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Comprehensive study of the pharmacological activities of *Datura stramonium*

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Abstract

The plant *Datura stramonium*, often known as thorn apple, is a member of the Solanaceae family. It is a wild plant with a number of therapeutic and pharmacological benefits. Tannin, saponin, glycosides, phenol, sterols, lignin, atropine, scopolamine, alkaloids, Different substances are contained in datura, including lipids, carbs, and proteins. *Datura stramonium* has actions that are antiepileptic, anti-asthmatic, analgesic, antioxidant, antibacterial, insecticidal, repellent, and protective of organophosphates. The phytochemical and pharmacological research of the *Datura stramonium* are the main topics of the current review.

Keywords: *Datura stramonium*, medicinal plant, phytochemistry, pharmacological activities, traditional uses

Introduction

The Solanaceae family includes the annual plant *Datura stramonium* (DS). Although it has its origins in America, it may be found in North, Central, and South America, Europe, Asia, and Africa ^[1]. *Datura stramonium* is an odorous, upright, freely branched plant that grows to a height of 2 to 5 feet. The root is whitish, thick, and fibrous. It has a spherical, tall, glabrous stem that is simple or forked. The leaves are irregularly undulating, smooth, toothed, and 8–20 cm long. The leaves have a bitter, sickening flavor that permeates herb extracts and lingers long after the leaves have been dried. All nightshades and agricultural plants, such as potato, *S. tuberosum*, *Lycopersicon*, *Coffea arabica*, and pepper, belong to the genus *Datura*. Genetic markers, which suggest that the *Datura* genus has a great deal of variation due to mutation, are heavily used to classify the various species within this genus. It has long been known that *Datura stramonium* possesses euphoric and hallucinogenic properties. It was smoked for hallucinations after being dried and total relaxation. When taken inappropriately, it is poisonous. It has been documented that eating food sources infected with *D. stramonium* can accidentally poison people and animals. The grain has occasionally been contaminated with *Datura* seeds in regions where *D. stramonium* is a common weed and where millet, wheat, rye, corn, and bean seeds are used for human consumption. *Datura*'s high concentration affects the central nervous system, causing symptoms like confusion, odd behavior, hallucinations, and eventual amnesia. The potential pharmacological and toxicological consequences of *D. stramonium* must thus be thoroughly understood. The review outlines the most important medical applications for *Datura stramonium* that have been identified over the course of many years of research involving both human and animal subjects as well as other types of experimental studies.

Phytochemistry

Sixty-four distinct kinds of tropane alkaloids are present in *D. stramonium*. There are various minor tropane alkaloids as well as the major tropane alkaloids hyoscyamine and scopolamine found in *Datura* species. Scopolamine, 3-(hydroxyacetoxy)-tropane, and 3-hydroxy-6-(2-methylbutyryloxy) tropane, Aponoscopolamine, 3,7-dihydroxy-6-tigloyloxytropane, 3,4-tigloyloxy-6-propionyloxytropane, 3,4-tigloyloxy-6-hydroxytropane, 3,4-tigloyloxy-6,7-epoxytropane, 3,4-tigloyloxy-6-hydroxytropane The existence of 3a,6a-ditigloyloxytropane and 7-hydroxyhyoscyamine is first reported by Berkov *et al.* The main components of *Datura stramonium* essential oil are sterols and their derivatives, including 26, 26-Dimethyl-5, 24(28)-ergostadien-3.beta.-ol (10.39%), 3.hydroxycholestan-5-ylacetate (14.97%), and 5.alpha.-Ergosta-7, 22-dien3.beta.-ol (16.53%).

The alkaloids atropine and scopolamine are D. stramonium's two main physiologically active compounds. Ivancheva Alkaloids, saponins, tannins, steroids, flavonoids, phenols, and glycosides were present in the aqueous and ethanolic extract of the stem-bark of *Datura stramonium*. Numerous additional amino acids, including tyrosine, glutamate, phenylalanine, and alanine, were also extracted from the seeds. The significant anticholinergic alkaloids identified from *Datura stramonium* were the tropane alkaloids. The vegetative and generative stages of leaves and capsules, respectively, have the maximum levels of alkaloid. In general, plants' younger sections had more alkaloids than their older counterparts. In the generative phase, alkaloid concentration in leaves reduced quickly. During the vegetative period, scopolamine levels in roots were lowest (0.013%), and they completely vanished during the generative period. Both during the vegetative (0.045%) and generative (0.056%) phases, atropine was found in the roots. Atropine content in stems was high (0.070%) whereas scopolamine content was low (0.023%) in both phases. The stems, leaves, and seeds contain the highest amounts of atropine. Young plants' stems and leaves contain the highest concentrations of hyoscyamine and scopolamine, with hyoscyamine always predominating.

Traditional Use of *Datura stramonium*

According to the World Health Organization (WHO), about 80% of the world's population, or four billion people, currently use herbal medicine for some aspect of primary healthcare. Plants typically produce a large number of secondary metabolites, which have historically served as a major source of many pharmaceutical drugs. In Ayurvedic medicine, D. stramonium is characterized as a helpful treatment for a variety of human illnesses, including toothaches, ulcers, bruises, inflammation, rheumatism, and gout, as well as sciatica, bruises, and swellings. D. stramonium is therapeutically used in several traditional medicines. Intestinal worms, especially cestodes, were expelled using the juice of the leaves in heated milk. Palm oil-infused seeds were used topically to bug bites and stings. The *Datura stramonium* leaves combined with mustard oil are beneficial for treating skin conditions. Flowers' juice is used for ear ache, while their seeds are purgatives for coughs, fevers, and asthma. Because of their narcotic effects, seeds are smoked. In Western Nepal, Datura leaves, Cannabis sativa leaves, and stems from Neopicrohiza scrofulariflora are all pounded with water and used topically to relieve headaches. To relieve pain, datura seeds are combined with rice grains and consumed orally indigestion. In some areas of Central Nepal, fresh leaves are heated and repeatedly applied to a strained body part before bedtime for what is thought to have an analgesic effect. Seeds are used as a febrifuge and tonic in India. To relieve pain, the leaves are roasted and applied locally. Indigestion. Before going to bed, fresh leaves are heated and frequently placed to a sore body part in some parts of Central Nepal, with the intention of having an analgesic effect. In India, seeds are used as a febrifuge and tonic. The leaves are roasted and used topically to alleviate discomfort.

Pharmacological Activities

Organophosphate Poisoning (OP)

The central cholinergic symptoms of OP can be effectively

treated with DS, which includes atropine and other anticholinergic substances. Observed that DS seed extracts had positive benefits. In their experiment, male rats received a single intraperitoneal injection of DS seeds 5 minutes before receiving a subcutaneous injection of 25 mg/kg of dichlorvos. The DS seeds were cooked in water to create a 2 mg/ml atropine solution. In a rat model of severe OP, pretreatment with Datura seed extract greatly enhanced survival.

Antiepileptic Effects

Rats were continuously administered one of three herbal treatments-S. later flora, G. sempervirens, or D. stramonium-through water supply for 30 days, beginning one week after status epilepticus was induced by a single injection of lithium (3mEq/kg) and pilocarpine (30g/kg), according to Peredery and Persinger During the treatment period and an extra 30 days when just tap water was administered, each rat's daily occurrence of spontaneous seizures during a 15-minute observation time was counted. Rats given diluted solutions of the three herbal fluid extracts did not exhibit any seizures while being treated. When this therapy was stopped, the rats experienced fewer spontaneous seizures than the controls.

Antimicrobial Activity

The methanol extracts from the aerial section of DS shown dose-dependent bactericidal action against gram positive bacteria. According to Sharma *et al.* [, DS was very efficient as a vibriocidal against several Vibrio cholera and Vibrio parahaemolyticus strains. Acetone extracts of DS have a minimum inhibitory concentration (MIC) value between 2.5 and 15 mg/ml, making them effective broad-spectrum vibriocidal agents.

Anti-Asthmatic Activity

A number of alkaloids, including atropine and scopolamine, found in D. stramonium have anticholinergic and Broncho dilating properties. Atropine and scopolamine expand bronchial smooth muscle and lessen asthmatic episodes by inhibiting muscarinic receptors, especially the M2 receptors, on airway smooth muscle and submucosal gland cells. Using D. stramonium as an antiasthmatic, cigarette is a good bronchodilator in asthmatic patients with minor airway blockage, according to Charpin *et al.* However, when a mother uses D. stramonium during pregnancy to treat her asthma, it will result in a continuous release of acetylcholine and the desensitization of nicotinic receptors, which could eventually cause permanent harm to the fetus.

Analgesic Activity

Using hot plate and formalin assays, the analgesic efficacy of alcohol-infused Datura seed was assessed in acute and chronic pain. When administered intraperitoneally to the rats, the extracts reduced pain in a dose-dependent manner; the ED50 in the hot plate and formalin tests, respectively, was 25 and 50 mg/kg.

Antifungal Activity

The fungicidal properties of the acetone extracts, in accordance with Mdee *et al.* point to the potential of DS seeds as a natural source of antifungal agent. DS extracts' MIC varies from 1.25 to 2.50 mg/m.

Anticancer Activity

At a therapeutic dosage of 0.05 to 0.1g, *D. stramonium* was said to have an anticancer effect on human nasopharyngeal epidermal carcinoma. However, caution should be exercised while utilizing *Datura* as a cancer preventative since unfavorable anticholinergic effects might arise.

Infertility in Women

Datura flowers are a successful therapy for female infertility. Ten days following your period, take 120 milligrams of the dried powder from *Datura* flowers with some honey. For 5 to 7 days, it is administered. This treatment works for infertility caused by an underlying condition.

Insecticidal Activity

The *datura* plant has a distinctive odor that deters a variety of insects and pests. The ethanol extracts of *D. stramonium* leaf and seed exhibited strong acaricidal, repellent, and oviposition deterrent efficacy against adult two-spotted spider mites (Tetranychusurticae) in laboratory settings, according to Kurnal *et al.* Using the Petri leaf disc-spray tower technique, leaf and seed extracts were sprayed at quantities of 167.25 and 145.75 g/L, and after 48 hours, they respectively induced 98% and 25% mortality among spider mite adults. These findings imply that *D. stramonium* may be effective in treating two-spotted spider mites.

Dosage

DS is generally administrated at a dose of 60-185mg powder for leaf and 60-120mg powder for seed

Conclusion

Plants are utilized for latex, gum, oil, fiber, tanning, and a variety of other products. Due to their abundance in minerals, vitamins, antioxidants, carbs, and proteins, they also had an immunomodulatory impact. The study found that *Datura stramonium* is a wild plant with a variety of therapeutic and pharmacological properties and these qualities were used for rheumatoid arthritis, asthma, boils, ear discomfort, headaches, wounds, burns, stress, depression, and inflammation. *Datura stramonium*, which has pharmacological properties and is created as herbal or botanical medicines by pharmaceutical businesses for a variety of ailments, is not utilized in its natural form due to its fatal impact.

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