Therapeutic Uses and Phytochemistry - A Review

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Abstract

Dhatura (*Datura stramonium*) is a wild weed belonging to family Solanaceae, is used for its healing properties. Various species of *Dhatura* are known such as *Datura innoxia*, *Datura metel*, *Datura stramonium* and *Datura wrightii*. And widely employed for their medicinal and toxic properties that are based upon more than 30 alkaloids, *Datura stramonium* is a commonly known natural plant throughout the world for its hallucinogenic effects. It is also known to produce other effects such as euphoria. It has *Munawwim* (Sedative), *Mohallil* (Resolvent), *Musakkin-e-Hararat* (Febrifuge), *Musakkir* (Narcotic), *Mujaffif* (Desiccant), *Muqi* (Emetic), *Mushtahi* (Appetiser), *Mukhaddir* (Anesthetic), *Musakkin* (Analgesic), *Rade* (Repellent) and *Muqawwi-e-Bah* (Aphrodisiac) etc. properties. It is used in *Bawaseer* (Haemorrhoids), *Dard-e-Sar* (Headache), *Humma* (Fever), *Haraq* (Burn), *Hudar* (Rheumatism), *Ganj* (Baldness), *Iraqunnisa* (Sciatica), *Inteshar-e-Shaar* (Hair Falling), *Isti sqa* (Ascites), *Juzam* (Leprosy), *Qurooh* (Wound), *Tashannuj* (Convulsions) and *Waja-ul-Mufasil* (Arthralgia) etc. In this paper, an effort has been made to compile the actions, therapeutic uses, phytochemical and pharmacological studies of *Dhatura* (*Datura stramonium*).

Keywords

Dhatura, *Datura stramonium*, *Musakkir*, Narcotic, Analgesic, *Mukhaddir*.

INTRODUCTION



Datura stramonium is commonly known as thorn apple or jimson weed or Mad Apple. It is native to deserts of the North American Southwest, Central and South America, Europe, Asia, and Africa. It is mainly distributed in the Himalaya region from

Kashmir to Sikkim up to 2700 m, in the hilly district of central and south India, and widely grows all over India. It is a large and coarse shrub of about 3 to 4 feet in height. The flowers are large and corollas are 6 cm long. The fruit is a large, four ovaled ovate capsule, very thorny and contains numerous black to dark brown seeds. The stems are simple, stout and mostly erect. The leaves are large, approximately 20 cm long and oval like with a wavy and coarsely dentate margin. The root is long, thick and tapering and somewhat branched. The *Mijaz* (Temperament) of *Datura* is Cold 4⁰ and Dry 4⁰ stage as its property it is used in very small quantity. It is a Unani medicinal plant with a broad range of medicinal applications such as antinociceptive, antioxidant, hypolipidemic, anti-rheumatoid and hypoglycemic properties. Dried leaves of *Datura stramonium* is used to cure asthma. (Singh *et al.*, 2013; Maheshwari *et al.*, 2013; Hakeem, 2002).

VERNACULAR NAMES

Afghani	:	Kachola
Africans	:	Olieblaar, Olieneut, Pietjie, Laporte StinkBlaar
Adkim	:	MofraDhweneain, Pepadiawu
Arabic	:	Jauzmasal
Ashanti	:	Pepediawu
Bengali	:	Sadadhutura
Brazil	:	Estramonio, Figueirado Inferno
Canarese	:	Bilidattura, Biliummatta, Dattura, Dhattura, Datururi,
Catalan	:	Estramoni, Figura Infernal Borda, HerbaTaupera
Chinese	:	Chan KiueTse, TouKiueEul, Tsoui Sin Hoa
Dutch	:	Doornappel
English	:	Apple Of Peru, Devils Apple, Devils Trumpet, Dewtry, Jamestown Weed, Jimson Weed, Mad Apple, Stink Weed, Thorn Apple
French	:	Chasse Taupe Endormeuse, Endormine, Estramon, Herbe
German	:	Asthmakraut, Botschen, Dolkraut, Dornapfel, Nagwart,
Greek	:	Strychnos Manikos
Hungarian	:	Maszag, Tsattanto
Italian	:	ImbutoneBlanco, NoceSpinosa, Pomo Spinosa, Stramonio
Loralai	:	Shinah Azghi
Malayalam	:	Matulam, Ummam, Ummata
Maxican	:	Tlaplat
Norwegian	:	Piggeple
Persian	:	Nanulah, Tatulah
Polish	:	Psinki
Portuguese	:	Estramonia Figueira Do Inferno
Punjabi	:	Dattura, Tattur
Roumanian	:	Bolandarita
Russian	:	Durman, Durnishnik
Sanskrit	:	Devika, Dhattura, Ghantika, Kitava, Madakara, Madana

South Africa	:	Apple Peru, Devils Apple, Devils Trumpet, Dewtry
Spanish	:	Estramonio, Higueraloca, Trompetilla
Suto	:	Mphufi, Letsowe, Lethsowi
Swedish	:	Spikklubbs
Tamil	:	Emanamam, Simaiyumatti, Turutturam, Umattai
Tonga	:	Zabazaba
Tulu	:	Umbe
Turkish	:	Tatule
Urdu	:	Dhatura
Uriya	:	Dhutura, Sukladhutura

(Ibn Baitar, 2006; Ghani, ynm; Anonymous, 2004; Kabiruddin, 2000; Ghulam, 2007; Kritkar and Basu, 2005)

DESCRIPTION ACCORDING TO UNANI CLASSICAL LITERATURE

The author of *Khazainul advia*, *Najmulghani* mentions about five (5) varieties of the drug according to flowers color

- i. Flowers of white color
- ii. Flowers of blue color
- iii. Flowers of red color
- iv. Flowers of yellow color
- v. Flowers of black color

The author of *Makhjanul mufradat*, Kabiruddin mentions about two (2) varieties of the drug

- i. Flowers of white color
- ii. Flowers of bluish color

PARTS USED

Leaves, seeds, flowers, root (Anonymous, 2004; Kabiruddin, 2000; Ghulam, 2007)

MIJAZ

Cold 4⁰ and Dry 4⁰ (Hakeem, 2002; Hakeem, 2009; Ghani, ynm; Anonymous, 2004; Kabiruddin, 2000; Ghulam, 2007)

DOSE

250mg -750 mg	(Hakeem, 2002)
500 -700 mg	(Anonymous, 2004)
3 grams	(Ghulam, 2007)
1-2 grams	(Kabiruddin, 2000)
1-3 grain up to 750 mg	(Ghani, ynm)

ACTIONS

ACTION	REFERENCE
<i>Dafa-e-Tashanuj</i> (Antispasmodic)	Ghani, ynm; Kabiruddin, 2000; Anonymous, 2007
<i>Mana-e-Arq</i> (Antihydrotic)	Ghani, ynm
<i>Hazim</i> (Digestive)	Ghani, ynm
<i>Munawwim</i> (Sedative)	Kritkar and Basu, 2005; Ghani, ynm; Ghulam, 2007; Hakeem, 2002; Kabiruddin, 2000; Ibn Baitar, 2006
<i>Muqawwi-e-Bah</i> (Aphrodisiac)	Ghani, ynm; Kritkar and Basu, 2005
<i>Mohallil</i> (Resolvent)	Ibn Baitar, 2006; Anonymous, 2007; Ghani, ynm; Kirtkar and Basu, 2005; Ghulam, 2007; Hakeem, 2002; Kabiruddin , 2000
<i>Mumsik</i>	Ghani, ynm; Ghulam, 2007; Hakeem, 2002
<i>Musakkin-e-Hararat</i> (Febrifuge)	Kritkar and Basu, 2005; Ghulam, 2007; Ghani, ynm; Kabiruddin 2000; Anonymous, 2007

ACTION	REFERENCE
<i>Mumsik-e-Mani</i>	Ghani, ynm
<i>Musakkir</i> (Narcotic)	Ibn Baitar, 2006; Kritikar and Basu, 2005; Ghulam, 2007; Ghani, ynm; Hakeem, 2002; Kabiruddin, 2000; Anonymous, 2007; Khan, 1874
<i>Mujaffif</i> (Desiccant)	Hakeem, 2002; Kabiruddin, 2000; Hakeem, 2009
<i>Muqi</i> (Emetic)	Kritikar and Basu, 2005; Ghani, ynm; Ibn Baitar, 2006
<i>Mushtahi</i> (Appetiser)	Ghani, ynm
<i>Mukhaddir</i> (Anasthetic)	Kritikar and Basu, 2005; Ghani, ynm; Ghulam, 2007; Kabiruddin, 2000; Anonymous, 2007; Hakeem, 2002; Ibn Baitar, 2006
<i>Musakkin</i> (Analgesic)	Hakeem, 2002; Kirtikar and Basu, 2005; Ghani, ynm; Kabiruddin, 2000; Ghulam, 2007; Anonymous, 2007; Hakeem, 2009; Khan, 1874
<i>Rade</i> (Repellant)	Hakeem, 2002
<i>Mundamil-e-Qurooh and Jakhm</i>	Kritikar and Basu, 2005; Ghani, ynm
<i>Qatil-e-Deedan</i> (Anthelmentic)	Ghani, ynm; Kirtikar and Basu, 2005; Ghulam, 2007; Kabiruddin, 2000
<i>Qatai wa Mukhrij-e-Balgham</i> (Expectorant)	Ghulam, 2007

THERAPEUTIC USES

CLINICAL INDICATION	REFERENCE
<i>Aatishak</i> (Syphilis)	Ghani, ynm
<i>Aasoob-e-Chasham</i> (Conjunctivitis)	Hakeem, 2002; Ghani, ynm
<i>Amraz-e-Jild</i> (Skin disease)	Ghani, ynm; Kritikar and Basu, 2005
<i>Bars</i> (Leucoderma)	Ghani, ynm; Kritikar and Basu, 2005
<i>Basoor</i> (Boils)	Ghani, ynm; Kritikar and Basu, 2005; Kabiruddin, 2000
<i>Bawaseer</i> (Haemorrhoids)	Hakeem, 2002; Ghulam, 2007,1992; Kirtikar and Basu, 2005
<i>Dard-e- Sar</i> (Headache)	Kirtikar and Basu, 2005; Ghani, ynm; Ghulam, 2007; Hakeem, 2002; Kabiruddin, 2000
<i>Huma</i> (Fever)	Ghani, ynm; Hakeem, 2002; Kabiruddin, 2000; Anonymous, 2007
<i>Haraq</i> (Burn)	Kritikar and Basu, 2005; Ghani, ynm
<i>Hudar</i> (Rheumatism)	Kritikar and Basu, 2005
<i>Ganj</i> (Baldness)	Ghani, ynm
<i>Irqunnisa</i> (Sciatica)	Kritikar and Basu, 2005; Kabiruddin, 2000

<i>Inteshar-e-Shaar</i> (Hair Falling)	Ghani, ynm; Kritikal and Basu, 2005
<i>Istisqa</i> (Ascites)	Hakeem, 2002; Kritikal and Basu, 2005
<i>Juzam</i> (Leprosy)	Gahni, ynm
<i>Jiryani-e-Mani</i>	Gahni, ynm
<i>Kharish</i> (Itching)	Ghani, ynm; Kabiruddin, 2000; Kritikal and Basu, 2005; Ghulam, 2007
<i>Khansi wa Nazla</i> (Cough and Cold)	Ghani, ynm; Kabiruddin, 2000; Kritikal and Basu, 2005; Anonymous, 2007
<i>Khafkan</i> (Palpitation)	Ghani, ynm
<i>Mouch</i> (Sprain)	Kritikal and Basu, 2005
<i>Niqrous</i> (Gout)	Ghani, ynm; Kabiruddin, 2000; Anonymous, 2007; Kritikal and Basu, 2005
<i>Qatil-e-Deedan</i> (Antihelmithic)	Anonymous, 2006; Kabiruddin, 2000; Kritikal and Basu, 2005; Ghulam, 2007
<i>Qurooh</i> (Wound)	Kritikal and Basu, 2005
<i>Suaal</i> (Cough)	Ghani, ynm; Kritikal and Basu, 2005
<i>Tashannuj</i> (Convulsions)	Hakeem, 2002; Kareem, 1879; Khan, 1313; Shirazi, ynm; Ghani, ynm
<i>Waja-ul-Mufasil</i> (Arthralgia)	Ghani, ynm; Kabeerudin, 2000
<i>Warm-e-Shobatein</i> (Bronchitis)	Ghani, ynm; Kritikal and Basu, 2005
<i>Waja-ul-Uzn</i> (Otagia)	Ghani, ynm
<i>Waja-ul-Asnan</i> (Toothache)	Kritikal and Basu, 2005
<i>Yarqan</i> (Jaundice)	Ghani, ynm; Kritikal and Basu, 2005
<i>Zeequnnafs</i> (Asthma)	Ghani, ynm; Hakeem, 2002; Kabiruddin, 2000; Kritikal and Basu, 2005; Anonymous, 2007
<i>Zof-e-Ishtaha</i> (Loss of appetite)	Ghani, ynm

BOTANICAL DESCRIPTION

Habit and Habitat

Datura stramonium is native to deserts of the North American Southwest, Central and South America, Europe, Asia, and Africa. It is mainly distributed in the

Himalaya region from Kashmir to Sikkim up to 2700 m, in the hilly district of central and south India, and wildy grows all over India. (Khare, 2007; Ananth, 2013).

PLANT DESCRIPTION

SCIENTIFIC CLASSIFICATION

Kingdom	:	Plantae
Order	:	Solanales
Family	:	Solanaceae
Genus	:	<i>Datura</i>
Species	:	<i>stramonium</i>

Datura stramonium is a large and coarse shrub of about 3 to 4 feet in height. On rich soil, it may even reach the height of 6 feet. The root is large, whitish in color, with a taproot system. The stem is green or purple, hairless, cylindrical, erect and leafy, smooth, branching repeatedly in a forked manner. Leaves and a single, erect flower arise through the forks of the branches. The alternate leaves are ovate or ovate-cordate in outline, but pinnately lobed. These lobes are somewhat shallow and point at their tips, there are usually 2 to 3 of these lobes on each side of the leaf blade. Leaves are cauline and ramal, exstipulate, up to 8 cm long and 6 cm across, petiolate, simple, dissected, acute, glabrous, unicosted, and arranged in reticular venation. The upper surface is dark and grayish green, generally smooth, whereas the underside is pale and when dry, minutely wrinkled. Leaves, when bruised, exude a rank, heavy, and somewhat nauseating narcotic odor. The flowers are ebracteate, ebracteolate, pedicellate, actinomorphic, bisexual, complete, regular, pentamerous, except fourth whorl and are hypogynous. They are sweet-scented and can produce stupor if breathed for a prolonged period of time. Each flower is replaced by a hard fruit that is dry and spiny, and spheroid-ovoid in shape. Underneath, each fruit is a truncated remnant of the calyx that curves sharply down. These fruits are initially green, but become brown with maturity, they divide into four segments to release the seeds. The seeds are dull, irregular and dark-colored, their surface may be pitted or slightly reticulated (Das *et al.*, 2012; Preissel, 2002; Ananth, 2013; Sayyed and Shah, 2014; Sanni *et al.*, 2014).

MICROSCOPIC EXAMINATION

Seeds -Shows in outline more or less elongated, irregular or wavy structure having bulgings at either side; testa single layered consists of thick-walled, lignified, sclerenchymatous cells forming club-shaped structure, followed by 3-5 layered more or less tangentially elongated, thin-walled, parenchymatous cells, endosperm encloses more or less curved embryo composed of polygonal, thin-walled, parenchymatous cells, filled with aleurone grains and abundant oil globules.

Powder-Brown and oily, shows fragments of testa of groups of thick-walled, light brown sclerenchymatous cells, polygonal, thin-walled parenchymatous cells containing oil globules and aleurone grains. (Anonymous, 2007).

PHYTOCHEMICAL STUDIES

Phytochemical studies of *Datura stramonium* have been conducted since the early 1930s. The major phytochemicals isolated from *Datura stramonium* are tropane alkaloids, atropine and scopolamine. It is reported that the whole plant contains 0.26% alkaloids. Seeds of *Datura* contain the alkaloid daturine, first isolated, purified and crystallized in 1833. Later, Ladenburg differentiated daturine into atropine and hyoscyamine, the latter alkaloid predominating. Schmidt, however, contended that atropine predominates. The seeds contain fatty oil (25%), from which a new fatty acid, daturic acid (C₁₇H₃₄O₂), was isolated. Dohme concluded that the stems contain more alkaloids (0.3% to 0.4%, volumetrically) than even the seeds (0.25% to 0.29%), and the seeds contain more alkaloid than the leaves (0.21% to 0.23%, and 0.27% for green leaves) (Khare, 2007).

Berkov *et al.*, (2003) suggested hyoscyamine as the main alkaloid in both diploid and tetraploid hairy root cultures of *Datura stramonium*. Iranbakhsh *et al.*, (2006) reported the percentage of atropine and scopolamine in different developmental stages and the parts of the *Datura*. Their study suggested that

the root contained lower levels of scopolamine than that of atropine and the same goes for the stem. In stems, atropine was almost three times higher than scopolamine. However, leaves and seeds contained higher level of scopolamine than that of atropine.

Li *et al.*, (2012) reported the different alkaloids from *Datura stramonium* seeds such as N-trans-feruloyltryptamine, hyoscyamilactol, scopoletin, umckalin, daturaolone, daturadiol, N-trans-ferulicacyltyramine, cleomiscosin A, fraxetin, 1-acetyl-7-hydroxy-beta-carboline and 7-hydroxy-beta-carboline-propionic acid.

Sixty-four tropane alkaloids have been detected from *Datura stramonium*. Two new tropane alkaloids, 3-phenylacetoxy-6, 7-epoxynortropine and 7-hydroxyl apoatropine were tentatively identified. (Devi *et al.*, 2011).

PHYSICOCHEMICAL PROPERTIES

Physical constants	Values
Foreign matter	Not more than 2 %
Total Ash	Not more than 6 %
Acid-insoluble ash	Not more than 1 %
Alcohol-soluble extractive	Not less than 5 %
Water-soluble extractive	Not less than 7 %

PHARMACOLOGICAL STUDIES

Analysis of the leaves revealed the presence of phytochemicals such as alkaloids, flavonoids, phenolic acids, tannins, saponins, glycosides, steroids, terpenoids, oxalate and phytate. Phenolic compound possess biological properties such as antiapoptosis, antiaging, anticarcinogen, antiinflammation, as well as inhibition of angiogenesis and cell proliferation activities (Han *et al.*, 2007).

Anti-inflammatory study

Sonika *et al.*, (2010) was studied that the ethanolic extract of *Datura stramonium* leaf showed significant anti-inflammatory activity against carrageenan induced paw edema in rats. In one experiment 39.43% inhibition of the edema was observed after 3 hour 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 *Datura stramonium* inhibited the carrageenan-induced edema that involves the 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.

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Antimicrobial study

In a study by Gul *et al.*, (2012) the *Datura stramonium* branches and leaves sample in three different solvents benzene, chloroform and ethanol was extracted and assessed for antibacterial and antifungal activity. The antibacterial activity was checked against Enterobacter, Micrococcusluteus, Pseudomonas aeruginosa, E.coli, Staphylococcus aureus and Klebsiella pneumonia. *Datura stramonium* chloroform extract produced maximum zone of inhibition 16 ± 0.7 mm against Enterobacter while minimum of 7 ± 0.7 mm against K. pneumonia. Benzene extract of the plant exhibited maximum of 15 ± 0.7 mm of zone of inhibition against Enterobacter and M. luteus while minimum of 9 ± 0.3 mm against S. aureus and K. pneumonia and ethanol extract of *Datura stramonium* gave maximum zone of inhibition against K. pneumonia while minimum against E.coli. The MBC values revealed that benzene extract (3.12mg/ml) was effective against P. aeruginosa while same concentration of chloroform extract was very active against S. aureus, P. aeruginosa and M. luteus. All the extracts of *Datura stramonium* have shown significant antifungal activity against Saccharomyces cerevisiae, Aspergillus fumigatus and Aspergillus niger with maximum antifungal activity against S. cerevisiae and zone of inhibition was about 16 ± 0.2 mm by ethanol

extract, 15 ± 0.3 mm by chloroform and 14 ± 1.6 mm by benzene extract while minimum antifungal activity was observed against *A. niger*.

Iranbakhsh *et al.*, (2010) studied that the effects of methanolic extract from root, stem and leaf of *Datura stramonium* on the vegetative and generative phases of the growth process of four bacterial strains (*Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus epidermidis* and *Bacillus subtilis*) and four fungi strains (*Fusarium semitectum*, *Fusarium colmorum*, *Ceratocystis ulmi* and *Rhizoctonia solani*). The result showed that the methanol extract from green leaf explant callus had inhibitory effects on the growth of *B. subtilis* and *S. epidermidis* with inhibition zones of 22 and 23 mm, respectively. An inhibition effect of the methanol extract from clear callus on the growth of *E. coli* was observed with (inhibition zone of 17 mm). An effect of the methanol extract from organogenesis callus on the growth of *C. ulmi* was observed. The inhibition effect of the methanol extract of green callus on the growth of *F. semitectum* was observed (Inhibition zones 17 mm). An effect of the methanol extract from green callus on the growth of *F. colmorum* was observed. Eftekhari *et al.* (2005) studied that the methanol extracts of aerial parts of *Datura 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*. Another study carried by Shagal *et al.*, (2012) showed that Ethanol extract exhibited the highest inhibitory activity against *Klebsiella pneumoniae* 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.

Sharma *et al.*, (2009) showed that *Datura 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 *Datura stramonium* was in the range of 2.5 to 15 mg/mL serving as broad-spectrum vibriocidal agents.

Antifungal study

Acetone extracts of *Datura stramonium* have been reported to have antifungal activity against several fungi including *Penicillium expansum*, *Aspergillus niger*, *Aspergillus parasiticus*, *Colletotrichum gloeosporioides*, *Fusarium oxysporum*, *Trichoderma harzianum*, *Phytophthora nicotiana*, *Pythium multivium* and *Rhizoctonia solani*. The MIC of *Datura stramonium* extracts ranges from 1.25 to 2.5

mg/mL. The fungicidal effects of the extracts indicate the potential of *Datura stramonium* seeds as a natural source of antifungal agent (Mdee *et al.*, 2009).

Antiasthmatic study

Pretorius *et al.*, (2006) reported that *Datura stramonium* contains a variety of alkaloids, including atropine and scopolamine, having anticholinergic and bronchodilating activity. Atropine and scopolamine act on the muscarinic receptors by blocking them (particularly the M₂ receptors) on airway smooth muscle and sub mucosal gland cells, which dilate bronchial smooth muscle and ease asthmatic attacks.

Charpin *et al.*, (1979) reported that using *Datura stramonium* as an antiasthmatic cigarette is an effective bronchodilator in asthmatic patients with mild airway obstruction. However, the exposure of *Datura 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.

Antiepileptic study

Though the antiepileptic activity of *Datura 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 *Datura stramonium*. One week after the induction of status epilepticus, the rat group treated with extracts of *Scutellaria lateriflora* (Skullcap), *Gelsemium sempervirens* (Gelsemium) and *Datura stramonium* (Jimson Weed) displayed no seizure during treatment. The results of this experiment strongly suggest that the appropriate combination of herbs with *Datura stramonium* may be helpful as adjunctive interventions to treat epilepsy (Peredery *et al.*, 2004).

Organophosphate poisoning study

Since *Datura stramonium* contains atropine and other anticholinergic compounds, it is a useful remedy for the central cholinergic symptoms of organophosphate (OP) poisoning. Bania *et al.*, (2004) determined the beneficial effect of *Datura* seed extracts following a severe OP poisoning. According to their experiment, *Datura 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.

Acaricidal, repellent and oviposition deterrent study

Datura plant generates a characteristic odor that acts as repellent for various insects and pests. Kurnal *et al.*, (2010) have reported that the ethanol extracts of *Datura 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 *Datura stramonium* could be used to manage the two-spotted spider mite.

Anticancerous study

Datura 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 (Balachandaran & Rajgopal, 2005).

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