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Phytochemical screening of *Datura metel* L. extracts: A medicinal plant growing at Braj region of western Uttar Pradesh

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Abstract

Plants are regarded as a chemical factory and a rich source of secondary metabolites because they contain a wide variety of beneficial chemical compounds. Medicinal plants offer a wide variety of bioactive chemicals, especially those belonging to the Solanaceae family. The major purpose of the current work was to analyze the phytochemical from the leaves, fruits, and stem extract of Datura metel and the existence of bioactive components using a range of phytochemical tests. *D. metel*, is a highly medicinal important, short-woody shrub plant from family Solanaceae growing at Braj region of western Uttar Pradesh. Disease free parts; leaves fruits & stem were collected, cleaned with tap water, dried in shade and coarsely powdered. Stem fractions were extracted by soxhlet extraction with acetone and water. Phytochemical analysis was examined in aqueous, ethanol, chloroform, petroleum ether and acetone extract. The significant result obtains in aqueous, ethanol, chloroform and acetone extracts of leaves, fruits and stem which was riches in alkaloids carbohydrates, glycosides, phenol, phytosteroids, flavones, terpenoids, cardioglycosides, sugar, amino acid & proteins. However, petroleum ether did not showe presence of carbohydrates, glycosides, phenol, tannins, anthraquinones, cardioglycosides, sugar, saponins, amino acid, & proteins. Chloroform extract also shows negative signal in anthraquinones, coumarins and quinones. The current study emphasizes the importance of investigating *D. metel* extract, which is rich source of bioactive phytochemicals and plays a significant role in its antifungal and antimicrobial properties, supporting its traditional medicinal uses and suggesting commercial applications in the pharmaceutical and nutraceutical industries, as well as further investigations for researcher.

Keywords: Aqueous, *Datura metel*, Ethanol, Medicinal plant, Phytochemicals, Solanaceae.

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Introduction

Medicinal plants are a natural gift from the environment that offer humans a number of health advantages. Africa and Asia have used medicinal plants for millennia to treat a wide range of illnesses and afflictions. India is unique in the world due to its unmatched abundance of medicinal resources and vast knowledge of treating a variety of medical conditions using herbal medication (Sharma *et al*. 2025). Medicinal plants are significant source of medication, and their usage is now extensively acknowledged throughout the worldwide human health system. Over the last century, research on medicinal plants around the world has become more significant in the search for safer, more effective medications for both animals and people. At present, there is increased interest in the chemical composition of plant-based herbal remedies. Products made from barks, roots and leaves (fluid extracts) are used to relieve sickness contributing to the diseases restraint (Cragg *et al*., 2011) growing interest in the study of medicinal plants and their historical use throughout the globe. The "backbone" of ancient medicine is made up of medicinal herbs, which are used every day by more than 3.3 billion people in nations that are developing. These plants are recognized plentiful sources that are crucial to synthesis and development of pharmaceuticals, contributing to the global improvement of human civilization (Mann *et al*., 2008). Plants are abundant in secondary metabolites, which include beneficial phytochemicals, therefore medicinal plants have been exploited as natural sources of antimicrobial substances as many of them exhibit antifungal activities (Saxena and Sharma, 1999).

Phytochemicals are naturally occurring bioactive substances that are mostly found in plants. The phytochemical procedures are largely utilized for the quality control of herbal formulations, which are primarily made up of numerous chemical components (Okwu, 2004). The primary class of phytochemicals, universally known as phytodrugs, comprise secondary metabolites such as terpenoids, alkaloids, flavonoids, phenols and their derivatives, sulfur compounds such as isothiocyanates and thiophenes, alkanes such as polyacetylene, and modified lipids and carbohydrates (Mensah *et al*., 2008). The scientific and pharmaceutical communities have recently expressed interest in historically used medicinal plants. This entails finding and isolating plant-produced secondary metabolites and using them as active components in medicinal compositions (Taylor *et al*., 2001). These compounds are advertised as preventing and treating a wide range of medical conditions. Analysis of plant phytoconstituents may be helpful in determining the many biological processes that plants carry out (Elango and Jadhav, 2010)

(i) Distribution and Botanical description:- Plants from the Solanaceae family are extremely high in bioactive components and have long been used by various civilizations throughout the world (Afroz *et al*., 2020). Solanaceae is a tiny to medium-sized plant family with over 2700 species detached across the 98 genera (Olmstead and Bohs, 2006). *D. metel* is a medicinal herb belonging to family Solanaceae, and it indigenous to Africa and Asia. However, it is commonly farmed and naturalized in moist and sub-tropical regions across the globe. It is believed that the term Datura comes from the Sanskrit words Dustura (Deepa *et al*., 2014). Datura is a globally widespread genus, with 14 identified species, 10 of which are found in India (Reddy *et al*. 2025). It is growing up to 3 feet high at different palace of Agra-Mathura district of Braj region of western Uttar Pradesh. This plant's leaves are around 10 to 20 cm long, and 5 to 18 cm wide and they are coated with tiny silky grayish hairs, dark green, simple, broadly ovate, alternate, and glabrous (Figure 1A). The fruit is in the form of a capsule covering with short spines, highly poisonous, green during young, and turns brown when it matures (Figure 1B). Stem is stout, upright, smooth, leafy, hairy, and pale yellow-green to reddish-purple (Figure 1C). Flowers of *D. metel* are trumpet shaped, large, white, and with a bitter fragrance. Given above, the current study used a comparative strategy to analyzed phytochemical screening on leaves, fruits, and stem extract of *D. metel* grown in the Braj area of western Uttar Pradesh.

Figure 1-A: Leaves, B: Fruits and C: Stem of *Datura metel L.* growing at Braj region of western Uttar Pradesh

(ii) Medicinal Important: *D. metel* is a historically significant and highly therapeutic plant which rich in alkaloid, that is used in a variety of traditional systems of medical, viz; homeopathy, TCM (traditional Chinese medicine), Ayurveda and Siddha (Chowanski *et al*., 2016). *D. metel* leaves are rich in bioactive chemicals, including alkaloids, terpenoids, and saturated fatty acids, saponins, tannins, flavonoids, phenols, and aminoacids, which contribute to their therapeutic characteristics and are used as an hallucinogen and intoxication (Donatus and Ephraim, 2009, Reddy *et al*., 2025). It treats catarrh, epilepsy, insanity, hysteria, rheumatic pains, hemorrhoids, unpleasant menstrual bleeding, skin ulcers, and wounds. Additionaly, burns are treated with it. It is used to treat laryngitis, coughing, and treacheries

(Kankia, 2014). *D. metel* has long been used to relieve pain and cure epilepsy, skin illnesses, and fever with catarrh, hysteria, heart disease, and diarrhea. It is used to cure asthma in China and Vietnam, and its extracts have also been used to treat chronic bronchitis and as a general anesthetic, in India, It is supposed to treat illnesses such as cerebral problems, infections, skin disorders, catarrhal, elephantiasis, ear discharge and crazy dog bites, and also indigestion (Reddy *et al*. 2025).

Materials and Methods

(i) Collection and storage of plant material-Disease-free plant parts of natural growing *D. metel* were collected during the vegetative growth period (August to October) from different site of Agra-Mathura region of western Uttar Pradesh during 2020-2021. The leaves, stems, and fruits were carefully cut with a cutter and stored in polythene bags that were later sealed. The stored materials were then washed by running tap water to remove any impurities, air-dried in the dark, coarsely fine-powdered with a crusher, and kept in an sealed poly bag for further analysis.

(ii) Extraction of plant materials-The Soxhlet extraction method was employed to extract phytochemicals from plant parts. The crude plant-extract was processed by the soxhlet abstraction method following (Okeke, 2009). A constant amount of leaf powder (100 gm) with a thimble using Whatman filter paper, run through a Soxhlet extractor for 48 hours, then The extract is filtered, and the solvent is dissolved using a rotary-evaporator to achieve a syrupy consistency, then dehydrated over anhydrous sodium sulphate and refrigerated (4°C) until further use in qualitative phytochemical analysis.

(iii) Fractions preparations- Distilled water, pure ethanol, Chloroform, petroleum ether and acetone were employed for fractions. A separate solvent of 250 ml was added to 25 g of dried leaf, stem, and fruit powder before packing it in a soxhlet device. The extract, which contained a volatile solvent, was concentrated using a rotary evaporator, the collection tube was sterilized using the concentrated extract.

(iv) Phytochemicals analysis extract- Extracts were examined, for occurrence of bioactive components like proteins, tannins, phytosterols, flavonoids, alkaloids, saponins, glycosides, and triterpenoids using a variety of phytochemical tests (Debela, 2002, Ayoola *et al*., 2008).

A.Test for Carbohydrates and Glycosides: (i) Molisch's test (ii) Fehling's test

B.Test for alkaloids

C.Test for Saponins (Foam test)

D.Test for Phytosterols

E.Libermann-Burchard's test

F.Test for Flavanol

G.Test for Tannins: (a) Gelatin Test (b) Ferric chloride Test

H.Quantitative phytochemical analysis: Alkaloids, Flavonoids, Saponins, Total phenols (Obadoni and Ochuko, 2001).

Results and Discussion

The findings reveal disparities in the distribution of these phytochemicals and their potential therapeutic importance. The results of distilled water, pure ethanol, chloroform, petroleum ether and acetone as summarized in Table 1 to 5. The phytochemical analysis have been studied in an aqueous extract of leaves, fruits and stem of *D. metel* is riches in carbohydrates, alkaloids, glycosides, protein, phenol, flavones, coumarins, tannins, flavonoids, Saponin, terpenoids, sugar, and steroids compounds, however the aqueous extract of stem and fruits shows negative signal in anthraquinone and also stem in quinones (Table 1). Leaves, fruits and stem had been analysis in ethanol extract, it is cleared from table 2, the extract of leaves fruits and stem was rich in alkaloids, carbohydrates, phenol, glycosides, proteins, tannins, saponins, phytosteroids, Flavones, and phenolic compounds and erpenoids while, anthraquinones and quinones do not show significant result in ethanolic leaves extract (Table 2).

Table 1: - Phytochemical analysis of the Aqueous extract of *D. metel*

Sr. No.	Tests Performed	Leaves	Fruit	Stem	Test Method used
1	Alkaloids	+	+	+	Dragendorff's / Wagner's Test
2	Carbohydrates	+	+	+	Molisch's / Benedict's Test
3	Glycosides	+	+	+	Keller-Kiliani Test
4	Phenol	+	+	+	Ferric Chloride Test
5	Tannins	+	+	+	Ferric Chloride / Lead acetate Test
6	Coumarins	+	+	+	NaOH + UV Test
7	Anthraquinones	+	-	-	Borntrager's Test
8	Phytosteroids	+	+	+	Liebermann–Burchard Test
9	Flavones	+	+	+	Alkaline Reagent / Shinoda Test
10	Terpenoids	+	+	+	Salkowski's Test
11	Cardioglycosides	+	+	+	Keller-Kiliani Test
12	Reducing sugar	+	+	+	Fehling's / Benedict's Test
13	Amino Acid & Proteins	+	+	+	Ninhydrin / Biuret Test
14	Saponins	+	+	+	Foam Test
15	Quinones	+	+	-	HCl + KOH Reaction

+ = Present, - = Absent

Table 2: - Phytochemical investigation of the Ethanol extract of *D. metel*

Sr. No.	Tests Performed	Leaves	Fruit	Stem	Test Method used
1	Alkaloids	+	+	+	Dragendorff's / Wagner's Test
2	Carbohydrates	+	+	+	Molisch's / Benedict's Test
3	Glycosides	+	+	+	Keller-Kiliani Test
4	Phenol	+	+	+	Ferric Chloride Test
5	Tannins	+	+	+	Ferric Chloride / Lead acetate Test
6	Coumarins	+	+	+	NaOH + UV Test
7	Anthraquinones	-	+	-	Borntrager's Test
8	Phytosteroids	+	+	+	Liebermann–Burchard Test
9	Flavones	+	+	+	Alkaline Reagent / Shinoda Test
10	Terpenoids	+	+	+	Salkowski's Test
11	Cardioglycosides	+	+	+	Keller-Kiliani Test
12	Reducing sugar	+	+	+	Fehling's / Benedict's Test
13	Amino Acid & Proteins	+	+	+	Ninhydrin / Biuret Test
14	Saponins	+	+	+	Foam Test
15	Quinones	-	+	+	HCl + KOH Reaction

Phytochemical analysis reselted in chloroform and acetone extract of leaves fruits and stem indicates a significant signal and its rich in alkaloids, glycosides, carbohydrates, phenol, phytosteroids, flavones, terpenoids, sugar, amino acid and proteins, while the do not shows significant results in coumarins, anthraquinones, saponins quinones in chloroform extract and also anthraquinones in acetone extract (Table 3 & 4).

Table 3: - Phytochemical analysis of the Chloroform extract of *D. metel*

Sr. No.	Tests Performed	Leaves	Fruit	Stem	Test Method used
1	Alkaloids	+	+	+	Dragendorff's / Wagner's Test
2	Carbohydrates	+	+	+	Molisch's / Benedict's Test
3	Glycosides	+	-	+	Keller-Kiliani Test
4	Phenol	+	+	+	Ferric Chloride Test
5	Tannins	-	-	+	Ferric Chloride / Lead acetate Test
6	Coumarins	-	-	-	NaOH + UV Test
7	Anthraquinones	-	-	-	Borntrager's Test
8	Phytosteroids	+	+	+	Liebermann–Burchard Test
9	Flavones	+	+	+	Alkaline Reagent / Shinoda Test
10	Terpenoids	+	+	+	Salkowski's Test
11	Cardioglycosides	+	-	+	Keller-Kiliani Test
12	Reducing sugar	+	+	+	Fehling's / Benedict's Test
13	Amino Acid & Proteins	+	+	+	Ninhydrin / Biuret Test
14	Saponins	-	-	-	Foam Test
15	Quinones	-	-	-	HCl + KOH Reaction

Table 4: - Phytochemical analysis of the Acetone extract of *D. metel*

Sr. No.	Tests Performed	Leaves	Fruit	Stem	Test Method Used
1	Alkaloids	+	+	+	Dragendorff's / Wagner's Test
2	Carbohydrates	+	+	+	Molisch's / Benedict's Test
3	Glycosides	+	+	+	Keller-Kiliani Test
4	Phenol	+	+	+	Ferric Chloride Test
5	Tannins	+	+	+	Ferric Chloride / Lead acetate Test
6	Coumarins	+	+	-	NaOH + UV Test
7	Anthraquinones	-	-	-	Borntrager's Test
8	Phytosteroids	+	+	+	Liebermann–Burchard Test
9	Flavones	+	+	+	Shinoda Test
10	Terpenoids	+	+	+	Salkowski's Test
11	Cardioglycosides	+	+	-	Legal's test
12	Reducing sugar	+	+	+	Fehling's / Benedict's Test
13	Amino Acid & Proteins	+	+	+	Ninhydrin / Biuret Test
14	Saponins	-	+	-	Foam Test
15	Quinones	+	+	-	Alkali test

Petroleum ether extract of leaves, fruits and stem shows positive result in alkaloids, coumarins, phytosteroids, terpenoids. However, saponins, carbohydrates, glycosides, phenol, tannins, amino acid and proteins, flavones, sugar, anthraquinones and cardioglycosides do not show the significant signal in petroleum ether extract of leaves, fruits and stem (Table 5)

Table 5: - Phytochemical constituents in Petroleum ether extracts of *D. metel*

Sr. No.	Tests Performed	Leaves	Fruit	Stem	Test Method used
1	Alkaloids	+	+	+	Dragendorff's / Wagner's Test
2	Carbohydrates	-	-	-	Molisch's / Benedict's Test
3	Glycosides	-	-	-	Keller-Kiliani Test
4	Phenol	-	-	-	Ferric Chloride Test
5	Tannins	-	-	-	Ferric Chloride / Lead acetate Test
6	Coumarins	+	+	+	NaOH + UV Test
7	Anthraquinones	-	-	-	Borntrager's Test
8	Phytosteroids	+	+	+	Liebermann–Burchard Test
9	Flavones	-	-	-	Alkaline Reagent / Shinoda Test
10	Terpenoids	+	+	+	Salkowski's Test
11	Cardioglycosides	-	-	-	Keller-Kiliani Test
12	Reducing sugar	-	-	-	Fehling's / Benedict's Test
13	Amino Acid & Proteins	-	-	-	Ninhydrin / Biuret Test
14	Saponins	-	-	-	Foam Test
15	Quinones	+	+	+	HCl + KOH Reaction

Phytochemical refers to the extensive range of chemical substances generated by plant parts. *D. metel* is a traditional herb plant and wildly growing at Braj region revealed the occurrence of various bioactive composites in leaves, fruits and stem-extracts. The results, as summarized in Table 1 to 5, it is clear indicate that, the significant result obtains in aqueous, ethanol, chloroform and acetone extracts of leaves, fruits and stem riches in alkaloids carbohydrates, glycosides, phenol, phytosteroids, flavones, terpenoids, cardioglycosides, sugar, amino acid & proteins (Table 1-4). However, petroleum ether did not showe presence of saponins, carbohydrates, glycosides, phenol, tannins, flavones, sugar, anthraquinones and cardioglycosides (Table 5). Chloroform extract also shows negative signal in anthraquinones, coumarins and quinones. Similar explanation has also been reported by Muthusamy at al., (2010), and Reddy *et al*., (2025) in leaf and stem extracts of *D. metel*. Accordingly to them, tannins and anthocyanins were only discovered in the leaves and showed greater amounts of proteins and phenols, flavonoids were identified in the stem but not in the leaves. In contrast, the stem extract had higher levels of alkaloids and flavonoids.

It is clear from obtained result, leaf extract of *D. metel* contains a rich-concentration of Anthraquinones compared to the fruits and stem Aqueous extract (Table 1). Petroleum ethere extract did not showed presence of carbohydrates, glycosides, phenol, tannins, anthraquinones, cardioglycosides, sugar, saponins, amino acid and proteins (Table 5). Comparable results have been supported by Archana *et al*., (2023) and Reddy *et al*., (2025), both author reported the *D. metel* is a highly source of bioactive compounds as alkaloids, terpenoids, flavonoids, tannins, steroids, phenols, saponins, and glycosides with distinct phytochemical profiles in the stem and leaves. Steroids were observed to be in moderate concentrations

and tannins were at their lowest concentrations. Elijah *et al*., (2020), who said that while steroids, flavonoids, saponins were not existing in the seed, they were significantly present in the leaf extract, while the terpenoids, glycosides highly-rich in the seed extract but absent in the leaf extract. However, antrocyanins, carotenoids and anthraquinones shows negative result in both extracts.

It is observed from Table 1-4, the alkaloids, carbohydrates, glycosides and phenol are detect higher presence in the leaves, stem and fruits. Phenols and glycosides are recognized for their antibacterial and antioxidant qualities, whereas alkaloids are recognized for their medicinal relevance. Phytosteroids, which play a significant part in hormonal activities and anti-inflammatory properties, are found in all extracts' leaves, fruits, and stem. Aqueous, ethanol, chloroform and acetone extract showing higher presence of carbohydrates, amino acid and proteins in leaves, fruits and stem of *D. metel*. These comparative findings of *D. metel* are supported by Jaber *et al*., (2019), Elijah *et al*., (2020) and Reddy *et al*., (2025).

Extensive study has been showed to determine the exact content, mechanism of action, and isolation of phytochemicals, which have been demonstrated to be useful in preventing a wide range of ailments. Many communities across the world have long utilized plants in the Solanaceae family because they are rich in bioactive compounds (Afroz *et al*., 2020). The aforementioned phytochemicals have important therapeutic benefits when found in leaves, fruits, and stem extract. This plant has long been used to treat breathing, skin conditions, and discomfort.

Conclusion

A complete phytochemical examination of *D. metel* leaves, fruits, and stems in solvents such as water, ethanol, chloroform, petroleum ether, and acetone indicated the existence of significant pharmacological bioactive chemicals, as well as therapeutic and nutritional abilities. The findings of this study highlight the, alkaloids carbohydrates, glycosides, phenol, phytosteroids, flavones, terpenoids, cardioglycosides, sugar, amino acid & proteins riches in aqueous, ethanol, chloroform and acetone extracts of leaves, fruits and stem. Similarly, petroleum ether did not showed presence of carbohydrates, glycosides, phenol, tannins, anthraquinones, cardioglycosides, sugar, saponins, amino acid, & proteins. The present investigation emphasizes the importance of investigating *D. metel* extract rich source of bioactive substances plays a major role in its antifungal and antimicrobial properties and supporting, suggesting for commercial applications in pharmaceutical and nutraceutical industries, and may also support further investigations towards isolation and identification of active substances for the researcher.

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