ABRUS PRECATORIUS LINNAEUS AND ITS BIOLOGICAL ACTIVITIES - A REVIEW

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ABSTRACT

Abrus precatorius Linnaeus (A. precatorius L.), commonly known as Gunja / Indian liquorices, is a medicinal plant of the family ‘fabaceae’. The plant is being used for therapeutic purpose since Vedic period. The plant has multidimensional medicinal properties. In traditional system of medicine as well as in Ayurvedic and Unani medicine, the plant is reported to possess medicinal effects as an antidote, aphrodisiac, remove biliousness, cures leukoderma, itching, useful in eye diseases, skin diseases and wounds. Modern researchers demonstrated several biological activities like anti-diabetic, anti-microbial, anti-migraine, anti-inflammatory, anti-serotonergic, anti-tumor, analgesic, anti-spasmodic etc. of A. precatorius L. In the present review the plant A. precatorius L. is described and its biological activities are discussed.

KEYWORDS: Abrus precatorius Linnaeus, biological activities.

1. INTRODUCTION

Abrus precatorius Linnaeus (A. precatorius L.), belonging to family Fabaceae, is an important medicinal plant. Since time immemorial the plant is being used for therapeutic purpose. Leaves, roots and seeds of the plant have shown medicinal effects. In Ayurveda roots and seeds of A. precatorius L. are used for treatment of cervical adenitis, dental caries, baldness, defect of vision and to remove dandruff.[1]

In traditional & folklore Medicine the plant is reported to possess beneficial effects in snake bite, in avabahuk, erysipelas and for promoting growth of ear lobes. Seeds of the plant,
though poisonous, are recommended to be applied locally in sciatica, stiffness of the shoulder joint, paralysis and other nervous diseases.\(^{[2]}\)

2. **ABRUS PRECATORIUS LINNAEUS**

2.1 **Different names**

Plant *A. precatorius* L. is known by different names in different countries.

In China *A. precatorius* L. is known as Siang-sztsze, people of Spain and France call the plant Tento muido and Pois rouge respectively. In German the plant is known as Paternostererbse but the people of Arab call the plant in the name of Ain-ed-dik. English people identified *A. precatorius* L. by several names like prayer bean, precatory bean, jequirity bean, rosary pea and Indian liquorice. They also called the plant as jequirity, crab eye, cock’s eyes, John Crow Bead, coral bead, red-bead vine etc. In India *A. precatorius* L. has different names too. In Sanskrit, Hindi and Marathi the plant is known as gunja. In Telugu and Tamil the plant is identified as Guruginia and Kundumani respectively. In Urdu *A. precatorius* L. is known as Ghunchi while people of Punjab and Gujrat call the plant as Mulati and Gumchi respectively.\(^{[1]}\)

2.2 **Taxonomical classification**

Taxonomical classification of *A. precatorius* L. is given below.


2.3 **Description**

*A. precatorius* L. is a climbing shrub. It grows to a height of 10 to 20 feet when supported by other plants. It is most common in dry areas at low elevation. The plant has leaves which are alternate, compound and feather-like with many leaflets (12 or more) arranged in pairs. The plant bears orange-pink flowers which are numerous and appear in the leaf axils along the stems. Flower produces short and stout brownish pods, which on opening shows presence of many coloured seeds mainly white as well as red and black seeds.\(^{[4]}\)
2.4 Distribution

The plant grows wild in thickets, farms and secondary clearings, generally supported by other plants or a fence. It also grows widely in fairly dry climates of tropical and subtropical regions in hedges and among bushes on open lands. The plant is native to India, from the Himalayas down to southern India but also found in Sri Lanka, Nigeria and the West Indies. Now-a-days the plant is also seen growing in all tropical regions throughout the world, most commonly in Africa, South America, Florida and Hawaii.
2.5 Varieties

_Abrus precatorius_ Linnaeus occurs in different varieties viz. _Abrus precatorius_ (India), _Abrus pulchellus_ (Africa), _Abrus sambiranensis_ (Madagascar), _Abrus schimperi_ (Africa), _Abrus somalensis_ (Somali), _Abrus aureus_ (Madagascar), _Abrus baladensis_ (Somalia), _Abrus bottae_ (Saudi Arabia and Yemen), _Abrus canescens_ (Africa), _Abrus diversifolius_ (Madagascar), _Abrus parvifolius_ (Madagascar), _Abrus fruticulosus_ (India), _Abrus gawenensis_ (Somalia), _Abrus laevigatus_ (Laos and Vietnam), _Abrus madagascariensis_ (Madagascar). It is reported that _Abrus_ is a genus of 13-18 species in the family.\(^7\)

2.6 Phytochemical studies

Phytochemical studies of _A. precatorius_ L. revealed that seeds contain alkaloids, tannins, flavonoids and a poisonous protein ‘abrin’ (Umamaheswari et al. 2012). Seeds also contain a fat-splitting enzyme, glucoside abrussic acid, haemagglutinin etc. Root contains about 15% glycyrrhizin (the principal component of licorice) & 8% of an acid resin. Leaves also contain glycyrrhizin, about 10% & abrin.\(^8-13\)

3. BIOLOGICAL ACTIVITIES

It is reported that _A. precatorius_ L. has number of biological activities such as anti-fertility, anti-microbial, anti-inflammatory, anti-arthritic, anti-serotonergic, anti-oxidant, anti-cancer, anti-diabetic, nephroprotective, bronchodilator, anticonvulsant as well as anti-ulcer activity.

3.1 Anti-fertility activity

By administering aqueous extract of _A. precatorius_ L. to male rats for 18 days, Adedapo and co-workers\(^14\) in 2007 noted testicular degeneration with reduction in the number of sperm cells. Seeds extract could lower cauda epididymal sperm motility in rats and could reduce testicular weight, sperm count etc. Investigator observed that ethanol extract of seeds when administered intragastrically to male rats at a dose of 100.0 mg/kg for 60 days significantly decreased the number of pregnant Female.\(^15\) In another experiment degeneration in later stages of spermatogenesis were found in the testis of rats treated with seeds.\(^16\) Chloroform/methanol extract of seeds was found active while ethanol (80%) extract of seeds was found inactive in anti-fertility effect in female rats.\(^17\) In female mice, however, anti-fertility effect was found lies on petroleum ether extract of the seeds when administered.
Fig. 4 Few phytochemicals of *Abrus Precatorius* Linnaeus

orally and not on ethanol (95%) and water extracts of seeds.\(^{[18]}\) Seed oil, administered orally to female mice, was also found having anti fertility effect at a dose of 25.0 mg/ mice and 150.0 mg/rat. For human it is claimed that seeds of *A. precatorius* L. could inhibit conception when taken orally.\(^{[19]}\) Irreversible impairment of the motility of spermatozoa was observed when methanol extract of *A. precatorium* seed was applied.\(^{[20]}\) It has been demonstrated that abrin, the isolated constituent from the seeds of *A. precatorius* L. could induce apoptosis by
causing DNA fragmentation in vitro.[21] In another experiment it was noted that abrin could inhibit sperm production and maturation process. Investigators were of the opinion that this was due to depletion of Leydig cells in tubular interstitial thus reducing serum testosterone level. Testicular and epididymal dysfunction might be due to this androgen deprived effect.[22]

3.2 Anti-microbial activity

Antimicrobial activity of *A. precatorius* L. was screened against four medically important human pathogen viz. *Bacillus subtilis, Pseudomonas aeruginosa, Staphylococcus aureus* and *Streptococcus pyogenes*. Agar disc diffusion method was employed to note antibacterial activity. Results showed that both aqueous and ethanol extracts of *A. precatorius* L. were effective but the ethanol extracts was more effective than the aqueous extract. Susceptible bacteria were *Staphylococcus aureus* followed by *Bacillus subtilis*. [23] Roots of *A. precatorius* L. were tested for antimicrobial activity against *Salmonella typhi, Salmonella paratyphi A, Salmonella paratyphi B, Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Klebsiella pneumonia*. Root extract of *A. precatorius* L. was found effective against the Gram positive organism *Staphylococcus aureus*. With petroleum ether extract and methanol extract of root, Minimum Inhibitory Concentration (MIC) against *Staphylococcus aureus* came 400 μg/ml and 440 μg/ml respectively which are considered as moderate activity.[24] Ethanol extract of seeds was also tested for anti bacterial activity against bacteria like, *Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa and Klebsiella pneumonia* as well as *Salmonella typhi, Salmonella paratyphi A and Salmonella paratyphi B* etc. Agar well diffusion method was used to note anti bacterial activity. Results showed ethanol extract had antibacterial activity towards all the above said bacteria.[25]

3.3 Anti-inflammatory activity

Anti-inflammatory activity of the extract of the plant *A. precatorius* L. was checked in rats using croton oil ear model. Acetylsalicylic acid, a very effective nonsteroidal anti-inflammatory agent, was used as control. Results showed that percent reduction of inflammatory response by *A. precatorius* L. extract was 67.10% and was comparable to that of acetylsalicylic acid which was 71.1%. There was also decrease in weight of the croton oil treated ears of the rats by local application of extract of the plant *A. precatorius* L. Authors thus asserted that *A. precatorius* L. extract had definite anti-inflammatory activity.[26] Ethanol/water (1:1) extract of the aerial parts of *A. precatorius* L. was tested for its anti-
inflammatory activity in carrageenan induced pedal edema in rats. No activity was noted.\textsuperscript{[27]} But triterpenoid saponins, isolated from the aerial parts of \textit{A. precatorius} L., when examined for its anti-inflammatory activity in croton oil ear model in rats showed significant activity. The acetates indicated greater inhibition than the parent compounds.\textsuperscript{[28]}

\textbf{3.4 Anti-arthritic activity}

Effect of \textit{A. precatorius} L. seed extract was studied on Freund’s adjuvant – induced arthritis model in rats. Results showed that the seed extract exhibited significant (p<0.001) anti-arthritic activity. Further, treatment with \textit{A. precatorius} L. seed extract did not produce gastric ulcer in the animals which is common when non steroidal anti-inflammatory drugs (NSAIDs), glucocorticoids or so called disease-modifying drugs such as gold or methotrexate are prescribed for treatment of rheumatoid arthritis indicating thereby that \textit{A. precatorius} L. seed extract is more effective in long term treatment of rheumatoid arthritis.\textsuperscript{[29]}

\textbf{3.5 Anti serotoninergic activity}

Effect of ethyl acetate extract of \textit{A. precatorius} L. leaves was tested on frog fundus strip using sumatriptan as a standard. Graded dose response of the extract on frog fundus strip was noted. This response suggested that ethyl acetate extract of \textit{A. precatorius} L. leaves possesses antiserotonergic activity.\textsuperscript{[30]}

\textbf{3.6 Anti-oxidant activity}

Ethanol extract of \textit{A. precatorius} L. seeds was evaluated for potential antioxidant activity. Antioxidant activities were checked by using tests such as hydrogen peroxide-scavenging activity, hydroxyl radical-scavenging activity, reducing power activity etc. Results showed that in all the above said tests seed extract has antioxidant activity. Antioxidant activity was correlated with presence of total phenolic compound as gallic acid and total flavonoids as rutin in seed powder of \textit{A. precatorius} L.\textsuperscript{[31]}

\textbf{3.7 Anti-cancer activity}

Anti-cancer activity of petroleum ether extract of \textit{A. precatorius} L. was tested on Ehrlich Ascitis Carcinoma (EAC) in mice. 5-fluoro uracil was used as standard anti-cancer drug. Results showed that mean survival time of the animals under Ehrlich Ascitis Carcinoma was significantly increased by the petroleum ether extract of \textit{A. precatorius} L. and was comparable to that of 5-fluoro uracil group. Treatment with petroleum ether extract of \textit{A. precatorius} L. also increased the haemoglobin content as well as RBC count and reduced the
WBC count towards normal level in EAC bearing mice. The investigators, therefore, claimed that petroleum ether extract of A. precatorius L. has potential anticancer activity. However, from other experiments conclusions were drawn that ethanol (95%) extract of dried leaves of A. precatorius L. administered intra-peritoneal to mice was inactive on Sarcoma 180 (ASC). Water extract of seeds, administered intra-peritoneal to mice was active on Yoshida solid and ASC Sarcoma but if administered subcutaneously was inactive on Yoshida ASC Sarcoma. Panneerselvam et al. in 2000 crystallized an agglutinin protein from the seeds of A. precatorius L. at room temperature with polyethylene glycol 8000 and showed that the protein had high antitumor activity.

3.8 Anti-diabetic activity

Studies in relation to human diabetes and traditional drugs were conducted in five districts of Lagos State of Nigeria. Respondents were mostly male (76%), educated who had 20-30 years experience in treating diabetes with traditional medicines. They opined that their diabetes was well under control by the traditional medicine, principal ingredient of which was leaves of A. precatorius L. Investigators thereby claimed that leaves of A. precatorius L. has anti diabetic effect on human diabetes.

Effect of leaf extract of A. precatorius L. on blood glucose level of diabetic albino wistar rats was evaluated. Diabetes was induced in the animal by administering alloxan. Significant reduction in blood glucose level was observed. Findings of this study suggest that extract of A. precatorius L. has hypoglycemic effect.

Anti diabetic activity of A. precatorius L. was also studied in alloxan induced diabetic in rabbits. It was found out that chloroform- methanol extract of seeds of A. precatorius L. produced antidiabetic effect by significantly decreasing blood glucose level in the alloxan induced diabetic animals. Results were comparable to that of chlorpropamide, a standard anti diabetic drug. Dhawan et al.(1977), however, stated that ethanol/water (1:1) extract of the aerial parts of A. precatorius L., administered orally to rats at a dose of 250.0 mg/kg, had no anti diabetic effect.

3.9 Nephroprotective activity

It is known that alcohol intake could induce severe renal injury as evident by derangement of serum electrolyte, elevation of creatinine levels and structural alterations of tubules,
glomeruli etc. Elevation of malondialdehyde level indicates that the damage is related to increased lipid peroxidation.\cite{42,43}

In 2006 Bagaria et al. noted that *A. precatorius* L. seed extract exhibited significant attenuation of both structural and functional derangement in alcohol induced nephropathy in rats. There was also reduction in malondialdehyde level. Authors commented, *this finding is supportive evidence that the seed extract of A. precatorius L. has protective effect against alcohol induced renal injury and that this effect may be related to a reduction in alcohol-induced lipid peroxidation*.\cite{44} Ligha and Jaja (2009) explained, *gallic acid, glycyrrhizin and trigonelline present in seed extract of A. precatorius L. are potent antioxidants. These metabolites may account for the ability of the seed extract of A. precatorius L. to attenuate alcohol induced lipid peroxidation of renal cell membrane in vivo*.\cite{45}

### 3.10 Bronchodilator activity

Use of the plant *A. precatorius* L. in traditional medicine of asthma is known in literature.\cite{46} Wingard et al.,1991\cite{47} and Mensah et al., 2011\cite{48} evaluated possible bronchodilator activity of the methanol extract of the leaves of *A. precatorius* L. by using various *in vivo* and *in vitro* models in guinea pigs. Salbutamol was used as standard bronchodilator agent. Results showed that methanol extract offered dose-dependent bronchodilator activity, a maximum degree of protection (41.62%) which was comparable to that of salbutamol (47.52%). It is, therefore, conceded that methanol extract of the leaf of *A. precatorius* L. exhibited muscle relaxant activity.\cite{49}

In another experiment it was observed that the extract of *A. precatorius* L. in the dose of 100mg/ml significantly inhibited histamine induced contractions on the guinea pig ileum preparation. Results of the study, therefore, supported H1 receptor antagonistic activity and the bronchodilator properties of the plant.\cite{9} Methanol extract of the leaves of *A. precatorius* L. was also investigated using isolated toad rectus abdominis and rat phrenic nerve-diaphragm muscle preparations as well as young chicks. From the results it was deduced that the methanol extract of the leaves of *A. precatorius* L. has muscle relaxant activity.\cite{49}

### 3.11 Anticonvulsant activity

Anticonvulsant activity of *A. precatorius* L. was studied in different experimental models of convulsion. Results showed that ethanol (70%) extract of fresh root of *A. precatorius* L. has anticonvulsant activity against metrazole induced convulsions but inactive against strychnine-
induced convulsions when administered intraperitoneally to mice.\textsuperscript{[50]} Ethanol/water (1:1) extract of the aerial parts of \textit{A. precatorius} L. was also inactive against electroshock-induced convulsions when administered to mice intraperitoneally even at a dose of 500.0 mg/kg.\textsuperscript{[27]}

3.12 \textit{Anti-ulcer activity}

Anti ulcer activity of the leaves of \textit{A. precatorius} L. in indomethacin induced gastric ulcer in albino rats was evaluated in our laboratory. Mitra in 2014 showed that formation of gastric ulcer in rats by indomethacin was inhibited (52.6\%) when rats were fed with powdered leaves of \textit{A. precatorius} L.\textsuperscript{[51]} It was noted that leaves of \textit{A. precatorius} L. could reduce acid level and increase mucus secretion in stomach by which it can inhibit ulcer formation. Tempted on this results further study was undertaken on role of \textit{A. precatorius} L. in experimental peptic ulcer. Results indicated that leaves of \textit{A. precatorius} L. could inhibit ethyl alcohol induced gastric ulcer and cysteamine induced duodenal ulcer in albino rats.\textsuperscript{[52]}

3.13 \textit{Immunostimulatory activity}

In 2004 Ohba et al. demonstrated that abrin B derived from seeds of \textit{A. precatorius} L. caused strong agglutination of cells.\textsuperscript{[53]} Agglutination increased depending on the order of differentiation in cells. In another experiment it was noted that native and heat - denaturized agglutinin of seeds of \textit{A. precatorius} L. alters the macrophage function of mice in vitro.\textsuperscript{[54]} Protein abrin presents in seeds of \textit{A. precatorius} L is toxic but in its non toxic dose of 1.25µg/kg body weight, abrin could increase total leucocytes, weights of thymus and spleen indicating thereby that it could potentiate an immune response of a host.\textsuperscript{[55]} Wambebe and Amosun (1984), however, showed that ethanol extract of leaves of \textit{A. precatorius} L inhibits muscle preparations, like toad rectus abdominis and rat diaphragm.\textsuperscript{[46]}

3.14 \textit{Cytotoxic activity}

Chloroform-ethanol extract as well as ethanol extract of dried leaf powder of \textit{A. precatorius} L. were prepared. Both the extracts were screened for in-vitro cytotoxic activity on human cancer cell lines. Results showed that ethanol extract showed better cytotoxic activity than chloroform-ethanol extract against cancer cell lines of cervical cancer (HeLA), liver cancer (hepG2), lung cancer (A549), colon cancer (HCT116) etc.\textsuperscript{[56]} Hussein Ayoub and Kingston, however, did not find cytotoxic activity of ethanol (95\%) extract of dried stem of \textit{A. precatorius} L. in cell culture on CA-9KB.\textsuperscript{[57]} In 1995 Otake et al. found that methanol and water extracts of dried seeds of \textit{A. precatorius} L produced weak cytotoxic activity in cell culture on cells MT-4.\textsuperscript{[58]} Further studies revealed that water extract of seeds, in cell culture,
produced strong cytotoxic activity on Sarcoma Yoshida ASC.\cite{59} and water extract of seeds was also found having cytotoxic activity in cell culture, on CA-98 and on the testes of *Poecilocera picta*.\cite{60}

### 3.15 Anthelmintic activity

Anthelmintic activity of *A. precatorius* L. was known when Molgaard et al. (2001) showed that extract of stem and root of *A. precatorius* L. was active on schistosomules of the trematode *Schistosoma mansoni* and cystercoids of the cestode *Hymenolepis diminuta*, in *vitro*.\cite{61} Ibrahim (1992), however, demonstrated that water extract of dried seeds of *A. precatorius* L. produced weak activity on *Caenorhabditis elegans*.\cite{62}

### 3.16 Anti-diarrheal activity

Nwodo et al. in 1991 showed that chromatographic fraction of dried seeds of *A. precatorius* L. was active against castor oil-induced diarrhea in rats. The fraction was given to rats intragastrically in the dose of 10.0 mg/kg. The observation was supported by Ibrahim in 1992.\cite{62}

### 3.17 Uterine stimulant activity

Studies were undertaken to evaluate uterine stimulant activity of *A. precatorius* L. It was found out that chromatographic fraction of seeds of *A. precatorius* L. in the concentration of 0.2 mg/ml, was active on the uteri of pregnant and non pregnant rats.\cite{63} Jamwal and Anand (1962), however, showed that ethanol (95%) extract of dried seed oil in the dose of 1000 mcg/ml when administered i.v. produced weak activity in guinea pigs.\cite{64} Nwodo (1991) also observed that seed oil of *A. precatorius* L., at a concentration of 3.6 mg, was active on the uteri of guinea pigs and rats but the action was blocked by indomethacin and not by atropine.\cite{65} Hikino et al. (1966) showed that water extract of seeds of *A. precatorius* L. was active on the uterus of guinea pig.\cite{66}

### 3.18 Anti-spasmodic activity

Leaves of *A. precatorius* L. has antispasmodic activity. Nwodo and Botting (1983) noted that ethanol (95%) extract of dried leaves was active on phrenic nerve-diaphragm of rats against nerve stimulation. Authors, however, did not find activity of petroleum ether extract of the leaves on phrenic nerve-diaphragm of rats against nerve stimulation as well as direct muscle stimulation. They also noted that petroleum ether extract of the leaves was inactive on toad rectus abdominus muscle against acetyl choline-induced contractions. The ethanol/water (1:1)
extract of the aerial parts of \textit{A. precatorius} L. was also found inactive on guinea pig ileum against acetyl choline and histamine - induced spasms.\cite{63}

### 3.19 Anti-migraine activity

\textit{A. precatorius} L. has anti migraine activity. Experimental results suggested that petroleum ether and ethyl acetate crude extracts of \textit{A. precatorius} L. exerted muscle contraction effect on male Wister albino rat and frog fundus muscle preparations when studied using Sherrington rotating drum.\cite{67}

### 4. CONCLUSION

Plant \textit{A. precatorius} L. has various biological activities. People of countries like Afghanistan, Brazil, Cambodia, Central Africa, East Africa, Egypt, Guinea-Bissau, Haiti, India, Jamaica, Kenya, Mozambique, Nepal, Nigeria, Pakistan, Sudan, Taiwan, Tanzania, Thailand, West Africa, West Indies etc. are using different parts of the plant in their traditional medicine.

### 5. CONFLICT OF INTEREST

None.

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