



## **DATURA STRAMONIUM LINN.** **(SOLANACEAE):**

# **A COMPREHENSIVE REVIEW OF** **PHARMACOGNOSTIC, ETHNOMEDICINAL,** **PHARMACOLOGICAL, PHYTOCHEMICAL** **AND BIOTECHNOLOGICAL ASPECTS.**

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### **ABSTRACT:-**

This review is intended to investigate the published report regarding phytochemicals, pharmacological properties, and biotechnological aspects and put forth the therapeutic potential of *Datura stramonium* Linn. It belongs to the family Solanaceae, one of the therapeutically important plants broadly distributed worldwide. It is commonly referred to as thornapple, devil's apple, angel's trumpet [in a broad sense], or devil's bugle.

### **Keywords:-**

Datura stramonium, Solanaceae, Biotechnological Potential, Phytochemicals.

### **1.INTRODUCTION:-**

*Datura stramonium* Linn. (D. stramonium), a member of the genus *Datura* and the Solanaceae family, [1] encompasses a remarkable collection of nine species, including *Datura stramonium*, *Datura ferox*, *Datura quercifolia*, *Datura pruinosa*, *Datura Leichhardt*, *Datura Innoxia*, *Datura discolor*, *Datura metal*, and *Datura wrightii*—all known collectively as moonflowers. Among them, *D. innoxia* and *D. stramonium* are particularly renowned. [7]. *D. stramonium* is indigenous to North America and was identified and scientifically categorized by the esteemed Swedish botanist Carl Linnaeus in 1753. [4,5] The term

"Datura" is derived from the Sanskrit word "Dhutra," which translates to "divine inebriation." Datura species are often referred to as devil's apple, angel's trumpet, or, more generally, devil's trumpet. [3] Currently, representatives of the jimsonweeds are considered worldwide and have become naturalized in numerous regions characterized by tropical and temperate climates. [2,6] Datura stramonium is an annual herb that can reach heights of 2-5 feet (60-120 cm), exhibiting an erect stature and an unpleasant odor. [8] The entire plant is toxic to varying degrees, with the seeds deemed to possess the highest toxicity; neither desiccation nor boiling diminishes its poisonous properties. [9] The pharmacological effects of D. stramonium are primarily attributed to its alkaloids, scopolamine, and atropine, which function as anticholinergic agents by obstructing the heptahelical G protein-coupled receptors within the nervous system. [10] These alkaloids are predominantly synthesized in the roots and subsequently distributed to the above-ground parts, including the leaves and flowers. [11] Introduction to D. stramonium

### **1.1 Classification [12]**

- Kingdom: Plantae
- Division: Magnoliophyta
- Class: Magnoliopsida
- Order: Solanales
- Family: Solanaceae
- Genus: Datura
- Species: Datura stramonium

### **1.2 Vernacular names [13]**

- English Name: Thorn apple, Devil's trumpet
- Hindi Name: Sadadhatura
- Tamil Name: Ummattangani
- Telugu Name: Ummetta
- Bengal Name: Dhatura
- Gujrati Name: Dhatoria
- Marathi Name: Kanaka
- Kannada Name: Anmatta
- Malayalam Name: Maraummam
- Arabic Name: Datura

## **2.GEOGRAPHIC DISTRIBUTION OF D. STRAMONIUM:**

The origins of Datura stramonium remain ambiguous [14]. It is typically encountered in tropical regions, including India, Mexico, and South America [15]. Additionally, it can be found in landfills across Europe [5]. This plant was introduced to the UK through various means, such as soybean waste and birdseed [16]. Jimson weed is indigenous to numerous temperate and subtropical areas, suggesting that it most likely originated in Central America. Despite its American roots, Datura stramonium is now commonly found in the cultivated fields of France. [17]

### 3. TRADITIONAL USES OF D. STRAMONIUM

Plant-derived drugs have found a place in modern medicine through the use of plant materials as indigenous remedies in folklore or traditional systems of healing.

The leaves of *Datura stramonium* L. are traditionally used to alleviate headaches, while vapors from leaf infusions help relieve the pain associated with rheumatism and gout[19].

In India, Fruits burned and ash is used for bronchitis and asthma[24].

In Europe, a remedy for hemorrhoids involves steaming the affected area over boiling water infused with the plant's leaves.

The juice of the fruit is applied to the scalp to treat hair loss and dandruff and is also used for acaricidal activity [26].

In Ethiopia, It is used for wound treatment against wound-causing bacteria [25].

The seeds and leaves of *D. stramonium* were historically employed to sedate hysterical and psychotic patients, as well as to treat insomnia[18].

Bulgaria It is used as an anti-asthmatic, spasmolytic, and antiviral remedy[27].

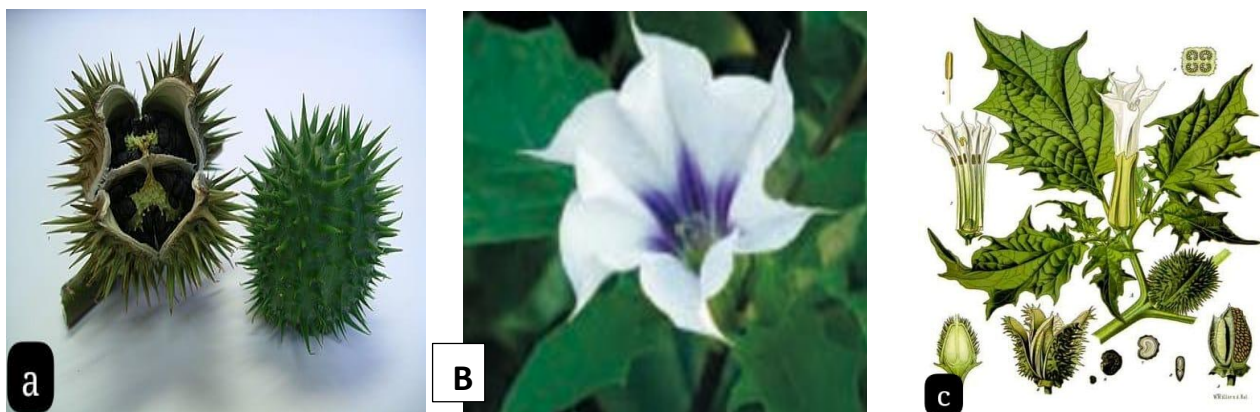
In Nepal, The plant is utilized in various ethno-veterinary practices[26].

The growing plant also acts as an insect repellent, protecting nearby plants from pests. In the Marche, Abruzzo, and government regions, *D. stramonium* is primarily used as an anthelmintic and antiparasitic, with records of its ongoing use collected from local farmers and shepherds, particularly the elderly.[20]

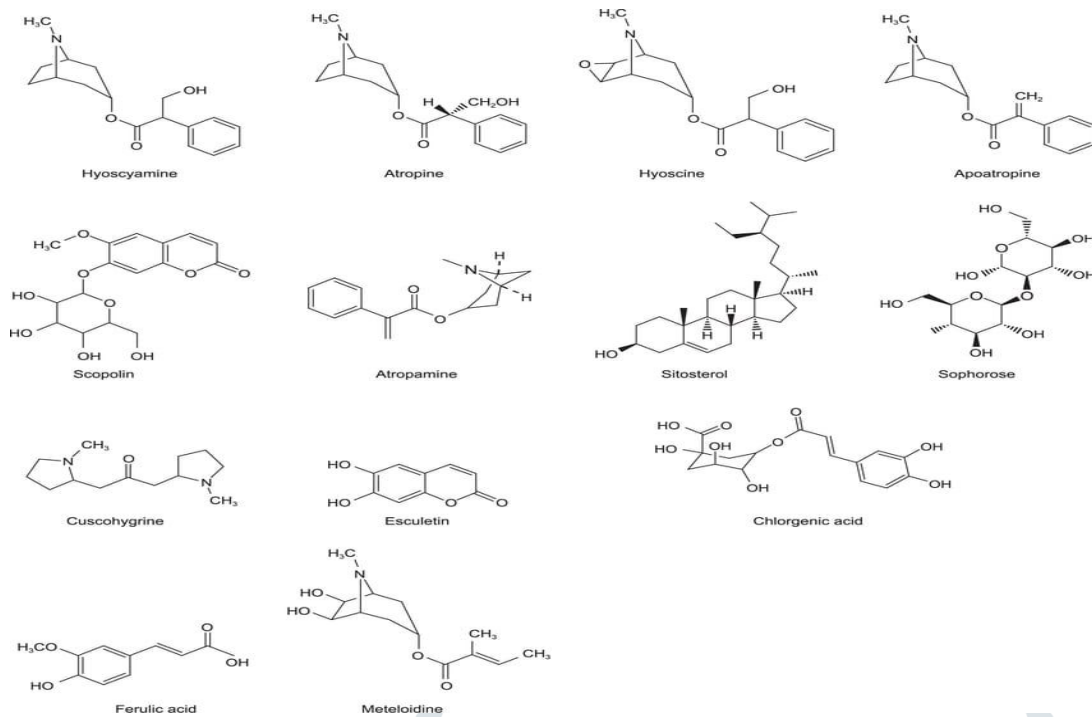
British soldiers use it to treat respiratory problems. It is also used for the treatment of various diseases such as motion sickness, nausea, and dizziness. It is used as an analgesic for bone-setting.

### 4. CHARACTERISTICS OF THE PLANT D. STRAMONIUM

*Datura stramonium* is considered an annual herb, characterized by its pale yellowish-green, herbaceous, glabrous, leafy, and smooth stem, which is erect and branched with very few hairs. The plant typically grows to a height of 2-4 feet with a diameter of 4-6 feet. It possesses large, simple, ovate leaves that are 4-6 inches long with coarsely dentate margins. The upper surface of the leaves is smooth and grayish-green, while the lower surface is pale green with wrinkles[21]. The leaves also have petioles and some hair. The flowers are large, with corollas about 6 cm long, and have a tubular calyx and funnel-shaped corolla. The flowers, which are white or purple, are approximately 3 inches in length and contain five stamens and a superior ovary[23,7]. The plant produces a large, thorny fruit that contains smooth, black, kidney-shaped seeds[22]. Under favorable conditions, the plant can produce an estimated 14,964 seeds. The root is thick, tapering, and branched.



**Fig 1: Morphology of the *D. stramonium* Linn. (a) seed capsules (left) mature (right) immature (b) flower (c) Macroscopic characters**



**Fig 2: Phytoconstituents of *D. stramonium* Linn.**

## **5. BIOLOGICAL AND PHARMACOLOGICAL ACTIVITIES :**

Real products have been playing a substantial part throughout the world in treating and averting human diseases. The literature proposes that *D. stramonium* L. has accounted for a wide variety of medicinal activities. The whole plant is used in the treatment of Cancer, Asthma, Skin infections, and Infertility and also as an Insect repellent. *D. stramonium* L. also exhibits activities such as Anticholinergic, Analgesic, Anti-fungal, and Anti-inflammatory.

### **5.1. Anticancer activity**

An integrated approach is essential for managing cancer by leveraging the expanding scientific knowledge. Worldwide, thousands of herbal and traditional compounds are being screened to validate their potential as anti-cancer drugs. *Datura stramonium* has been used in therapeutic doses of 0.05-0.10 g to treat cancer. However, it is considered likely unsafe, as it can cause side effects such as vomiting, hypertension, and loss of consciousness, potentially leading to coma. It may also interact with anticholinergic drugs.[30] The seeds of *D. stramonium* are effective in treating gliomas, owing to their inhibitory effect on the proliferation of human glial tumor cells[31,32]. Moreover, the hostility of gliomas correlates inversely with the concentration of glial fibrillary acidic protein (GFAP). Interestingly, *D. stramonium* seed agglutinin was found to improve the expression of GFAP, which provides them anticancer potential against gliomas. Experiments on genetic toxicity of the methanolic seed extracts of *D. Stramonium* on human-breast adenocarcinoma (MCF-7) cells revealed an increase in genetic toxicity with the increasing concentration of the extract with an IC<sub>50</sub> value of 113.05 g/MI[33].

### **5.2. Anti-asthmatic activity**

Alkaloids found in *D. stramonium*, Such as atropine and scopolamine, which possess significant anticholinergic and broncho-dilating activities, block the muscarinic receptors (which are important for airways regulation), subsequently dilating bronchial smooth muscles [34,35]. The antiasthmatic *D.*

stramonium cigarette acts as a potential bronchodilator in asthmatic patients with mild airways. A substantial decrease in the specific airway resistance (saw) was observed after inhaling smoke from the cigarette [36]

### **5.3. Infertility in women**

Fertility medicines. These are the main treatments for infertility that are due to ovulation trouble and Moonflower is successful. It is given for 5 to 7 pentads. This remedy is effective in infertility. [29]

### **5.4. Insect repellent**

Ethanollic extracts of leaves of *D. stramonium* were evaluated for larvicidal and mosquito-repellent activities against *Aedes aegypti*, *Anopheles Stephens*, and *Culex quinquefasciatus*. The LD50 values for larvicidal activity were found to be 86.25, 16.07, and 6.25 mg/L against *Aedes aegypti*, *Anopheles Stephens*, and *Culex quinquefasciatus* Respectively. The ethanollic 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 *Culex quinquefasciatus* at higher concentration (1%). [37]

### **5.5. Anti cholinergic**

The alkaloids present in *Datura stramonium* are organic esters that are clinically used as anticholinergic agents. Jimson weed has also been reported as a drug of abuse and has been involved in accidental poisonings in both humans and animals. Symptoms of acute Jimson weed poisoning include dry mouth with excessive thirst, dry skin, pupil dilation leading to impaired vision, urinary retention, rapid heart rate, confusion, restlessness, hallucinations, and loss of consciousness. These symptoms are associated with anticholinergic syndrome, which occurs due to the inhibition of central and peripheral muscarinic neurotransmission. [38,40]

### **5.6. Antifungal**

Acetone extracts of *D. stramonium* have been reported to have antifungal activity against several fungi including blue mould of stored apple, *Aspergillus niger*, *Aspergillus parasiticus*, *Colletotrichum gloeosporioides*, *Fusarium oxysporum*, Toxic house mold *harzianum*, *Phytophthora nicotiana*, and *Rhizoctonia solani*. The MIC of *D. stramonium* extracts ranges from 1.25 to 2.5 mg/mL. [29]

### **5.7. Anti-inflammatory**

*Coriandrum sativum* (*C. sativum*), *Datura stramonium* (*D. stramonium*), and *Azadirachta indica* (*A. indica*) have been traditionally used to treat inflammation. Ethanollic extracts from the fruits of *C. sativum* and the leaves of *D. stramonium* and *A. purple* were screened for anti-inflammatory activity in albino rats. All the extracts evidence anti-inflammatory effects, comparable to the standard drug Voltaren, using the carrageenan-induced rat paw edema method. Of these plants, *A. indica* exhibited the highest anti-inflammatory activity per hour. [23]

## **6. BIOTECHNOLOGICAL ASPECTS:**

### **6.1 Biodiesel Preparation**

Global energy demand is increasing with population growth. *Datura stramonium* oil biodiesel shows superior kinetic viscosity and comparable calorific values and cetane numbers to diesel fuel, making it a promising alternative energy source after trans-esterification.[41]

### **6.2 Callus induction**

The efficiency of callus induction and rebirth in *Datura stramonium* can be repaired through the manipulation of carbon sources and concentrations during embryo culture.[42]

### **6.3 Bioremediation**

*Datura stramonium* is used in bioremediation to remove 2,4,6-trinitrotoluene (TNT) from explosive waste sites through nitroreduction. Additionally, its extracts have been shown to reduce the toxicity of cypermethrin pesticides.

## **7. CONCLUSION :**

Based on the existing review of literature, *D. stramonium* reveals its valuable therapeutic use as an Antiasthmatic, Antifungal, Anticancer, anti-inflammatory, and in other parasite infestation. It has a potent free radical scavenging activity Which is sufficiently demonstrated in different experimental and clinical studies. Its potential as a free-radical scavenger and cytoprotective agent needs to be in future research work. Various unique molecules of *D. stramonium* can also be chemically modified or used as “lead” for developing more effective drug molecules. Considering these facts, I endeavored to present a comprehensive review enlightening the phytochemistry, pharmacology activities, and biotechnological aspects of the plant *Datura stramonium*. Future research can be directed to an extensive investigation of phytochemistry, clinical trials, pharmacokinetics, and acquiring safety data to add new dimensions to the therapeutic utilization of *Datura stramonium* and other *Datura* species.

## **References:**

1. Aamana Batool, Zahra Batool, Rahmatullah Qureshi, Naveed Iqbal Raja. Phytochemicals, Pharmacological Properties and Biotechnological Aspects of Highly Medicinal Plant: *Datura stramonium*. Journal of Plant Sciences. Vol. 8, No. 2, 2020, pp. 29-40. Doi: 10.11648/j.jps.20200802.12
2. Benítez, G., March-Salas, M., Villa-Kamel, A., Cháves-Jiménez, U., Hernández, J., Montes-Osuna, N., Moreno-Chocano, J., & Cariñanos, P. [2018]. The genus *Datura* L. [Solanaceae] in Mexico and Spain—ethnobotanical perspective at the interface of medical and illicit uses. Journal Ethnopharmacological 219, of 133 151. <https://doi.org/10.1016/j.jep.2018.03.007>
3. Symon, D.E., & Haegi, L. [1991]. *Datura* [Solanaceae] is a new world genus. In: Hawkes JG, Lester RN, Nee M, Estrada N [eds] Solanaceae III: taxonomy, chemistry, evolution. Royal Botanic Gardens Kew, London, 197–210.
4. Oudhia, P., R. S. Tripathi. 1998. Allelopathic potential of *Datura stramonium* L. Crop. Res. 16 [1]: 37-40.
5. Preissel U. Preissel, H. G. 2002. *Brugmansia* and *datura*: angel's trumpets and thornapple. Buffalo N.Y: Firefly Books. Pp: 106-129.

6. Weaver, S. E and S. I. Warwick. 1984. The biology of Canadian weeds. 64. *Datura stramonium* L. Canadian.
7. Buchholz, J., Williams, L., & Blakeslee, A., [1935]. Pollen-tube growth of ten species of *Datura* in interspecific pollinations. *Proceedings of the National Academy of Sciences* 21, 651-656. doi: 10.1073/pnas.21.12.651
8. Singh, S. K. K. Saroj, U. J. Tirupathi, A. K. Singh and R. H. Singh. 1998. An antimicrobial principle from *Spheranthus indicus*. *Int J crude drug*.
9. Setshogo, M.P. A Review of Some Medicinal and or Hallucinogenic Solanaceous Plants of Botswana: The Genus *Datura* L. *Int. J. Appl. Res. Nat. Prod.* 2015
10. Pretorius, E.; Marx, J. *Datura Stramonium* in Asthma Treatment and Possible Effects on Prenatal Development. *Environ. Toxicol. Pharmacol.* 2006, 21, 331–337. [CrossRef] [PubMed]
11. Cinelli, M.A.; Jones, A.D. Alkaloids of the Genus *Datura*: Review of a Rich Resource for Natural Product Discovery. *Molecules* 2021, 26, 2629. [CrossRef]
12. Soni, P., A. A. Siddiqui, V. Soni. 2012. Pharmacological properties of *Datura stramonium* as a potential medicinal tree: An overview. *Asian Pac. J. Trop. Biomed.* 2: 1002-1008.
13. Stace, C. 1996. *New flora of British Isles*. Cambridge University Press, Cambridge, UK, 2nd edition. *Environ. Sci.* 8 [2]: 287-289.
14. Clapham, A. R., T. G. Tutin, and D. M. Moore. 1987. *Flora of the British Isles*, 3rd edition. Cambridge University Press, Cambridge UK.
15. Witt, A., Luke, Q., 2017. *Guide to the naturalized and invasive plants of Eastern Africa*, [ed. by Witt, A., Luke, Q.]. Wallingford, UK: CABI. vi + 601 pp.
16. Salisbury, E. J. 1961. *Weeds and Aliens*. New Naturalist series, Collins, London.
17. 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*.
18. Pandey M, Debnath M, Gupta M, Chikara SK. *Phytomedicine: An ancient approach turning into a future potential source of therapeutics*. *J Pharmacogn Phytother* 2011
19. Paolo MG. Traditional antihelmintic, antiparasitic, and repellent uses of plants in Central Italy. *J Ethnopharm* 2001
20. Shagal MH, Modibbo UU, Liman AB. Pharmacological justification for the ethnomedical use of *Datura stramonium* stem-bark extract in the treatment of diseases caused by some pathogenic bacteria. *Int Res Pharm Pharmacol* 2012
21. Radford, A. E., H. E. Ahles and C. R. Bell. 1964. *Manual of vascular Flora of Carolinas*. University of North Carolina Press, Chapel Hill.
22. Taleb, A. 1995. *Alore alustree des principales mauvaises des cultures du Gharb*.
23. Gupta, D. P. 2008. *The herb, habitat, morphology, and pharmacognosy of most important medicinal plants*. Printwell Offset Publishers, Madhya Pradesh, 1st edition
24. Sharma, M. C., S. Sharma. 2010. Phytochemical, preliminary pharmacognostical, and antimicrobial activity of combined crude aqueous extracts. *Int J. Microbial*
25. Takhi, D., M. Ouinten. 2011. Study of antimicrobial activity of secondary metabolites extracted from spontaneous plants from the areas of Laghouat, Algeria. *Adv. Environm. Biol.*
26. Puyvelde, V., L. I. Geysoen, F. X. Ayobangan, E. Hakizamungu and A. Nshimiyimana, A. Kalisha. 1985. Science of medicinal plants of Ruanda for the acaricidal activity. *Journal of Ethnopharmacology*.
27. Ivanov, I. and S. Nikalov. 1988. Tropane alkaloids in the pharmacognosy medicinal. *Fizkultura, Sofia*.
28. Oseni OA, Olarinoye CO, Amoo IA. Studies on chemical compositions and functional properties of thorn apple (*Datura stramonium* L) Solanaceae. *Afr J Food Sci.*, (2011)
29. <https://rjppd.org/HTMLPaper.aspx?Journal=Research%20Journal%20of%20Pharmacology%20and%20Pharmacodynamics;PID=2018-10-4-6>
30. Balachandran P, Rajgopal G. Cancer—an Ayurvedic perspective. *Pharm Res* 2005

31. Alper, M. Investigation of potential anti-cancer and anti-inflammatory effects of *Datura stramonium* ethanolic extracts against selected human cancer cell lines. *Fresenius Environ. Bull.* 2019
32. Mir, M.A.; Hamdani, S.S.; Sheikh, B.A.; Mehraj, U. Recent Advances in Metabolites from Medicinal Plants in Cancer Prevention and Treatment. *Curr. Immunol. Rev.* 2019
33. Iqbal, S.; Sivaraj, C.; Gunasekaran, K. Antioxidant and Anticancer Activities of Methanol Extract of Seeds of *Datura stramonium* L. *Free Radic. Antioxid.* 2017
34. Choudhary, M.; Sharma, I.; Agrawal, D.C.; Dhar, M.K.; Kaul, S. Neurotoxic Potential of Alkaloids from Thorn Apple (*Datura stramonium* L.): A Commonly Used Indian Folk Medicinal Herb. In *Medicinal Herbs and Fungi*; Springer: Berlin/Heidelberg, Germany, 2021
35. Kuraki, T. Bronchodilators for COPD: At What Stage Should Therapeutic Intervention Be Initiated? In *Chronic Obstructive Pulmonary Disease*; Springer: Berlin/Heidelberg, Germany, 2017
36. Al-Snafi, A.E. Medical Importance of *Datura fastuosa* (Syn: *Datura metel*) and *Datura stramonium*—A Review. *IOSR J. Pharm.* 2017
37. Swathi S, Muruganathan G, Ghosh SK, Pradeep AS. Larvicidal and repellent activities of ethanolic extract of *Datura stramonium* leaves against mosquitoes. *Int J Pharm Phytochem Res* 2012
38. Taha SA, Mahdi AW. *Datura* intoxication in Riyadh. *Trans R Soc Trop Med Hgy* 1984
39. Diker D, Markovitz D, Rothman M, Sendovski U. Coma as a presenting sign of *Datura stramonium* seed tea poisoning. *Eur J Int Med* 2007
40. Boumba A, Mitselou A, Vougiouklakis T. Fatal poisoning from ingestion of *Datura stramonium* seeds. *Vet Human Toxicol* 2005
41. Witte, Muller K and Arfmann HA, Investigation of the alkaloid pattern of *Datura innoxia* plants by capillary gas-liquid chromatography-mass spectrometry, *Planta Medica*.
42. Altameme, H. J., I. H. Hameed and M. A. Kareem. 2015. Analysis of alkaloid phytochemical compounds in the ethanolic extract of *Datura stramonium* and evaluation of antimicrobial activity. *African Journal of Botany*.
43. Taleb, A. 1995. *Alore alustree des principales mauvaises des cultures du Gharb*.