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REVIEW ARTICLE

DATURA (*DATURA METEL*): A REVIEW BASED UPON ITS AYURVEDIC PROSPECTIVE

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ABSTRACT

Restorative plants are considered the most important herbal plants which play a significant role in the preparation of medicines in the whole world. Herbal plants are used for the preparation of medicines from ancient times. Datura, a plant from the *Solanaceae* family, also known as Jimson weed or Devil's catch, consists of both toxic and restorative qualities. Datura is known as a therapeutic plant around the globe. Datura has a particular spot in Ayurveda since all parts of the plant specifically leave, flowers, seeds and roots, have been used as a medicine. In Ayurvedic medicinal system, *D. stramonium* has been used for treatment of various human disease e.g. inflammation, sciatica, ulcers, gout, wounds, rheumatism, swelling, bruises, fever, asthma and bronchitis. This plant possesses numerous therapeutic properties. Some studies revealed its toxicity and safety profile too apart from its pharmacological properties like pain-relieving, calming, anti-viral, antidiarrheal and anti-diabetic.

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INTRODUCTION

Plants are an essential part of human life in various cultures (1). The utilization of herbal medicines for the treatment of different ailments have been practically in use from ancient times (2). They are rich source of food, grain and fuel (3). The extracts of roots, leaves, seeds and the other parts of the herbal plants are broadly used for dietary enhancement and as medicines (4). WHO assessed that <80% of the world's population depend on traditional medicines for their essential medical care requirements (5). Natural medicines can comprehensively be ordered into a few essential systems as following: (6)

Ayurveda herbalism
Chinese herbalism
African herbalism
Western herbalism
Folk herbalism

There are various reasons that patients prefer herbal medicines instead of using allopathic medicines (7). Herbal products are considered as safer and healthier as compared to synthetic drugs (8,9,10).

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In India, around 800 plant species are being in practice by different communities for various ailments (11). Datura is one of the major herbaceous perennial plant belonging to *Solanaceae* family which is grown in temperate and tropical region of the globe. Datura has been used traditionally for religious purposes in India (Ajungla L., 2009). In Ayurvedic medicinal system, *D. stramonium* has been used for treatment of various human disease e.g. inflammation, sciatica, ulcers, gout, wounds, rheumatism, swelling, bruises, fever, asthma and bronchitis. This plant is rich in tropane alkaloids mainly atropine, hyoscamine, and scopolamine which are responsible for its pharmacological and therapeutic actions. However, these alkaloids are responsible for hallucinogenic and narcotic effects at higher concentration too which can also lead to hospitalization and death if not treated on time (Ajungla L., 2009). The genus "Datura" contains alkaloid content called solanine which is also present in other rural plants including potato, tomato, espresso and pepper. Grouping of various species inside the *Solanaceae* family depends vigorously on genetic markers, which describes that this genus has an immense variety (12,13). In the 11th century, Arab Physician Avicenna was first documented *Datura metel* (Fig.1) in Sanskrit literature (14). The use of this plant has extremely wide importance due to its hallucinogenic property and its properties vary from one continent to another. It has a wide range of uses especially in medicinal terms (15). It has been used traditionally to soothe torment, respiratory issues, fevers,

and other disorders. It is an incredible producer of a psychedelic drug. Because of the presence of alkaloid content and psychedelic properties, it possesses harmful properties when taken in higher doses. Therefore, the plant has been gathered under Schedule E-1 of Drugs and Cosmetics Act-1940.

Figure. 1 ***Daturametel***

Taxonomical classification of *Daturametel* (16)

Taxonomical Rank	Taxon
Kingdom	Plantae
Division	Magnoliophyta
Subdivision	Angiospermae
Class	Magnoliopsida
Subclass	Asterids
Order	Solanales
Family	Solanaceae
Genus	*Datura*
Species	*metel*
Common name	*Datura*

Vernacular names (17,18)	
English	Downy thorn-apple
Hindu	Datura, Hindu thorn-apple, hoary thorn-apple, horn-of-plenty, metel, purple thorn-apple
Chinese	yang jinhua
Hindi	sadadhatura
Arabic	Tatura, jozmashel, jozmathel
Korean	huindogmalpul
Portuguese	burbiaca
Spanish	burladora
Swedish	indiskspikklubba

Botanical description: *Datura metel* is herbaceous, leafy annual herb that belongs to the family *Solanaceae*. It reaches up to the height of 1.5m. The stem of the plant is dark violet in appearance. Leaves are alternate, long (10-20cm), broad (5-18cm), dull green, shallowly lobed and glabrous. Flowers are bisexual, huge, and trumpet-formed whose breadth is 2-6cm and 5-20cm in length. The flowers are sweet-scented, color vary from white to yellow and light to dull purple where pollination occurs through bugs. The fruit of this plant is present in the capsulated form with shorter spines (19,20,21).

Various species of Genus Datura

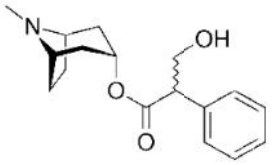
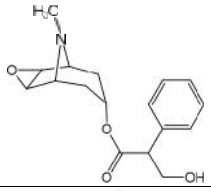
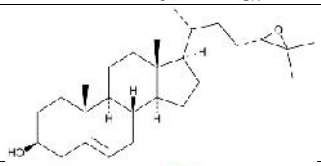
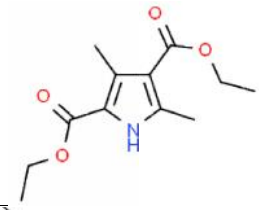
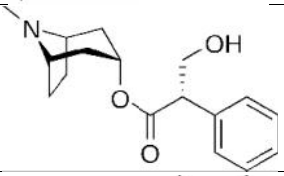
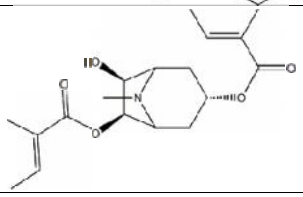
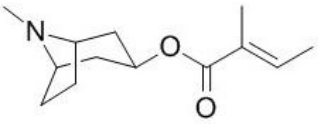
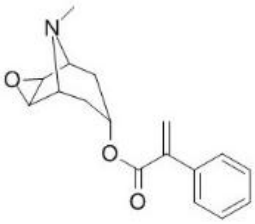
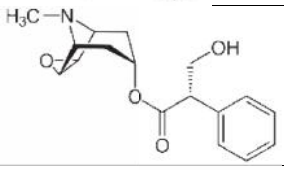
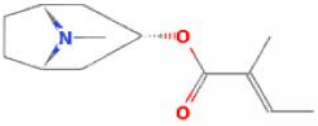
- *Datura arenicola* Gentry Ex. Bye & Luna
- *Datura ceratocaula* Ortega
- *Datura discolor Bernh.*
- *Datura ferox L.*
- *Datura innoxia Mill.*
- *Datura kymatocarpa* Barclay
- *Datura lanosaA.S.*Barclay ex Bye
- *Datura leichhardtii Benth.*
- *Datura metel L.*
- *Datura pruinosa Greenm.*
- *Datura quercifolia Kunth*
- *Datura reburra Barclay*
- *Datura stramonium L.*
- *Datura wrightii Regel*

Geographical Distribution: Datura is most probably found in American origin. Now it is also cultured in North, Central and South America, Europe, Asia, and Africa. *D. metel* is also found in East Asia or India, and is used in Bangladeshi as traditional herbal medicine (22,23).

Phytochemical Constituents *Datura metel* is a rich source of alkaloid content that is mainly present in its roots which extend consistently with the expansion in the age of the plant (24,25). Chemical constituents of the Datura plant have countless tropane alkaloids (hyoscyamine, hyoscine, littorine, acetoxytropine, valtropine, fastusine, fastusinine), that are different from anolides and distinctive trigloyl esters of tropine and pseudotropine (26,27). Calystegines, the nortropane alkaloids with glycosidase inhibitory development have been found in various Datura species. The roots contain a higher proportion of atropine which is also extracted from various parts of the plant. The leaf part ordinarily contains a higher proportion of scopolamine and modestly lower proportions of atropine (28,29). The structures of some of the phytochemicals are shown in Table no. 1.

Folk view: Classical herbal medicines have a central spot among rural areas in many countries for maintaining primary health care in the absence of a proper modern medical care system (36,37,38,39). In these areas, there are extra social factors that support the utilization of botanical plants, for example, the idea of an interrelation between the ecosystem and culture, a "man-earth" relationship (40). Folk medicines are fairly a novel approach towards medicines which can be classified under a traditional medicinal system like Ayurveda or Unani. In India, ancient physicians adopt ethno medical therapy where they used to treat cut wounds, skin disease, growing, maturing, dysfunctional behavior, malignant growth, asthma, diabetes, jaundice, scabies, skin inflammation, venereal illnesses, snakebite and gastric ulcer. They also used to give guidelines to tribal people to prepare medicines from these plants. In Folk medicines, Kavirajes have their preparations, differ from each other (41,42,43,44,45,46). In Rajshahi District, people of Bangladesh used to consume squashed leaves of *Datura metel* against pain, whereas the root administration of the plant is effective against insanity (47). Leaf seed and fruit of datura are used as an anthelmintic, antidote, carminative and to cure acne, impotency and rheumatoid arthritis (48). In ancient times, the ripe seeds of *Datura metel* were used against respiratory tract issues as a sedative and anesthetic, before operations and during labor. Also, the roots played a very significant role in protecting from evil eyes and devils (49). They used fruits and leaves of the plant for skin related problems and joint pain (50). It was used to diminish the surrounding negativity (51). It is used against Rheumatoid pain in Jhenaidah district of Bangladesh where the leaves of this plant are mixed with *Brassica compestris* seed oil (52). In the Pabna and Pirojpur districts of Bangladesh, it is utilized for arthritis and pain (53). Leaves of Datura and *Cannabis sativa* and the stem of *Neopicrorhiza scrofulari flora* mixed in water and used during headaches (54). There are reported cases where the datura plant is used against Asthma by some folk communities (55).

Table 1:1. Chemical structures of some major phytochemicals of *Datura mete*

Phytochemicals of Datura		
1.Leaves (30)	a.Atropine	
	b.hyoscyamine and scopolamine	
	c.l-oxo21,24S-epoxy-(20S,22S-witha-2,5,25-trienolide	
	d.pyrrole derivative (2'-(3,4-dimethyl-2,5-dihydro1Hpyrrol-2-yl)-1'-methylethyl pentanoate)	
2.Roots (31)	a. Hyoscyamine	
	b.3α, 6β-ditigloyloxytropan-7β-ol	
	c.tigloidine	
	d.apohyoscine	
	e.hyoscine	
	f.3α-tigloyloxytropane	

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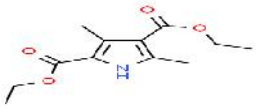
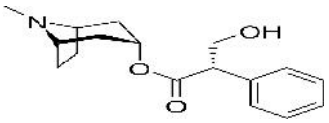
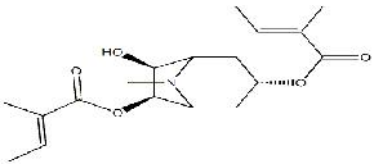
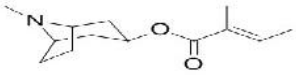
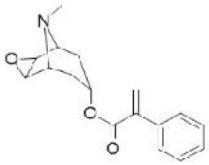
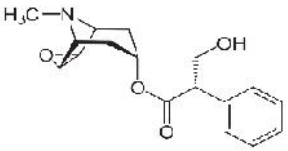
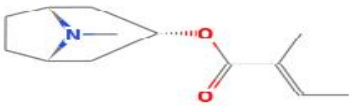
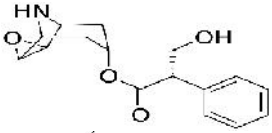
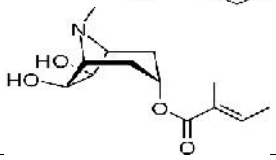
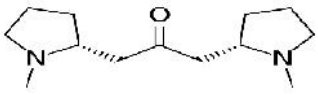
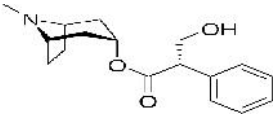
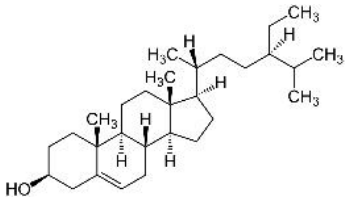
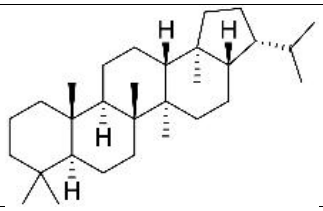
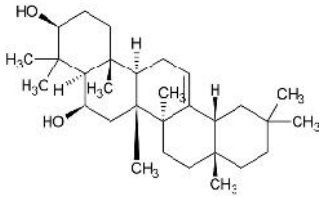
❯ **Roots (31)**	❯ pyrrole derivative (2'-(3,4-dimethyl-2,5-dihydro1Hpyrrol-2-yl)-1'-methylethyl pentanoate)	
	❯ Hyoscyamine	
	❯ 3α, 6β-ditigloyloxytropan-7β-ol	
	❯ tigloidine	
	❯ apohyoscine	
	❯ hyoscine	
	❯ 3α-tigloyloxytropane	
	❯ norhyoscine	
	❯ meteloidine	
	❯ cuscohygrine	
❯ **Seeds(32)**	❯ Hyoscyamine	
	b.daturanolone	
	c.fastusic acid	
❯ **Flowers (33,34)**	❯ Withanolide (baimantuoluoline A, B, and C and withafastuosin E and withametelin C)	
	❯ withametelins I, J, K, L, M, N, O, P, 12βhydroxy-1,10-seco-withametelin B and 1	
	c. 10- seco-withametelin B	

Continue …

) Flowers (33,34)) Fruit (35)	) Withanolide (baimantuoluoline A, B, and C and withafastuosin E and withametelin C)) withametelins I, J, K, L, M, N, O, P, 12βhydroxy-1,10-seco-withametelin B and 1) 10- seco-withametelin B) β-sitosterol	
	) triterpene	
	Daturanolone) daturadiol	
) *In vitro* propagate d shoots	Cholesterol and 5α-pregnane3β 20β-diolC28 sterol 3β	
	24ξ-dihydroxy-ergosta-5	
	25- dienolide	

In the Lakki Marwat district of Pakistan, the leaves, seeds, roots and whole plant are used as Narcotic and to cure chronic skin infections and asthma (56).

Ayurvedic view: Ayurveda is the unique system of medicines for the treatment of many human disorders in Indian culture (57). In Ayurveda pharmacopeia, Datura is a notable medicine that goes under the Upavisha Varga (Plants with venomous impacts) as portrayed in different traditional writings (58).

Raspanchak (Properties) (59,60,61,62)

Sanskrit/English	Sanskrit/English
Virya/Potency	Ushna/Hot
Vipak/Metabolic property	Katu/Pungent
Guna/Physical property Rasa/Taste	Guru/Heavy Kashaya/Astringent, Madhura/sweet, Tikat/bitter

Properties of *Daturametel*

- **Shotha:** It reduces swelling.
- **Vedana:** It is used as a painkiller.
- **Arsha:** It is used as a cure for piles.
- **Hridmadenta**: It is used as a curative agent against heart-related disorders.
- **Amlapitta:** It is used against hyperacidity.
- □□त्त□श□□□: It is used to cure gall bladder stone.
- **Shwasa:** It is used to cure asthma.
- **Vrikshul:** It reduces kidney pain.
- **Rajahkrichara:** It is used to treat dysammnoria.
- **Nadimandata:** It slows down the pulse rate.
- **Sheyammutra:** It prevents urination.
- **Vatavikara:** It is used to treat joint pain.
- **Ashmari:** It is used to treat stone disease.

Modern view: The significant problem faced by the herbal drug industry in today's scenario is the deterioration of natural products. Due to deforestation and other environmental conditions, the medicinal plants are facing the problem of getting endangered or extinct. Various other factors (like the expense of raw material) cause problems for accessibility of certifiable medicines, which supports the adulteration of the plant by replacement with non-organic compounds, depleted medicines, or less expensive plant or by other parts of the plant (63). The deterioration activity affects the laws of many nations.

This act can also show adverse effects on the human body, either by the impacts of the drug on the human body or its association with other substances (64,65). Formulated herbal medicines shows the changes that have been done in the original form of the drugs either by modifying the chemical chain composition or by changing the administration route of the drug, or using different processing methods. These are the root causes of associating toxicity of modern era's herbal drugs (66). Herbal drugs play a vital role in the medicinal system. As

Datura metel has various properties to treat diseases out of which the main property is anti-asthmatic due to which it is used in anti-asthmatic ayurvedic products. So, instead of using allopathic medicines for the treatment of asthma, we can prefer ayurvedic medicines as it has fewer side effects.

Uses of *D. metel*

Antigout	Half of the xanthine oxidase inhibitory action (*in vitro*) was found in the methanolic concentrates of *D. metel* which was equivalent to the antigout drug, allopurinol which appeared 93.21% hindrance at 100 µg/mL fixation with an IC50 estimation of 6.75µg/mL. The methanolic extract was screened for *in vivo* hypouricaemic action against potassium oxonate-initiated hyperuricemia in mice and the concentrate was detected successfully (67).
Anti-proliferative	Three withanolide glycosides named datura metelins, along with two known ones, daturataturin, and 7,27-dihydroxy-1-oxowitha2,5,24-trienolide, were extracted from the methanolic concentrate of *Datura metel L.* All compounds were tried for their anti-proliferative action towards the human colorectal carcinoma (HCT-116) cell line. The nonglycosidic compound displayed the most important action of the tried withanolides, with an IC50 estimation of 3.2±0.2 µM (68).
Anti-carcinogenic	Withanolides can hinder tumor cell multiplication and angiogenesis and activate the stage II protein quinone reductase (69). Nitrogen-containing polyhydroxylated heterocyclic components are inhibitors of different glycosidases and detected as most compelling against different diseases including diabetes, anti-tumor, and viral diseases (70,71).
Anti-fungal	Distinctive polar and nonpolar dissolvable concentrates of *D. metel* demonstrated huge antifungal properties against a wide range of contagious species. The hexane, chloroform and methanolic parts of *Datura metel L.* were examined for antifungal properties utilizing pathogenic types of Aspergilli. The chloroform portion was found to have antifungal properties (72,73).
Anti-bacterial	Rough fluid and ethanol concentrates of a leaf, stem bark and roots of *D. metel* were examined against eight clinical bacteria named (*Streptococcus* beta-hemolytic, *S. dysenteriae Pseudomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Klebsiella pneumonia, Bacillus cereus and Salmonella typhi*). The leaf and stem bark extracts showed antagonistic effects against the test micro-organisms species with inhibitory zones (74).
Hypo-glycemic	The seeds of *D. metel* were tested for hypoglycemic and anti-hypoglycemic activity. Seed powder of *D. metel* possesses blood-glucose-lowering impact in normoglycemic and in the alloxan-initiated hyperglycemic rat. In this manner, the people use the seeds of *D. metel* for controlling diabetes which was approved by this study (75).
Antioxidant agent	The aqueous extract of the leaf, stem bark and underlying roots of *D. metel* show phytochemical and antioxidant activities. The fluid concentrate of the plant showed antioxidant activities between 49.30-23.82% and can acknowledge the plant as a characteristic source of antioxidants(75).
Free-radical scavenging	*D. metel* seeds were analysed for the fatty acids and fat-soluble bioactive compounds. Its seeds contain a good quantity of oil and might be a good source of fundamental unsaturated fats and lipid-dissolvable compounds. The presence of tocopherols and sterols may have restorative significance (76).
Anaesthetic	The seed concentrate of *Datura metel* possesses anesthetic property relatable to the thiopentone sodium sedation with great anesthetic indices (77).
Analgesic	Scopolamine and Hyoscyamine are the two alkaloid components extracted from *D. metel* which are responsible for the analgesic activity. Scopolamine acts as a CNS depressant while Hyoscyamine acts in the body by blocking all the secretions of the body (78).
Anti-inflammatory	Ethanolic extract of *D. metel* possesses an important anti-inflammatory activity utilizing LPS-invigorated RAW 264.7 murine macrophages. Among them, datura folisides A and B, baimantuoluoside B and 12-deoxywithastramonolide showed hindrance of nitrite creation with IC50 of 20.9, 17.7, 17.8, and 18.4µM (79).
Anti-fertility	The unrefined acetone concentrate of *Datura metel* seeds was offered orally to the female mouse in the grouping of 0.5%, 1% and 2% individually. After treatment, the female mouse was mated with the ordinary male mouse. Again after 10 days of mating they were dismembered to notice the number of implantation locales in the uterine horns. It was revealed that 2% seed extricates caused 100% anti-implantation activity followed by 1% and 0.5% seed separates which caused 40% and 80% anti-implantation activity individually. The author concluded that the seed concentrates of *Daturametel* might be suggested as a good source of antifertility components with fewer side effects (80).
Anti-spasmodic	The impact of the plant leaf and root concentrates, scopolamine and acetylcholine were studied on the isolated smooth muscle of mice. The leaf concentrate and scopolamine demonstrated antispasmodic impacts, though root concentrate and acetylcholine caused constriction of the confined mice uterus and rectum entire muscle. The results show that the plant contains antispasmodic and spasmogenic constituents (81,82,83).

Conclusion

Conclusively this review is mainly focused on ayurvedic value of Datura, apart from its applicability in now day's modern science in order to prove its value as chemotherapeutic agent. Continuous efforts in the relevant areas is still necessary to establish rational and sustainable exploitation of the world's biodiversity. *D. metel L.* is a medicinal plant used as herbal medicine to treat a wide range of health problems around the globe. This plant can be explored further as per its diversity for traditional uses. It is considered a deliriant poison as it contains high alkaloid content but also possesses therapeutic properties like anti-inflammatory, anti-diabetic, anti-oxidant, analgesic, antipyretic and anti-microbial properties as per the reported studies. Further investigations and quantification of phytoconstituents responsible for the specified pharmacological profiles and toxicity are required. This plant should be used with a great care by knowledgeable health care professionals only because of its psychotropic effects. The adverse effects can be extremely severe and detrimental. Therefore, after so many beneficial therapeutic effects, the risk-benefit ratio should be always taken into consideration before using this plant.

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