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Forensic Aspects of Abrus precatorius for Medicine and Toxicological Contemplations

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Abstract:

Abrus precatorius is the most prominent medicinal plant worldwide. Despite its medicinal value, it is highly poisonous to humans as well as animals. About every part of the plant is used for several medical purposes and almost all the parts are toxic. Seeds are the most poisonous part of plants and contain the active constituent i.e. Abrin which is highly responsible for the toxicity in individuals. It is widely used for the occultist purpose as well. Time for an antidote, proper treatment, and manner of detoxification are the key points to cure the Abrus precatorius poisoning. Manner of treatment is based on the symptoms noticed after poisoning. This review successfully discusses the morphological, toxicological, treatment, analysis (including extraction and detection) and therapeutic uses as well as Abrus precatorius for forensic considerations.

Keywords: *Abrin, Seeds, Toxicity, Anti-abrin, Analysis, Biological Matrices, Therapeutic Potential.*

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Introduction

In *Abrus precatorius, Abrus* means graceful or beautiful, which is stated as per the seeds' appearance of the plant. About every part of the plant is used for several medical purposes and almost all the parts are toxic. Omnipresent nature is one of the factors responsible for cattle poisoning mainly (Livestock) because of their open gazing habit **(Kafle *et al.*, 2018).** The toxicity of seeds of *A. precatorius* is coupled with its utilization as a homicidal agent in addition to fish poison. Boiled seeds and intact beans are harmless, are swallowed **(Prabha *et al.*, 2015)**.

Abrus precatorius is one of the popular plants for medical purposes and belongs to the Fabaceae family (Leguminosae) i.e. Pea family. A sweet-tasting agent known as Glycyrrhizin is present in roots, leaves, and stems. Leaves are alternate and pinnately compound having 10-15 leaflets (shown in Figure 1). Flowers are pea-like and purple, yellow, or pink. The seed pots are in clusters 2.5 to 5cm in length, green to brown, and are split open exposing seeds. Based on origin and habitat, seeds are of different colors (Figure 2). They are tasteless and odorless, egg-shaped, bright scarlet red having large black spots majorly (Figure 3). Seeds are 8mmx6mm in dimensions and 105mg in weight and contain *Abrin* and *Toxalbumin* (Thermolabile toxalbumin) as active principles or toxic agent **(Prabha, *et al*. 2015)**.

Additionally, seeds contain poisonous abrussic acid, urease, fat splitting enzymes, proteins, and haemagglutinin **(Vij, 2011)**. Once because of uniformity in weight and size, they were also known as Rati and used for weighing silver and gold. Where 8 Rati= 1 Masha; 12 Masha= 1 Tola (11.6 grams) **(Prabha, *et al*. 2015).**

Figure No. 1: Morphology of Leaf of *Abrus precatorius* (Solanki and Zaveri, 2012).

Figure No. 2: Different Types of Seeds of *A. precatorius* (Balachandran and Rajendiran, 2015)

Figure No. 3: Seeds of *Abrus precatorius* (tariquesani.net.edu)

Toxicity

Due to a hard seed coat, it can easily pass without digestion through the gastrointestinal tract. But well-chewed seeds results in fatal incidents and toxicity. Unripe seeds are more dangerous because they are easily broken and possess a soft seed coat. Poisoning has also been experienced by a finger prick when it is stringing the seed. The appearance of symptoms may take a few hours to several days **(Prabha *et al*. 2015).**

The plant *Abrus precatorius* Linn produced different pharmacological activity e.g. Antimalarial, Antidiabetic, Anti-inflammatory, Immunomodulator, Nephroprotectie, etc. the plant also have the traditional value of being used in conditions such as an aphrodisiac, removal of biliousness, useful in eye diseases, curing leucoderma, itching, skin diseases and wounds **(Prabha *et al.* 2015).**

Other Names of *Abrus precatorius*: Jequirity, Gunja, Indian licorice, Rati, Rosary bead, Coral bead vine, Kundumani (Tamil) **(Maregesi, *et al*. 2016).**

Active Principle

Abrus precatorius contains a well-known protein Abrin (an amino acid) which is also known as Toxalbumins (Thermolabile) and is the active principle in the seed. Abrin or Toxalbumin is highly toxic and similar to Viperine snake venom and causes cell death by the inhibition of protein synthesis. Despite its poisonous nature, several parts of the plant are used to treat illness being used as home remedies **(Narayanan *et al*., 2005).**

Abrin is similar to Diphtheria toxin, Pseudomonas toxin, and Ricin which is a ribosome-inactivating protein. Abrin contains two chains A and B. Chain A has RNA-N-glycosidase function, cause 28 S rRNA, Adenine depurination. Chain B binds on the cell surface with beta-D-glycopyranosidase moieties and facilitates the entry of Chain A. It prevents the elongation factor from binding to rRNA which inhibits the RNA translation completely **(Gadadhar & Karande, 2013)**.

Other Toxic Constituents: Besides this Abrin, *A. preactorious* also principally contains triterpene, glycosides (abralin), flavonoids, and alkaloids. Abrine- N-methyltryptophan, abralin-a glucoside, haemagglutinin (a lipolytic enzyme), and lipolytic enzyme **(Bhakta and Das, 2020).**

Toxic Dose

Abrin is a lethal toxin having lethal dose to human being in 0.1-1 microgram/Kg body weight. This is about 90-120mg (1 to 2 crushed seeds). Abrin is 100 times more poisonous when administered through a subcutaneous route. Fatal Period is about 3 to 5 days **(Karthikeyan & Amalnath, 2017).**

Treatment

Abrus precatorius poisoning is treated by using:

- Anti-abrin Injection
- Dissected Needles
- Maintain the alkaline pH of urine
- Orally provide the Hydrochloric-pepsin mixture **(Biswas, 2012).**

Methodology (Methods for Extraction, Isolation and Detection)

1. **Extraction of Poison of *Abrus precatorius* from Biological Matrices:**

Stass–otto method is most commonly used and apart from this Ammonium Sulphate method is also used. For the extraction of Drugs and poisons from blood and urine different procedures followed are mentioned as:

Stass-otto Method: Extract: Acid-Ether

This method is more commonly used for the extraction of Alkaloids, Glycosides, Acidic, and basic drugs.

Stage-A

Biological matrix (50gms) is minced and mix with the rectified spirit (in plenty amount) and acidify with Tartaric acid in a flask. Now, this mixture is heated on steam bath (1-2 hours) with thorough shaking on frequent intervals. After this, the extraction is allowed for 24 hours with steam off. [Filtered through a fluted filter paper]. The evaporated filtrate is formed and again the residue is extracted with Acidulated alcohol (In the same way) filter and washed several times with hot rectified spirit. Now, the combined filtrate is evaporated in the porcelain basin on a steam bath in a syrupy consistency.

Stage-B

To the syrupy residue of stage, A 100 mL rectified spirit slowly added by constant stirring. Warmed with occasional stirring for 30 minutes and filtered. Repeat the process once and add combined alcohol extract and evaporate almost till dryness.

Stage-C

Dissolve the residue in dilute H_2SO_4 (Water acidulated) of 50 mL and filter it after an hour. Now put the aqueous solution into a separating funnel and extract it with any of a suitable solvent (Ether or Chloroform) in about 25 ml. The solvent contains Salicylic acid along with its derivatives (Aspirin, Sulphonal, Narcotine, Barbiturates, Acetanilide, Alkaloids, and certain Glycosides). Hence the Alkaloids and Glycosides of *A. precatorius* will be easily extracted.

In the case of other basic drugs and Morphine **Stage D** is followed with an Alkaline medium **(DFS Toxicology Manual, 2010)**.

2. **Detection of *Abrus precatorius* Extracts by Spot Test: For Active Elements of Plant Toxins:**

Purified extracted samples of plant material as well as other like Biological and Non-biological samples are analyzed by various Spot (Color) Tests like:

Table No. 1: Different Spot Tests for *Abrus precatorius* Detection (DFS Toxicology Manual, 2010)

Test	Reagent and Quantity	Observation
Marquis Reagent Test	Extract residue (Dry)+Marquis Reagent(2 drops)	Pink color.
Fat Blue B-Potassium Hydroxide Test	Extract residue (Dry) + Ethanolic solution(5%) + aq. KOH Sol. (2 drops) (In Porcelain Basin)	Orange to Red color.
Van Urk Reagent	Extract residue (dry) + Van Urk Reagent (1 drop)	Green color changed to Blue color.
Agglutination Test (Special Test)	Aq. solution of Extract residue (2 drops) + Defibrinated Blood (2mL) (In small test tube)	RBCs agglutination in a sealing wax-like mass.

[Note: Reagent Preparation: (DFS toxicology manual, 2010)

1. **Marquis Reagent:** Marquis Reagent is prepared by 1 volume of Formaldehyde or Formalin solution mixing into 9 volumes of Conc.H_2SO_4.
2. **Van Urk Reagent:** Van Urk Reagent is prepared by mixing 1gram p-Amino Benzaldehyde in 100 mL of ethanol and 10 mL of Hydrochloric acid.]

Sign and Symptoms

The chewing of plant seeds before swallowing leads to toxicity. When the seeds are swallowed as such without chewing they do not cause toxicity because of the hard outer covering that escapes the disintegration of seeds in the gut of an individual. On boiling, the Abrin loses its toxicity so after cooking they are not poisonous at all. Death is dependent upon the amount of toxin administered or injected into the wound or under the skin. The symptoms may take a time of few hours to 2-3 days **(Vij, 2011).** When animals ingest the seeds they do not show specific signs and symptoms because it expelled fully in dung (excreta) **(Kafle *et al.*, 2018)**. Convulsions, cerebral edema, and cardiac arrhythmias are the common causes of Abrin that are noticed from different reports **(Vij, 2011).**

Table No. 2: Common Signs and Symptoms of *Abrus precatorius* poisoning in Humans and Animals. (Vij, 2011)

Mode of Administration		Signs and Symptoms
Oral		Nausea, diarrhea, abdominal pain, vomiting, and all these are followed by Circulatory collapse.
Dermal (Injection)	In Humans	Painful swelling, ecchymosis with necrosis, and inflammation at the injection site. Vomiting, faintness, general prostration, and vertigo. Death due to cardiac failure.
	In Animals	Edema, necrosis, and hemorrhagic fluid oozing out from the injection site, inflammation. (Animals are not able to move because they do not take food for 3-4 days cause comatose and death).

Post-Mortem Appearance

Multi-organ hemorrhages, congestion, and edema are seen in this case of poisoning. Heart dilation, Pleural Hemoglobin is shown in *A. precatorius* poisoning. Petechial hemorrhages under pleura, skin and pericardium. Inflamed, lesion, Sui, and seeds fragment, edema at the injection site **(Biswas, 2012)**.

Medico-legal Aspects

Sharp pointed, small needles called as ‘suis’ are arranged and dried in sun. They are produced by decorticated seeds and mix with Opium, Dhatura, or Onion and made a paste with water and spirit. Two needles are inserted into holes by their base in a bamboo stick or a wooden handle. The blow of striking with a great force to any animal, and drive the produced needle into the flesh. In homicidal cases, 2 fingers keep the needle between them and slapped the victim driving the needle into the victim’s body. Malingerers use the powdered seeds for conjunctivitis. Sometimes, seeds are used as an arrow or abortifacient poison. This poison is used for revenge mostly **(Vij, 2011).**

For the sake of punishment, it is illegal to introduce into the vagina for infidelity, also applied to the uterus for abortion. It is used on the skin to show bruise for false charges. Sometimes, the juice is used on for the

treatment of paralysis and pain, which accidentally results in poisoning **(Khan, 2016).**

Therapeutic Uses of *Abrus precatorius*

A. precatorius plant holds a wide range of medicinal potential; it includes Anti-fungal, anti-bacterial, anti-tumor, anti-diabetic, anti-migraine, anti-spasmodic, anti-serotonergic, analgesic, treatments of wounds, inflammation, ulcers, sores, and throat scratches. Ayurveda suggested that the administration of these plant elements is beneficial in edema, skin disease, alopecia, helminths, urinary disorder, antifertility, and itching (Several medical purposes are mentioned below) **(Bhakta & Das, 2020)**.

- **Ethnobotanical Uses**

  Abrus precatorius shows an anti-suppurative property. Lime ground with *A. precatorius* and pour on sore, abscess, and acne. Treatment of bile hemoglobinuria and Jaundice from roots. As snake bite remedy it is administered by chewing the roots and leaves for flu and cough (orally) **(Watt & Breyer-Brandwijk, 1962)**.

- **Ancient Uses**

  In Ayurveda has potential as an expectorant, aphrodisiac, and laxative. Seeds are emetic, antiphlogistic, purgative, tonic, aphrodisiac, and anti-ophthalmic and excised against cysticercoids. In Tanzania, Competence in treatment for epilepsy, in CDRI Lucknow antifertility program and China as folk-medicine for hepatitis, bronchitis, and laryngitis are being set up and researched **(Kamboj & Dhawan, 1982).**

- **Other Biological Uses**

1. *Antifertility Effects*: Among the most popular *Lawsonia sinermis* and *Piper longum*, *Abrus precatorius* is the most effective. Steroidal fraction (crystalline) and oil of seeds of Abrus show antifertility activity. EC50 (dose concentration giving half of the maximal response) is 2.29 mg/ml of methanol extracted seed weaken the motility of washed individual sperm. The highest tested concentration was 20 mg/mL **(Sinha, 1990)**.
2. *Antidiabetic Effects*: By squeezing leaves in water till the liquid comes out. It includes leaf of *Abrus precatorius, Blighia sapida,* and *Alchornea cordifolia* **(Gbolade, 2009).**
3. *Antitumor Activity*: Water extract of seeds subcutaneously immobile on Sarcoma (Yoshida ASC) AP01254. Whereas, intraperitoneal administration found dynamic on Sarcoma (Yoshida solid and ASC). [On Mice] **(Reddy & Sirsi, 1969).**
4. *Anti-serotonergic*: Ethyl acetate extraction of leaves on soxhlet shows tannins, amino acids, proteins, carbohydrates, alkaloids, saponins, and antiserotonergic functions on Frog **(Kulkarni, 2005).**
5. *Anti-migraine Activity*: Proved by using muscles of frog fundus and male albino rat. *A. precatorius* extract of crude Ethyl Acetate and Petroleum ether perform on equally muscle preparation **(Khairnar *et al*., 2011).**
6. *Anti-microbial Activity*: Leaves extract seed oil and stem extract applied against *Staphylococcus epidermis* and *aureus, Streptococcus anginosus, Escherichia coli*, and some commonly occurring bacteria by using agar diffusion technique. Almost every part of *A. precatorius* contains anti-bacterial property **(Alli *et al.*, 2011).**
7. *Anti-malarial Activity*: Aerial part of *A. precatorius* contains Abruquinone and Isoflavanquinone shows an anti-malarial property**.** IC 50 below 20 g/ml74 that means inhibits the biological (bacterial) entities with high potential **(Chukuo *et al.*, 1995)**.
8. *Abortifacient Effect:* Dried seed's water extract ingestion (intragastrically) 125.0 mg/kg in pregnant rats was active **(Sethi *et al.*, 1990)**.
9. *Agglutinin Activity*: Fresh seed's water extract, at a concentration of 2.0 microliters/mL in cell culture, was found active on Human Lymphocytes **(Krupe *et al.*, 1968).**
10. *Intragenic Activity*: Dried seed's water extract with a dose of 125.0mg/kg was administered intragastrically and was active in rats **(Nath, 1992).**

Conclusion

Abrus precatorius is one of the most popular plants for medicinal purposes since ancient times. Ayurveda holds a great role of Abrus. Besides its medicinal value, it is highly poisonous in nature. About every part of the plant is used for several medical purposes and almost all the parts are toxic in nature. Abrus seed

is the most poisonous part of the plant and contains the active constituent. In Ayurveda, it shows the properties like anti-fungal, anti-bacterial, anti-tumor, anti-diabetic, anti-migraine, anti-spasmodic, anti-serotonergic, analgesic, treatments of wounds, inflammation, ulcers, sores, and throat scratches. Chewed seeds show toxicity due to disintegration. On boiling the Abrin loses its toxicity so after cooking they are not poisonous at all. Abrin or toxalbumin is highly toxic and similar to viperine snake venom and causes cell death by the inhibition of protein synthesis. Abrus precatorius poisoning plays an eminent role in forensic science. Abrus precatorius poisoning is most commonly homicidal (by using Suis) and plays an efficient role in the investigation. Not only humans but animals also show this poisoning by grazing accidentally. Purified extracted samples of plant and from biological matrices are analyzed by various Spot tests and the most common extraction from biological matrices is done by acid- ether extraction. Initially, during ancient time, its treatment was not possible but now the treatment is available based on the symptoms.

References:

Alli, AI, JO Ehinmidu, and YKE Ibrahim. "Preliminary Phytochemical Screening and Antimicrobial activities of some Medicinal Plants used in Ebiraland, Bayero." *J Pure Applied Sci* (2011): 4(1): 10-16.

Bhakta, Sonali and Shonkor Kumar Das. "The Medicinal Values of Abrus precatorius: A Review Study." *Journal of Advanced Biotechnology and Experimental Therapeutics* (2020): 3(2): 84-91.

Biswas, Gautam. "Organic Irritants-Vegetables." Review of Forensic Medicine and Toxicology (Including Clinical and Pathological Aspects). New Delhi: *Jaypee Brothers Medical Publishers (P) LTD.*, 2012. 459-460.

Balachandran, N. and Krishnamurthy Rajendiran. "Multicoloured Seed Coat and Flower in Abrus precatorius (Leguminosae), India" *Current Science* (2015):109(4):682-684.

Chukuo, S, et al. "Potent Anti-platelet, Anti-inflammatory and Anti-allergic Isoflavanquinones from the roots of Abrus precatorius." *Plant Medica* (1995): 61(4):307-312.

DFS.gov.in,Manuals_close, ToxicologyManualedit, 2010.

Gadadhar, S and AA Karande. "Abrin Immunotoxin: Targeted Cytotoxicity and Intracellular Trafficking Pathway." *PLoS One* (2013): 8:e58304.

Gbolade, AA. "Inventory of Antidiabetic Plants in selected Districts of Lagos State, Nigeria,." *J Ethno Pharm Col*, (2009): 121-137.

Kafle, Arjun, Sushree Sangita Mohapatra and Inderpal Reddy. "A Brief Review on Toxicity of Abrus Precatorius in Animals." *Journal of Entomology and Zoology Studies* (2018): 6(2): 1102-1104.

Kamboj, VP and Dhawan BN "Research on Plants for Fertility regulation in India." *J Ethnopharmacol* (1982): 6(2): 191-226.

Karthikeyan, A and Amalnath SD, "Abrus Precatorius Poisoning: A Retrospective Study of 112 Patients." *Indian J Critl Care Med* (2017): 21:224-5.

Khairnar, AS, et al. "Determination of Antimigraine Property of Leaves Extracts of Abrus precatorius by Serotonergic Receptor Agonist Activity." *J Pharm Res*, (2011): 4(4).

Krupe M., Wirth W., Nies D., Ensgraber A. " Studies on the "Mitogenic" Effect of Hemoglutinating Extracts of Various Plants on the Human Small Lymphocytes in Peripheral Blood Cultured In-vitro,." *Z Immunitatsforsch Allerg Klin Immunol* (1968): 1:19-42.

Kulkarni SK. *"Handbook of Experimental Pharmacology"* 3rd revised ed. Delhi: Vallabh Prakashan, 2005. 85-86.

Narayanan, S, et al. "Ribosome Inactivating Proteins and Apoptosis." *FEBS Lett* (2005): 579: 1324-31.

Nath D., Sethi N., Singh RK., Jain AK. "Commonly used Indian Abortifacient Plants with Special Reference to their Teratologic Effects in Rats." *Journal of Ethnopharmacology* (1992): 36:2:147-154.

Prabha, Meena, et al. "Pharmacological Activities of Abrus precatorius (L.) seeds." *International Journal of Pharmaceutical and Medicinal Research* (2015): 3(2);195-200.

Reddy, SVV and M Sirsi. "Effects of Abrus precatorius on experimental tumors,." *Cancer Res*, (1969): 29:1447-1451.

Sethi, N., D. Nath and RK Singh. "Tetratological Aspects of Abrus precatorius seeds in rats." *Fititerapia* (1990): 61:1:6-63.

Sinha, R. "Post-testicular antifertility effects of Abrus precatorius Seed Extract in Albino Rats." *J Ethopharmacol* (1990): 28(2): 173-5.

Solanki, Anant and M. Zaveri. “Pharmacognosy, Phtochemistry and Pharmacology of Abrus precatorius Leaf: A Review", *International Journal of Pharmaceutical Sciences Review and Research* (2012). 71-76.

Vij, Krishan. "Plant Irritants." Vij, Krishan. *Textbook of Forensic Medicine and Toxicology*. Chennai: Elsevier, 2011. 477-478.

Watt, JM and Breyer-Brandwijk MG *"The Medicinal and Poisonous Plants of Southern and Eastern Africa"*, 2nd Ed,. London: E.S.Livingstone, Ltd., 1962.