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Table: 1, Figs: 2

Phytochemical components in *Datura metel* plant and their therapeutic properties

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CONTENTS

ABSTRACT

Datura, discovered by Carl Linnaeus in 1753, is a member of the Solanaceae family which is believed to possess both dangerous and therapeutic properties. Several plant portions of *Datura* species, especially *Datura metel*, have strong antiviral, painkiller, anti-inflammatory, and antidiarrheal properties thanking to a wide range of physiologically active components. *Datura's* medicinal properties allows it to treat a variety of human diseases, such as ulceration, inflammatory processes, paralysis, gouty arthritis, tumours, contusions, scoliosis, chills, toothaches, emphysema, and bronchiolitis. While some research on *Datura metel* has revealed possible pharmacological effects with its effective chemical constituents the toxicity of these substances is still largely unknown and under research. Additionally, toxic symptoms have been brought into vision by the repeated usage of *Datura metel* for recreational purposes. An overview of the geographical distribution, phytonutritional makeup, therapeutic specialisations and toxicological traits of the plant *Datura metel* are all included in this concise review article.

Keywords : Atropine, *Datura metel*, Pharmacological, Phytochemical.

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1. INTRODUCTION

The Solanaceae family includes the well-known venomous plant *Datura metel L*., which is widespread throughout the globe. Numerous significant phytochemicals found in it can be utilised to treat a wide range of ailments (18). For millennia, traditional Chinese medicine has utilised *Datura metel L*. to treat rheumatism, asthma, convulsions, and discomfort (28). The chemical makeup of *D. metel's* leaves and flowers is comparable, and they have major benefits in terms of a high and reliable output (47). These plants' therapeutic usefulness is determined by the chemical components that cause certain physiological actions in the human body (17,24). Few research use big data platforms to thoroughly examine the mechanisms of *Datura metel's* constituents, despite the fact that it is helpful in improving sinus rhythm (59). The yearly *Datura* shrub, which is really just a weed in the Solanaceae family, is well renowned for both its therapeutic and poisonous characteristics. Sanskrit *Dustura* or *Dahatura* is the source of the English word "*Datura*"(19). The plant is frequently called a "Thorn apple." Several *Datura* species are well recognized for their therapeutic properties, for example: oxygen depletion, *Datura metel*, & *Datura wrightii* (29). There are many more components that are used to cure ailments like piles, diabetes, and jaundice. Tropane, withanolide, trigloyl esters from tropine, calystegines, and pseudotropine alkaloids are present in this plant (16). Dogs and other animals are also prone to suffer from *Datura* seeds (37).

Figure 1. Single Plant of *Datura metel*

Figure 2. *Datura metel* in population

2. PLANT- *DATURA METEL*

2.1. Illustration

The flowers are glabrescent, of 0.5-1.5 m long annual herbs and dark violet stalks are typically present. The dimensions of a leaf blade are as follows: Peduncle: 2 to 5 cm, leaf blade: 5-20-45 cm, base lobed or entire, apex acuminate, membranous, glabrescent, veins: 4 to 6 sets, developing flowers: 1 cm for the petioles, tubular calyx: 4-9 cm. White, yellowish purple, & pastel purple are among the hues of the funnel-shaped corollas. They range in size from fourteen to twenty cm and can be tripled or doubled. Anthers measured 1.1 to 1.2 cm in length. Deflexed, subglobose, 2-3 cm diameter, tuberculate, atypically 4-valved capsules are supported by remaining calyx fragments. The light brown, discoid-shaped seeds have a length of about 3 mm (6).

2.2. Taxonomical Categorization

Genus: Datura;

Species: *Datura fastuosa (Datura metel)* (41);

Order: Solanales;

Family: Solanaceae;

Class: Magnoliopsida

Subclass: Asterids;

Division: Magnoliophyta;

Subdivision: Angiospermae;

Kingdom: Plantae**.**

2.3. Physicochemical Characteristics

Datura metel dried seeds were examined physically and chemically, and the outcomes demonstrated that the plant had total ash content 5.6% weight per weight, water soluble ash of 4.5% weight per weight, water soluble extractive of 26.35 mg/gram, foaming index of 18.18, swelling index of 2.6 ml/g, moisture content of 1.4 ml, crude fibre content of 17.5% weight per weight, and loss on drying of 390 mg (38). Fatty substances and calcium oxalate were also found in the fruit (33).

2.4. Distribution

Currently South Africa, India, South America, Pakistan all cultivates *D. metel* (8).

2.5. Components that are Medicinally Useful

All the useful parts of the plant were identified in studies. They included: roots, stalks, leaves, flowers, fruits, seeds (7).

2.6. Chemical Constituents

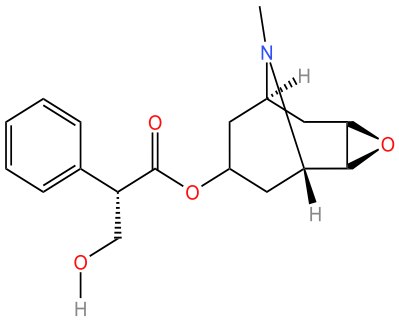
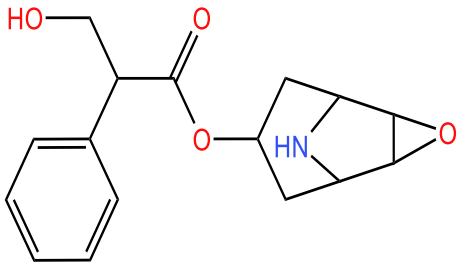
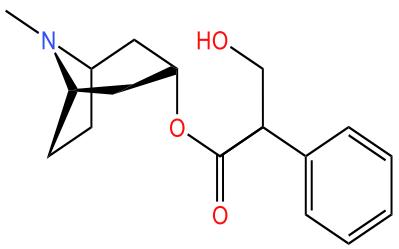
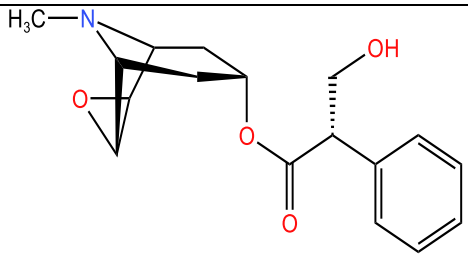
The minor and major tropane alkaloids predominate among the many phytochemicals found in *D. metel*. Hyoscine, atropine, scopolamine and aposcopolamine are the most important

alkaloids. According to studies on the distribution of these drugs, atropine and scopolamine are manufactured in different regions of the plants at varying moments throughout their life cycles. Young stems and leaves always contain hyoscyamine in the highest concentration. *D. metel* has 64 tropane alkaloids in total, and due to their tendency to exert an anticholinergic effect, all of them have been employed in pharmacopoeias. Since sterols and their derivatives make up the majority of essential oils, the essential oil from *D. metel* also contains significant amounts of, 26, 26-dimethyl-5,24(28)-ergostadien-3-ol (10.39 %). Phytate, tannins, and oxalate concentrations were also higher in the seeds than inside the coat of the seed. Compared to the seeds, the seed coat seemed to have more nitrogen, calcium, total ash, cellulose, potassium and sodium (20). Polar extractives and crude extractives contained saponins, tannins, flavonoids and alkaloids (36). Atropine and scopolamine, two alkaloid compounds, are the main physiologically active components of *D. metel* (42). Solanaceae family of plants, specifically the genus *Dunalia, Withania, Datura, Physalis*, *Acnistus*, and *Jaborosa*, discovered by Michel Félix Dunal, Henry Witham, Carl Linnaeus**,** Heinrich Wilhelm Schott**,** contain the majority of the withanolides (40), a type of oxygenated C28 ergostane-type steroidal lactones. Withanolides had also obtained much attention recently because of their diverse variety of biological characteristics. It includes anticancer (23), cytotoxic (30), anti-inflammatory (15, 22), immunosuppressive (9), and chemo preventive effects (45). *Datura metel* is used widely in mainland China (11). Traditional Chinese medicine has utilised the dehydrated flower of *Datura metel*, also known as flos *Datura*, to cure asthma, cough, seizures, and insanity (54). Recent research has shown that it has a clear impact on the management of psoriasis (53,55). Additionally, it had been used clinically in the Heilongjiang University of 53 Chinese Medicine's first affiliated hospital in China (48, 60). A variety of withanolides, particularly baimantuoluoline A-K & baimantuoluoside A-H (27, 46, 51, 52, 56-58) have been identified based on chemical analyses from earlier investigations, which revealed withanolides were the main constituent of *D. metel* flower's medically helpful part for psoriasis. The parts of *D. metel's* leaves are relatively similar to those found in its blooms because of the variety of its parts. We looked into the chemical components of *D. metel's* leaves because we wanted to increase the resources we had available and find additional bioactive components. As a result, along with six already-known withanolides, nine novel withanolides were discovered and given the names daturafolisides A-I. Examples of compounds are Daturataturin A, Baimantuoluoside B, & 12-deoxywithastramonol ide, *Datura*- metelin J. From the above compounds, 67 configurations were clarified using connections with previously published data, such as 1D & 2D NMR (1 H-COSY, HSQC, HMBC, 1 H & NOESY), MS, and CD spectrum analyses. The ability of each isolate to reduce RAW 264.7 polymorphic nuclear leukocyte aggravation caused by lipopolysaccharide (LPS) was tested in vitro. The research details the separation of these chemicals from the leaf of *D. metel*, its structural analysis, and their anti-inflammatory properties.

2.7. Pharmacological Properties

The detailed pharmacological properties of the plant like anti-ulcer, antioxidant, antibacterial, anticholinergic, herbicidal, protective, reproductive, neurologic, antifungal, wound healing, antispasmodic, mydriatic, sedative, antipyretic, antiasthmatic, anti-inflammatory and hypoglycaemic activities are mentioned in the given text.

Table 1: Chemical Constituents in *Datura metel*

 **Hyoscine**	 **Aposcopolamine**
 **Atropine**	 **Scopolamine**

2.7.1. Anti-Ulcer Activity

Investigation showed that the mucin production and the overall amount of mucosal g proteins were unchanged in terms of total carbohydrates, protein, gastrointestinal cell shedding, or repeated units. Gastrointestinal discharge, acid, and peptic outflow were all significantly reduced. Furthermore, it raised prostaglandins (10).

2.7.2. Antioxidant and Antibacterial Activities

The antioxidant as well as antibacterial activity of crude extracts of *D. metel* leaf samples in ethyl acetate, chloroform, hexane, butanol and methanol at various concentrations (12.5, 25, 50, 100, and 200 ppm) ranged from 42-54% for dry samples to 47-71% for fresh samples. The absorbance gradually rose with increasing amounts of organic crude extracts obtained from fresh and dried samples (4). The results of crude methanolic extracts of *D. metel* were reported by other researches having hepatoprotective effects (5). The antibacterial property of herbal crude extracts is typically influenced by the dosage as well as the type of bacterium utilised. The various crude extracts from *D. metel's* dry and fresh leaves demonstrated antibacterial potential against one gram positive (*S. aureus*) and three gram negative (*E. coli, P. aeruginosa*, and *K. pneumoniae*) bacteria for a total of four dosages of 2 mg/ml, 1 mg/ml, 0.5 mg/ml, and 0.25 mg per ml using dimethyl sulphoxide (DMSO). Also, it was found that the chemical components in the isolated compounds were the source of these antibacterial effects (4,43,50). The crude extracts contained bioactive substances such tannins and

flavonoid components. However, the antioxidant and antibacterial properties were being induced by these bioactive substances. Fractionation can reduce or raise the concentration of the active ingredients in the crude extract. They have been thoroughly investigated because of their ability to immobilise microbial population, enzymes, cell membrane protein production, and other elements (26,49). Additional study is required to isolate and pinpoint particular active ingredients as well as to comprehend how these chemicals work as antioxidants in vivo. The fresh leaves methanol crude extract of *D. metel* had the best efficiency against the investigated microorganisms, according to the most recent antibacterial analysis of different *D. metel* crude extracts. In a manner similar to this, the leaves' improvised methanolic extract demonstrated the strongest antioxidant efficacy. The existence of phytochemicals such alkaloids, steroids, flavonoids, as well as tannins is required for such isolated compounds of *D. metel* to be have antibacterial and antioxidant effects, according to a phytochemical study. Crude extracts from the plant have the potential to be novel sources of antioxidants and antimicrobials.

2.7.3. Anticholinergic Activity

Hyoscyamine was the major chemical constituent that had been found in the stems and leaves of young plants. Due to its anticholinergic qualities, it was utilised in a number of pharmacopoeias (34).

2.7.4. Herbicidal Activity

The potential herbicidal properties of methanolic extract of dried plant leaves of *Datura metel* have been used to get rid of undesired weeds (21).

2.7.5. Protective Effect

Serotonin is a hormone which had a wide range of pharmacological properties, was abundantly found in *Datura metel* (12). Serotonin had been shown in recent work using transgenic rice leaves to serve a defensive function against Reactive Oxygen Species (ROS) in postponing senescence (25).

2.7.6. Neurologic Effect

It was discovered in research that melatonin, serotonin, and a number of other neurotransmitters are present in sensually active plants which have shown effects in people over the past ten years (1,13). According to recent investigations (2,14), melatonin in *Datura metel* has shown a frontal cortex deleterious effect in male adult Wistar rats. Also melatonin consumed via plant species, nuts, and veggies is incorporated into the human body's digestive system and metabolites have been found in urine tests (31). According to this information, melanin in our food and plant-based medicines may have an impact on our well-being and have the ability to treat a number of chronic diseases.

2.7.7. Sedative, Anti-Spasmodic and Mydriatic Activity

Tropane alkaloids are used as barbiturates, antispasmodics, and mydriatics and are discovered in *D. metel* (35). The plant's anaesthesia, psychedelic, anti-asthmatic, anti-spasmodic, anti-tussive, hypnotic, broncho-dilator, anodyne, relaxing, and immediate response properties are most notable in the leaves and seeds. For rheumatoid arthritis, sciatica, migraines, unpleasant cancers, flea, allergies, viruses, and glandular

inflammations like measles, leaves are applied locally. Additionally, they are smoked to alleviate spasmodic asthma and applied topically for earaches. Furthermore, seeds are applied outside to create mounds (3). Seeds, leaves, and roots are used to treat brain disorders, fever, diarrhoea, skin issues, and skin conditions.

2.7.8. Hypoglycaemic Activity

Wister rats and diabetic rats showed that the hypoglycaemic & antihyperglycemic effects of *D. metel* seed were investigated. *D. metel* seeded powder was diluted in 1 % sodium CMC and orally administered to diabetes, robust, and rats having blood glucose levels greater than 300 mg/dL at dosages of 25, 50, & 75 mg/kg body weight. Blood was drawn at several times during the day and the treated animals showed symptoms of dose-dependent hypoglycaemia. In rats with diabetes brought on by alloxan, *D. metel* was similarly found to have the dose-dependent antihyperglycemic activity. Blood glucose levels were lowered by *D. metel* seed powder in both naturally hyperglycaemic and rats given alloxan to cause them to become hyperglycaemic. Our findings may therefore confirm the widespread belief that *D. metel* seeds seem to be helpful for managing diabetes and that they hold promise for the development of potent phytomedicine for the condition (32).

2.7.9. Wound Healing Effects

A 24-well plate was cultured with a cell density of 200000 and raised to 80% confluence of test sample. A little linear wound was now visible on the monolayer's surface when it was gently scraped with a clean tip. The cells were cleaned with PBS [Phosphate buffer saline] before being exposed to various doses of extracts made from methanol (5, 25 & 50 mg/mL) lasting 24 hours. Under inverted phase-contrast microscopy, the growth of cells was seen, and the wound contracted (39). The methanolic extract of *D. metel* leaves (5, 25 and 50 mg/mL) was tested against L929 murine fibroblasts for 24 hours to determine its potential for healing wounds. The wound gap was bridged by methanolic extract of 5 mg/mL at 8, 16, and 24 hours, respectively, by 36.33, 49.61 and 57.36 margins. At 25 mg/mL (77.72 -91.33) & 50 mg/mL (79.31 - 100) over the same period, the wound closure was even better. The control group, on the contrary only displayed a wound closure rate of 22.83-41.55.

2.7.10. Anti-Fungal Activity

The micro-broth dilution method is used to assess the fungus' susceptibility to various concentrations of the plant (44). *D. metel* was initially identified as having promise against pathogenic species of Aspergillus during plant antifungal activity screening. Therefore, hexane, methanol, acetate, and alcohol fractions were produced by sequentially extracting powdered aerial portions of *D. metel* using organic solvents. Sextane, chloroform, acetone, and methanolic concentrations of 1.42, 2.11, 2.12, and 3.75 percent respectively, were formed by *D. metel* dry powder. The antifungal effect of all 4 *D. metel* fractions was tested using *A. fumigatus* and *A.niger* by a micro-broth diluting test. It was shown that the bulk of the antifungal property in *D. metel* came from the chloroform fraction.

3. CONCLUSION

A flowering plant called *Datura metel* is mainly encountered in the wild. There are many tropane alkaloids in it, including atropine and scopolamine, which are likewise anticholinergic in nature. They have been well examined for their pharmacological effects, which include pain relief, CNS stimulation, decongestion of the inhalation system, skin infection treatments, toothaches, dental issues, and decongestion of the skin. Although all plant components are poisonous, it has been discovered that mature seeds have the highest alkaloid content. They can therefore be used to treat the symptoms, signs, and effects of specific central anticholinergic consequences as well as organophosphate-induced toxicity. While a bark extract is utilised topically to treat burns, ulcer, inflammations, as well as other skin issues, a leaf extract is infused into the body for curing sinus infections. *Datura metel* has been used for a very long time to treat ailments like gout, pain, abscess, migraines, serpent bite, inflammations, sprains, and tumours because of its medicinal properties. Additionally, *D. metel* is used in ayurveda medicine to treat bodily aches, sciatica, ulcers, rheumatism, inflammation, bruising, and swellings as well as asthma, bronchitis, and other respiratory conditions. Additionally, it is applied topically to lessen the discomfort of sciatica and rheumatism. When it comes to getting rid of cestodes and other intestinal worms, the concoction made from the milk in the leaves is quite beneficial.

AUTHOR'S CONTRIBUTION

S. Das designed the manuscript and developed the concept, A. Majumder did a critical revision of the article, and B.Pentela along with R.Ghai helped in drafting the article. All authors have contributed equally.

DECLARATION

We declare that all authors of this manuscript have made substantial contributions. We did not exclude any author who substantially contributed to this manuscript. We have followed our ethical norms established by our respective institutions.

CONFLICT OF INTEREST

The authors announce that they have no conflict of interest.

ETHICAL APPROVAL

The authors declare that the study was carried out following scientific ethics and conduct. However, this study did not involve any use of animals hence no ethical approval has been obtained from the concerned committee.

4. REFERENCES

1. Abbasi, B.H., Younas, M., Anjum, S., Ahmad, N., Ali, M., Fazal, H. and Hano, C. (2020). Serotonin in plant signalling and communication. *Neurotransmitters in plant signaling and communication* **2020**: 75-92.
2. Abena, A.A. and Miguel, L.M. (2004). Neuropsychopharmacological effects of leaves and seeds extracts of Daturafastuosa. *Biotechnology (Pakistan)* **3(2)**: 109-113.

3. Ahmad, F., Fouad, H., Liang, S.Y., Hu, Y. and Mo, J. C. (2021). Termites and Chinese agricultural system: applications and advances in integrated termite management and chemical control. *Insect science* **28(1)**: 2-20.
4. Alabri, T.H.A., Al Musalami, A.H.S., Hossain, M.A., Weli, A.M. and Al-Riyami, Q. (2014). Comparative study of phytochemical screening, antioxidant and antimicrobial capacities of fresh and dry leaves crude plant extracts of Datura metel L. *Journal of King Saud University-Science* **26(3)**: 237-243.
5. Alam, W., Khan, H. and Khan, S.A. (2021). Evaluation of hepatoprotective effects of crude methanolic extract of Datura metel L. in mice. *Cellular and Molecular Biology* **67(1**): 171-176.
6. Al-Snafi AE. (2017). Medical importance of Datura fastuosa (syn: Datura metel) and Datura stramonium-A review. *IOSR Journal of Pharmacy* **7(2)**: 43-58.
7. Antony, V.S., Silky, V., Raji, P., SaiPriya, C. and Selvarani, J.A. (2019). Bioactivity studies of Datura metel, Aegle marmelos, Annona reficulata and Saraca indica and their green synthesized silver nanoparticle. *Journal of Pure and Applied Micrbiology* **13(1)**: 329-338.
8. Bawazeer, S., Rauf, A. and Bawazeer, S. (2020). Potent In Vitro α-Glucosidase and β-Secretase Inhibition of Amyrin-Type Triterpenoid Isolated from Datura metel Linnaeus (Angel's Trumpet) Fruits. *BioMed Research International* **2020**: 1-5.
9. Budhiraja, R.D., Sudhir, S. and Garg, K.N. (1984). Antiinflammatory activity of 3 β-Hydroxy-2, 3-dihydro-withanolide F. *Planta medica* **50(02)**: 134-136.
10. Cheng, Y., Liu, Y., Tan, J., Sun, Y., Guan, W., Liu, Y., Yang, B. and Kuang, H. (2020). Spleen and thymus metabolomics strategy to explore the immunoregulatory mechanism of total withanolides from the leaves of Datura metel L. on imiquimod-induced psoriatic skin dermatitis in mice. *Biomedical Chromatography* **34(9)**: e4881.
11. Chu, C., Xia, L., Bai, L.P., Li, Q., Li, P., Chen, H.B. and Zhao, Z.Z. (2009). Authentication of the 31 species of toxic and potent Chinese materia medica by light microscopy, part 3: Two species of T/PCMM from flowers and their common adulterants. *Microscopy research and technique* **72(6)**: 454-463.
12. Erland, L.A., Turi, C.E. and Saxena, P.K. (2019). Serotonin in plants: origin, functions, and implications. *Serotonin* **201**9: 23-46.
13. Erland, L.A.E. and Saxena, P.K. (2019). Mammalian Neurotransmitter Are Important Signals Mediating Plant Morphogenesis. *Sensory Biology of Plants* **2019**: 411-449.
14. Firdaus, N., Viquar, U. and Kazmi, M.H. (2020). Potential and pharmacological actions of Dhatura safed (Datura metel L.): as a deadly poison and as a drug: an overview. *International Journal of Pharmaceutical Sciences and Research* **11:** .3123-3137.
15. Habtemariam, S. (1997). Cytotoxicity and immunosuppressive activity of withanolides from Discopodium penninervium. *Planta medica* **63(01)**: 15-17.
16. Hanif, S., Jabeen, K., Akhtar, N. and Iqbal, S. (2022). GC-MS analysis & antifungal activity of Datura metel L. against Rhizoctonia solani Kuhn. *Anais da Academia Brasileira de Ciências* **94(1):** 1-8.
17. Imo, C., Arowora, K.A., Ezeonu, C.S., Yakubu, O.E., Nwokwu, C.D., Azubuike, N.C. and Sallah, Y.G. (2019). Effects of ethanolic extracts of leaf, seed and fruit of Datura metel L. on kidney function of male albino rats. *Journal of Traditional and Complementary Medicine* **9(4):** 271-277.
18. Islam, T., Ara, I., Islam, T., Sah, P.K., de Almeida, R.S., Matias, E.F.F., Ramalho, C.L.G., Coutinho, H.D.M. and Islam, M.T. (2023). Ethnobotanical uses and phytochemical, biological, and toxicological profiles of Datura metel L.: A review. *Current Research in Toxicology* **2023**: 100106.
19. Jaber, A., Edmond, C., Ibrahim, G. and Lamis, A. (2019). Phytochemical study and antioxidant activity of extract from the leaves of lebanese Datura metel L. *European Journal of Pharmaceutical and Medical Research* **6**: 65-71.
20. Jamdhade, M.S., Survase, S.A., Kare, M.A. and Bhuktar, A.S. (2010). Phytochemical studies on datura metel linn. In marathwada region, maharashtra. *Journal of Phytology* **2(12)**: 46-48.
21. Javaid, A., Shafique, S. and Shafique, S. (2010). Herbicidal effects of extracts and residue incorporation of Datura metel against parthenium weed. *Natural product research* **24(15)**: 1426-1437.
22. Jayaprakasam, B. and Nair, M.G. (2003). Cyclooxygenase-2 enzyme inhibitory withanolides from Withania somnifera leaves. *Tetrahedron* **59(6)**: 841-849.
23. Jayaprakasam, B., Zhang, Y. and Seeram, N.P. (2003). Growth inhibition of human tumor cell lines by withanolides from Withania somnifera leaves. *Life sciences* **74(1)**: 125-132.
24. Jyothsna, S., Manjula, G., Suthari, S. and Rao, A.N. (2020). Qualitative elemental analysis of selected potential anti-asthmatic medicinal plant taxa using EDXRF technique. *Heliyon* **6(2)**: .e03260.
25. Kang, K., Kim, Y.S., Park, S. and Back, K. (2009). Senescence-induced serotonin biosynthesis and its role in delaying senescence in rice leaves. *Plant physiology* **150(3)**: 1380-1393.

26. Kesharwani, J., Yoon, K.Y., Hwang, J. and Rai, M. (2009). Phytofabrication of silver nanoparticles by leaf extract of Datura metel: hypothetical mechanism involved in synthesis. *Journal of Bionanoscience* **3(1)**: 39-44.
27. Kuang, H.X., Yang, B.Y., Xia, Y.G. and Wang, Q.H. (2011). Two new withanolide lactones from flos daturae. *Molecules* **16(7)**: 5833-5839.
28. Liu, Y., Jiang, H.B., Liu, Y., Algradi, A.M., Naseem, A., Zhou, Y.Y., She, X., Yang, B.Y. and Kuang, H.X. (2020). New indole alkaloids from the seeds of Datura metel L. *Fitoterapia* **146**: 104726.
29. Maheshwari, N.O., Khan, A. and Chopade, B.A. (2013). Rediscovering the medicinal properties of Datura sp.: A review. *Journal of medicinal plants Research* **7(39)**: 2885-2897.
30. Minguzzi, S., Barata, L.E., Shin, Y.G., Jonas, P.F., Chai, H.B., Park, E.J., Pezzuto, J.M. and Cordell, G.A. (2002). Cytotoxic withanolides from Acnistus arborescens. *Phytochemistry* **59(6)**: 635-641.
31. Murch, S.J., Alan, A.R., Cao, J. and Saxena, P.K. (2009). Melatonin and serotonin in flowers and fruits of Datura metel L. *Journal of Pineal Research* **47(3)**: 277-283.
32. Murthy, B.K., Nammi, S., Kota, M.K., Rao, R.K., Rao, N.K. and Annapurna, A. (2004). Evaluation of hypoglycemic and antihyperglycemic effects of Datura metel (Linn.) seeds in normal and alloxan-induced diabetic rats. *Journal of ethnopharmacology* **91(1)**: 95-98.
33. Mustapa, M.A., Taupik, M., Suryadi, A.M.A., Pakaya, M.S., Akuba, J., Djuwarno, E.N. and El Kiyat, W. (2023). Cytotoxicity and fragmentation pattern of Datura metel L. leaves using ultra-performance liquid chromatography-mass spectroscopy. *Journal of Applied Pharmaceutical Science* **13(6)**: 57-67.
34. Neha, R.S., Rai, G., Mourya, P. and Pandey, V (2022). Therapeutic and detrimental effects of Datura: A systematic review. *Advance Pharmaceutical Journal* **7(6)**: 181-188
35. Nuhu,H. and Ghani, A. (2002). Alkaloid content of the leaves of three Nigerian Datura species. *Nigerian Journal of Natural Products and Medicine* **6(1)**: 15-8.
36. Okwu, D.E. and Igara, E.C. (2009). Isolation, characterization and antibacterial activity of alkaloid from Datura metel Linn leaves. *African Journal of pharmacy and pharmacology* **3(5)**: 277-281.
37. Papadoyannis, I.N. (1995). Determination of Datura alkaloids by using chromatographic techniques: A review. *Natural Toxins* **3(4)**: 310-316.
38. Parveen, S., Sharma, R., Bais, R. and Saini, RL. (2022). Study on biodiesel production from Datura innoxia and Datura metel seed oils from western Rajasthan, India. *Ecology, Environment and Conservation* **28(4)**: 1857-1862.
39. Prasathkumar, M., Anisha, S., Khusro, A., Essa, M.M., Chidambaram, S.B., Qoronfleh, M.W. and Emran, T.B. (2022). Anti-pathogenic, anti-diabetic, anti-inflammatory, antioxidant, and wound healing efficacy of Datura metel L. leaves. *Arabian Journal of Chemistry* **15(9)**: 104112.
40. Puente, L., Nocetti, D. and Espinosa, A. (2019). Physalis peruviana Linnaeus, an update on its functional properties and beneficial effects in human health. *Wild Fruits: Composition, Nutritional Value and Products* **2019**: 447-463.
41. Ramachandran, S., Meenatchisundaram, S., Subramanian, S., Thatipelli, S., Mandal, A.K. and Allu, R., 2022. Development of Chromatographic Fingerprint Profile and Multi-elemental Analysis of Datura metel L. *Pharmacognosy Research* **14(2)**: 146-152.
42. Sayegh, H.A., Zein, M., Jaber, A., Ibrahim, G. and Cheble, E. (2021). Quantification of Atropine and Scopolamine in Different Plant Organs of Datura Metel: Development and Validation of High-Performance Liquid Chromatography Method. *Journal of Clinical and Laboratory Research* **3(3)**: 2768-0487.
43. Sekar, D., Kolanjinathan, K., Saranraj, P.and Gajendiran, K. (2012). Screening of Phyllanthus amarus, Acalypha indica and Datura metel for its antimicrobial activity against selected pathogens. *International Journal of Pharmaceutical and Biological Archives* **3(5)**: 1231-1236.
44. Sharma, G.L. (2002). Studies on antimycotic properties of Datura metel. *Journal of ethnopharmacology* **80(2-3)**: 193-197.
45. Su, B.N., Park, E.J., Nikolic, D., Santarsiero, B.D., Mesecar, A.D., Vigo, J.S. and Kinghorn, A.D. (2003). Activity-guided isolation of novel norwithanolides from Deprea subtriflora with potential cancer chemopreventive activity. *The Journal of Organic Chemistry* **68(6)**: 2350-2361.
46. Tan, J., Liu, Y., Cheng, Y., Sun, Y., Pan, J., Guan, W.and Yang, B. (2020). New withanolides with anti-inflammatory activity from the leaves of Datura metel L. *Bioorganic Chemistry* **95**: 103541.
47. Tan, J.Y., Liu, Y., Cheng, Y.G., Sun, Y.P., Pan, J., Yang, S.H., and Yang, B.Y. (2020). Anti-inflammatory sesquiterpenoids from the leaves of Datura metel L. *Fitoterapia* **142**: 104531.
48. Tang, L., Wang, Q., Yang, B., Xiao, H., Sun, Y. and Kuang, H. (1994). Protective effects of active fraction and constituents from Flos Daturae on Chinese hamster ovary cells injuried by dimethyl sulfoxide. *Chinese Traditional and Herbal Drugs* **37(12)**: 1826-1831.

49. Tyagi, A., Rao, N.R., Yadav, D. and Kanojia, K. (2023). An Investigation of Silver Nanoparticles With Its Toxicological Effects And Applications. *Journal of Survey in Fisheries Sciences* **10(4S)**: 718-727.
50. Vadlapudi, V. and Kaladhar, D.S.V.G.K. (2012). Antimicrobial study of plant extracts of Datura metel L. against some important disease causing pathogens. *Asian Pacific Journal of Tropical Disease* **2**: S94-S97.
51. Yang, B., Wang, Q., Xia, Y., Feng, W., and Kuang, H. (2007). Withanolide compounds from the flower of Datura metel L. *Helvetica Chimica Acta* **90(8)**: 1522-1528.
52. Yang, B., Wang, Q., Xia, Y., Feng, W., and Kuang, H. (2008). Baimantuoluolines D-F, Three New Withanolides from the Flower of Datura metel L. *Helvetica Chimica Acta* **91(5)**: 964-971.
53. Yang, B.Y., Cheng, Y.G., Liu, Y., Liu, Y., Tan, J.Y., Guan, W. and Kuang, H. X. (2019). Datura metel L. ameliorates imiquimod-induced psoriasis-like dermatitis and inhibits inflammatory cytokines production through TLR7/8-MyD88-NF-κb-NLRP3 inflammasome pathway. *Molecules* **24(11)**: 2157.
54. Yang, B.Y., Guo, R., Li, T., Wu, J.J., Zhang, J., Liu, Y. and Kuang, H.X. (2014). New anti-inflammatory withanolides from the leaves of Datura metel L. *Steroids* **87**: 26-34.
55. Yang, B.Y., Guo, R., Li, T., Liu, Y., Wang, C.F., Shu, Z.P. and Kuang, H. X. (2014). Five withanolides from the leaves of Datura metel L. and their inhibitory effects on nitric oxide production. *Molecules* **19(4)**: 4548-4559.
56. Yang, B.Y., Xia, Y.G., Liu, Y., Li, L., Jiang, H., Yang, L. and Kuang, H.X. (2014). New antiproliferative and immunosuppressive withanolides from the seeds of Datura metel. *Phytochemistry Letters* **8**: 92-96.
57. Yang, B.Y., Xia, Y.G., Wang, Q.H., Dou, D.Q. and Kuang, H.X. (2010). Baimantuoluosides DG, four new withanolide glucosides from the flower of Datura metel L. *Archives of pharmacal research* **33**: 1143-1148.
58. Yang, B.Y., Xia, Y.G., Wang, Y.Y., Wang, Q.H., and Kuang, H.X. (2013). Two novel norwithasteroids with unusual Six- and seven-membered ether rings in side chain from flos Daturae. *Evidence-Based Complementary and Alternative Medicine* **2013**: 1-6.
59. Yang, F., Liu, P., Zhang, X., Zhang, Z., Lu, H. and Geng, N. (2022). Mechanism of Datura metel on sinus bradycardia based on network pharmacology and molecular docking: A review. *Medicine* **101(49)**: e32190.
60. Zhang, H. and Qu, X. (2002). Advances in experimental studies on treatment of psoriasis by traditional Chinese medicine. *Journal of Traditional Chinese Medicine= Chung i tsa Chih Ying wen pan* **22(1)**: 61-66.

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