Advances in Bioresearch
Adv. Biores., Vol 14 (5) September 2023: 360-366

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.14.5.360366

Advances in Bioresearch

REVIEW ARTICLE

A Review on Potential Medicinal Herb: *Datura stramonium* L.

Shivani Singh1, Shivam Parmar2, Sweety Singh1*
Department of Botany, Narain College, Shikohabad1,*
[2]Department of Botany, R.B.S. College, Agra
(Affiliation- Dr. B.R. Amedkar University, Agra**)**
Email- shivanisengar15@gmail.com

ABATRACT
Datura stramonium, commonly known as Jimson weed, stands out as a highly significant plant. This annual herb thrives in temperate and sub-tropical regions and is revered for its medicinal value due to its abundance of tropane alkaloids. With a diverse range of phytoconstituents such as alkaloids, flavonoids, amino acids, and more, this plant exhibits various pharmacological activities, including anti-asthmatic, antimicrobial, antioxidant, anticancer, and anti-inflammatory properties. The tropane alkaloids derived from Datura species have a profound impact on the human nervous system and find application in medicines. However, caution must be exercised as this plant is potentially poisonous and considered a hallucinogen. Improper usage can lead to restlessness, and acute poisoning may even result in death. This paper aims to provide an exclusive review encompassing the plant's phytochemicals, pharmacological properties.
KEYWORDS- *Jimson weed, Tropane alkaloids, Phytochemicals, Pharmacological.*

Received23.06.2023 Revised 27.06.2023 Accepted 29.09.2023

How to cite this article:
Shivani S, Shivam P, Sweety S. A Review on Potential Medicinal Herb: *Datura stramonium* L. Adv. Biores. Vol 14 [5] September. 2023. 360-366.

INTRODUCTION

Since the past, plants have been used extensively to cure illnesses and injuries in people all over the world. The growing popularity of natural products has increased demand for medicinal plants in both developed and developing nations. According to Kirtikar JD *et al.* [20], herbal therapy has a significant role in both traditional and contemporary medical systems. The Solanaceae family includes the widely distributed annual plant *Datura stramonium* L. (*D. stramonium*). It is one of the most well-known traditional medicinal plants. It is a wild flowering plant that has been looked at as a potential local source for tropane alkaloids, which include the anti-cholinergic pharmaceuticals atropine and scopolamine and include a methylated nitrogen atom (N-CH3). It has been utilized for religious visionary purposes all throughout the world from ancient civilizations, and witches in mediaeval Europe. Shiva, the god, was rumored to enjoy Datura and Cannabis. The little thorn apple is still offered in Shiva statues at temples during holidays and other occasions.

CLASSIFICATION

Kingdom	Plantae
Sub kingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Solanales
Family	Solanaceae
Genus	*Datura*
Species	*stramonium* L.

BOTANICAL DISCRIPTION

An annual herb with a height of 50–200 cm that is glabrous (sometimes farinose). This plant grows annually in rich soil and is bushy, smooth, and fetid. Although it is an annual, the thorn apple is a big, rough herb that branches quite freely, giving it a bushy appearance. Its spreading branches have almost equally wide coverage. On fertile ground, it might grow as tall as six feet. The plant is smooth overall, but the younger parts have a slight downiness and are coated in short, curled hairs that fall off as the plant grows. It emits a vile, oppressive, and mildly unpleasant narcotic odor. The leaves emit this fetid fragrance, especially when they are crushed, but the blossoms are sweet-scented, yet breathing in their exhalations for any period of time might make you drowsy. [19].

ROOT

The root is fairly massive, yellowish in colour, and produces several long, thick fibres. The plant's taproot, which makes up its root system, is shallow relative to its size and regularly branches. [19].

STEM

The stem is cylindrical, fistular, and green or purple. It is mostly hairless, while immature stems frequently contain noticeable hairs. The stem is thick, leafy, erect, smooth, and pale yellowish green in color. It branches frequently in a forked manner, producing a leaf and a single, upright flower in each of the forked branches [18].

LEAVES

When the petioles are excluded, the alternate leaves can measure up to 8 cm long and 6 cm wide. Although they have an oval or ovate-cordate shape, they are pinnately lobed. There are typically 2–3 of these lobes on each side of the leaf blade; they are shallow and pointed at their tips. Each leaf's border is smooth or gently undulating save for a few secondary lobes or coarse dentate teeth.When young, the leaves may be slightly pubescent; however, as they become older, they lose their hair, and the upper surface of each leaf is frequently dull and dark green. Jimsonweed's leaf emits a pungent, bitter smell. The exstipulate, cauline and ramal leaves are petiolate, simple, dissected, acute, glabrous, unicosted, and have reticular venation. They are also alternate to opposing leaves. The strong, branching veins are clearly formed and the leaves are big and angular, uneven at the base, with a wavy and coarsely serrated border. The underside is paler and, when dried, minutely wrinkled. Its upper surface is dark and grayish-green and normally smooth.[17].

FRUITS

A hard fruit that is dry, spiky, and about 112" long, 1" wide, and spheroid-ovoid in shape, replaces each bloom. Each fruit has a truncated, downward-curving remnant of the calyx underneath it. When these fruits reach maturity, they change from green to brown and split into four parts, releasing the seeds. [19].

SEEDS

The big, dull, amorphous, and dark-colored seeds may have pits or a little reticulation on their surface. Jimsonweed reproduces in order to spread [19].

DISTRIBUTION

The origin of *Datura stramonium* is uncertain. It is locally found in the areas of tropical climates such as India, Mexico, and South America [34]. It is found in the garbage dumps in the Europe [31]. It was brought in UK from variousresources such as soybean waste and bird seed [69, 73]. Jimson weed is the native plant of the most of temperate and subtropical areas so it is most probably originated in Central America. Although *Datura stramonium* is originated in America but it is commonly found in the cultivated fields of France [25].

Jimson weed is indigenously found in Middle East, Germany, France, United States, South America, Caspian region and Hungary [29]. Thorn apple is widely distributed inthe temperate regions of the world [6]. In UK Jimson weed isinfrequently found especially during the hot summers. *Daturastramonium* is found on most of the places as a weed ranging from roadsides to farm in India [20]). The plant is present in the gardens, pastures and wastelands of district Baghdad [1]. It isnot only a native plant of South Africa but it is also found in many other parts of the world as it was used by Red Indians fora long period of time as euphoric agent, and it is also utilized as therapeutic agent in the great Britain since 1800's [32].

CULTIVATION AND COLLECTION

Thorn apples are simple to grow and do well in an environment that is open and sunny. It thrives in soil that is relatively excellent, but it grows best in soil that is rich in calcium or in a good sandy loam with the addition of leaf mould. The seeds are drilled in the open in May, 3 feet apart, and scarcely covered. thinly, as they develop quickly and fully from seed and reach an ideal size.In the drill, thin out the young plants so that there are 12 to 15 inches between each one. In the beginning, weeds should not be allowed to grow in the soil. Give rotten cow manure a mulching if the summer is hot and dry. If cultivated for leaf crop, the capsule should be removed as soon as it forms since the spines in the plant might rip the leaves in a wind. The plant grows to a height of 1 meter in August and produces both flowers and fruits. The end of August sees the collection of stems with leaves and blooming tops, which are dried as quickly as possible at 45 to 50 °C. When the plant is fully bloomed, the leaves should be collected and dried with care. In the late summer, they are typically picked. The crop is hacked by the sickle in the month of August on a lovely morning after the sun has dried the dew, and the leaves are peeled from the stem and dried carefully as rapidly as possible. [2-4].

PHARMACEUTICAL VALUE & ETHANO-MEDICINAL VALUE OF *DATURA STRAMONIUM* L.

The use of plant material as an indigenous treatment in folklore or traditional systems of medicine led to the development of plant-derived medications used in contemporary medicine. The leaves of *D.stramonium* L. are used to treat headaches, and the vapours produced by an infusion of the leaves' leaves are used to treat gout and rheumatic pain. Asthma and bronchitis are treated by inhaling the smoke produced by the burning leaf. Steaming the portion of *D. stramonium* over leaf-infused, hot water is the European treatment for hemorrhoids. To treat dandruff and falling hair, the fruit juice is applied to the scalp. Additionally, it is used to soothe hurtful wounds and sores. *D. stramonium* seeds and leaves were used to cure sleeplessness awell as hysteria and psychosis in patients [5]. *D. stramonium* has been used as a psychedelic. Additionally, it is utilized to relieve asthmatic bronchial spasm and the smooth muscles of the bronchial tube. *D. stramonium* was reportedly taken internally to cure sadness, epilepsy, and insanity. It serves as the foundation for ointments used externally to treat burns and rheumatism [6]. Additionally, it is used to treat hemorrhoids and Parkinson's disease. After roasting, its leaves can be applied to relieve discomfort.The acrid narcotic plant helps the body recuperate by reducing pain. The plant's seeds have the strongest therapeutic properties. The herb is applied topically as a poultice to treat acute neuralgia, abscesses, and fistulas. The plant contains scopolamine as well, making it a strong cholinergic-blocking hallucinogen that has been used to soothe schizoid patients.Hyoscyamine and atropine found in its leaves make them a potent source of mind-altering substances. Because Datura seeds have analgesic, anthelmintic, and anti-inflammatory properties, they are used to treat toothaches, stomach and intestinal pain brought on by worm infestation, and fever brought on by inflammation. Its fruit juice is administered to the scalp to cure hair loss and dandruff. The developing plant serves as an insect deterrent, shielding nearby plants from pests [7]. In March, Abruzzo, and Latium, *D. stramonium* is mostly utilized as an anthelmintic and an anti-ant parasite. From farmers and shepherds, records of the plant's continuous use in these industries were gathered.

Table 1 Traditional uses of *Datura stramonium* in Different Countries

SR. NO	COUNTRIES	TRADITIONALUSES	REFRENCES
1.	Ethiopia	It is used for wound treatment against wound causing bacteria	[35]
2.	Rwanda	It is used for acaricidal activity	[26]
3.	Pakistan	Green leaves are used for softening the boils. Fruit juice is used for earache	[30]
4.	India	Fruit is burned and ash is used for bronchitis and asthma	[28]
5.	Bulgaria	It is used as anti-asthmatic, spasmolytic and antiviral remedy	[34]
6.	Japan	It is used to treat brain tumor.	[9]
7.	Spain	Leaves are used to treat spleen diseases.	[9]
8.	China	It is used during surgery as anaesthesia.	[9]
9.	Nepal	The plant is utilized in the various ethno veterinary practices.	[26]

PHYTOCHEMICALS

The major tropane alkaloids hyoscyamine and scopolamine and several minor tropane alkaloids have been identified in *Datura* species. Typical examples of minor alkaloids in *D. stramonium* are tigloidin,

aposcopolamine, apoatropin, hyoscyamine N-oxide and scopolamine N-oxide17-20. 6 ditigloyloxytropane and 7-hydroxyhyoscyamine are reported for the first time in this species [8].Distribution of hyoscyamine and scopolamine in *D. stromonium* was studied. The production of hycyamine and scopolamine in *D. stromonium* has been investigated in the different plant parts, at different stages of their life cycle. The maximum contents were found in the stems and leaves of young plants, hyocyamine being always the predominate component. These compounds were included in many pharmacopieas because of their anti-cholinergic activities [9]. *D. stramonium* contain variety of alkaloids including atropine, hyoscamine and scopolamine [10]. Sixty-four tropane alkaloids have been detected from *D. stramonium*. Two new tropane alkaloids, 3-phenylacetoxy-6, 7-epoxynortropane and 7- hydroxyapoatropine were tentatively identified. The alkaloids scopoline, 3-(hydroxyacetoxy) tropane, 3- hydroxy-6-(2-methylbutyryloxy) tropane, 3-tigloyloxy-6- hydroxytropane, 3, 7-dihydroxy-6-tigloyloxytropane, 3- tigloyloxy- 6-propionyloxytropane, 3 phenylacetoxy-6,7- epoxytropane, 3-phenylacetoxy-6-hydroxytropane, aponorscopolamine, 3, 6 - ditigloyloxytropane and 7- hydroxyhyoscyamine are reported for the first time for this species. Other alkaloids found in *D. stramonium* include [11]. Hygrine, 3á, 6-Ditigloyloxy- 7- hydroxytropane, 6-Hydroxyhyoscyamine, Pseudotropine, 3á-Tigloyloxytropane, Hydroxy-6-tigloyloxytropane, Phenyl acetoxytropane, 3-Tigloyloxy-6-(2- methyl butyryloxy) tropane, Hyoscyamine, 3-Tigloyloxy-6-isovaleroyloxy-hydroxytropane, Scopolamine, Tropinone, Scopine, 6-Hydroxy acetoxy tropane, 3,6-Diacetoxytropane, 3-Tigloxyloxy-6-acetoxytropane 3-Tigloyloxy-2- methyl butyryl oxytropane, 6-Ditiglotoxytropane, 3- Acetoxy-6-isobutyryloxytropan, 3-(2-Phenylpropionyloxy) tropane, Littorine, 6-Hydroxyapoatropine, 3, 6- Ditigloyloxy- 7-hydroxytropane, 3-Tropoyloxy-6- acetoxy tropane, 3,6Dihydroxytropane,3-Tigloyloxytropane, 3-Tigloyloxy-6- propionyloxy-7- hydroxytropane, 3á-Apotropoyloxytropane, Aposcopolamine, 3, 6-Ditigloyloxytropane, 3-(3'- Acetoxytropoyloxy) tropane, 3á-Tigloyloxy-6- hydroxytropane, Tropine, 3-Acetoxytropane, 3-Hydroxy-6- acetoxytropane, 3-Hydroxy-6-methylbutyryloxytropane, 3- Tigloloxy-6- isobutyryl-oxytropane, Aponorscopolamine, 7- Hydro-oxyhyoscyamine, Meteloidine, 3, 6-Ditigloyloxytropane. The phytochemical analysis of the plant revealed that *D. stramonium* contained saponins, tannins and alkaloids and glycosides. The secondary metabolites identified in the plant materials in the study of Banso A, Adeyemo S showed antimicrobial activity. [12].

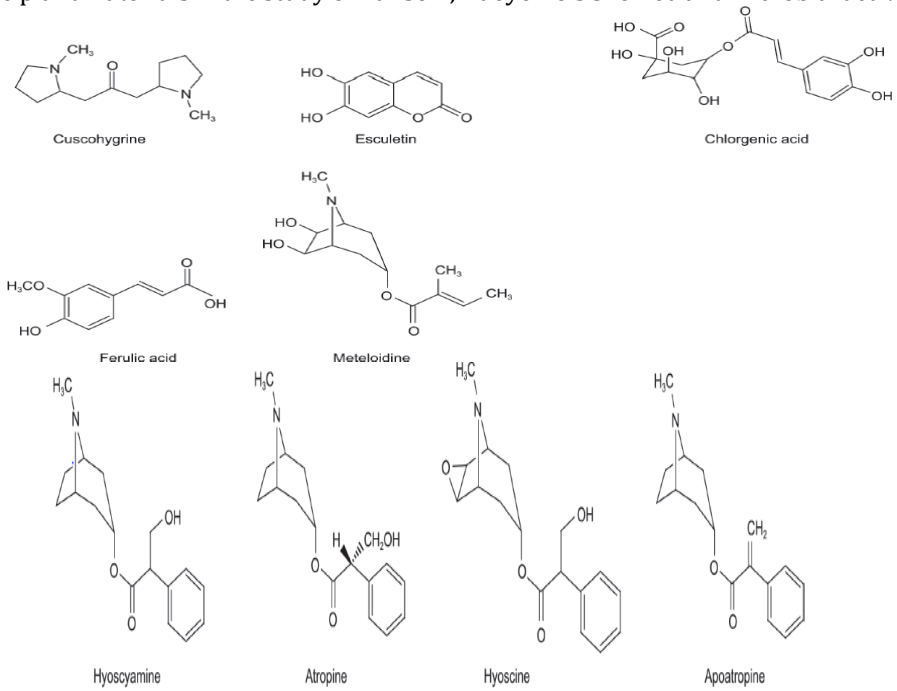

Fig1: **Various important phytochemicals found in *Datura stramonium* (6,9,30)**

PHARMACOLOGICAL ACTIVITY

ANTI ASTHMATIC ACTIVITY-

The use of *D. stramonium* to treat asthma and its potential effects on fetal development were investigated. When a pregnant woman uses *D. stramonium* to treat her asthma, the continual release of acetylcholine that results from the desensitization of nicotinic receptors could eventually cause irreparable harm to the fetus. Therefore, we draw the conclusion that pregnant women should utilize this African herbal treatment with caution [13, 14].

ANTICHOLINERGIC ACTIVITY

The chemical esters that make up the *D. stramonium* 's alkaloids are employed in medicine as anticholinergic drugs. Jimson weed has a history of abuse and has been linked to unintentional human and animal poisoning. Acute jimson weed poisoning symptoms included severe thirst, dry mouth, dry skin, dilated pupils, blurred vision, urine retention, fast heartbeat, confusion, restlessness, hallucinations, and loss of consciousness. Inhibition of muscarinic neurotransmission both centrally and peripherally causes the anticholinergic syndrome [15-17].

ACARICIDAL, REPELLENT PROPERTY

In a laboratory setting, the ethanol extracts from the leaf and seed of *D. stromonium* (Solanaceae) were tested for their ability to kill, fend off, or prevent the oviposition of adult two-spotted spider mites (T. urticae Koch) (Acari: Tetranychidae). Using the Petri leaf disc-spray tower method, leaf and seed extracts were administered in quantities of 167.25 and 145.75 g/L, respectively, and after 48 hours, 98% and 25% of spider mite adults died. These findings imply that extracts of *D. stramonium* may be effective in treating two-spotted spider mites [18].

ANTIMICROBIAL ACTIVITY

In a dose-dependent manner, the methanol extracts of *Datura inoxia* L. and *D. stramonium* L. exhibited efficacy against Gram-positive bacteria. Escherichia coli and *Psuedomonas aeruginosa* showed little to no antibacterial action. [Gupta S *et al*., 2010]. *Withania somnifera, Terminalia* a*rjuna*, and *D. stramonium* mixed crude ethanolic extract anti-microbial activity in cup plate diffusion method for antibacterial and antifungal activity. With comparison to the standard antibiotic Ciprofloxacin, the extracts were screened for possible antibacterial activity against *Staphylococcus aureus*, *Bacillus subtilus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Micrococcus luteus*, and *Candida albicans* [19, 33].

ANTI-CANCER ACTIVITY

The rising quantity of knowledge generated by scientific advancements calls for an integrated strategy to the management of cancer. Thousands of traditional and herbal substances are being tested on a global scale to confirm their efficacy as anti-cancerous medications. *D. stramonium* was utilized to treat cancer at a therapeutic dose of 0.05-0.10 g. Unsafe and may cause coma, hypertension, vomiting, and loss of consciousness; none the less, it may interact with anti-cholinergic medications. [20, 37, 37].

ANTI-INFLAMATORY ACTIVITY

The treatment of inflammation usually involves the use of *Coriandrum sativum* (*C. sativum*), *D. stromonium,* and *Azadirachta indica* (*A. indica*) ethanol-based extracts of *C. sativum* fruit and *D. stromonium* leaf material. The anti-inflammatory effect of ethanol extracts of *C. sativum* fruit, *D. stromonium* leaf, and A. indica leaf was initially screened in albino rats. All ethanolic extracts exhibited significant anti-inflammatory activity comparableto the standard drug diclofenac sodium against carrageen an induced a method. Among these plant *A.indica* showed maximum anti-inflammatory activity per hour [21, 22].

LARVICIDAL AND MOSQUITO REPELLENT ACTIVITIES

D. stromonium leaf extracts in ethanol were tested for their larvicidal and anti-mosquito properties against *Aedes aegypti*, *Anopheles stephensi*, and Culexquinque fasciatus. The LD50 values for larvicidal activity against *Aedes aegypti*, *Anopheles stephensi*, and *Culexquinque fasciatus* were determined to be 86.25, 16.07, and 6.25 mg/L, respectively. The ethanolic leaves extract of *D. stromonium* provided complete protection time (mosquito repellency) of 2.7, 71.7 and 117.7 min against *Aedes aegypti*, *Anopheles stephensi* and *Culexquinque fasciatus* at higher concentration (1%) [23, 32].

ANTIFUNGAL ACTIVITY

Fusarium mangiferae was resistant to the antifungal effects of a mixture brewed from *D*. *stromonium, Calotropis gigantea*, *A. indica* (neem), and cow dung (T1) and then methanol-water (70/30 v/v) extracts of *D. stromonium, Calotropis gigantea*, and *A. indica* T2. The study demonstrated that the concoction-brewed compost T1 may effectively minimize floral malformation in mango when sprayed at bud break and again at fruit set. It is also inexpensive, simple to manufacture, and sustainable and environmentally benign [24-27].

CONCLUSION

The most recent review provides comprehensive information on the bioactive components, ethnopharmacology, and scientifically asserted medical applications of *D. stramonium.* Different portions

of *D. stramonium* have been said to include a variety of alkaloids, carbohydrates, fats, proteins, and tannins. The plant exhibits a variety of behaviors, including analgesic and anti-asthmatic ones, which may be brought on by the presence of the active chemical ingredients under investigation. *In vitro* and *in vivo* experiments have been used in the pharmacological research thus far. Investigation and measurement of phytoconstituents and pharmacological profile are thus necessary. An Indian medicinal plant called *Datura stramonium* is frequently used in phytomedicine to treat conditions including asthma, cough, convulsions, and other different human afflictions. On the basis of the plant's wide range of traditional uses and its reported chemical profile, more research into the plant is possible. However, extreme caution is urged because high doses might result in fatal intoxication. This plant should only be utilized under the supervision of a trained professional because the toxic dose is extremely near to the therapeutic dose.

REFERENCES

1. Altameme, H. J., I. H. Hameed and Kareem, M. A. (2015). Analysis of alkaloid phytochemical compounds in the ethanolic extract of *Datura stramonium* and evaluation of antimicrobial activity. African Journal of Botany,14(19):1668-1674.
2. Balachandran, P., Rajgopal G. (2005). Cancer—an ayurvedic perspective. Pharm Res, 51(1):19-30.
3. Banso, A., Adeyemo, S. (2006). Phytochemical Screening and antimicrobial assessment of *Abutilon mauritianum*, *Bacopa monnifera* and *Datura stramonium*. Biokem,18(1):39-44.
4. Berkov, S., A. Parlov, P. Ksaovacheva, P. Stanimirora and S. Philipov. (2003). Alkaloid spectrum in diploid and tetraploid root cultures of *Datura stramonium.* Z Naturfrosch C,58:42-46.
5. Berkov, S., R. Zaved and T. Douncheva. (2006). Alkaloid patterns in some varieties of *Datura stramonium.* Filoterapia,77:179-182.
6. Clapham, A. R., T. G. Tutin and D. M. Moore. (1987). Flora of British Isles, 3rd edition. Cambridge university press, Cambridge UK.
7. Das, S., Kumar, P., Basu, SP. (2012): Review article on phytoconstituents and therapeutic potentials of *Datura stramonium* linn. J Drug Del Therap,2(3):4-7.
8. Diker, D., Markovitz D, Rothman M, Sendovski U.Coma (2007). As a presenting sign of *Datura stramonium* seed tea poisoning. Eur J Int Med,18(4): 336-338.
9. Friedman, M. and Levin, C. E. (1989). Composition of Jimson Weed seed. Journal of agriculture and food chemistry,37:998-1005.
10. Gary, I., Stafford, A., Anna, K., Jager, B., Johannes, VS. (2005). Activity of traditional South African sedative and potentially CNS acting plants in the GABA- benzodiazepine receptor assay. J Ethnopharm,100:210-215.
11. Gupta, DP. (2008). The herb, habitat, morphology and pharmacognosy of most important popular Indian medicinal plant. 1st ed. Madhya Pradesh: Print well Offset Publisher;185-187.
12. Gupta, S., Raghuvanshi, M., Jain, D. (2010). Comparative studies on anti-inflammatory activityof *Coriandrum sativum, Datura stramonium* and *Azadirachta Indica*. Asian J Exp Biol Sci,1(1):151-154.
13. Hong, L., Z. Guo, K. Huang, S. Wei, B. Liu, S. Meng, C. Long.(2015). Ethnobotanical study on medicinal plants used by Maonan people in China. Journal of ethnobiology and ethnomedicine,11(32).
14. Ionkov, I., Witte, L. and Alfermann, H. A. (1994). Spectrum of tropane alkaloids in transformed roots of *Datura innoxia* and Hyoscyamus cultivated in vitro. Planta Medica. pp: 60.
15. Ivancheva, S., Nikolova, M., Tsvetkova, R. (2006). Pharmacological activities and biologically active compounds of Bulgarian medicinal plants. In: Inperato F, editor. Phytochemistry. Advances inresearch. Kerala: Signpost, 87-103.
16. Jarald, E., Edwin, S. (2007). Textbook ofpharmacognosy and phytochemistry. 1st ed. NewDehli:CBS Publisher and Distributors, 224.
17. Joshi, S.G.(2010). Medicinal Plants. Oxford &IBH Publishing Co. Pvt. Ltd., New Delhi. pp370-371.
18. Keshari, A.K., Ghimire, K.R., Mishra, B.S. and Adhikari, K. K. (2005). A textbook of Higher secondary Biology, (3rd Ed.), Vidhyarthi Pustak Bhandar,Bhotahity, Kathmandu, pp 403- 404.
19. Khare, C. P. (2007). Indian Medicinal Plants,Rajkamal Electric Press, Delhi, India, pp 203.
20. Kritikar KR and Basu BD (1994). Indian Meditional Plants (2nd Ed.), International Book Distributors, Dehradun, India, Volume III, pp 1783-1787.
21. Kurnal NA, Yalcin SCC.(2009). Acaricidal, repellent and oviposition deterrent activities of *Datura stramonium* L. against adult *Tetranychus urticae* (Koch). J Pest Sci , 14: 54-57.
22. Pandey M, Debnath M, Gupta M, Chikara S.K. (2011). Phytomedicine: An ancient approach turning into future potential source of therapeutics.J Pharmacogn Phytother ,3(3): 27-37.
23. Paolo MG.(2001): Traditional antihelmintic,antiparasitic and repellent uses of plants in CentralItaly. J Ethnopharm ,68(1-3):183-192.
24. Preissel, U. Preissel, H. G. (2002). Brugmansia and datura: angel's trumpets and thornapple. Buffalo NY: firefly books, pp:106-129.
25. Pretorius E, Marx J. (2006): *Datura stramonium* in asthma treatment and possible effects onprenatal development. Environ Toxicol Pharm, 21(3): 331-337.
26. Puyvelde, V., Geysoen, L.I., F. Ayobangan, F.X., Hakizamungu, E.and A. Nshimyimana, Kalisha, A. (1985). Science of medicinal plants of Ruanda for the acaricidal activity. Journal of Ethnopharmacology, 13: 209-215.
27. Shagal, M.H., Modibbo, U.U., Liman , A.B. (2012).Pharmacological justification for the ethnomedical use of *Datura*

stramonium stem-bark extract in treatment of diseases caused by somepathogenic bacteria. Int Res Pharm Pharmaco, 2(1):16-19.
28. Sharma, M.C., Sharma, S., (2010). Phytochemical, preliminary pharmacognostical and antimicrobial evaluation of combined crude aqueous extract. IntJ Microbiol Res, 1(3): 166-170.
29. Shinwari, M. I. and Khan, M.A. (2000). Folk use of medicinal hills of Margalla Hills National Park Islamabad. Journal of Ethnopharmacology,69:45-46.
30. Singh, H. B., Singh, R.S. and Sandhu, I.S. (2003). Herbal medicines of Manipur. A colour encyclopedia, Daya publishinghouse Dehli. pp: 15.
31. Strahil, B., Rawia, Z., Tsvetelina, D. (2006). Alkaloid patterns in some varieties of *Datura stramonium*. Fitoterapia,77(3):179-182..
32. Swathi, S., Murugananthan, G., Ghosh, S.K., Pradeep, A.S. (2012). Larvicidal and repellent activities of ethanolic extract of *Datura stramonium* leaves against mosquitoes. Int J Pharm Phytochem Res,4(1):25-27.
33. Taha, S.A., Mahdi, A.W. (1984). *Datura* in toxication in Riyadh. Trans R Soc Trop Med Hgy,78:134-135.
34. Takhi, D., Ouinten, M. (2011). Study of antimicrobial activity ofsecondary metabolites extracted from spontaneous plants fromthe areas of Laghouat, Algeria. Adv. Environm. Biol. 5(2):469-476.
35. Toth, A., Benescsene, G. B. and Balazs, G. (1997). Changes in field weeds in Hungary during the last 46 years. Proceedings of1997 Brighton Conference – Weed, pp: 249-254.
36. Usha, K., Singh, B., Praseetha, P., Deepa, N., Agarwal, D.K., Agarwal, R. (2005). Antifungal activity of *Datura stramonium, Calotropis gigantea* and *Azadirachta indica* against *Fusarium mangiferae*and floral malformation in mango. Eur J Plant Pathol, 124(4):637-657.
37. Witt, A., Luke, Q. (2017). Guide to the naturalized and invasiveplants of Eastern Africa, [ed. by Witt, A., Luke, Q.]. Wallingford, UK: CABI.vi + 601 pp.