

# Pharmacological Potency and Phytochemistry of *Datura metel*: A Mini Review

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## Abstract

Plants have been traditionally used to cure illnesses through every age. The use of plants to develop medicines is not new to human race. Among the wide variety of plants, some are edible while others can be used superficially. Still there are others that tend to be poisonous. One such plant is *Datura metel*; belonging to family Solanaceae. Despite its widespread nature, this plant treats a variety of ailments such as catarrh, psoriasis, fever, asthma, bronchitis, skin diseases, digestive, cardiac and other neurological disorders. This mini-review aims to highlight the phytochemistry, traditional uses and pharmacological potential of *Datura metel* based on the published literature. Studies reveal that the *Datura metel* owes its healing potency to the presence of phytochemicals such as baimantuoluoline A, ophiobolin A, daturaolone, daturglycosides, datumetine and withanolides. These phytochemicals impart characteristic anti-oxidant, analgesic, anti-pyretic, contraceptive, antimicrobial, anticancer, insecticidal, antiinflammatory, neurological and antidiabetic efficacy to the plant making it a suitable candidate for potentially effective therapeutic agent.

## KEYWORDS

*Datura metel*, phytochemicals, anti-cancer, anti-diabetic, analgesic

## 1.0 INTRODUCTION

A vast variety of bioactive substances with pharmacological activity can be found in medicinal plants. In reality, plant-based products are the basis for most conventional medications. For instance, *Datura* sp; a medicinal flowering plant in the Solanaceae family [1], is one such species. It is mainly used as a hallucinogen and intoxicant [2]. It is extensively grown in South Africa, America, Europe, Asia, and other tropical and subtropical areas [3]. Although it can grow well in most soil types, *Datura* species prefer moist, nutrient-rich, or alkaline soil [4]. Despite its narcotic properties, the plant has unique health benefits that make it an extremely valuable medicinal herb [5, 6]. This could be explained by the presence of analgesic, cytotoxic, neurological, insecticidal, antimicrobial, antidiabetic, antiasthmatic, anti-inflammatory, antioxidant, and analgesic activities [7, 8]. In addition, the larvicidal qualities of the *Datura* genus against the red flour beetle (*Tribolium castaneum*) are

well-known for its ability to repel mosquitoes [9, 10]. *Datura* is a genus of annual or perennial herbs. [11]. Leaves are mostly simple with leaf blade, and petiolate that are either fully dentate or sinuate with 5–18 cm width and 10–20 cm in length. Leaves are generally covered in soft, short hair with greyish appearance [2]. Flowers are generally found in the axils of leaves or in the forks of branches where they grow in inflorescences. Bigger flowers are usually action-morphic with strong pedicels. Peduncles, bracteoles, and bracts are usually absent. The corolla is funnel-shaped and elongated, with cuspidate lobes. It is commonly observed that elongated anthers undergo longitudinal dehiscence. Fruit consists of four-valved dry unevenly dehiscent capsule surrounded by persistent calyx remnants [11]. There are simple, glabrous, alternating, broadly ovate, dark green, shallowly lobed leaves. Trumpet-shaped lone flowers with varying shade of colours; ranging from white, yellow to different shades of purple are usually enjoyed by their pleasant fragrance. Since insects are hermaphrodites, they pollinate the flowers. The fruit is shaped like a capsule and is covered in short spines. *Datura* is found in warmer parts of the world and prefers warm temperatures [12]. *Datura* is probably an American plant that is widely grown for its beautiful flowers in all tropical and subtropical regions [13]. *D. metel* is grown all over East Asia and India, where it is utilised in traditional herbal medicine from Bangladesh. *D. metel* flowers are used as a medicine in traditional Chinese medicine as baimantuoluo. It treats skin inflammation and psoriasis [14]. *D. metel* seeds are commonly used to treat pneumonia, ulcer, skin rashes, jaundice and diabetes in Ayurvedic medicinal system. In Brazil, flowers are dried and smoked like cigarettes, and seeds are used to make sedative tea [15, 16]. These days, many *Datura* species are

cultivated for the numerous advantages mentioned above.

### 1.2 Phytochemistry of *Datura metel*

*Datura* generally contains high concentrations of moisture, ash content, protein, fats, and crude fibre (Table 1). In addition, *Datura* contains significant amounts of alkaloids, flavonoids, phenolic compounds, tannins, and cardiac glycosides [17, 18]. Furthermore, a variety of amino acids; including glutamate, tyrosine, phenylalanine, and alanine, have been extracted from the seeds [8]. *Datura* species are rich in tropane alkaloids; especially hyoscine [(-)-Scopolamine]. It is a combination of atropine and hyoscyamine present in varying amounts in different plants [11, 19]. Seeds contain 0.426% and flowers contain 0.43% of hyoscyamine. Likewise leaves contain 0.426% of atropine [8]. Upon maturity, these contents increase in amount and efficiently help in the developmental stages [20, 21].

**Table 1: Chemical constituents of *Datura metel* Traditional Uses of *Datura metel*:**

Chemical Constituents	<i>D. metel</i> (%) [8]
Fat/lipid	14.72
Carbohydrate	51.22
Protein	20.73
Moisture	4.63
Ash content	5.14
Crude fibre	17.35

Since ancient times, *Datura* has been used to cure illnesses like fever with catarrh, epilepsy, diarrhoea, hysteria, heart problems, skin disorders and cardiac issues. It acts as a pain reliever when used as crushed leaves. It treats asthma in Chinese medicine while in Vietnam, its flowers and leaves are added to anti-asthmatic cigarettes. Oral

administration of 3-5 g flower extract of *D. metel* is used as general anaesthesia that lasts for five to six hours and takes effect in five minutes. The *D. metel* flower is used to treat chronic bronchitis, asthma, and pain. Asthma and chronic bronchitis can be treated with leaves [22, 23]. In Bangladesh, leaves are used to treat allergies, scabies, and eczema [24].

## 2.0 PHARMACOLOGICAL POTENTIAL OF DATURA METEL

*D. metel* is a rich reservoir of tropane alkaloids that serve as sedatives, mydriatics and anti-spasmodics [25]. The plant as a whole has proven efficacy against asthma, and acts as hallucinogenic, anti-tussive, anodyne, narcotic, bronchodilator and hypnotic agent. Leaves of *D. metel* treats earache and alleviates neuralgia, sciatica, rheumatoid arthritis, scabies, allergies, eczema, allergies, glandular inflammation, lumbago and other painful tumours. Moreover, piles outside can be made with seeds. Seeds, leaves, and roots are used to treat skin conditions, brain disorders, fever with catarrh, diarrhoea, and insanity [26].

### 2.1 Anti-oxidant Agent

Datura species are known to possess anti-oxidant characteristics as they play a vital role in the cure of cancers by inhibiting cell damage and ageing [27]. Chloroform leaves extract of *D. metel* exhibited maximum concentration-dependent anti-oxidant activity. Whereas the IC<sub>50</sub> values of hydro-alcoholic seed extracts showed slightly higher anti-oxidant activities than the methanolic seed extract (IC<sub>50</sub> of 28.34 µg/mL) [7,19]. Both phenolic and flavonoid contents present in *D. metel* extracts' help in scavenging free radicals (DPPH) [8, 28].

### 2.2 Anti-microbial Agent

At least seven bacterial strains were shown to be susceptible to *D. metel* seed oil. Results revealed both

maximum and minimum inhibitory concentration (MIC) against *Lactobacillus delbrueckii lactis* (19 mm) and *Pseudomonas aeruginosa* (18 mm). The inhibition zone grew as the concentration of seed oil increased, and the anti-bacterial activity showed a concentration-dependent response [29].

Significant anti-fungal activity was demonstrated by various polar and non-polar solvent extracts of *D. metel* against a wide variety of fungal species. The anti-fungal characteristics of *D. metel* fractions in methanol, hexane, acetone and chloroform were investigated against Aspergilli. Among them, chloroform extract showed significant anti-fungal property with a MIC of 625.0 mg/ml against all three species of Aspergilli (*A. fumigatus*, *A. niger*, and *A. flavus*). Both spore germination inhibition and microbroth dilution were used to investigate [30]. MIC of 12.5 mg was assessed via disc diffusion assay against *A. flavus* and *A. niger*. The findings indicated that the 1.25–2.50 mg/ml in vitro MICs [31, 32]. From *D. metel* L., a novel compound known as 2(3,4 dimethyl2,5dihydro1Hpyrrol2yl)1 methylethyl pentanoate was isolated. Its *anti-Aspergillus* and *anti-Candida* in vitro activity was assessed.

The anti-fungal compound 2(3,4 dimethyl2,5dihydro1Hpyrrol2yl)1 methylethyl pentanoate (DHP) was investigated for its post-anti-fungal effect (PAFE) on *A. fumigates*. The secretory proteins that DHP inhibited were identified, but the mechanism by which DHP inhibited these proteins is unknown [33, 34]. *D. metel's* aqueous and methanolic extracts were tested against *Ascochyta rabiei*; chickpea blight. Bacterium under in-vitro conditions Bajwa et al., found that extracts from the shoot of the plant reduced *A. rabiei's* growth by 21.34% and 20.40%, respectively, and that extracts from the roots reduced the growth of *A.*

*rabiei* by 21.34%, 15.25%, and 11.29%, [35]. According to Dabur et al., same compound demonstrated characteristic anti-fungal efficacy against every tested species, including *Candida albicans*, *Candida fumigatus*, *Candida flavus*, and *Candida niger* [34].

### 2.3 Arthritis Treatment

Excess uric acid in the body is the cause of gout, also referred to as gouty arthritis [36]. It results in the production of tiny monosodium urate monohydrate crystals in bodily tissues, especially the joints [37]. *D. metel* treats gout via xanthine oxidase inhibitory activity. The standard anti-tuberculant drug allopurinol demonstrates 93.21% inhibition at 100 g/mL concentration with an  $IC_{50}$  (6.75 g/mL); comparable to the *D. metel*, methanolic extract. Furthermore, the efficacy of the methanolic extract was evaluated in preventing potassium oxonate-induced hyperuricaemia in vivo using mice. Results were observed positive [38]. Scopolamine and hypscyamine, which are also the two commercially significant anaesthetics, antispasmodics, and anticholinergic medications, are the two most significant alkaloids that are produced in the roots of *Datura* plants and then translocated to the aerial parts [39, 40].

### 2.4 Anti-cancer Potency

*D. metel* is abundantly supplied with steroidal lactones, withanolides; potent antioxidant, anti-tumor, anti-inflammatory and immunosuppressive agents. They have the ability to activate the phase II enzyme quinone reductase that inhibits angiogenesis and the growth of tumour cells [41]. As a member of Solanaceous family, *Datura* also contains calystegines [42]. Also, daturametelins; three withanolide glycosides and two known –ones, daturaturin and 7,27dihydroxyloxowitha 2,5,24trienolide, were also obtained from *D. metel* methanolic extract. Human colorectal carcinoma

(HCT116) cell line was used to assess each compound's anti-proliferative activity. Among the tested withanolides, the non-glycosidic compound exhibited the highest activity ( $IC_{50}$ = 3.2±0.2 M) [43].

### 2.5 Hypoglycemic Activity

Hypoglycemic potency of *D. metel* seeds were studied in Wistar albino rats. 25, 50 and 75 mg/kg *D. metel* seed powder doses were orally administered to normal (as mucilage-treated) and diabetic rats with blood glucose levels above 300 mg/dL. The seeds were suspended in 1% sodium CMC. Animals receiving treatment showed dose-dependent hypoglycemia as determined by the collected blood samples at various points during a 24-hour period. *D. metel* also demonstrated dose-dependent anti-hyperglycemic activity in diabetic rats induced by alloxan. *D. metel* seed powder reduced blood glucose levels in rats that were neither normo-glycemic nor hyperglycaemic due to alloxan. Thus, *D. metel* seeds are proven to be used in diabetes management [44].

### 2.6 Insecticidal Activity

*Datura* species are prominent insecticidal agents that efficiently treat pest infestations. *D. metel* methanolic seed extracts actively target *Helicoverpa armigera* (Hubner), by adversely affecting its developmental (pupal period, larval survival, adult emergence and pupation percentage) stages [4,8]. *Phalaris minor* Retz; being the most bothersome wheat weeds, are also targeted by *D. metel* in 5, 10, and 15% (w/v) aqueous and organic solvent (methanol and n hexane) extracts. Root extract containing 15% hexane and 51% methanol considerably decreased germination. Furthermore, *D. Metel*'s aqueous and organic solvent extracts at all concentrations dramatically inhibited the growth of shoots and roots and greatly decreased biomass [45].

### 3.0 TOXICITY AND CYTOTOXICITY PROFILE

In addition to having many positive health effects, the anticholinergic alkaloids found in the *Datura* species, such as tropane possess toxic effects [6]. Toxic symptoms include fever, dry mouth, dry skin, tachycardia, convulsions, rapid and weak pulse, hallucinations, delirium, coma, acute confusion and death [4, 8]. Neurological effects of *D. metel* were assessed in rats (at 400 and 800 mg/kg) alongwith the analysis of its antidepressant qualities. These effects included increased brain motor activity, aggravated catalepsy, antagonised apoptosis, and a reduction in the duration of barbiturate-induced sleep. Furthermore, the study showed that the seed extracts were safer to use to induce sleep due to their superior anaesthetic indices [46].

The *Datura* plant is toxic in every part. Even a tiny dose is exceedingly toxic due to the presence of toxic tropane alkaloid or anti-cholinergic substances such as scopolamine, hyoscyamine, and atropine that can cause neural toxicity [23].

Cytotoxicity of *D. metel* was determined via MTT [3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide] assay. Results revealed that withametelins I, J, K, L, M, N, O, P, 12 $\beta$ -hydroxy-1,10-seco, withametelin B, and 1,10-seco withametelin B were isolated. Against the stomach cancer cell line (BGC823), leukaemia cell line (K562) and lung cancer cell line (A549), withametelins I, K, L, and N showed better cytotoxicity, with IC<sub>50</sub> ranging from 0.05 to 3.5 M. Further analysis demonstrated moderate cyto-toxic activity against of Withamelin against BGC823 and K562, but less cytotoxicity against A549 [41].

#### 4.0 CONCLUSION

*D. metel* serves as a suitable candidate in therapeutic industry owing to its significant anti-oxidant potency that is essential for treating a wide range of illnesses. Being a

reservoir of important phytochemicals, *D. metel* tends to cure a diverse nature of disorders such as neurologic, digestive, skin, respiratory, diabetic, microbial and cancerous cell mechanistics. Thus, keeping in mind the toxicology profile, the appropriate use of *Datura* species can make a difference and turn a new page in the healthcare sector.

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#### CONFLICT OF INTEREST

The author declare no conflict of interest.

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