

A Review On Pharmacological Study Of Datura Stramonium L.

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1. INTRODUCTION

Plants have always played a major role in the treatment of human traumas and diseases worldwide. The demand for medicinal plant is increasing in both developed and developing countries due to growing recognition of natural product. Herbal medicine is an important part of both traditional and modern system of medicines [Kirtikar JD et al., 1994]. *Datura stramonium* L. (*D. stramonium*) is a widespread annual plant of the Solanaceae family. It 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-CH₃) and include the anti-cholinergic drugs atropine, and scopolamine. From ancient civilization it was traditionally used for religious visionary purposes throughout the world and used by 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 temple.

2. SCIENTIFIC CLASSIFICATION OF DATURA STRAMONIUM L.

Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Solanales
Family	Solanaceae
Genus	<i>Datura</i> L.
Species	<i>D. stramonium</i> L. (URL 3).

3. BOTANICAL DESCRIPTION OF DATURA STRAMONIUM L.

A glabrous (sometime farinose) annual herb, 50- 200 cm, in height (Joshi, 2000). This plant is a bushy, smooth, fetid, annual plant, and in rich soil. The Thorn apple is a large and coarse herb, though an annual, branching somewhat freely, giving a bushy look to the plant. Its spreading branches covering an area almost as broad. On rich soil it may attain a height of even 6 feet. 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 odour. This foetid odour arises from the leaves, especially when they are bruised, but the flowers are sweet-scented, though producing stupor if their exhalations are breathed for any length of time. (Keshari, 2005).

ROOT

The root is rather large of a whitish color, giving off many fibers, very long - thick. Root system consists of taproot that

is shallow for the size of the plant; it branches frequently. (Keshari, 2005).

STEM

The stem is green or purple and largely hairless, although young stems often have conspicuous hairs, cylindrical, fistular. Stem is stout, erect and leafy, smooth, a pale yellowish green in color, branching repeatedly in a forked manner, and producing in the forks of the branches a leaf and a single, erect flower. (Keshari, 2005).

LEAVES

The alternate leaves are up to 8 cm long and 6 cm across (excluding the petioles). They are ovate or ovate-cordate in outline, but pinnately lobed. These lobes are somewhat shallow and pointed at their tips; there are usually 2-3 of these lobes on each side of the leaf blade. The margin of each leaf may have a few secondary lobes or coarse dentate teeth; otherwise it is smooth or slightly undulate. The leaves may be slightly pubescent when young, but become hairless with age; the upper surface of each leaf is often dark green and dull. The foliage of Jimsonweed exudes a bitter rank odor. Leaves are cauline and ramal, exstipulate; alternate to opposite, petiolate, simple, dissected, acute, glabrous, unicosted, reticular venation. The leaves are large and angular, 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 (Keshari, 2005).

INFLORESCENCE

Solitary, erect axillary (Keshari, 2005).

FLOWERS

Ebracteate, ebracteolate, pedicellate, actinomorphic, bisexual, complete, regular, pentamerous, except fourth whorl, hypogynous. The plant flowers nearly all the summer. The flowers are large and handsome, about 3 inches in length, growing singly on short stems springing from the axils of the leaves or at the forking of the branches. The flowers are succeeded by large, egg shaped seed capsules of a green color, about the size of a large walnut and covered with numerous sharp spines, hence the name of the plant. When ripe, this seed-vessel opens at the top, throwing back four valve-like forms, leaving a long, central structure upon which are numerous rough, dark-brown seeds. The appearance of the plant when in flower and fruit is so peculiar that it cannot be mistaken for any other native herb. (Keshari, 2005).

CALYX

Sepals 5, gamosepalous, tubular, five toothed, sepaloïd, hairy, persistent, valvate aestivation, inferior. The calyx is long, tubular and somewhat swollen below, and very sharply five-angled, surmounted by five sharp teeth. (Keshari, 2005).

COROLLA

Petals 5, gamopetalous, petals fused at the base, infundibuliform, surface hairy, white, twisted aestivation, inferior. The corolla, folded and only half-opened, is funnel-shaped, of a pure white, with six prominent ribs, which are extended into the same number of sharp pointed segments. The flowers open in the evening for the attraction of night-flying moths, and emit a powerful fragrance. The funnel form corolla of each flower is up to 5" long and 2" across when fully open; its outer rim has 5 shallow lobes. Each of these lobes forms an acute point in the middle. The corolla is white or pale violet throughout, except at the throat of the flower, where thick veins of dark violet occur (Keshari; 2005).

ANDROCIUM

Stamens 5, polyandrous, alternipetalous, epipetalous, filament long and smooth, anthers ditheous, basifixed, introse, inferior (Keshari, 2005).

GYNOCIUM

Carpels two (bicarpellary), syncarpous, ovary posterior obliquely placed to the right and anterior to the left, superior, bilocular with many ovules on swollen placentae, axile placentation, style long, stigma small, bilobed and capitate (Keshari, 2005).

FRUITS

Each flower is replaced by a hard fruit that is dry and spiny; it is about 1½ " long, 1" across, and spheroid-ovoid in shape. Underneath each fruit is a truncated remnant of the calyx that curves sharply downward. These fruits are initially green, but become brown with maturity; they divide into 4 segments to release the seeds. (Keshari, 2005).

SEEDS

The large seeds are dull, irregular, and dark-colored; their surface may be pitted or slightly reticulated. Jimsonweed spreads by reseeding itself. (Keshari, 2005).

4. DISTRIBUTION / HABITAT OF DATURA STRAMONIUM L.

D. stramonium is naturalized to all four deserts of the American Southwest. Species of *Datura* can be found throughout the world, except in the colder or Arctic regions. The plant lives in sandy flats, plains, arroyos up to 2,500 feet above sea level and amidst disturbed soils. Jimson weed is commonly seen among roadsides in the Southwest it is mainly found in The Himalaya from Kashmir to Sikkim up to 2700 m, hilly district of central and south India. (Khare, 2007).

Being of tropical origin, *D. stramonium* is a cosmopolitan weed of the warmer regions of North, Central and South America, Europe, Asia, and Africa. It grows nearly throughout the United States except for the Northwest and northern Great Plains, and as such is found throughout Pennsylvania. It is essentially a temperate plant but is found growing in the vicinity of cultivation, on rank soil, where refuse is deposited, in all parts of world. (Joshi, 2000)

Datura is distributed throughout the world, particularly the warmer regions. *D. stramonium* is indigenous to India. Out of 15 species reported from different parts of the world, only 10 are known to occur in

India. They are found commonly in wastelands, gardens and roadsides. They are distributed in rich localities under semi-arid and arid regions of Punjab, Haryana, Rajasthan, and Gujarat; the Central Plateau of Andhra Pradesh and Maharashtra and the southern peninsular region of Tamil Nadu. *D. stramonium* is Indigenous to Mexico and is distributed in Latin American countries. A wealth of genetic stock on genotypes and varieties are maintained in several research institutes in Germany, Bulgaria, USSR and Poland. Geographic distribution of *D. stramonium* is widely present across the United States. It has been reported in every state except Alaska and Wyoming. (URL 1, 2).

Although most commonly found in agricultural areas, especially where grazing is present, the plant can thrive in a wide variety of climatic condition. In non-agricultural areas it can be located on the side of roads, where the soil has been disturbed. In California, the presence of Jimson weed has been expertly confirmed in every county along the coast except Del Norte and Mendocino, and its presence completely encircles the Bay Area. In Southern California the plant is present in every county along the coast and also inland in San Bernadino and Kern Counties. Jimson weed can be observed mostly in disturbed areas, like roadsides, agricultural fields and stream banks. While the plant can survive in numerous moisture regimes, it is most prevalent in a xeric regime (hot, dry summer, wet, cool winter). It requires an abundance of sunlight, and is rarely found in heavily wooded areas. It is not found in mountainous areas above the tree line. Although *D. stramonium* has an annual or short perennial life cycle, the seeds can remain viable for long periods of time, perhaps explaining its wide distribution throughout the United States. (URL 1, 2).

5. CULTIVATION AND COLLECTION

Thorn apple is easily cultivated, growing well in open, sunny situation. It flourishes in moderately good soil but grows best in calcareous rich soil, or in a good sandy loam, with leaf mould added. Seeds are sown in open in May, in drill 3 feet apart, barely covered. Sown thinly, as the plants attain a good size and grow freely from seed. Thin out the young plants to a distance of 12 to 15 inches between each plant in the drill. The soil should be kept free from weeds in the early stages. If the summer is hot and dry, give a mulching of rotted cow-manure. If grown for leaf crop, the capsule should be picked off as soon as formed, as in a wind the spines tear the leaves. In August the plant reaches to a height of 1 meter and bears flowers and fruits. In the end of August stems with leaves and flowering tops are collected and dried as soon as possible at 45 °C to 50 °C. The leaves should be gathered when the plant is in full bloom and carefully dried. They are generally harvested in late summer. In August, the crop is cut by the sickle on a fine day in the morning, after the sun has dried off the dew, and the leaves are stripped from the stem and dried carefully as quickly as possible. (Jarald E, et al., 2007 and Gupta DP et al., 2008 and Gary I et al., 2005).

6. PHARMACEUTICAL VALUE OF DATURA STRAMONIUM L. ETHANOMEDICINAL VALUE

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 *D. stramonium* L. are used for the relief of headache and vapours of leaf infusion is used to relieve the pain of rheumatism and gout. The smoke from the burning leaf is inhaled for the relief of asthma and bronchitis. European remedy of *D. stramonium* 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 *D. stramonium* were used to sedate hysterical and psychotic patients, also to treat insomnia (pandey M et al., 2011). *D. stramonium* was used as hallucinogenic drug. It is also used to relax the smooth muscles of the bronchial tube and asthmatic bronchial spasm. It was reported that *D. stramonium* was used internally to treat madness, epilepsy and depression. Externally it forms the basis of ointment for burns and rheumatism (Paolo et al., 2001). 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 seeds of the plant are medicinally the most active. Externally, the plant is used as a poultice in treating fistulas, abscesses wounds and severe neuralgia. Scopolamine is also found in the plant, which makes it a potent cholinergic-blocker 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 inflammation. 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 (Das S et al., 2012). *D. stramonium* is mostly used as anthelmintic and ant parasitic in Marche, Abruzzo and Latium. Records of continued use of the plant in these sectors was collected from farmers and shepherds.

7. PHYTOCHEMICALS

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, apotropin, hyoscyamine N-oxide and scopolamine N-oxide 17-20. 6 ditigloyloxytropine and 7-hydroxyhyoscyamine are reported for the first time in this species (Das S et al., 2012). Distribution of hyoscyamine and scopolamine in *D. stramonium* was studied. The production of hycyamine and scopolamine in *D. stramonium* 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, hyocyanine being always the predominate component. These compounds were included in many pharmacopieas because of their anticholinergic activities

(shagal MH et al., 2012). *D. stramonium* contain variety of alkaloids including atropine, hyoscyamine and scopolamine (ivancheva S et al., 2006). Sixty-four tropane alkaloids have been detected from *D. stramonium*. Two new tropane alkaloids, 3-phenylacetoxy-6, 7-epoxynortropine and 7-hydroxyapoatropine were tentatively identified. The alkaloids scopoline, 3-(hydroxyacetoxy) tropane, 3-hydroxy-6-(2-methylbutyryloxy) tropane, 3-tigloyloxy-6-hydroxytropine, 3, 7-dihydroxy-6-tigloyloxytropine, 3-tigloyloxy-6-propionylxytropine, 3 phenylacetoxy-6,7-epoxytropine, 3-phenylacetoxy-6-hydroxytropine, aponor scopolamine, 3, 6 -ditigloyloxytropine and 7-hydroxyhyoscyamine are reported for the first time for this species. Other alkaloids found in *D. stramonium* include (strahil B et al., 2006): Hygrine, 3á, 6-Ditigloyloxy-7-hydroxytropine, 6-Hydroxyhyoscyamine, Pseudotropine, 3á-Tigloyloxytropine, Hydroxy-6-tigloyloxytropine, Phenylacetoxytropine, 3-Tigloyloxy-6-(2-methylbutyryloxy) tropane, Hyoscyamine, 3-Tigloyloxy-6-isovaleroyloxy-hydroxytropine, Scopolamine, Tropinone, Scopine, 6-Hydroxyacetoxytropine, 3,6-Diacetoxytropine, 3-Tigloyloxy-6-acetoxytropine, 3-Tigloyloxy-2-methylbutyryloxytropine, 3á, 6-Ditigloyloxytropine, 3-Acetoxy-6-isobutyryloxytropine, 3-(2-Phenylpropionylxy) tropane, Littorine, 6-Hydroxyapoatropine, 3, 6-Ditigloyloxy-7-hydroxytropine, 3-Tropoyloxy-6-acetoxytropine, 3,6-Dihydroxytropine, 3-Tigloyloxytropine, 3-Tigloyloxy-6-propionylxy-7-hydroxytropine, 3á-Apotropoyloxytropine, Aposcopolamine, 3, 6-Ditigloyloxytropine, 3-(3'-Acetoxytropoyloxy) tropane, 3á-Tigloyloxy-6-hydroxytropine, Tropine, 3-Acetoxytropine, 3-Hydroxy-6-acetoxytropine, 3-Hydroxy-6-methylbutyryloxytropine, 3-Tigloyloxy-6-isobutyryloxytropine, Aponorscopolamine, 7-Hydroxyhyoscyamine, Meteloidine, 3, 6-Ditigloyloxytropine. The phytochemical analysis of the plant revealed that *D. stramonium* contained saponins, tannins and alkaloids and glycosides. The secondary metabolites identified in the plant materials in the study of Banso A, Adeyemo S showed antimicrobial activity. (Banso A et al., 2006).

8. PHARMACOLOGICAL ACTIVITY

Antiasthmatic Activity

D. stramonium in asthma treatment and possible effects on prenatal development was studied. Exposure of the foetus to *D. stramonium* when a mother use it for asthma, will cause a continuous release of acetylcholine, resulting in the desensitization of nicotinic receptors, this could ultimately result in permanent damage to the foetus. Therefore we conclude that this African herbal remedy should be used with caution during pregnancy. (Pretorius E et al., 2006).

Anticholinergic Activity

The alkaloids found in *D. stramonium*, are organic esters used clinically as anticholinergic agents. Jimson weed has been reported as a drug of abuse and has been involved in the accidental poisoning of humans and animals. 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. The anticholinergic syndrome results from the inhibition of central and peripheral muscarinic neurotransmission. (Taha SA et al., 1984 and Diker D et al., 2007)

Acaricidal, Repellent And Oviposition Deterrent Properties

The ethanol extracts obtained from both leaf and seed in *D. stromonium* (Solanaceae) were investigated for acaricidal, repellent and oviposition deterrent properties against adult two-spotted spider mites (*T. urticae* Koch) (Acari: Tetranychidae) under laboratory conditions. Leaf and seed extracts, which were applied in 167.25 and 145.75 g/ L concentrations, respectively (using a Petri leaf disc-spray tower method), caused 98% and 25% mortality among spider mite adults after 48 h. These results suggest that *D. stromonium* extracts could be used to manage the two-spotted spider mite. (kurnal NA et al.,2009) .

Antimicrobial Activity

The methanol extracts of *D. stromonium* L. and *Datura innoxia* L. showed activity against Gram positive bacteria in a dose dependent manner. Little or no antimicrobial activity was found against *Escherichia coli* and *Pseudomonas aeruginosa* [gupta S et al., 2010]. The anti-microbial activity of combined crude ethanolic extract of *D. stromonium*, *Terminalia arjuna* and *Withania somnifera* in cup plate diffusion method for antibacterial and antifungal activity. The extracts were subjected to screening to detect potential antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Micrococcus luteus* and *Candida albicans* with compare Ciprofloxacin standard drug (sharma MC et al., 2010).

Anticancer Activity

An integrated approach is needed to manage cancer using the growing body of knowledge gained through scientific developments. Thousands of herbal and traditional compounds are being screened worldwide to validate their use as anticancerous drugs. *D. stromonium* in therapeutic dose of 0.05-0.10 g was used to cure cancer. Likely unsafe produce vomiting, hypertension, loss of consciousness may lead to coma but may interact with anticholinergic drugs (balachandran et al., 2005).

Antiinflammatory Activity

Coriandrum sativum (*C. sativum*), *D. stromonium* and *Azadirachta indica* (*A. indica*) are traditionally used in treatment of inflammation. Ethanolic extracts of fruits of *C. sativum*, leaves of *D. stromonium*. Ethanolic extracts of fruits of *C. sativum*, leaves of *D. stromonium* and *A. indica* were subjected to preliminary screening for anti-inflammatory activity in albino rats. All ethanolic extracts exhibited significant anti-inflammatory activity comparable to the standard drug diclofenac sodium against carrageenan induced rat paw edema method. Among these plant *A. indica* showed maximum anti-inflammatory activity per hour (Gupta S et al., 2010).

Larvicidal And Mosquito Repellent Activities

Ethanolic extracts of leaves of *D. stromonium* were evaluated for larvicidal and mosquito repellent activities against *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus*. The LD50 values for larvicidal activity were found to be 86.25, 16.07 and 6.25 mg/L against *Aedes aegypti*, *Anopheles stephensi* and *Culex*

quinquefasciatus respectively. The ethanolic leaves extract of *D. stromonium* provided complete protection time (mosquito repellency) of 2.7, 71.7 and 117.7 min against *Aedes aegypti*, *Anopheles stephensi* and *Culex quinquefasciatus* at higher concentration (1%) (Swathi S et al.,2012)

Antifungal Activity

Antifungal activity of a concoction brewed from *D. stromonium*, *Calotropis gigantea*, *A. indica* (neem) and cow manure (T1) followed by methanol-water (70/30 v/v) extracts of *D. stromonium*, *Calotropis gigantea* and *A. indica* T2 against *Fusarium mangiferae*. The study proved that the concoction-brewed compost T1 is effective, inexpensive, easy to prepare and constitutes a sustainable and ecofriendly approach to control floral malformation in mango when it is sprayed at bud break stage and again at fruit set stage (Usha K et al., 2009).

9. CONCLUSION

Present review gives a broad information about the bioactive constituents, ethno pharmacology along with the scientifically claimed medicinal uses of *D. stromonium*. Several alkaloids, carbohydrates, fat, proteins and tannins have been reported to be present in different parts of *D. stromonium*. The 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. The pharmacological studies so far have been performed in vitro and in vivo. Therefore, there is a need of investigation and quantification of phytoconstituents and pharmacological profile. *Datura stramonium* is an Indian medicinal plant widely used in phytomedicine to cure diseases such as asthmas, cough, convulsions and other various human ailments. The plant may be explored further as per its great variety of traditional uses and on the basis of its reported chemical profile. But a great caution is advised since excess dose cause severe intoxication and death. The toxic dose is very close to the medicinal dose so this plant should only be used under the guidance of a qualified practitioner.

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