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## REVIEW ARTICLE

PHYTOCONSTITUENTS AND THERAPEUTIC POTENTIALS OF *DATURA STRAMONIUM* LINN

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## ABSTRACT

*Datura stramonium* Linn is one of the widely well known folklore medicinal herb. It is a wild growing flowering plant and was investigated as a local source for tropane alkaloids which contain a methylated nitrogen atom (N-CH<sub>3</sub>) and include the anti-cholinergic drugs atropine, and scopolamine. This plant has contributed various pharmacological actions in the scientific field of Indian systems of medicines like analgesic, antiasthmatic activities. The present paper will give exclusive information on the chemical constituents and mainly psychopharmacological activities of this plant. *Datura stramonium* has been scientifically proven to have alkaloids, tannins, carbohydrates, proteins. This study highlights the pharmacological activities of *Datura stramonium*, which may be due to the presence of its scientifically proven chemical constituents.

Keywords: *Datura stramonium*, phytochemistry, ethnopharmacology, pharmacology.

## INTRODUCTION

From ancient civilization it was traditionally used for religious visionary purposes throughout the world and used for witchcraft in medieval Europe. The god Lord Shiva was known to smoke Cannabis and *Datura*. People still provide the small thorn apple during festivals and special days as offerings in Shiva icons at temples. An extract made from the leaves is taken orally for asthma and sinus infections and stripped bark are applied externally to swellings, burns and ulcers<sup>1</sup>. The incidence of *D. stramonium* poisoning is sporadic with a cluster of poisoning cases in the 1990s and 2000s, the United States media contained stories occurring mostly among adolescents and young adults dying or becoming seriously ill from ingesting. Some medicinal uses of the plant are its anti-inflammatory property of all part of the plants<sup>2</sup>, stimulation of the central nervous system (CNS)<sup>3</sup>, respiratory decongestion<sup>4</sup>, treatment of dental and skin infections, alopecia<sup>5,6</sup> and also in the treatment of toothache<sup>7</sup>. It is a hallucinogenic plant that causes serious poisoning. Consumption of any part of the plant may result in a severe anticholinergic reaction that may lead to toxicity and occasionally cause diagnostic difficulties<sup>8</sup>. Cases of poisoning have been reported after eating the berries; death may occur from heart failure after ingesting 125 seeds<sup>9</sup>, because the seeds contain the highest concentration and has a rapid onset of action<sup>10</sup> and thus may be potentially useful as an alternative to atropine for the treatment of the muscarinic symptoms of organophosphate toxicity and some of central anticholinergic effects<sup>11</sup>. The wide distribution, the strong toxicity and the potential for occurrence in foodstuffs are responsible for the numerous incidents in humans<sup>12-17</sup>.

## Vernacular Names:

Sanskrit	: Dhastura
Bengali	: Dhattura
English	: Angel's Trumpet
Gujrati	: Unmatta
Hindi	: Dattura
Marathi	: Kanaka
Malayalam	: Marau mmam
Tamil	: Ummatta

## Taxonomical Classification:

Kingdom	: Plantae
Subkingdom	: Tracheobionta
Superdivision	: Spermatophyta
Division	: Magnoliophyta
Class	: Magnoliopsida
Subclass	: Asteridae
Order	: Solanales
Family	: Solanaceae
Genus	: <i>Datura L</i>
Species	: <i>Stramonium</i>

## Botanical description

Jimson weed (*Datura stramonium*) is known to contain highly toxic tropane alkaloids, including the pharmacologically active compounds atropine and scopolamine. *D. stramonium* is a bushy, smooth, foetid annual on rich soil it may attain a height of even 6 feet. The branching stems are spreading and leafy, stout, erect, smooth, a pale yellowish green in color, branching repeatedly in a

forked manner. Leaves are generally light dull green, ovate to triangular ovate 4 to 6 inches long, uneven at the base, with a wavy and coarsely-toothed margin, and have the strong, branching veins very plainly developed. The upper surface is dark and grayish-green, generally smooth, the under surface paler, and when dry, minutely wrinkled. Flowers are axillary, erect, white, and sweet scented (especially at night). The average length of flower is about 3 inches. The calyx is long, tubular and somewhat swollen below and very sharply five angled surmounted by five sharp teeth. The corolla, folded and only half-opened is funnel shaped, of a pure white, with six prominent ribs. Fruits are as large as walnuts and full of thorns (hence the English name "thorn apple"). Seeds are black (Lindley 1985). The root is very long – thick and whitish, giving off many fibers. The plant is smooth, except for a slight downiness on the younger parts, which are covered with short, curved hairs, which fall off as growth proceeds. It exhales a rank, very heavy and somewhat nauseating narcotic odor. This foetid-scented though producing stupor if their exhalations are breathed for any length of time. The plant is strong narcotic, but has a peculiar action on the human frame which renders it very valuable as medicines. The whole plant is poisonous, but the seeds are the most active; neither drying nor boiling destroys the poisonous properties. The Symptoms of acute jimson weed poisoning included dryness of the mouth and extreme thirst, dryness of the skin, pupil dilation and impaired vision, urinary retention, rapid heartbeat, confusion, restlessness, hallucinations, and loss of consciousness.

#### PHYTOCONSTITUENTS:

The major tropane alkaloids hyoscyamine and scopolamine and several minor tropane alkaloids have been identified in *Datura* species. Typical examples of minor alkaloids in *D. stramonium* are tigloidin, aposcopolamine, apotropanin, hyoscyamine N-oxide and scopolamine N-oxide<sup>17-20</sup>.

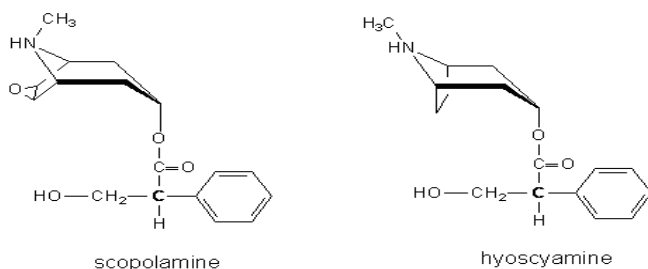


Figure 1 : Chemical structures of the major alkaloids of *D. stramonium*.

Sixty-four tropane alkaloids have been also detected from *D. stramonium*. Two new tropane alkaloids, 3-phenylacetoxy-6,7-epoxynortropine and 7-hydroxyaprotropine were tentatively identified. The alkaloids scopolamine, 3-(hydroxyacetoxy) tropane, 3-(3-hydroxy-6-(2-methylbutyryloxy) tropane, 3-tigloyloxy-6-hydroxytropane, 3,7-dihydroxy-6-tigloyloxytropane, 3-tigloyloxy-6-propionyloxytropane, 3-phenylacetoxy-6,7-epoxytropane, 3-phenylacetoxy-6-hydroxytropane, apotropanolamine, 3,6-dihydroxy-

ditigloyloxytropane and 7-hydroxyhyoscyamine are reported for the first time for this species<sup>22</sup>. Previous studies also showed the presence of proteins, highly distributed in the seed coat than the seed; in contrast the fat, carbohydrate and fiber contents of the seed were higher than the coat. In addition, the seeds also contained higher concentration of phytate, tannin and oxalate than the coat<sup>23</sup>.

#### ETHANOPHARMACOLOGY

- Datura is internally used in relieving the spasm of bronchitis in asthma. It is also used in the treatment of Parkinsonism and Hemorrhoids. Its leaves, applied after roasting, are useful in relieving pain.
- The bitter narcotic plant relieves pain and encourages the healing process. The plant has a very long history of being used as herbal medicine.
- Its leaves, flowering tops and seeds have anodyne, antiasthmatic, antispasmodic, hallucinogenic, hypnotic, mydriatic and narcotic properties. The seeds of the plant are the most active medicinally.
- Datura is internally used for treating giddiness, dry mouth, hallucinations and coma.
- Externally, the plant is used as a poultice in treating fistulas, abscesses wounds and severe neuralgia.
- Traces of scopolamine are also found in the plant, which is a potent cholinergic-blocking hallucinogen that has been used to calm schizoid patients.
- Its leaves, containing hyoscyamine and atropine, can be used as an immensely powerful mind-altering drug.
- The seeds of datura are analgesic, anthelmintic and anti-inflammatory and as such, they are used in the treatment of stomach and intestinal pain that results from worm infestation, toothache, and fever from inflammations.
- The juice of its fruit is applied to the scalp, to treat dandruff and falling hair.
- The growing plant works as an insect repellent, which protects neighboring plants from insects.

#### PHARMACOLOGICAL ACTIONS:

*D. stramonium* seed extract has an analgesic effect on both acute & chronic pain which were produced by hot plate and formalin tests. It is likely that, this effect can be attributed to the alkaloid which interact with opioid system. The whole plant is toxic, particularly the foliage & seeds. The anticholinergic syndrome results from the inhibition of central and peripheral muscarinic neurotransmission. The patient presents with dry skin and mucosa, flushing, mydriasis with loss of accommodation that causes blurred vision and photophobia, altered mental status, hyperpyrexia, sinus tachycardia, urinary retention, myoclonic jerking. Other symptoms may include ataxia, impaired short-term memory, disorientation, confusion, hallucinations, psychosis, agitated delirium, seizures, coma, respiratory failure and

cardiovascular collapse<sup>24</sup>. Its anticholinergic compounds are likely to produce delirium and stupor but rarely cause deep coma. The ethanolic extracts obtained from both leaf and seed in the thorn apple were investigated for acaricidal, repellent and oviposition deterrent properties against adult two-spotted spider mites under laboratory conditions. Leaf & seed extracts, which were applied in 167,250 and 145,750 mg/l concentrations, respectively caused 98% and 25 % mortality among spider mite adults after 48 h<sup>25</sup>. Exposure of the foetus to this plant when a mother uses it for asthma, will cause a continuous release of Ach, resulting in the desensitizing of nicotinic receptors, this could ultimately result in permanent damage to the foetus<sup>26</sup>. The main effects of jimsonweed seeds were: decreased body weight gain, serum alkaline phosphatase and blood urea nitrogen. Female rats showed more marked responses to jimson weed seed than did males. In addition to the effects seen in both sexes, the females developed decreased serum total protein and cholesterol, and increase serum glutamic, pyruvic transaminase and chloride, red blood cell count, haemoglobin concentration and packed red cell volume<sup>27</sup>. An extract prepared from the seeds of the DS possess activity typical of a protein haemagglutinin or lectin. The extract is capable of agglutinating erythrocytes from several species, and is non-specific with regard to human ABO blood groups. Laboratory monitoring of changes in some blood parameters in horses intoxicated with jimsonweed was carried out. It was established that the intoxication was accompanied by hyperchromaemic, erythrocytosis, leukocytosis, neutrophilia and regenerative shift, lymphocytopenia, aneosinophilia, increased haematocrit values and low erythrocyte sedimentation rat<sup>28</sup>. All parts of the plant are toxic but the highest amount of the alkaloids is contained in ripe seeds<sup>29</sup>. They act as competitive antagonist of acetylcholine at peripheral and central muscarinic receptor sites. Poisoning results in widespread paralysis of parasympathetic innervated

organs<sup>30</sup>. *Datura* aqueous leaf extract induces cytotoxicity & oxidative stress in human cancer cell lines. Severe toxicity has been associated with coma and seizures, although death is rare<sup>31</sup>.

**Anticholinergic activity of *D. stramonium*:** The alkaloids found in *D. stramonium*, are organic esters used clinically as anticholinergic agents. Jimson weed (also called Jamestown weed, thornapple and stinkweed) has been reported as a drug of abuse<sup>32-33</sup> and has been involved in the accidental poisoning of humans and animals<sup>34-37</sup>. Symptoms of acute jimson weed poisoning included dryness of the mouth and extreme thirst, dryness of the skin, pupil dilation and impaired vision, urinary retention, rapid heartbeat, confusion, restlessness, hallucinations, and loss of consciousness. Chronic and subchronic toxic effects of concern could be more subtle than those observed in acute poisonings of man, which have come to the attention of the medical profession, or of domestic animals that have consumed the plant as a source of food.

## CONCLUSION

Present study gives a broad information about the bioactive constituents, ethnopharmacology along with the scientifically claimed medicinal uses of *D. stramonium*. Several alkaloids, carbohydrates, fat, proteins and tannins have been reported to be present in different parts of *D. stramonium*. Plant shows various types of activities such as analgesic and antiasthmatic activity which may be due to the presence of the investigated active chemical constituents. In future to extend this study, elaborated psychopharmacological studies will be done as the plant contains alkaloids. Furthermore other parts of the plants are to be exploited for further pharmacological investigations along with the establishment of mechanism and chemical constituents responsible for the respective therapeutic potential.

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