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Forensic Study of Indian Toxicological Plants as Botanical Weapon (BW): A Review

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Abstract

Poisons, those silent weapons capable of destroying life mysteriously, secretly and without violence, have ever had a peculiar fascination for mankind. The plant originated weapons or "BOTANICAL WEAPONS (BW)" were also used by criminals in burglary, rape and murder cases. The Botanical weapons are may be the part of the toxic and poisonous plants or may be the toxic constituents of plants.

In India, there are so many cases were available where criminal by mixing it in food material or contact of the irritating toxic parts of the plants to victim's body in the buses/trains. Poisonous plants are those biological weapons which cause serious problems or even death occur.

These weapons are first choice of professional poisoners in toxi-crime because they are easily available and having no cost. They have played so large a part, in romance as well as in crime, that the subject is one which claims the attention of even student of human nature. Through this article authors have studied some toxic and poisonous plants of India, which are generally used by the criminals to commit the crimes. In this paper, all the toxicological substances of these plants are also mentioned, which provide a prefect database for the forensic toxicologists.

Keywords: Botanical Weapons; Toxic Plants; Toxi-crime; Bioterrorism

Introduction

A poison is a substance which, when administered, inhaled or ingested, is capable of acting deleteriously on the human body. Thus, there are really no limits, between a medicine and a poison, for a medicine in a toxic dose is a poison and a poison in a small dose may be a medicine means, it depends on dose/quantity only. In law, the real difference between a medicine and a poison is the intent with which it is given. If the substance is given with the intention to save life, it is a medicine but if it is given with the intention to cause bodily harm, it is a poison [1]. It is fact that virtually any substances can be harmful at high concentration- as Paracelsus (1493-1541), the father of toxicology said in the sixteenth century, "Everything is poison, there is poison in everything, only the dose makes a thing not a poison" [2]. In the context of biology, poisons are substances that can cause disturbances to organisms. Throughout human history, intentional application of poison has been used as a method of assassination, murder, suicide, and execution. Poison includes both naturally produced compounds and chemicals manufactured by humans. Natural poisons are produced by species of bacteria, fungi, protists, plants and animals. Poisonous plants are those which cause serious problems or even death occur, if a small quantity of its stem, leaves, seeds, fruits and roots are ingested [3]. Some other plants are normally harmless but they may become toxic if preparative from them are taken in excess in strong doses or for along period of time as suggested by Qureshi et al. [4].

Poisoned weapons were used in ancient India, and war tactics in ancient India have references to poison. A verse in Sanskrit reads "*Jalam visravayet sarmavamavisravyam ca dusayet*," which translates to "Waters of wells were to be mixed with poison and thus polluted."Chanakya (c. 350–283 BC), also known as *Kautilya*, was adviser and prime minister to the first Maurya Emperor Chandragupta (c. 340–293 BC). Kautilya suggested employing means such as seduction, secret use of weapons, and poison for political gain [5]. *Susruta Samhita* has described several modes of poisoning in ancient India. He has explained how the poisons are mixed with food, drink, honey, and snuff or sprinkled over cloths, beds, couches, shoes, garlands and jewellary, saddles of horses, etc. Therefore, it may be concluded that these practices were in vogue in his time [6]. Gradually, there arose a class of "professional poisoners" who could ingeniously mask the bitter taste or strange odours of the poisons with sweet tasting and pleasant substances [1].

The incidence of poisoning in India is among the highest in the world, and it is estimated that more than 50,000 people die every year from toxic exposure [7]. The causes of poisoning are many - civilian and industrial, accidental and deliberate. The commonest agents in India appear to be pesticides (organophosphates, carbamates, chlorinated hydrocarbons, and pyrethroids), sedative drugs, chemicals (corrosive acids and copper sulfate), alcohols, plant toxins (datura, oleander, strychnos, and gastro-intestinal irritants such as castor, croton, calotropis, etc.), and household poisons (mostly cleaning agents). [8]. Poisonous plants of India have been described by few workers [9-10]. A lot of work has been reported on toxicology of plants but no work has been done specially on poisonous plants study in terms of forensic context. In the present study, a review has been performed on almost poisonous plants of India about their fatal dose and fatal period. In this article, we reported basic details such as the botanical and family names, toxic parts of plant, chemical constituents and information about fatal dose and fatal period of the important plants.

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Poisoning in India

There are more than 4000 species of medicinal plants growing as herbs, shrubs, and trees in India, many of which are poisonous when administered in large doses. The toxic principles belong to alkaloids, glycosieds, toxalbumins, resind, cannabinoides and polypeptides. Suicide in India, as poison can be easily obtained and many poisonous plants grow wild, eg.datura, oleanders, aconite, nux vomica, etc. Many Indians consider the taking of life by blood-shed a greater crime than poisoning, strangling etc. Accidental poisoning occurs from the use of philters or love potions and quack remedies containing poisonous drugs. The incidence of poisoning in India is among the highest in the world, and it is estimated that more than 50,000 people die every year from toxic exposure [3]. The causes of poisoning are many - civilian and industrial, accidental and deliberate. One recent study pertaining to poisoning statistics demonstrated more of such differences between northern and southern Indian states [11].

Classification of Poison

According to their mode of action, poisons are broadly classified in three groups, these three broad groups are sub-divided on the basis of their effect on the body, type of composition etc., which are available in the literature [1-3] and summarized as shown in Figure 1.

Criminal Offences in Indian Panel Code (IPC)

The administration of a poison is a criminal offence whenever (i) It is with intent to kill, (ii) with intent to cause serious injury, (iii) used recklessly even though there is no intent to kill, (iv) for stupefying to facilitate a crime, eg., robbery or rape, (v) to procure an abortion, (vi) to annoy the victim, (vii) to throw poison on another person with intention to injure him [11].

Now a day, in India mostly poisons are used for robbery and suicidal purposes. For example Datura is used by that sect of the thugs who poisoned wayfarers. Even today the poisoning and robbing of travelers was of frequent occurrence in India. By the judicious use of datura a whole household can be so drugged that the thieves can ransack the house at their ease. Datura has frequently been detected in the vomit of the victims of a midnight robbery. Red chilli powder is frequently used in the robbery or a confession of some guilt by introducing it into the nostrils, eyes, urethra, vagina, or rectum. Hyocyamus is used in war to control shell-shock. Poisoning is generally accidental though an overdose or rarely homicidal as in the crippen case. In forensic work,



it can be used as a truth serum or lie detector. Hemlock was Athenian state-poison by which Socrates died.

Characteristics of Ideal Poison

The characters of an ideal homicidal/suicidal poison should be (i) cheap, (ii) easily available, (iii) colourless, odorless and tasteless, (iv) capable of being administered, either in food, drink or medicine, without producing any obvious change to prevent suspicion, (v) highly toxic (vi) capable of painless death (vii) signs and symptoms should resemble a natural disease, or the serious ill effects should be delayed sufficiently long for the accused to escape suspicion, (viii) must be rapidly destroyed or made undetectable in the body.

The number of factors, which are affecting the characteristics of poisoning any victim's as dose/quantity given to the victim, in which form (physical/chemical) the poison inject to the body, resistivity of body and condition of the victim (he/she might be drug addict/ in sleep or intoxication). Unless the poison is given in liquid form or small amount, the greater part of it may be lost by vomiting. However, the reorganization of poisoning during life is a matter of the first important, both from the point of view of the medical jurist and as a forensic crime scene investigator.

Review

It is essential to take cognizance of the fact that overuse or abuse of the medicinal constituents of plants can cause danger [9]. Plants containing glucosides, acids or alkaloids are used as medicines. Thus when taken in excess often have adverse effect. The latex, white or coloured sap found in families of *Apocynaceae*, *Asclepiadaceae*, *Sapotaceae*, *Euphorbiaceae* and *Papaveraceae*, if used in excess always act as poison. Plants of family *Araceae* have calcium carbonate oxalate crystals, which cause intense irritation of mouth and throat, as also swelling of throat and intestinal lining. This may cause suffocation or death.

Some plants containing orthophosphoric acids cause painful irritation and eruption if they came in contact with skin or mucous membrane. There are some plants or products like seeds of *Annona squamosa* L. and unripe pineapple when consumed induce abortion in pregnant women. The review on all toxic plants has been summarized in Table 1, this table provide a fundamental database for the forensic community which has been reviewed with the available literature [12 – 18], those who are working the field of forensic crime scene and as well as toxicologist as standard comparison during laboratory examination, which plants contains which type of constituents in it. Even plant toxins were quite low in incidence, which is because of the difficulty in testing for such toxins in the laboratory, as compared to chemicals.

Conclusion

In this paper, more than 50 poisonous plant species belonging to number of families are reported in the present paper. The poisonous parts of the majority of plants species were seeds, latex and root or root bark. Besides these poisonous parts of some plants were fruits, stem bark, tubers or bulbs and sometimes whole plant also. Some plants causes poisoning to both human beings as well as livestock populations, while some causes poisoning to human being only [19].

There are many plants which have no medicinal value and not used for the edible purpose but which are at times ingested through oversight, particularly by children. Many of these are responsible for poisoning in cattle. Some of the plants have been used for the poisoning purposes and for committing suicide. Citation: Khajja BS, Sharma M, Singh R, Mathur GK (2011) Forensic Study of Indian Toxicological Plants as Botanical Weapon (BW): A Review. J Environment Analytic Toxicol 1:112. doi:10.4172/2161-0525.1000112

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Sr.No.	Name of Plant/Family	Common Name/Hindi Name	Toxic Parts	Toxic Constituents	Fatal Dose	Fatal period
1.	Abrus precatorius (Fabaceae)	Rosary pea, Crab's eyes, Gunchi (Hindi)	Roots, seeds and leaves	Abrin, Abrine and Abrasine	1 - 2 seed or 90-120 mg/kg (Abrin)	3 – 5 days
2.	Aconitum napellus (Ranunculaceae)	Indian aconite, Monkshood and mitha zahar (Hindi)	All parts especially Dried tuberous root	Aconitine, Pseudo Aconite, Indaconitine Bhikhaconitine, Picraconitine, and Aconine	1 - 2 gram (root) 1 - 2 mg (Aconotine)	2 to 6 h
3.	Adenia palmata (Passifloraceae)		Fruit	Toxalbumin (Cyanogenic glycoside) and Emulsin (enzyme)	-	-
4.	Aesculus hippocastanum (Hippocastanaceae)	Horse –chestnut, conker	All parts especially seeds	Aescin and Aesculin	-	-
5.	Alocasia macrorrhiza (Araceae)	Giant taro, Elephant ear	All parts	Calcium oxalate crystals and toxic Proteins	1/30 to 1/15 of a grain	15 min
6.	Anamirta cocculus (Menispermaceae)	Indian berry or fish berry	Fresh fruit	Picrotoxin and Dihydro-picrotoxine	-	-
7.	Antiaris toxicaria (Moraceae)	Upas tree, Antiaris	Leaves and bark	α- Antiarin	LD - 0.116 mg/kg <i>i.v.</i> α- antiarin	2 – 3 days
8.	Argemone mexicana (Papaveraceae)	Argemone and Sial-kanta (Hindi)	All parts especially seeds	Berberine, Protopine, Sanguinarine and Dihydro-Sangunarine	-	-
9.	Atropa belladonna (Solanaceae)	Deadly nightshade	All parts	Atropine, Scopolamine, Hyoscyamine, and Belladonnine	120 mg (atropine) 30 mg (hyoscine)	24 h
10.	Calotropis gigentea (Apocyanaceae)	Calotropis and madar, akdo(Hindi)	Juice and roots	Uscharin, Calotoxin, Calactin and Calotropin	0.12 mg/kg calotropin	12 to 24 h
11.	Cannabis sativa (Cannabinaceae)	Indian hemp Hashish	Bhang- Dried Leaves & fruit shoots Majoon- Sweet prepared with bhang Ganja- flowers top of female plant Charas- resin of leaves and stems	Cannabin, Cannabinon and Cannabinol	10 gm/kg b.wtbhang, 8 gm-ganja, 2 gram–charas	5 – 8 Days
12.	Capsicum annum (Solanaceae)	Chillies and Mirch (Hindi)	Fruit	Capsaicin and Capsicin	-	-
13.	Cerbara odollum (Apocynaceae)	Dabur , pilikirbir (Hindi)	Fruit and seed	Cerberin, Cerberoside, Odollin, Odolotoxin, Thevetin and Cerapain	Kernel of one fruit	1 - 2 days or more
14.	Cerbera thevetia (Apocynaceae)	Yellow oleander and Pila kaner	All parts especially leaves & fruits	Thevetin, Thevetoxin, Nerifolin, Peruvoside, Ruvoside and Cerberin	8 - 10 seeds,15 - 20 g of root, 5 to 10 leaves	Depend upon Quantity
15.	Cinchona officinalis (Rubiaceae)	Cinchona	Bark	Quinine, Cinchonine and Cinchonidine	8 - 10 g	2 h to 2 days
16.	<i>Citrullus colocynthis</i> (Cucurbitaceae)	Indian wild gourd or bitter apple, bitter cucumber	Fruit, Root and dried pulp	Colocynthin	1 - 2 gramColocynthin	24 h to 2-3 days
17.	Cleistanthus collinus (Euphorbiaceae)	-	Leaves and Bark	Cleistanthin	0.5 mg/kg (animals)	-
18.	Colchicum autumnale (Colchicaceae)	Meadow saffron		Colchicine	Similar to arsenic poisoning	Similar to arsenic poisoning
19.	Conium maculatum (Apiaceae)	Poison hemlock	All parts	Coniine and Methyl Coniine	1 cm piece of plant	-
20.	Crotolaria spectabilis	Jhunjhunia (Hindi)		Mono-crotaline	65 mg/kg (chicken)	-
21.	Croton tiglium (Euphorbiaceae)	Croton oil seed and Jamal-gota (Hindi)	Seed and oil	Crotin-a toxal-bumine, Tiglinic acids, Crotonic acid and Crotonoside	4 - 6 seeds, 1 - 2 ml oil	6 h to 3 days
22.	Cytissus scoparius (Leguminosae)	Yellow broom	Seed, leaves and twigs	Cytisine and Sparteine	-	-
23.	Datura fastuosa (Solanaceae)	Thorn apple and datura (Hindi)	All parts especially seeds and fruit	Atropine, Hyoscyamine, Hyscine and Dutarin	0.6 - 1 gram	24 h
24.	<i>Dieffenbachia</i> sp. (Araceae)	Dieffenbachia, dumbcane	All parts	Cyanogenic Glycosides and Calcium oxalate	-	-
25.	<i>Digitalis purpurea</i> (Terophularaceae)	Fox glove	Roots, leaves and seeds	Digitoxin, Digitalin Digitalein and Digitonin	15-30 mg (Digitalin) 4 mg (Digitoxin)	1 h to 24 h
26.	<i>Dioscorea hispida</i> (Dioscoreaceae)	Karukandu (Hindi)	Tubers	Spiro Alkaloid Dioscorine	120 mg/kg on mice	

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27.	Erythroxylum coca (Linaceae)	Coke, snow	Leaves	Cocaine, Procaine, Butacaine and Dibucaine	1 - 1.5 g Cocaine (Oral)	15 min to 10 h
28.	<i>Euphorbia helioscopia</i> (Euphorbiaceae)	Sun spurge	Milky latex	Non-Haemolytic Saponin and Phasin	-	-
29.	<i>Gloriosa superba</i> (Liliaceae)	Superb lily, Flame lily and Kalihari (Hindi)	Tubers and roots	Colchicine, Superbine, Gloriosine and Glucosine	-	-
30.	Gossypium sp. (Malvaceae)	Kapas (Hindi)	Seed oil	Gossypol	2.57 g/kg (Rat)	
31.	Hyoscyamus niger (Solanaceae)	Henbane and Ajwayan (Hindi)	All parts	Atropine, Hyoscine and Hyscyamine	125mg (hyoscyamine)	24 h
32.	<i>Jatropa multifida</i> (Euphorbiaceae)	Bherenda (Hindi)	foliage and fruits	Curcin	-	-
33.	Lantana camara (Verbenaceae)	Lantana, bunch berry	Entire plant, especially the berries	Lantanine, Lancamarone and Lantadenes A,B	-	-
34.	<i>Lasiosiphon eriocephalus</i> (Thymeleaceae)	Rameetha (Hindi)	Stem, leaves and bark	Lasioside and Lasiocephatin	0.5 mg/kg roots (cats)	-
35.	Lathyrus sativus (Fabaceae)	Gross pea, Khesari (Hindi)	Seeds	β-Aminopropionitrile, β-Cyanoalanine,2,4-diamino Butyric acid, Selenium and 3-N-oxalyl-2,3-Di- aminopropinoic acid	-	-
36.	Lobelia nicotiancefolia (Campanulaceae)	Indian lobelia and deonal (Hindi)	All parts	Lobeline	10 mg (Lobeline), 3.75 gram(leaves)	30 min to a day
37.	Manihot esculenta (Euphorbiaceae)	Sakarkanda (Hindi)	Tubers	Cyanogenic Glycoside	-	-
38.	<i>Manihot utilissima</i> (Euphorbiaceae)	Cassava, tapioca	Root and leaves	Linamarin- a Cyanogenic Glycoside	300 gram(adult) 125 g (child) fresh root	-
39.	<i>Mucuna prurita</i> (Leguminosae)	Velvet bean, Konch (Hindi)	Seeds	Mucunain, Serotonin	-	-
40.	<i>Myristica fragrans</i> (Myristicaceae)	Nutmeg, Mace tree	Seeds	Myristicin and Elemicin	1 - 3 nutmegs (adult) 2 nutmegs (child)	-
41.	Nerium odorum (Apocynaceae)	White oleander and Kaner (Hindi)	All parts	Neriodorin, Neriodorein and Karabin	15 - 20 g root / 24 - 36 hours	
42.	<i>Nicotiana tabacum</i> (Solanaceae)	Tobacco and tambaku (Hindi)	All parts except ripe seeds	Nicotine	60 - 100 mg nicotine or 2 gramtobacco	5 - 15 min
43.	Ochrocarpus longifolius (Gutiferae)	Naag kesar	All parts	Surangin A and Surangin B	LD - 9 mg/kg surangin A and 1 mg/kg surangin B (Cats)	-
44.	Papaver somniferum (Papavaraceae)	Opium poppy and afim (Hindi)	Ripe and dried capsules, petals and seeds	Morphine, Narcotine, Codeine and Thebaine	2 gram(opium), 0.2 gram(morphine) and 0.5 gram(codeine)	2 to 6 h
45.	Parthenium hysterophorus (Compositae)	Carrot grass	Leaves and seeds	Parthenin	-	-
46.	Pegnum hermala (Zygophyllaceae)	Wild rue	All parts	Harmaline, Harmine, Harmane, Harmalol, Asicine, Vasicinone	Harmaline-120 mg/kg (rat), Harman-200 mg/kg (rabbit)	-
47.	Plumbago zeylanica (Plumbaginaceae)	Ceylon leadwort and chitra (Hindi)	Root	Plumbagin	5 gm	Few days
48.	Prunus amygdalus (Rosaceae)	Almond, Baadam (Hindi)	Almond	Amygdalin	20 almonds (adult) 10 almonds (Child)	
49.	Rauvolfia serpentina (Apocynaceae)	Chandrabhaga (Hindi)	Roots	Reserpine, Reserpidine, Reserpinine and Serpentine	-	-
50.	<i>Ricinus communis</i> (Euphorbiaceae)	Castor bean, Erandi (Hindi)	Entire plant especially seeds	Recine and Recinine	6 mg of ricin (10 seeds)	2 to several days
51.	Semecarpus anacardium (Anacardiaceae)	Marking nut And bhilawa (Hindi)	Juice	Semecarpol and Bhilawanol	5 – 10 gm	12 – 24 h
52.	Solanum nigrum (Solanaceae)	Black nightshade	Immature berries	Solanine and Steroids	-	-
53.	Strychnos nux-vomica (Loganiaceae)	Poison nut and Kuchila (Hindi)	All parts especially seeds	Strychnine, Brucine and Vomicine	15 – 20 mg/kg (1 seed - Oral)	1 – 2 h
54.	<i>Thevetia peruviana</i> (Apocynaceae)	Suicide tree and Pila kaner (Hindi)	Seeds and milky juice	Thevetin A and Thevetin B	Kernel of 01 fruit , 2 leaves (child)	-

Table 1: Review of the toxic/poisonous Indian plants.

There are some plants like *Cerbera odollum*, *Cleistanthus collinus*, *Strychnos nux -vomica*, *Abrus precatorius*, *Colchicum autumnale*, and *Datura metel* are very toxic plants and used for homicidal and suicidal purposes. Almost no other plant has such a history of crime as datura and the seeds are favorite poisons used for this purpose. *Colchicum autumnale* poisoning has been compared with arsenic poisoning. Those plants which are allergens or less poisonous, are used in burglary purpose in buses/trains *Mucuna prurita* is most useful plants for burglary purpose. Sometimes accidental poisoning by poisonous plants has also been observed in tribal area of south Rajasthan.

To this day, some writers continue to talk about ricin as a potential bioterrorism weapon insisting that Iraq was producing ricin but completely ignoring the evidence that this production was small scale, terminated in the mid 2000s and was for use in assassination [20-21].

Significance of this review on such plants helps to forensic investigators in solving the crime and searching the poisoning- plantmaterials on crime spot. On crime spot forensic connoisseur can get evidence related to suicidal, accidental or homicidal poisoning by poisonous plants like parts of plants, spot of crime like forest/garden, symptoms of poisoning can help to direct the investigation of right path. On the basis of plant origin toxicity forensic team can tell whether it is suicide, homicide or accident.

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