

REVIEW ARTICLE

Chronicle of *Datura* Toxicity in 18th and 19th Century

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Abstract

Background: *Datura stramonium* is a poisonous and common flowering plant that is a member of the *Solanaceae* family. *Datura* poisonings are a rare occurrence in the 21st century, making toxicological information on this plant sparse. Historical information on *Datura* provides useful information on the clinical symptoms and characteristics of poisonings. This review looks at the state of knowledge on *Datura*'s chemical properties and clinical characteristics in the 18th and 19th century.

Methods: A literature review was conducted, and an online database search identified 197 articles. Ultimately 42 articles met the search criteria and were included for review.

Results: Medical literature on *Datura* focused predominantly on clinical poisonings, medical treatments, and identifying its chemical properties. Clinical poisonings included cases of accidental and intentional poisonings, and provided information on the age of patients, their symptoms, and treatments. *Datura* was also used to treat a variety of conditions, including asthma, inflammatory diseases, epileptic seizures, and hallucinations. Chemical experimentation on *Datura* commonly looked at isolating alkaloids and assaying their concentrations in various plant organs.

Conclusion: Historical literature on *Datura* shows that cases of poisoning were a common occurrence. These historical sources provide useful information on *Datura* poisoning's clinical findings, and preliminary uses of *Datura* in medical treatments. Early chemical exploration of *Datura* also set the groundwork for future research.

Keywords: *Datura Stramonium*; History; Poisoning

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INTRODUCTION

Datura is a genus of flowering plants that are part of the *Solanaceae* family (1). *Datura* are believed to be indigenous to the Americas and Asia, but have been transported around the world and are now widespread as a common garden plant (1). Common names for *Datura* include Jimsonweed and thornapple. All species of *Datura* are poisonous. *Datura* species produce tropane alkaloids, bicyclic and nitrogenous organic compounds that have a significant effect on human and animal physiology (2). *Datura* is known for its narcotic effects and psychoactive properties (3). All organs of *Datura* contain alkaloids, and the most common alkaloids found are atropine and scopolamine, both of which have anticholinergic properties (4). While these alkaloids are toxic, they also have many modern day medical applications (4).

Documented cases of *Datura* poisoning in the 21st century are sparse as they are a relatively rare occurrence. Reported cases tend to be from either accidental consumption among children, or intentional consumption from adolescents for the plants' hallucinogenic effects (5). The prevalence of *Datura* toxicity is more common in low and middle income countries (6). Acute *Datura stramonium* poisoning is clinically distinct

and leads to irritability and sinus tachycardia (7, 8). Historical literature and information on *Datura* is useful in establishing the past knowledge and understanding of these toxic plants, as well as useful information on clinical findings. The objective of this paper is to explore the state of knowledge on *Datura* in the 18th and 19th centuries, particularly in instances of *Datura* poisoning and its symptoms and treatment methods, clinical applications of *Datura*, and its chemical properties.

RESULTS

A review of medical literature on the use of *Datura* in the 18th and 19th century was conducted. An online search was performed using Pubmed and Simon Fraser University's library database, which contains a wide variety of journal articles, manuscripts, books, periodicals, and other media accessible to students attending the university. From this search 197 articles were identified. The 197 articles were screened by title and 145 articles were removed. The remaining 52 full articles were then assessed for eligibility. Ultimately 42 articles were included for review (Figure 2). Articles included in this review were English language articles, published before the 20th century, and had a focus on

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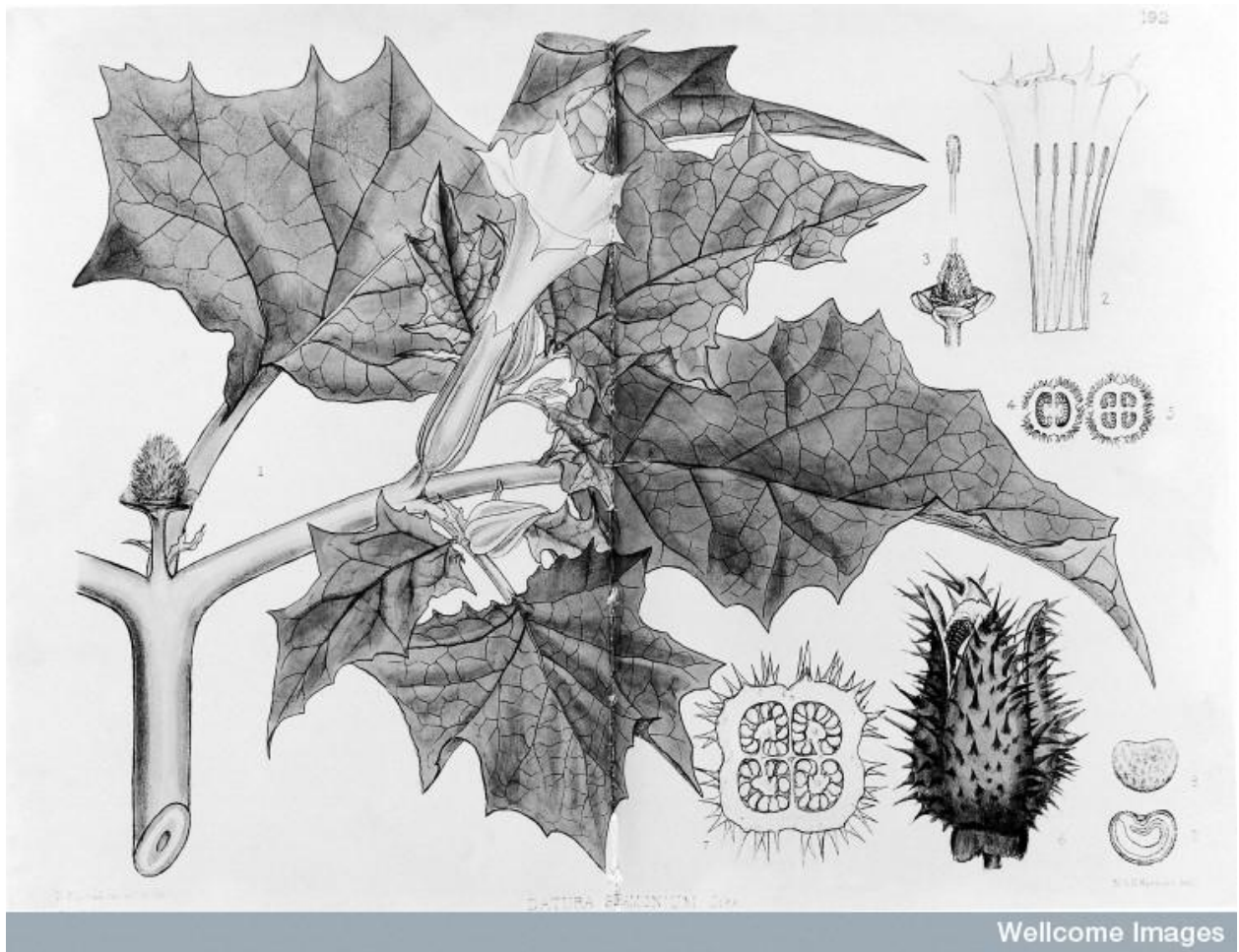


Figure 1. Illustration of *Datura stramonium*. Retrieved from Wellcome Library, London. <https://creativecommons.org/licenses/by/4.0/>

on medical outcomes (including clinical poisonings in man), chemical properties, or clinical applications of *Datura*. Articles were excluded if they did not have a significant focus on *Datura*, focused on botany or other non-medical topics, or were published in the 20th or 21st century.

Intentional Poisonings

Cooke (1860) reports that *Datura* seeds were often used by criminals to intoxicate victims in Bengal. Cooke states that the seeds have also been used for fatal poisonings in Bombay (9). He also describes the several species of *Datura* found throughout the world as highly narcotic (9). An article from 1842 reports the use of *Datura* for criminal activity in Bengal, where thieves would mix *Datura* seeds with sweetmeats which would then be consumed by their target (often a travel companion), resulting in lethargy in the victim (10). The treatment for *Datura* poisoning suggested in this article is emetics and cold affusion (10). An article from 1878 reported a story from India originally published in the *Chemist and Druggist*, where thieves would join a party of travellers, prepare food for the party that would contain *Datura* seeds, then rob these traveller upon *Datura* intoxication (11). A paper from 1766 reports that *Datura* seeds are used by highwaymen in Egypt to rob merchants. Thieves would mix

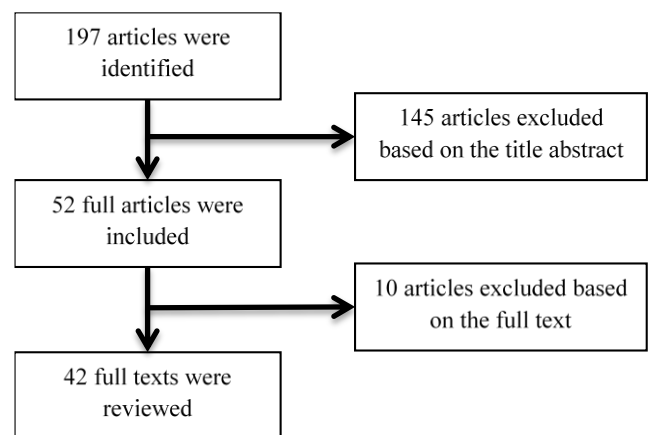


Figure 2. Inclusion of articles.

Datura bread thieves would then rob the merchants of their possessions (12). A correspondence letter from 1890 reported that *Datura* was one of the preferred methods of poison used among thieves in India (13).

A report published in the *Medical and Surgical Reporter* in 1887 described a double murder in India, where a woman mixed *Datura* seeds into bread she prepared for her husband (14). When her husband and another man consumed the poisoned bread, they were said to have behaved giddily and madly before collapsing and succumbing to the poison (14). Blyth (1885) also describes the prevalence of the use of *Datura* in accidental and intentional poisonings in India (15).

Slavens (1831) reports on a family that had different members suffer from *Datura* poisoning over a period of four months (16). The first two cases of poisoning were proven to be from the consumption of whole *Datura* seeds, but subsequent poisonings did not show this evidence. It was later concluded that the perpetrator had beat the seeds in a piece of linen, then boiled the linen producing a solution that was added to the victims' drinks (16). Hooker (1836) wrote about a case where a family of five were poisoned by *Datura*, where sulfate of zinc with ipecac was used to induce vomiting. It was suspected that a neighbour had intentionally provided the family *Datura* leaves to eat, yet not enough evidence was available to lay charges (17).

Brierre de Boismont (1853) described a case where a man attempted suicide by consuming *Datura*, and proceeded to show giddiness and intoxication, as well as hallucinations (18).

Accidental Poisonings

Walker (1885) reported an instance where a girl had consumed ripened Stramonium fruit, and presented with symptoms of dilated pupils and swelling throughout the body. The treatment provided to the girl was subcutaneous administration of hydrochloride of pilocarpine, which led to a rapid recovery (19). Brewston (1851) reported two young children having consumed *Datura* seeds (20). The symptoms reported included fixed, dilated pupils, delirium, and loss of vision (20). In 1874, an article on poisons and poisonous plants reported on *Datura stramonium*. The article outlined that many children die from consumption of the seeds, and that the plant can be used to produce a strong medicine for treating spasmodic cases (21).

Wenzel (1877) reported a girl who showed spasms, pale face, spasmodic breathing and elevated pulse (22). It was later determined that the girl had eaten the leaves and sprouts of *Datura stramonium* (22). Wenzel also described an additional case where a young girl had consumed *Datura* seeds, leading to convulsions, elevated pulse, and sensitivity to light (22).

Brierre de Boismont also describes a case of accidental poisoning of three children who consumed *Datura* seeds in 1843, and the subsequent hallucinations (18).

De Witt (1798) describes two cases of *Datura stramonium* poisoning. The first case consisted of a girl who consumed *Datura* seeds, resulting in a high fever, dilated pupils, and a weak pulse (23). The second case consisted of a woman who had received bad advice concerning the use of a concentrated solution of dried *Datura* seeds as a home remedy, resulting in delirium, elevated pulse, and convulsive motions (23).

A communication from 1833 describes three cases of *Datura* poisoning. The first case was a woman who presented with dilated pupils and lack of vision, pain and

confusion, and anxiety (24). The doctor later determined that the patient had been accidentally poisoned by *Datura stramonium* in the leaves her mother had gathered for tea (24). The second case showed similar symptoms of poisoning, and also had *stramonium* accidentally included in the patient's tea (24). The third case was a woman who was recovering from dysentery and was prescribed to take one *Datura* leaf and prepare an infusion to be self-injected. The patient instead had taken a larger volume of *Datura* infusion that left her comatose, and took multiple days to recover fully (24).

In 1886, a mother and her adult son showed symptoms of *Datura* poisoning after accidentally mixing *Datura* seeds into their coffee (25). Symptoms of the poisoning were reported as dilated pupils, dry tongue and thirst, partial delirium, and redness and swelling of the body (25). Both the mother and son recovered from the poisoning, and the treatment used was an eighth of a grain (approximately 8 milligrams) of sulphate of morphia administered every 2 or 3 hours (25).

Gregory (1847) recorded a case of accidental poisoning of a man by *Datura*, whose symptoms included dilated pupils, reduced vision, difficulty breathing, and slow pulse (26).

Clinical Applications

A publication from 1860 states that smoking *Datura* leaves can relieve asthma, and that consuming large quantities of the leaves will result in "temporary idiocy" (27). The same article reports that boiling *Datura stramonium* leaves in a litre of water produces a cure for hydrophobia that lasts 24 hours (27). Trousseau (1859) suggests that dried *Datura* leaves smoked as two cigarettes or through a pipe is the preferred method of asthma attack treatment (28). Trousseau also noted that this treatment appears ineffective in regular tobacco smokers (28). A correspondence from 1812 reported the smoking the roots and lower stem of *Datura* resulted in effective asthma relief (29). Wood (1849) also reports that *Datura stramonium* can be used to treat asthma (30). Cunningham (1828) also supports the smoking of *Datura* seeds as a method to relieve asthma (31).

Wood reports on several other medical uses of *Datura stramonium*, including treatments for epilepsy, neurological and rheumatic conditions (30). Wood also states that *Datura* can also be turned into an ointment for external applications to treat pain and inflammation, and that many American surgeons use *Datura* as a pupil-dilator (30).

Kirchoff (1827) wrote about a treatment for rheumatism where *Datura* leaves would be boiled into an extract then applied internally or externally to areas of pain (32). An article from 1787 reports that ingestion of *Datura stramonium* seeds results in delirium, and that large doses of these seeds would likely be fatal (33). The same article also suggests that applications of the leaves to the foot can relieve foot spasms, and that applying the leaves as a poultice or ointment can relieve inflammation and hemorrhoids (33). Cunningham described multiple uses of *Datura* for various conditions, including the use of the leaves to reduce instances of epileptic seizures (31). Anderson (1838) reported four cases where the consumption of *Datura* extract was used to successfully treat symptoms of epilepsy (34). *Datura*

stramonium leaves have also been used to treat ulcers and hemorrhoids (31). A *stramonium* compress was also applied as part of the treatment in a case of an enlarged spleen (31).

Jones (1848) reported using *Datura stramonium* as an emmenagogue to restore menstrual flow in a patient (35). In 1806, Baldwin wrote about the use of *Datura stramonium* to cure a case of dropsy, where the leaves of *Datura* were dried then crushed into pills (36). King (1798) writes that a medicine can be produced from *Datura* seeds by boiling the seeds in water and producing an extract (37). King then reports the successful use of this medicine in two instances, each where a man showed symptoms of inflamed meninges (37).

Pomeroy (1820) describes preparing pills from the extract of *stramonium* stalks and leaves to relieve the symptoms of Trigeminal neuralgia (also known as tic douloureux) (38). A response to this report by Orfila describes a similar use of *Datura stramonium* to relieve a case of severe headache (38). Zollickoffer (1845) provides a procedure for developing a tincture and an ointment of *Datura stramonium*, and also writes about the use of *Datura* to relieve chronic rheumatism (39). Moureau (1841) describes the use of *stramonium* extract to treat ten patients experiencing hallucinations (40). Seven of these patients were completely cured of their hallucinations using this method (40). Briere de Boismont also describes Dr. Moreau's treatment for hallucinations, where patients are given small doses of clarified sugar of *stramonium* (18). De Rossett (1802) prescribed a concentrate of *Datura stramonium* to be consumed by a man who experienced "mental derangement" (41). Seemann (1852) describes the use of *Datura* seeds in Central and South America, where Indigenous people prepare a drink prepared from *Datura* seeds which is given to children, and is believed to allow the children to detect gold deposits (42). Children are then provided with an Indian corn beer to reverse the effects of *Datura* (42). Cooke describes the use of a medicine derived from the leaves and seeds of *Datura* to produce a coma-like state as part of traditional healing rituals (9). A beverage containing *Datura* is also used in South American cultures to produce a mental state where individuals are believed to communicate with dead relatives (9). Turner (1864) reported that a patient suffering from *Datura* poisoning recovered after the use of opium (43). Blyth also describes the delirium of *Datura* poisoning, as well as methods of pharmaceutical preparations of *stramonium* tinctures (15).

Chemical Properties

Dohme (1893) assayed the alkaloidal values of different parts of *Datura stramonium*, and found that the stem followed by the seeds had the largest percentage of alkaloids (44). Mayer (1863) describes a process for assaying the alkaloidal value of *Datura stramonium*, as well as methods to produce *stramonium* extracts (45). Nagelvoort (1896) describes an assay process for measuring the alkaloidal value of *Datura stramonium* (46). Nagelvoort also reports the use of *Datura* in Chinese teas and traditional medicines (46). Wormley (1894) describes the chemical characteristics of atropine, an alkaloidal substance found within *Datura stramonium*, and describes its properties through several chemical reagent tests (47). Orfila (1817) performed animal experiments on the

effects of *Datura* consumption through external observation and animal dissection (48). Stephenson (1834) describes the chemical properties of *Datura stramonium*, as well as its toxic effects on the body (49).

DISCUSSION

Significant insight can be gained from examining the historical medical literature on *Datura*. In contrast to contemporary cases of *Datura* poisoning, the majority of cases in the 18th and 19th centuries were from not only accidental ingestion, but also intentional poisonings. Historical cases showed that individuals who unintentionally consumed *Datura* tended to be very young children and adults. The most common route of poisoning was from ingestion of whole plant parts in children, or contamination of food or drink in adults. A significant number of reports on *Datura* identified occurrences of intentional poisonings. Papers published in the United States reported a mix of accidental and intentional *Datura* poisonings, while papers focused on India or Egypt consistently described intentional poisonings. Intentional poisonings in the United States were most likely to come from domestic disputes between neighbours or family members, and doses given were meant to be fatal. Many reports from India and Egypt focused on the use of *Datura* by thieves, and that these doses were intentionally non-fatal. *Datura* was shown to be an easily available poison. From the 19th century it is clear that psychoactive compounds such as *Datura* were in use by thieves. In the 21st century, similar behaviours including date rape have shifted to include more effective and synthetic agents (50, 51).

Datura was substantially used in medical treatments throughout the 18th and 19th centuries. The most common medical use of *Datura* was through the treatment of asthmatic attacks. Asthma was treated through smoking *Datura*, and various parts of the *Datura* plant were suggested for asthma relief, including the leaves, roots, stems and seeds. *Datura* was also used for several inflammatory diseases, where an extract was consumed or an ointment was prepared. *Datura*-based medicines came in the form of liquid injections, concentrated solutions for internal consumption, pills, and salves. *Datura* was also used for mental health issues including hallucinations, and conditions like epilepsy. *Datura* also was shown to have uses among Indigenous cultures, particularly in traditional medicines and cultural practices for its hallucinogenic effects. Uses of *Datura* in the 19th century were predominantly focused on asthmatic relief and to treat inflammatory conditions. In the 21st century, the alkaloids found in *Datura* are used in several medical applications, including pupil dilation, an antidote for organophosphate poisoning, and to reduce heart rate (52).

Investigations into the chemical and pharmacological properties of *Datura* were also explored in the 18th century. Significant attention was applied to the alkaloids found in *Datura* and isolating these compounds. While the initial investigations into isolating alkaloids was rudimentary, updated and more effective practices for isolating tropane alkaloids from plants are now used in the 21st century (1, 53, 54).

CONCLUSION

In conclusion, several historical sources on *Datura* showed that cases of poisoning were a common occurrence, most often through accidental poisoning but also through intentional and criminal poisonings. Information from these sources reveals many of the symptoms of *Datura* poisoning as well as methods of treatment. Characteristics and demographic information on cases of *Datura* poisoning were examined, as well as the routes of entry. Several investigations into the chemical properties of *Datura* were also identified. These articles looked at the chemical and physical properties of *Datura* as well as methods to isolate alkaloids. Many medical uses of *Datura* were also found in the literature, particularly its use in asthma treatment. From performing this review of literature on *Datura*, findings on the clinical symptoms of *Datura* poisoning and medical uses of this plant were identified.

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REFERENCES

- Jakabová S, Vincze L, Farkas Á, Kilár F, Boros B, Felinger A. Determination of Tropane alkaloids Atropine and Scopolamine by Liquid Chromatography–Mass Spectrometry in Plant Organs of *Datura* Species. *J Chromatogr A* 2012;1232:295-301.
- Waller GR, Nowacki EK. *Alkaloid Biology and Metabolism in Plants*. New York: Plenum Press; 1972.
- Gaire BP, Subedi L. A Review on the Pharmacological and Toxicological Aspects of *Datura Stramonium* L. *J integr med* 2013;11:73-9.
- Krenzelok EP. Aspects of *Datura* Poisoning and Treatment. *Clin toxicol* 2010;48:104-10.
- Wiebe TH, Sigurdson ES, Katz LY. Angel's Trumpet (*Datura Stramonium*) Poisoning and Delirium in Adolescents in Winnipeg, Manitoba: Summer 2006. *Paediatr Child Health* 2008;13:193.
- Afshari RM, Balali-Mood M. Pattern of Acute Poisonings in Mashhad, Iran 1993-2000. *J Toxicol Clin Toxicol* 2004;42:965-75.
- Amini M, Khosrojerdi H, Afshari R. Acute *Datura Stramonium* Poisoning in East of Iran - a Case Series. *Avicenna J Phytomed* 2012;2:86-9.
- Adab ASS, Afshar R, Alizadeh V, Afshari R. None *Datura Stramonium* Plant Poisoning. Proceeding of the 11th Meeting of Asian Pacific Association of Medial Toxicology (APAMT); Hong Kong 2012.
- Cooke MC. *The Seven Sisters of Sleep: Popular History of the Seven Prevailing Narcotics of the world*. 1st ed. London: James Blackwood, Paternoster Row; 1860.
- [No authors listed]. Effects of *Datura*. *Prov Med J Retrospect Med Sci* 1842;4:291-2.
- NEWS AND MISCELLANY: Professional Poisoners. *Medical and Surgical Reporter* 1878;39:43.
- Account of the Egyptian Plants represented in the Plate. *The Weekly amusement*. 1766:642-3.
- M GO. Letter from London. *J Am Med Assoc* 1890;XV:266-7.
- Poisoning by *Datura* Seeds. *Med Surg Rep* 1887;57:591.
- Blyth AW. *Poisons; their effects and detection : a manual for the use of analytical chemists and experts; with an introductory essay on the growth of modern toxicology*. 1st ed. New York: William Wood and Company; 1885.
- Slavens J. Cases of Poisoning with the *Datura Stramonium*, or Jamestown Weed. *J Med Assoc Sci* 1831;4:172.
- Hooker C. Case of poisoning with *Datura stramonium*: showing the uncertainty of circumstantial evidence in medico-legal investigations. *Boston Med Surg J* 1836;15:60.
- Brierre de Boismont AJF. *Hallucinations*. 1st ed. Philadelphia: Lindsay and Blakiston; 1853.
- Pilocarpine In *Datura*-Poisoning. *British Med J*. 1885;2:560.
- John Le Gay B. Cases of Poisoning by *Datura Stramonium*. *Prov Med Surg J* 1851;15:699.
- Poisons and poisonous plants. *Ballou's Mthly Mag* 1874;39:9.
- Wenzel HP. Three cases of narcotism: Case 1.--Hoffman's Anodyne Poisoning. Case 2.-- Poisoning by *Datura Stramonium* Leaves and Sprouts. Case 3.--Poisoning by *Datura Stramonium* Seeds. *Med Surg Rep* 1877;37:127.
- Witt BD. Article VIII: Two Cases of the Effects of the *Datura stramonium* (Thorn Apple) on the Human Body; with a few Observations and Remarks. *The Medical Repository of Original Essays and Intelligence, Relative to Physic, Surgery, Chemistry, and Natural History*. 1798;2:A30.
- Cases of poisoning by *Datura stramonium*. *Boston Med Surg J* 1833;9:10.
- Poisoning by the Seed of *Datura Stramonium*; Two Cases; Recovery. *Med Surg Rep* 1886;54:241.
- Gregory DG. ART. III.--A Case of Poisoning by the Seeds of the *Datura Stramonium*. *West J Med Surg* 1847;7:333.
- Science and inventions. *The Critic* 1860;21:424-5.
- SL A. *Lectures on Asthma, Delivered at Hotel Dieu, by Prof. Trousseau*: [Translated from the Gazette des Hopitaux of Oct. 19th, 1858, for the Boston Medical and Surgical Journal] Lecture VI.--Treatment of Asthma. *Ohio Med Surg J* 1859;11:500.
- Correspondent A. Account of the singular efficacy of *Datura stramonium* in the cure of the asthma. *The Medical Repository of Original Essays and Intelligence, Relative to Physic, Surgery, Chemistry, and Natural History*. 1812;3:311.
- Wood GB. *The dispensatory of the United States of America*. 1st ed. Philadelphia: Grigg and Elliot; 1849.
- Cunningham M. Article III.--Practical Observations on the *Datura Stramonium*. *North Am Med Surg J* 1828;5:252.
- ART. III. Observations on the Use of the *Datura stramonium* in Chronic Rheumatism, Neuralgia, &c. &c.; and on an Epidemic Fever which prevailed in parts of Holland, in 1826. *NY Med Phys J* 1827;6:362.
- Useful Articles selected from Mr. Cutler's Account of the vegetable Productions, naturally growing in some Parts of America, botanically arranged: *Datura*. *Linn. Gen. Plant*. 218. *HYOSCYAMUS*. *Linn. Gen. Plant*. 219. *SOLANUM*. *Linn. Gen. Plant*. 224. *ASCLEPIAS*. *Linn. Gen. Plant*. 270. *The Columbian Magazine*. 1787;1(10):469.
- Anderson EA. ART. IV.--BLOCKLEY HOSPITAL REPORTS: Cases Illustrative of the Power of the *Datura Stramonium* (thorn apple, Jamestown weed) in suspending and arresting Epileptic Paroxysms. *The American Medical Intelligencer A Concentrated Record of Medical Science and Literature*. 1838;2(10):159.
- Jour BFJ. *Datura Stramonium* an Emmenagogue. *Med Exam Rec Med Sci* 1848;9:336.
- Baldwin W. VIII. On the Use of *Datura Stramonium*, in Dropsy. *Phila Med Phys J* 1806:161.
- King A. ARTICLE IX: Medical Observations on the Virtues and Properties of the Seeds of the *Datura stramonium*. CASE I. CASE II. *The Medical Repository of Original Essays and Intelligence, Relative to Physic, Surgery, Chemistry, and Natural History*. 1798;2(1):A35.

38. Pomeroy T. Effects of Datura Stramonium in Tic Douloureux. *New England J Med Surg Coll Branch Sci* 1820;9:224.
39. Zollickoffer W. ART. IX. Remarks on the use of the Datura Stramonium (or Thorn Apple) in Chronic Rheumatism. *Am Med Rec* 1822;5:97.
40. Moreau MJ. On the Treatment of Hallucinations by Datura Stramonium. *Prov Med Surg J* 1841;3:126-7.
41. De Rosset AJ. MEDICAL K PHILOSOPHICAL NEWS:DATURA STRAMONIUM. The Medical Repository of Original Essays and Intelligence, Relative to Physic, Surgery, Chemistry, and Natural History. 1802;5(1):69.
42. Seemann MB. On the Datura Sanguinea. *Am J Pharm* 1852:83.
43. Turner AP. Poisoning from the Datura Stramonium in which Recovery followed the Use of Opium. *Am J Med Sci* 1864;47:552-5.
44. Alfred RLD. The relative alkaloidal value of the various parts of the plant of Datura stramonium. *Am J Pharm* 1893:479.
45. Mayer FF. ASSAY OF ALKALOIDS--PURE AND IN PREPARATIONS: A.--The Solution of 0-5 gramme of pure Sulphate of Atropia dissolved to 100 cc. in water. B.--Preparations of Datura Stramonium. IV. Tinctura Stramonii Fol. (By displacement). V. Tinctura Stramonii Sem. U. S. P. VI. Extractum Stramonii Fol. Fluidum (By Prof. Procter's formula.) VII. Extractum Stramonii Fol. Alcoholicum. (U. S. P.) IX. Extractum Stramonii Fol. Siccum. (Ph. Boruss. half strength.) I. Tinctura Belladonnae U. S. *Am J Pharm* 1863;35:20.
46. Nagelvoort JB. FLORES DATURAE ALBAE. *Am J Pharm*. 1897:142.
47. Wormley TG. Notes on some of the chemical properties of the mydriatic alkaloids. *Am J Pharm* 1894:513.
48. Orfila MJB. A general system of toxicology; or, A treatise on poisons, found in the mineral, vegetable, and animal kingdoms, considered in their relations with physiology, pathology, and medical jurisprudence. Abridged and partly translated from the French of M. P. Orfila, by Joseph G. Nancrede. 1st ed. Philadelphia: M. Carey & Son; 1817.
49. Stephenson J. Medical botany, or, Illustrations and descriptions of the medicinal plants of the London, Edinburgh, and Dublin pharmacopoeias : comprising a popular and scientific account of poisonous vegetables indigenous to Great Britain. 1st ed. London: Ibotson and Palmer; 1834.
50. Kouta C, Tolma EL, Pavlou SE. Date rape among Cypriot female college students: an explorative study. *Glob Health Promot* 2013;20:38-46.
51. Havig SM, Wiik E, Karinen R, Brochmann GW, Vevelstad M. Codeine-spiked beer in adate rape case? *Int J Legal Med* 2016;130:1513-8.
52. Gryniewicz G, Gadzikowska M. Tropane alkaloids as medicinally useful natural products and their synthetic derivatives as new drugs. *Pharmacol Rep* 2008;60:439- 63.
53. Jaremicz Z, Luczkiewicz M, Kisiel M, Záráte R, El Jaber-Vazdekis N, Migas P. Multi- development-HPTLC method for quantitation of hyoscyamine, scopolamine and their biosynthetic precursors in selected solanaceae plants grown in natural conditions and as in vitro cultures. *Phytochem Anal* 2014;25:29-35.
54. Śramska P, Maciejka A, Topolewska A, Stepnowski P, Haliński Ł. Isolation of atropineand scopolamine from plant material using liquid-liquid extraction and EXTrelut(®)columns. *J Chromatogr B Analyt Technol Biomed Life Sci* 2016.