Chapter

Pharmacological, Biopesticide, and Post-Harvest Loss Management Application of Jimsonweed (*Datura stramonium*)

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Abstract

Datura stramonium is one of the most intriguing, in part because of its well-known therapeutic and psychoactive properties in the treatment of many diseases. Datura species have been found to exhibit a variety of biological activity. Insecticide, fungicide, antioxidant, antibacterial, hypoglycemic, and immune response boosting properties have been linked to the genus' species. These effects are linked to the existence of secondary metabolites such as terpenoids, flavonoids, with anolides, tannins, phenolic compounds, and tropane alkaloids, which are the most prevalent atropine and scopolamine in the genus Datura. Ingestion of Jimson weed produces the toxidrome of anticholinergic intoxication. Understanding and recognizing the classic signs and symptoms of anticholinergic intoxication can help clinicians evaluate persons presenting with Jimson weed poisoning. Moreover, this review is to identify the most important phytochemical substances extracted from the Jimsonweed and to characterize their biological activity for health effect and biopesticide application. Biopesticides are less harmful than chemical pesticides because they do not leave harmful residues, generally target one specific pest or a small number of related pests rather than broad spectrum chemical pesticides that affect other beneficial insects, birds, mammals, or non-target species, are effective in smaller quantities, decompose quickly and do not cause environmental problems, and are often cheaper. In conclusion, *Datura stramonium*, beside its medicinal value, can applicable for biopesticide application and for postharvest loss control of insects such as weevil.

Keywords: *Datura stramonium*, phytochemical components, pharmacological potential, biopesticide, weevil

1. Introduction

By 2050, the world's population is predicted to reach over 10 billion people; more than half of this increase will occur in Africa, resulting in an additional 1.3 billion people on the continent. As a result, more people will need to be nourished in the next decades, and more food and vaccines will be required around the world than previously. The

Figure 1.
Datura stramonium. a: Datura plant (leaves and flowers); b: D. stramonium Plant (leaves and fruit).

phytochemical and ethnopharmacological properties of the Jimson plant have always piqued people's curiosity [1]. The genus has 14 species of annual herbs and perennial shrubs ranging in height from 1 to 1.5 meters, with straight stems, thorny fruits, foul-smelling leaves, and highly scented trumpet-shaped flowers that bloom at the stem forks [2]. *Datura* plants thrive in nitrogen-rich soils and soils that have been disturbed by human activity, such as agricultural soils, roadsides, and animal pens [3]. Steroids, phenolic compounds, fatty acids, with anolides, and lactones are the most common components; however, the genus is best recognized for producing tropane-type alkaloids [4]. Therefore, this chapter aims to identify the main phytochemical components isolated from the Jimson weed (*Datura stramonium*) and describe their activity against biopesticides and medicinal effect, with an emphasis on the relevant literature.

2. Overview of Jimson weed

Jimson weed is a wild-growing herb that contains belladonna alkaloids. There have recently been reports of teens intentionally ingesting Jimson marijuana for hallucinogenic purposes. These individuals present to the emergency department with physical indications of atropine intoxication, mental problems, and hallucinations. A positive history, if available, and detection of anticholinergic symptoms are required for diagnosis. It is crucial to distinguish between lysergic acid diethylamide consumption and schizophrenia. Both central and peripheral signs of Jimson weed intoxication can be reversed by physostigmine, an anticholinergic drug. Ingestion of *Datura stramonium* is fairly common and can lead to intoxication and to anticholinergic manifestations that are potentially dangerous (**Figure 1**).

3. Phytochemical components and pharmacological potential of Jimson weed

The phenolic compounds (metabolites) present are linked to the biological functions assigned to the genus Datura. Plants create these chemicals in both their primary and secondary metabolism [5]. Plants' primary metabolites play a direct role in their growth, development, and reproduction, whereas secondary metabolites play an ecological role [6]. Different classes of phenolic compounds, such as terpenoids, flavonoids [7], steroids [8, 9], lectins [10, 11], glycosides, fatty acids, saponins [12], tannins [13], phenolic compounds [14], withanolides [15], and various volatile terpenes [16, 17], have been identified in *Datura* species.

3.1 Phenolic compounds

In methanolic and hydroalcoholic extracts, the existence of distinct classes of phenolic compounds in the genus Datura has been demonstrated. Flavonoids, tannins, and glycosidic phenolic substances are found in *D. metel* and *D. stramonium* [12].

In diverse solvent fractions such as ethyl acetate, butanol, hexane, chloroform, and methanol, Hossain et al. [14] investigated the existence of phenolic compounds in *D. metel*. Gallic acid, vanilic acid, quercetin, and ferulic acid were identified as the primary phenolic components in the methanolic extracts of *D. metel* roots and leaves [18].

On the other hand, LC-ESI-MS/MS analysis of the methanolic extract of *D. innoxia* aerial organs revealed the presence of 20 distinct phenolic compounds, with (−)-epicatechin, (+)-catechin, hyperoside, and p-coumaric acid being the most abundant metabolites detected [19].

3.1.1 Withanolides

Withanolides are steroidal lactones that have been identified from various Solanaceae genera [20]. Biological actions such as anti-inflammatory, antioxidant, anticancer, insecticide, antifood, and immunosuppressive characteristics have been found for these substances [20]. Within the genus *Datura (daturalactones)*, various withanolides have been identified and described, distinguishing themselves by having an epoxy in the lactone ring [21]. Five with anolides were discovered in the aerial portions (flowers, leaves, and stems) of *D. quercifolia Kunth* that have modest cytotoxic and prooxidant effects, as well as acetylcholinesterase inhibitory activity [22].

D. metel leaves have yielded a number of previously unknown withanolides, two of which exhibit anti-inflammatory properties [23]. In addition, 13 others with anolides were isolated from *D. metel* flowers and showed immunosuppressive properties against splenocyte proliferation in mice, as well as activity *in vitro* against human gastric adenocarcinoma cell proliferation (SGC-7901), human hepatoma (HepG2), and human breast cancer cell proliferation (HepG2) (MCF-7) [24].

3.1.2 Terpenes

Datura produces volatile substances that protect plants from herbivore harm by having varying quantities and types of glandular and non-glandular trichomes [25]. *D. wrightii* contains 17 volatile chemicals, the majority of which are sesquiterpenes (**Figure 2**), such as limonene, linalool, (E)-3,8-dimethyl-1,4,7-nonatriene (DMNT), and (E)—ocymene, with (E)—caryophyllene being the most common [25].

3.1.3 Lectins

D. stramonium and other Solanaceae have been found to contain lectins, a category of carbohydrate-specific binding proteins [26]. The biological role of lectins is controversial, albeit due to their toxicity in both mammals and insects, a defensive role for plants has been hypothesized [27].

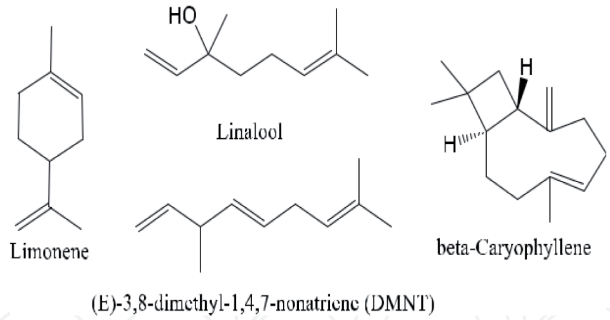

Figure 2.
Structure of some isolated volatile compounds (terpenes) in the genus Datura in response to insect damage.

The chitin-binding lectin *D. stramonium* agglutinin (DSA) has been isolated and purified from *D. stramonium* seeds [28]. In diabetic patients, the use of *D. stramonium* agglutinin in lectin microarrays has been used to identify kidney diseases. The amount of nacetyl-D-glucosamine (GlcNAc) coupled to (−1,4)-linked N-acetyl-D-glucosamine identified by lectin *D. stramonium* agglutinin (DSA) was significantly higher in individuals with diabetic nephropathy, according to the results of lectin microarrays [29].

3.1.4 Alkaloids

Datura has a diverse phytochemical makeup of tropane-type alkaloids, which are the plant's most potent chemicals [30, 31].

Tropane alkaloids, in particular, are a collection of roughly 200 alkaloids with a tropane ring (N-methyl-8-azabicyclo in their chemical structure, with L-ornithine as the major precursor) [32]. Atropine (hyoscyamine) and scopolamine (hyoscine) are the most prevalent alkaloids in the genus *Datura* [33].

The alkaloid fraction of *D. ceratocaula* revealed 36 compounds with a distinctive mass fragmentation spectrum, with atropine being the most abundant alkaloid in seed and scopolamine being the most abundant alkaloid in flowers [34]. Atropine and scopolamine were found in similar abundances in *D. ferox*, with 0.32 g of scopolamine per 100 g of dry plant material [35].

Scopolamine and atropine were the major alkaloids, with quantities changing based on the region of the plant [36]. The most abundant alkaloids in *D. quercifolia* are tropinone, tropine, pseudotropine, atropine, and scopolamine [37].

In the species *D. stramonium*, at least 67 tropane alkaloids (**Table 1**) have been found in various sections of the plant. Tropine, 3-tigloyloxy-6-propionyloxy-7-hydroxytropane, and 3,6-ditigloyloxy-7-hydroxytropane [38] have been identified as the most prevalent, alongside atropine and scopolamine. Okwu and Igara [39], on the other hand, discovered one steroidal alkaloid in *D. metel* that had antibacterial activity.

3.2 The biological functions of the Datura

3.2.1 Insecticide action

Different writers have looked at the insecticidal and repellant properties of *Datura* species. In contact and spray application experiments, leaf extracts of *D. metel* (acetone, water, and petroleum ether) have been shown to exhibit insecticidal and insect repellent activity against a variety of insect species. In organic extracts of

Alkaloid	Specie	Organ
Scopolamine	All	Roots, leaves, flowers, and seeds
Atropine	All	Roots, leaves, flowers, and seeds
3-Tigloyloxy-6,7-dihydroxytropane	*Datura stramonium*	Roots
Apoatropine	*Datura stramonium*	Roots, leaves, flowers, and seeds
3-Tigloyloxy-6-hydroxytropane	*Datura stramonium*	Roots
Hyoscyamine	*Datura quercifolia*	Roots, leaves, flowers, and seeds
3α-Tigloyloxy-6-isovaleroyloxy-7-hydroxytropane	*Datura stramonium*	Roots
3,6-Ditigloyloxy-7-hydroxytropane	*Datura stramonium*	Roots
Scopolamine	*Datura stramonium*	Roots, leaves, flowers, and seeds
Tropine	All	Roots, leaves, flowers, and seeds
3-acetoxynortropane	*Datura quercifolia*	Roots

Table 1.
Most abundant tropane alkaloids identified in the genus Datura [33, 37, 38].

D. metel, EC50 values of 12,000 ppm for grasshoppers and 11,600 ppm for red ants were found [31]. In the case of *D. stramonium*, pesticide activity has been assessed in non-polar extracts in adult individuals and larvae of various insects, both by contact and by food [27].

The larvicidal efficacy of *D. stramonium* aqueous root extract was tested on two mosquito species and found to be between 50 and 100 percent larval mortality at 100 percent concentration of the extracts 24 hours after treatment [40]. Different quantities of an aqueous extract of *D. stramonium* leaves and seeds were shown to be effective against flea beetles, a common maize pest [41].

The toxic effect of acetone extracts from *Datura inoxia* was evaluated against *Tribolium castaneum*, *Trogoderma granarium*, and *Sitophilus granarius*, where the plant extracts were observed in addition to the inhibition of enzymes acetylcholinesterase, carboxylesterase, acid phosphatases, and alkaline phosphatases (ALP) in toxicity test survivors [41].

3.2.2 Herbicidal

In aqueous and methanolic extracts, *D. metel* has shown possible herbicidal efficacy against "noxious weed parthenium," with the root showing superior effects to the stems, with both extracts reducing weed germination as well as stem development in individuals of a few weeks [1]. Similarly, germination inhibition was seen in methanolic and hexane root extracts of *D. metel* when it was tested for herbicide action against Phalaris minor.

Sakadzo et al. [42] found that an aqueous extract of *D. stramonium* inhibited root development, plumule length, and dry matter amount in *Amaranthus hybridus* and Tegetes minuta, with herbicidal effects both pre- and post-emergence.

3.2.3 Acaricide activity

The methanolic extracts of *D. stramonium* leaves and seeds showed acaricidal effects, with 98 percent mortality of adult Tetranychus urticae Koch (spider mites) in the leaf extract and 25 percent mortality in the seed extract, with a direct relationship between concentration and mortality rate for the leaf extracts but not for the seed extracts [7].

In adult mite immersion trials, an ethanolic extract from *Datura stramonium* leaves caused 20% mortality against *Rhipicephalus microplus* (Asian blue tick) [43]. *In vitro* experiments showed that the methanolic extract of *D. stramonium* inhibited the oviposition of Rhipicephalus (Boophilus) microplus by 77% [44].

3.2.4 Antifungal activity

Three members of the genus, *D. discolor, D. metel, and D. stramonium*, were tested for antifungal activity. Ethanolic and methanolic extracts from D. discolor stems and leaves were combined with culture medium to prevent the growth of Aspergillus flavus, Aspergillus niger, Penicillium chrysogenum, Penicillium expansum, Fusarium moniliforme, and Fusarium poae [12].

Rhizoctonia solani was inhibited by aqueous and methanolic extracts of *D. metel* leaves. D. metel's methanolic extract was up to 35 percent more toxic than the other 15 species investigated, preventing mycelial growth and being used in agriculture (herbicide, acaricide, insecticide) and medicine (antibacterial, cytotoxic, or antioxidant) production of sclerotium [15].

Furthermore, extracts of all parts of *D. metel* in various solvents (hexane, chloroform, acetone, and methanol) showed antifungal activity against three Aspergillus species: *A. fumigatus*, *A. niger*, and *A. flavus*, with the chloroform fraction having the lowest inhibitory concentration (MIC) of 625.0 g/mL [45].

The growth inhibition of five fungal species: *A. flavus*, *A. niger*, Alternaria solani, Fusarium solani, and Helianthus sporium used to assess the antifungal efficacy of methanol extracts from the leaves, seeds, stems, and roots of *D. inoxia* [46].

The antifungal activity of *D. stramonium* extracts on *Candida albicans* was stronger in aqueous extracts (74 percent), while methanol and chloroform extracts had good inhibitory activities (69 percent and 65 percent, respectively) [47].

3.2.5 Antibacterial activity

D. stramonium leaf and fruit extracts with different polarity solvents were tested against five pathogenic bacteria, with the extracted methanol and chloroform fractions from both leaves and fruits showing growth suppression of all tested microorganisms at various doses. All isolated fractions from the fruits efficiently inhibited the growth of *Pseudomonas aeruginosa* and Klebsiella pneumonia. The chloroform extract of leaves showed the greatest growth inhibition (77%) against *K. pneumonia* [47].

Using the paper disk diffusion method and ampicillin as a positive control, antibiotic activity of methanolic extracts (80%) of *Datura inoxia* against *Bacillus subtilis*, *Staphylococcus aureus*, and *Escherichia coli* was determined. Except for *E. coli* (2.5 g/mL), the results showed action against all bacteria at the greatest concentration of the extracts [48].

In the paper disk diffusion method, however, methanolic, ethanolic, and aqueous extracts of *D. stramonium* showed antibacterial activity against gram-positive and gram-negative bacteria. With a minimum inhibitory concentration of 25% w/v, ethanolic extract of leaves inhibited the growth of bacteria in *P. aeruginosa, K. pneumoniae*, and *E. coli* [49]. At 2.5, 1.25, and 0.75 mg/mL, the methanolic leaf extract showed antibacterial activity against gram-positive bacteria such as *Staphylococcus haemolyticus, S. aureus*, *Shigella dysenteriae*, and *Bacillus cereus*, as well as gram-negative bacteria such as *P. aeruginosa*, K. *pneumoniae, and E. coli* [13].

3.2.6 Antioxidant activity

Aqueous extracts of *D. metel* stems, roots, and leaves had antioxidant activity ranging from 23.8 to 49.3% [50]. *D. stramonium* methanolic extract had IC50 values of 35.3, 10.5, and 49.36 g/mL for radical DPPH, superoxide, and radical cation ABTS, respectively [51]. In comparison with *D. metel*, the antioxidant capacity and concentration of phenolic compounds and flavonoids, as well as the higher antioxidant capacity (221.25 1.06 mg EPA/g), were tested in *D. innoxia*, which had significantly higher values in all assays [52]. The presence of the maximum number of phenolic components, including flavonoids and tannins, in *D. metel* leaf methanol extract exhibited the highest antioxidant capacity in a DPPH purification test against other solvents and plant parts [53].

3.2.7 Hypoglycemic activity

The hypoglycemic action of *D. metel* seeds was investigated by adding pulverized seeds to the food of rats with induced diabetes, which resulted in a considerable decrease in blood glucose levels after 8 hours [54]. Although a hydromethanolic extract of *D. stramonium* root was tested in diabetic mice and found to have no substantial hypoglycemic effect, the extract considerably lowered blood glucose levels in diabetic by orally loaded mice at relatively large doses (100, 200, and 400 mg/kg) [55]. The antihyperglycemic effects of *D. inoxia* methanolic leaf extract were seen in -glucosidase, −amylase, lipase, and urease [56].

3.2.8 Cytotoxic activity

The ethyl acetate portion of the ethanolic extract of *D. metel* flowers was tested against cancer cell lines and found to be cytotoxic against the A549 (tongue), BGC-823 (gastric), and K562 (leukemia) cell lines [57]. Similarly, methanolic extracts of *Datura stramonium* seed were found to be cytotoxic to MCF7 (breast cancer) cells, with a cytotoxicity of 66.84 percent at 599 μg/mL [51]. These findings were similar to those reported by Gupta et al. [58], who investigated the cytotoxic effects of methanolic extracts of *D. stramonium* leaves on A549 and MCF7 cells, finding considerable immune stimulation [59]. The methanolic leaf extract of *D. innoxia* revealed a possible cytotoxic impact on MCF-7 human breast cancer cell lines, with an IC50 of 93.73 g/mL [59].

Rhinoxia B, a phytosterol isolated from *D. inoxia* leaf extracts, was found to have antiproliferative activity against human colon adenocarcinoma cells, HCT 15, with an IC50 of 4 M [58].

3.2.9 Other activities

Datura has anticholinergic (mydriatic, antispasmodic), anesthetic, analgesic, sedative-hypnotic, anti-parkinsonian, and aphrodisiac qualities due to the presence of tropane alkaloids. Tropane alkaloids' actions are linked to a competitive antagonist of muscarinic receptors. Some tropane alkaloids and derivatives, on the other hand, have exhibited differing affinities to the nicotinic acetylcholine receptor, albeit to a lesser amount, and are in some cases partial agonists [60]. Tropane alkaloids' nervous system effects are also linked to the action of monoaminergic neurotransmitters, as tropane alkaloids exhibit varying degrees of affinity for monoaminergic transporters [61].

4. Discussion

4.1 Jimson plant in Ethiopia

Ethiopia is primarily found in the tropical and subtropical regions of the world. As a result, the climatic conditions are favorable for the growth of the Jimson plant, and around 35–45 percent of Ethiopia's climate is suited for the Jimson plantation. In Ethiopia, Jimson plant has been seen in a number of locations. Oromia, Gambella, Somalia, Southern Nations, Nationalities and Peoples, Sidama, and Amhara [28] are just a few of the locations where it can be found.

4.1.1 Biopesticide based on atropine

In 1850, a Belgian chemist named Jean Servial Stas was the first to successfully isolate an alkaloid poison, extracting nicotine from the tissues of the murdered Gustave Fougnie with a mixture of acetic acid and ethyl alcohol. To keep pests away from plants and crops, Jimson seed is used as a pesticide. This method is effective against insecticide-resistant pests while causing no harm to beneficial insects. Jimson oil and seed extracts, which are used to make pesticides, are known to have germicidal and antibacterial capabilities, making them useful for protecting plants from various pests. One of the most significant differences between Jimson-based insecticides and their synthetic counterparts is that they do not leave any residue on the plants. Jimson insecticides are frequently employed in agriculture because they serve an important role in pest management. There has been a noticeable movement worldwide from synthetic pesticides to non-synthetic pesticides, owing to widespread understanding of the synthetic pesticides' adverse effects not just on plants and soil, as well as other living organisms.

Because atropine has multiple modes of action, insect species are unlikely to develop resistance to it based on just one. Most synthetic pesticides, on the other hand, target the insect's nervous system, and resistance to one chemical leads to resistance to all others that use the same response pathway. Atropine has long been thought to be an environmentally beneficial insect pest management strategy for plant protection.

4.1.2 The effect of atropine on pest growth regulation

The ability of Jimson products to control insect proliferation is a fascinating feature. The insect larva feeds and sheds its old skin as it grows. Ecdysis, or molting, is the process of shedding old skin and is controlled by an enzyme called ecdysones. The action of ecdysones is reduced when Jimson components, particularly atropine, enter the body of the larva, causing the larva to fail to molt, remain in the larval stage, and eventually perish. The larva will only perish after entering the pupal stage if the atropine concentration is not high enough. If the concentration is any lower, the adult that emerges from the pupa will be completely deformed and sterile [62].

4.1.3 Feeding prevention's atropine effect

An insect larva will seek to feed on a leaf if it is sitting on it. The maxillary glands are responsible for this particular eating trigger. As a result, peristalsis in the alimentary canal is accelerated, and the larva becomes hungry and begins feeding on the leaf's surface. Because atropine antagonizes the muscarine-like activities of acetylcholine and other choline esters, if the leaf is treated with a Jimson product, it will act as an antimuscarinic agent. The insect does not feed on the atropine-treated surface as a result of this perception. Its swallowing ability is also impaired [63].

4.1.4 Atropine has an anti-oviposition action

Another way atropine keeps pests at bay is by stopping females from laying eggs. When seeds in storage are covered with atropine or crude Jimson oil, this ability is known as oviposition prevention, and it comes in useful. The insects will no longer feed on them after this treatment. Further damage to the grains will be prevented, and the female will be unable to lay eggs throughout her life cycle's egg-laying period.

4.2 Anticholinergic poisoning from Jimson weed

4.2.1 Poisoning symptoms and signs

Symptoms begin to appear shortly after consumption [64]. The dryness of the mouth is the initial symptom, followed by a strong need to drink. The pupils then dilate, resulting in hazy vision. The skin appears flushed and heated. The face, neck, and chest may be affected by an atropine rash, which is more common in youngsters. Swallowing, talking, and peeing may be challenging for the patient. Tachycardia and palpations become more noticeable. Fever is common in children and can reach dangerously at high levels. Various behavioral and mental symptoms are reported depending on the amount of stramonium consumed. The patient is anxious, restless, and bewildered. His exuberance and hyperactivity may make him prone to muscle weakness and incoordination. Memory and orientation are disrupted, visual hallucinations are widespread, and mania and delirium are possible side effects. Coma and convulsions have been seen at larger doses, and cardiac and respiratory collapse can lead to death [64]. The psychosis usually passes in 12 hours, whereas the clinical abnormalities pass in 24 to 26 hours. The condition, on the other hand, can last up to 48 hours [64].

4.2.2 Diagnosis

A positive history of Jimson marijuana consumption is unquestionably beneficial in determining the diagnosis. In the absence of such information, the diagnosis is based on the recognition of paralysis of organs innervated by parasympathetic nerves, as well as strange mental symptoms. Intoxication with stramine must be distinguished from intoxication with lysergic acid diethylamide (LSD) and schizophrenia. Dilated pupils, tachycardia, and fever are all physical manifestations of Jimson marijuana and LSD [32]. However, the latter does not usually have a dry mouth or a flushed appearance. Goose pimples also emerge with LSD toxicity due to the sympathomimetic action. Another historically reported diagnostic method is to identify atropine in the patient's urine by placing a drop of urine in the eye of a cat and observing pupillary dilatation [32].

4.2.3 Treatment

Even if it has been several hours following intake, induced emesis is indicated. If the patient refuses to cooperate, an Ewald tube should be used to perform a stomach lavage to remove any leftover Jimson weed contents. The belladonna alkaloids cause decreased gastrointestinal motility and can stay in the stomach for long periods of time, despite their normally quick absorption. To bind unabsorbed material, roughly 5 mg of activated charcoal should be given *via* the tube once the gastric lavage has become clear. The patient is subsequently administered a cathartic, such as magnesium sulfate, to increase intestinal transit time and decrease absorption. To keep the agitated patient from hurting himself or others, physical restraints may be required. The stimulation will be kept to a minimum in a quiet, gloomy atmosphere.

Any fever should be treated with the appropriate antipyretics. When toxicity is present, hospitalization is recommended. Physostigmine inhibits the enzyme acetylcholinesterase as an anticholinesterase drug, allowing acetylcholine to accumulate at the neuroreceptor site. Physostigmine crosses into the CNS and reverses hallucinations and mental symptoms because of its tertiary amine structure [65]. If the diagnosis is correct, both central and peripheral effects should be reversed within minutes of injection if the diagnosis is correct. Neostigmine and pyridostigmine bromides are also anticholinesterase drugs, but they do not penetrate the CNS since they are quaternary amines.

4.3 Pharmacological activities (medicinal significance of *Datura stramonium*)

The World Health Organization estimates that four billion people, or about 80% of the world's population, already use herbal medicine for some component of primary health care. Plants produce a large number of secondary metabolites, which are a major source of many pharmacological medications [66]. *D. stramonium* is an effective cure for a variety of human illnesses, including ulcers, wounds, inflammation, rheumatism and gout, sciatica, bruising and swellings, fever, asthma, bronchitis, and toothache, according to Ayurvedic medicine. *D. stramonium* is used in a variety of folk medicine therapies [67]. Seeds with palm oil were used externally for insect bites and stings, and the juice of the leaves in heated milk was used to expel intestinal worms, especially cestodes When *Datura stramonium* leaves are combined with mustard oil, they can be used to treat skin problems. The juice of flower petals is used to treat earaches, and the seeds are used to treat coughs, fevers, and asthma. Seeds are smoked because of their narcotic properties [68]. Datura leaves, coupled with *Cannabis sativa* leaves and Neopicrorhizascrofulariflora stems, are mashed with water and applied to alleviate headaches in Western Nepal. Datura seeds are pulverized with rice grains and consumed orally for indigestion treatment. Fresh leaves are warmed and frequently placed on an injured body part before retiring to bed in portions of Central Nepal for the purported analgesic effect. Seeds are used as a tonic and febrifuge in India. Native Americans have utilized Datura seeds as a euphoric stimulant for many years when the leaves of *Datura stramonium* are mixed with mustard oil. It has been utilized as a medicinal agent in the United Kingdom since the 1800s [69].

4.3.1 Anticancer properties

At a therapeutic dose of 0.05 to 0.1 g, *D. stramonium* was found to have anticancer properties against human epidermal carcinoma of the nasopharynx. However, while utilizing Datura as an anticancer treatment, caution should be exercised because serious anticholinergic effects can develop [70].

4.3.2 Women's infertility

Datura flowers are an effective treatment for female infertility. The dried powder of Datura flowers is administered with honey 10 days after menstruation in a dosage of 120 mg. It is administered over a period of 5 to 7 days. This treatment is successful in cases of infertility caused by unknown factors [71].

4.3.3 Poisoning with organophosphates

Datura stramonium, which contains atropine and other anticholinergic chemicals, is an effective treatment for OP's central cholinergic symptoms. Following a severe organophosphate poisoning, Bania et al. [72] observed that DS seed extracts were beneficial. DS seeds were boiled in water to generate a 2 mg/mL atropine solution, which was then given to male rats as a single intraperitoneal injection 5 minutes before the subcutaneous administration of 25 mg/kg dichlorvos. In a rat model of severe organophosphate poisoning, pretreatment with Datura seed extract greatly enhanced survival.

4.3.4 Anti-asthmatic effects

D. stramonium includes a number of alkaloids with anticholinergic and bronchodilating properties, including atropine and scopolamine. Atropine and scopolamine expand bronchial smooth muscle and alleviate asthmatic episodes by inhibiting muscarinic receptors (especially the M2 receptors) on airway smooth muscle and submucosal gland cells. According to Charpin et al. [73], cigarette is an efficient bronchodilator in asthmatic patients with minor airway blockage when *D. stramonium* is used as an antiasthmatic.

When a mother uses *D. stramonium* for asthma, the fetus is exposed to it, which causes a continuous release of acetylcholine and desensitization of nicotinic receptors, which can lead to lasting damage to the fetus [74].

4.3.5 Analgesic effects

The hot plate and formalin tests were used to assess the analgesic impact of alcoholic Datura seed in acute and chronic pain. When the extracts were given intraperitoneally to the rats, they relieved pain in a dose-dependent manner, with ED50s of 25 and 50 mg/kg in hot plate and formalin tests, respectively [75].

4.3.6 Antiepileptic activity

Rats were continuously administered one of three herbal treatments, *S. lateriflora*, *G. sempervirens*, and *D. stramonium*, through water supply for 30 days, 1 week after status epilepticus was induced by a single injection of lithium (3 mEq/kg) and pilocarpine (30 g/kg), according to Peredery and Persinger [76]. During the treatment period and an additional 30 days when just tap water was administered, the number of spontaneous seizures per day was recorded for each rat during a 15-minute observation time. During therapy, rats given a dilute solution of the three herbal fluid extracts had no seizures. When the therapy was discontinued, the rats experienced a similar number of spontaneous seizures as the controls.

4.3.7 Antimicrobial effect

The bactericidal activity of methanol extracts of the aerial portion of DS against gram-positive bacteria was dosage dependent [48]. Sharma et al. [77] claimed that DS was highly efficient as a vibriocidal against Vibreo cholerae and Vibreo parahaemolyticus strains. The MIC value of acetone extracts of DS was in the range of 2.5–15 mg/mL, making them effective as broad spectrum vibriocidal agents.

4.3.8 Antifungal effect

The fungicidal properties of acetone extracts reveal the potential of *D. stramonium* seeds as a natural source of antifungal agent, according to Mdee et al. [78]. DS extracts have MICs ranging from 1.25 to 2.50 mg/mL.

4.3.9 Insecticidal effect

The odor of the Datura plant functions as a repellant for a variety of insects and pests. Under laboratory conditions, Kurnal et al. [79] found that ethanol extracts of *D. stramonium* leaf and seed have substantial acaricidal, repellant, and oviposition deterrent effect against adult two-spotted spider mites (Tetranychusurticae). After 48 hours, leaf and seed extracts at concentrations of 167.25 and 145.75 g/L (applied using a Petri leaf disc-spray tower method) killed 98 percent and 25 percent of spider mite adults, respectively. These findings imply that *D. stramonium* may be useful in the treatment of two-spotted spider mites.

4.3.10 Dosage

D. stramonium is generally administrated at a dose of 60–185 mg powder for leaf and 60–120 mg powder for seed [80].

5. Conclusion

Datura species are among the oldest plants used in traditional medicine, according to legend. Because of its psychoactive properties, it has been a source of major cultural traditions. The impacts of Jimson plants have been examined in numerous general biological activities, such as pesticide, fungicide, and antibacterial, among others, based on this cultural knowledge. Plants are utilized for a variety of purposes, including food, shelter, fiber, tan, gum, oil, and latex. They are high in minerals, antioxidants, vitamins, carbs, and proteins, and as a result, they have an immunomodulatory effect. *Datura stramonium* is a wild plant with a variety of medical and pharmacological qualities that have been used to treat cancer, rheumatism, ear discomfort, headaches, wounds, burns, stress, depression, insomnia, asthma, boils, and inflammation, according to this review. Pharmaceutical firms make *Datura stramonium* as herbal or botanical medications for a variety of ailments; however, it is not utilized in its native form due to its fatal effect. Furthermore, research into plant components has led to research into more critical biological activities such as cancer cell cytotoxicity. The relevance of studying secondary metabolites of the genus *Datura* has resulted in significant biological discoveries. However, new research continues to uncover new metabolites with potential biological activity in a variety of systems, establishing the genus as a valuable source of chemicals with novel pharmaceutical applications. This ability of Jimson products to control insect proliferation is a fascinating feature. The insect larva feeds and sheds its old skin as it grows. Overall, besides its medicinal value, Jimson weed can applicable for biopesticide application and for post-harvest loss control such as weevil.

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