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Review Article

Phytochemistry, medicinal values and pharmacological potential of *Datura stramonium* L. review

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Abstract

India has a great wealth of various naturally occurring plant drugs which have great potential pharmacological activities. *Datura stramonium* L.is a wild growing shrub belongs to the solanaceae family. It has both poisonous and medicinal properties. It is important medicinal plant from which tropane alkaloids, amino acids, tannin, phytic acids, carbohydrates have been isolated. Its diverse biological activities include anti-asthmatic, antibacterial, antifungal, anti-inflammatory, larvacidal, antispasmodic, anti-oxidant, antinociceptive, anti-rheumatoid and anti-ulcer activities. The neurotoxicity is attributed to the presence of tropane alkaloids which contain a methylated nitrogen atom (N-CH3) and include the anticholinergic drugs atropine, and scopolamine, as well as the narcotic cocaine. Traditionally it is used in skin disorder, ear pain, cough, fever and asthama. Its diverse biological activities include anti-asthmatic, antibacterial, antifungal, anti-inflammatory, larvacidal, antispasmodic, antioxidant, antinociceptive, anti-rheumatoid and anti-ulcer activities. *Datura stramonium* contain biologically active substances like alkaloids, atropine, scopolamine, tannin, carbohydrate and proteins. The present review is focused on the phytochemical, pharmacological studies, medicinal properties and toxicology of the *Datura stramonium*.

Keywords: *Datura stramonium*, medicinal, toxicology, phytochemistry, pharmacognosy.

1. INTRODUCTION

Datura stramonium is a wild-growing herb, known as Jimson weed. It also has several other names: thorn apple, angel's trumpet, loco weed, etc. Datura belongs to family solanaceae. It is 60-120 cm or more tall, branched and pubescent plant. Leaves are ovate, sinuate dentate and minutely puberulose. The flowers are white to creamy or violet and 6 to 9 cm long (stace C. 1997). *Datura stramonium*has both the poisonous and medicinal uses (Devi MR 2011).The incidence of *Datura stramonium* poisoning is sporadic with a cluster of poisoning cases occurring mostly among adolescents. Some medicinal uses of the plant are its antiinflammatory property of all part of the plants (Spring, 1989), stimulation of the central nervous system (CNS) (Guharov and Barajas,1991; Manandhar, 1995), respiratory decongestion (Zagari, 1992), treatment of dental and skin infections (John,1984; Darias et al., 1986; De Foe and Senatore, 1993) and also in the treatment of toothache (Abebe,1986) and alopecia (John, 1984). It is a hallucinogenic plant that causes serious poisoning.

Datura stramonium is toxic when consumed improperly. Accidental poisoning of humans and animals who consumed food sources contaminated with *Datura stramonium* has been reported (Naude*et al*., 2005). In areas where millet, wheat, rye, corn, and bean seeds are used for human consumption, and where *Datura stramonium* is a common weed, the grain sometimes has been contaminated with Datura seeds (Norton S. 2008).In the Hindu religion, the seed of *Datura stramonium* is believed to be associated with the God Shiva, which can promote misuse of the plant on religious occasions, such as Shivaratri and Swasthani Puja (Gaire 2008).

The administration of large amounts of *Datura stramonium* affects the central nervous system with symptoms such as confusion, bizarre behavior, hallucinations and subsequent amnesia. Though death by *Datura stramonium* poisoning is rare, recovery may take several days (Bhakta *et al*., 2013) Therefore, a thorough understanding of the possible pharmacological and toxicological effects of *Datura stramonium* is needed. This re-

view focuses on the botany, phytochemistry, pharmacognocy, toxicology and medicinal uses of *Datura stramonium.*

2. Regional and other names

Sanskrit : Umatta-virkshaha
English : Thornapple
Hindi : Sadah-Datura, Safed Datura
Tamil : Umatai
Arab : Jonz-masal
Gujrat : Dhatoria
Bengali : Dhattura
Malayalam: Maraum

3. Taxonomic position of *Daturastromonium*

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Solanales
Family: Solanaceae
Genus: Datura
Species: Daturastromonium

4. Botanical description

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 giving off many fibers. 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 grayishgreen, generally smooth, whereas the underside is paler, 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 sweetscented, 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 (Preissel*et al*., 2002 and Das *et al*., 2012).

5. Ethnomedicinal uses

Plant derived drugs come into use in the modern medicine through the uses of plant material as indigenous cure in folklore or traditional systems of medicine. The leaves of *Daturastromonium* L. are used for the relief of headache and vapours of leaf infusion is used to relive the pain of rheumatism and gout. The smoke from the burning leaf is inhaled for the relief of asthma and bronchitis. European remedy of *Daturastromonium* for haemorrhoid is to steam the part over boiling water containing leaf. The fruit juice is applied to the scalp for the treatment of falling hair and dandruff. It is also applied to smooth painful wounds and sores. Seeds and leaves of *Daturastromonium*were used to sedate hysterical and psychotic patients, also to treat insomnia (Pandey *et al.,* 2011). The growing plant works as an insect repellant, which protects neighboring plants from insects.

6. Phytochemistry

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 (Jakabova*et al*., 2012). The major phytochemicals isolated from *Datura stramonium* are tropane alkaloids, atropine and scopolamine. It is reported that the whole plant contains 0.26% alkaloids. The main alkaloids are hyoscyamine and hyoscine (scopolamine). It also contains protein albumin and atropine. Atropine is formed from hyoscyamine by racemisation. These alkaloids are usually present in the proportion of about two parts of hyoscyamine to one part of hyoscine, but in young plants hyoscine is predominant alkaloid. Ditiglyol esters of 3,6dihydroxytropane and 3,6,7-trihydroxytropane has been isolated from the roots in addition to hyoscine, hyoscyamine, tropine and pseudotropine. It also contains 6hydroxyhyoscymine, skimmianine, metelodine, acetyl derivatives of caffeic, p-coumaric and ferulic acid, stigmasterol, campesterol, with anolide I, steroidal glycosides, daturataturins A and B, flavonoids, chrysins, quercetin and their esters. Withastramonolide and coumarins (umbelli-

feron and scopolin) are also present in the plant (Langonjam*et* al., 2013).Distribution of hyoscyamine and scopolamine in D. stromonium was studied. The production of hycyamine and scopolamine in *Daturastromonium* has been investigated in the different plant parts, at different stages of their life cycle. The maximum contents were found in the stems and leaves of young plants, hyocyamine being always the predominate component. These compounds were included in many pharmacopieas because of their anticholinergic activities (Shagal*et al.*, 2012).Protein and ash are highly distributed in the seed coat than the seed. In contrast the fat, carbohydrate and fiber contents of the seed were higher than the seed coat. The seeds also contained higher concentration of phytate, tannin and oxalate than the seed coat. In seed coat calcium, iron, potassium, sodium and phosphorus were higher than the seeds (Oseni*et al.*, 2011). Leaves extract contain different types of secondary metabolites such as glycosides, phenol, lignins, saponins, sterols and tannins (Nain *et al.*, 2013). The primary biologically active substances in *Datura stramonium* are the alkaloids atropine and scopolamine (Ivancheva *et al.*, 2006). The phytochemical analysis of the plant revealed that *Datura stramonium* contained saponins, tannins, alkaloids and glycosides.

7. Pharmacognosy

*Datura stramonium*L. is widely growing plant and well known to have great pharmacological potential with a great utility and usage in folklore medicine folklore medicinal herbs. It contains alkaloids, tannins, carbohydrates and proteins and use in medicine due to its analgesic and antiasthmatic activities (Soni*et al.*, 2012). Leaves are used in asthma treatment (savithramma *et al.*, 2007 and Pretorius *et al.*, 2006).*Datura stramonium*L.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 interacts with opioid system (Khalili*et al.*, 2004).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 (Alberto et al., 2001).

The leave extract of *Datura stramonium* L. exhibits antibacterial activity. The antibacterial activity against the microorganism strains of Salmonella typhii, Pseudomonas aeruginosa, Proteus vulgaris in the alcoholic extract of the leaves *Datura stramonium* L. was found to be most efficient and moderately effective against Klebsiella pneumonia, Staphylococcus-aureus and Escherica coli. The leaf extract of *Datura stramonium* L. was found to exhibit excellent antifungal activity. 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. The main effects of jimsonweed seeds were: decreased body weight gain, serum alkaline phosphatase and blood urea nitrogen. 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 rate (Binev et al., 2006). All parts of the plant are toxic but the highest amount of the alkaloids is contained in ripe seeds (Chang *et al.*, 1999; De Frates, 2005).They act as competitive antagonist of acetylcholine at peripheral and central muscarinic receptor sites (Dugan *et al.*, 1989). Poisoning results in widespread paralysis of parasympathetic innervated organs (Friedman *et al.*, 1989). Datura aqueous leaf extract-induced cytotoxicity & oxidative stress in human cancer cell lines. Severe toxicity has been associated with coma and seizures, although death is rare (Dewitt *et al.*, 1997).

8. Conclusion

Studies indicated that *Datura stramonium* L. is a wild plant having various medicinal and pharmacological properties. Phytochemical of the plant are alkaloids, atropine, scopolamine, tannin, saponine, glycosides, phenol, sterols, lignins, fats, carbohydrates and proteins. The current review demonstrated that the whole part of *Datura stramonium*L. has got many uses and toxicity to a greater extent. This plant has been used in

curing different types of diseases.The plant shows various types of activities such as analgesic and antiasthamatic activity which may be due to the presence of the investigated active chemical constituents.The outcome of this review work may facilitate the enrichment of concept and the possible outcome from the use and consumption of *Datura stramonium* L.

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