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Abrus precatorius Linn (Fabaceae): phytochemistry, ethnomedicinal uses, ethnopharmacology and pharmacological activities

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Abstract
The ethnomedicinal uses, phytochemistry, ethnopharmacology and pharmacological applications of *Abrus precatorius* L (Fabaceae), an endemic medicinal plant in Nigeria is herein highlighted. In traditional medicine, this plant is useful for treating cough, sores, wounds caused by dogs, cats and mice, mouth ulcer, gonorrhea, jaundice and haemoglobinuric bile, tuberculous painful swellings, skin diseases, bronchitis, hepatitis, schistosomiasis, stomatitis, conjunctivitis, migraine and eye pain. Phytochemical studies of bioactive constituents of *Abrus precatorius* have been reported. Several types of alkaloids, terpenoids and flavonoids including luteolin, abrectorin, orientin, isoorientin, and desmethoxycentaviridin-7-O-rutinoside, glycyrrhizin, abrusoside A to D, abrusogenin and abruquinones D, E and F were identified from the plant. Various pharmacological studies on *A. precatorius* showed it possessed antimicrobial, antioxidant and hepatoprotective activities. *Abrus precatorius* seeds contain abrin, one of the most potent toxins known to man. However, because of the seed's outer hard coat, ingestion of uncrushed seeds caused only mild symptoms and typically results in complete recovery. In ethnomedicinal practice, seven whole seeds of *A. precatorius* are ingested in a single dose to aid vision. Ingestion of the crushed seeds causes more serious toxicity, including death. This species is an important medicinal herb which can be used for various purposes. Further scientific study of *Abrus precatorius* is required to evaluate the acclaimed traditional uses and discover new lead compounds.

Keywords: *Abrus precatorius*, phytochemistry, abrin, ethnomedicinal uses, pharmacology

Introduction
Abrus precatorius L known as "Idon Zakara" in Hausa is indigenous to India. It is commonly found in tropical and subtropical regions. It grows wild in thickets, farms, secondary clearings and sometimes in hedges. It is most common in rather dry areas at low elevation throughout the tropics and subtropics and is known as rosary pea [1, 2]. The name *Abrus*, meaning beautiful or graceful, is used to describe the appearance of the seed [3]. Other names include prayer bean, Crab's eye, Indian liquorice, Ratti, jequerity pea, precatory beans, jumble beans, saga-saga, and lucky beans [4]. It belongs to the family Fabaceae. Abrus is a genus of 13 to 18 species [5]. Synonyms include *Abrus aureus* (Madagascar), *Abrus baladensis* (Somalia), *Abrus canescens*, *Rhynchosia precatoria*, *Abrus madagascariensis* (Madagascar), *Abrus parvifolius* (Madagascar), *Abrus pulchellus* (Africa), *Abrus sambiranensis* (Madagascar), *Abrus schimperi* (Africa), *Abrus somalensis* (Somalia), *Abrus wittei* (Zaire) among others [6]. Some species of the genus *Abrus* are as shown in Table 1. The Leaves resemble tamarind leaves having 20-40 leaflets and the plant is described as beautiful, much branched, slender, perennial, deciduous, woody, prickly twinning or climbing herb [7]. The leaves have been used as food and as medicine. It is commonly chewed or sucked to obtain its sweet taste [8]. It is also reportedly boiled with food for example, cereal pulp, as a sweetener and even as a vegetable. Also, fresh leaves have been reportedly pressed on the gum for sores in the mouth and used in many countries in preparations for skin cancer [9, 10]. *A. precatorius* leaves have also been used in Nigeria for the treatment of many diseases including malaria, typhoid, cough, respiratory tract infections and hepatitis [11].

The medicinal properties are attributed to several bioactive phytoconstituents, including albrin which is poisonous [12]. This article seeks to provide update on the ethnomedicinal applications, ethnopharmacology, phytochemistry and pharmacology of *Abrus precatorius* toward identification of further research directions, among others.

Table 1: *Abrus species*

***Abrus aureus* R. Vig.**	***Abrus kaokoensis* Swanepoel & H. Kolberg**
Abrus baladensis Thulin	*Abrus schimperi* Baker
Abrus canescens Baker	*Abrus sambiranensis* R.Vig.
Abrus diversifoliatus Breteler	*Abrus pulchellus* Thwaites
Abrus fruticulosus Wight & Arn.	*Abrus precatorius* L.
Abrus gawenensis Thulin	*Abrus parvifolius* (R.Vig.) Verdc.
Abrus laevigatus E.Mey.	*Abrus madagascariensis* R.Vig.
Abrus longibracteatus Labat	*Abrus lusorius* Vell.

Morphological description (botanical description)
Abrus precatorius is an ornamental, twining, woody vine which grows to a height of 10 to 20 feet when supported by other plants. Leaves are alternate, compound, feather-like, pinnately divided, with small oblong leaflets [3]. The branches are greenish yellow in colour. The Flowers are numerous and appear in the leaf axils along the stems. They are small and occur in clusters 1 to 3 inches long, usually red to purple, or occasionally white. The fruit is a legume (pea shaped pod) about 3 cm long containing hard ovoid seeds (shiny, scarlet and black in colour) about 1 cm long. The seeds are red with a black spot covering one end (Figure 1). The root is woody, tortuous and much branched, with a sweet taste, rather like liquorice [13].

Fig 1: Picture of *Abrus precatorius*

Geographical distribution

Abrus precatorius is a plant that originates from Southeast Asia and is native to India. It is found in subtropical areas of the world and in all tropical countries. It grows at altitudes up to 1200 m on the outer Himalayas. It is a common plant in Nigeria [3, 14].

Taxonomic Description

The taxonomic description of *Abrus precatorius* is outlined in Table 2:

Table 2: Taxonomic description of *A. precatorius*

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Subfamily	Faboideae
Tribe	Abreae
Genus	Abrus
Species	*Abrus precatorius* Linn.

Ethnomedicinal uses

All parts of *Abrus precatorius* are used in traditional medicine practice including the dried red-black colored seeds, leaves and roots [15, 16]. The plant is used in traditional medicine to treat scratches, sores and wounds caused by dogs, cats and mice [17] and are also used with other ingredients to treat leucoderma, tetanus and rabies [15]. The leaves are used as nerve tonic [18], applied on cuts and swellings and mouth ulcer [5]. The roots are used for gonorrhea, jaundice and haemoglobinuric bile [15]. The fixed oil extracted from seeds is said to promote the growth of human hair [19]. The seed oil has potent antimicrobial activity [20]. The powdered seeds are also useful in tuberculous painful swellings [16]. The leaves are used for their anti-suppurative properties [6]. In addition, the leaves are often used as a substitute for liquorice and are useful in leucoderma, itching and other skin diseases [21]. The decoction is widely used for cough, cold and colic; Decoction of dried root is used to treat bronchitis and hepatitis [22]. For graying of hair, a paste of leaves and seeds is applied [15]. The juice is employed as a cure for hoarseness; mixed with oil, it can be applied to painful swellings [6]. *A. precatorius* is known to be useful in treatment of schistosomiasis [23].

According to the Nigerian folk medicine, evaporated alcoholic extracts are widely used in vaginal pessaries for abortion [24]. In Ayurvedic medicine, leaves of *A. precatorius* are used for their laxative expectorant and aphrodisiac effect [25] as well as for treatment of stomatitis, conjunctivitis, alopecia, migraine, lymphomas/leukemia [26] and dysmenorhea [14]. Decoction of the leaf is used for the treatment of cough. The root is used as treatment for venereal diseases. Decoction of the whole aerial plant is used for treatment of pneumonia and the powdered seed is sprinkled in the eye at night to treat eye pain (Personal Communication, Muazzam 2016).

Ethnopharmacology

Extracts of *A. precatorius* have been found to possess antibacterial, antifungal [27], anticancer [28], analgesic [29], anti-inflammatory [22, 30], antispasmodic [31], antidiabetic [32, 33], antiserotonergic [34], antimigraine [35], abortifacient [36] and antihelminthic [23].

The water extract of *A. precatorius* seeds administered intraperitoneally to mice was active in sarcomas - antitumor activity [37, 38]. The ethanol extract of leaves of *A. precatorius* showed marked effect on milk-induced leucocytosis and eosinophilia in the management of asthma [39]. Also, the leaf methanol extract produced dose-dependent bronchodilator activity, justifying the use of the plant in asthma [40]. Platelet inhibiting activities attributed to abruquinones had been observed [41, 42]. Other activities include antifertility, decreased sperm motility and altered sperm morphology in epididymis, antiestrogenic [43, 44]; antiepileptic [45]; nephroprotective [46, 47, 48]; immunomodulator, immunostimulatory [49, 50]; insecticidal [51]; antiviral, antidepressant [16, 18]; anti-oxidative [52]; cytotoxic [53]; neuroprotective [54]; diuretic, antimalarial [55], which is attributed to abruquinone, an isoflavanquinone, isolated from the extract of aerial parts [56, 57]. Other pharmacological activities exhibited include antiallergic [39] and anticataract [22, 58].

Phytochemistry

Secondary metabolites present in *A. precatorius* include alkaloids [59], flavonoids/flavones such as luteolin, abrectorin, orientin, isoorientin, and desmethoxycentaviridin-7-O-rutinoside [60], triterpene glycosides, saponins, steroids and other terpenoids, fixed oil carbohydrate, protein, tannins, anthocyanins and amino acids. The plant roots and leaves contain sweet-tasting glycyrrhizin as a major phytoconstituent [61].

Other phytoconstituents unique to *Abrus precatorius* are sweet-tasting abrusoside A to D and abrusogenin, a triterpene [62] isolated from an n-butanol soluble extract of the leaves, as well as abrus agglutinin, isoflavanquinones including abruquinones D, E and F.

Abrin

Abrin, the toxic principle, is a mixture of at least five lectins, abrin A - D, and abrus-agglutinin. The abrins consist of two peptide chains connected by a disulfide bridge. Abrin A consists of an A-chain with N-glycosidase activity, which inhibits protein synthesis, and lectin-like B-chain responsible for binding with cell-surface receptors and penetration of abrin-A molecule into the cell. The relative molecular weights of abrin A-C are around 64.000, that of two agglutinins 128.000 [63].

Triterpenoids

Abrusosides A to D and Four Novel sweet triterpene Glycosides In addition to abrusoside A, abrusosides B, C, and D, three further sweet glycosides based on the novel cycloartane-type aglycone, abrusogenin, were isolated from an n-butanol soluble extract of the leaves of Abrus precatorius. Also, the dichloromethane extract of the pericarp of *Abrus precatorius* afforded abrusogenin [62, 64].

Flavonoids and Anthocyanins

Flavonoids have been isolated from the seeds. From the aerial parts of *A. precatorius* two isoflavanqinones were extracted with dichloromethane. From the roots *of A.precatorius* five isoflavanquinones were extracted by methanol and separated by partition chromatography on a silica gel column. Three of them were new and were designated as abruquinones D, E, and F. Anthocyanins (eg abrectorin and delphinidin) are also present in the seeds [57].

Alkaloids

The hydroalcoholic extract of seeds of *Albrus precatorius* was found to contain Precatorine, trigonelline, choline and abrine [65].

Carbohydrates and amino acids

Seeds are rich in several essential amino acids like serine, alanine, valine, choline and methyl ester [66]; carbohydrates such as galactose, arabinose, and xylose are present in the aerial parts [6].

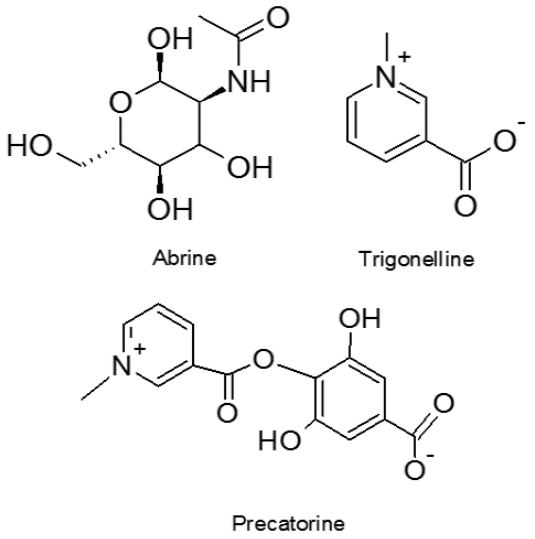

Fig 2: Chemical structures of alkaloids present in *Abrus precatorius*

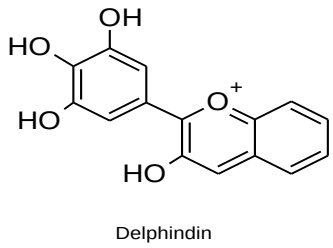

Fig 3: Chemical structure of anthocyanidin present in *Abrus precatorius*

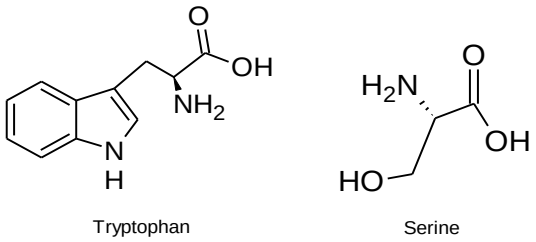

Fig 4: Chemical structures of Amino acids present in *Abrus precatorius*

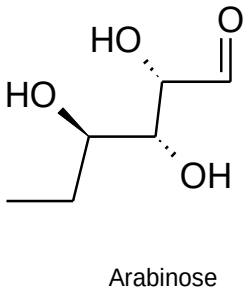

Fig 5: Chemical structure of sugar present in *Abrus precatorius*

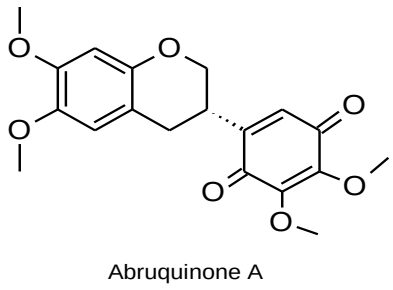

Fig 6: Chemical structure of isoflavanquinone present in *Abrus precatorius*

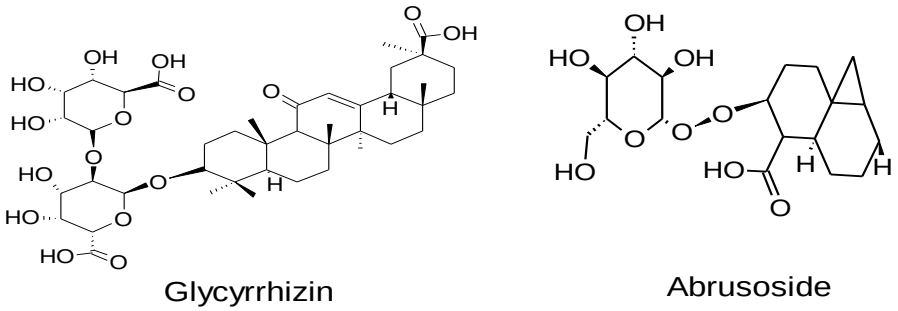

Fig 7: Chemical structure of triterpenoids present in *Abrus precatorius*

Table 3: Phytochemical constituents present in the different parts of *Abrus precatorius*

Plant part	Phytochemicals present	Reference
Leaves	abrin, abruslactone A, abrusoside A, *abrusoside* C, abrusoside D, hemiphloin, abrusoside, arabinose, galactose, xylose, choline, hypaphorin, *precatorine*, glycyrrhizin, montanyl alcohol, inositol, D-monomethyl ether, pinitol	[63] Sujit *et al*, 2012; [64] Karawya, 1981 [62] Ragasa *et al*, 2013 [65] Chang *et al*, 1983 [66] Paul *et al*, 2013 [8] Kennelly *et al*, 1996
Root	*abrol, abrasine*, precol, protein, abraline, abricin, abrusogenic acid, abrusogenic acid methyl-ester, abrus lactone, abrussic acid, anthocyanins, calcium, campesterol, cycloartenol, delphindin, gallic acid, trigonelline, hypaphorine, choline, N,N-dimethyltryptophan, N,N-dimethyltryptophan-metho-cation-methylester, ρ-coumaroylglucodelphindin, pectin, pentosans, phosphorus, precatorine, polygalacturonic acids, polysaccharides, quinones, abruqinones A,B,C,D,E,F, O,G, arabinose, galactose, xylose, glycyrrhizin, oleanolic acid, 7,5-dihydroxy-6,49-dimethoxyisoflavan-7-O-D-galactopyranoside	[67] Ali and Malek, 1966; [68] Choi *et al*, 1989 [69] Khaleqe *et al*, 1966 [70] Saxena *et al*, 1999
Seeds	Essential amino acids like serine, alanine, valine, abrusin, abrusin-2'-0-apioside, hederagenin, abrusgenic-acid, abrusgenic-acid-methyl-ester, dimethoxycentaureidin-7-0-rutinoside, Abruslactone, abrisapogenol, β-amyrin, abrin, abrussic-acid, anthocyanins, calcium, campesterol, choline, cycloartenol, delphinidin, gallic-acid, glycyrrhizin, hypaphorine, N, N-dimethyl-tryptophan, N,N-dimethyl-tryptophan-metho-cation-methyl-ester, ρ-coumaroylgalloyl glucodelphinidin, pectin, pentosans, picatorine, polygalacturonic-acids, precasine, precatorine and protein trigonelline, magnesium, sodium, potassium, phosphorus, manganese, zinc, iron, copper, cellulose and muscilase	[71] Mohan and Janardhanan, 1995; [72] Rajaram and Janardhanan, 1992 [73] Lefar *et al*, 1968

Pharmacological activities

Antimicrobial activity

The anti-microbial effects of *Abrus precatorius* extracts from leaves, stem and the seed oil were evaluated against some microorganisms namely *Staphylococcus aureus, Staphylococcus epidermidis, Enterococcus faecalis, Streptococcus anginosus, Bacillus subtilis, Corynebacterium spp Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, Pseudomonas aeruginosa* and *Candida albicans* using the agar well diffusion technique. Among these, *Staphylococcus aureus* was the most sensitive organism with an MIC of 8µg/ml for the leaf extract. Extract from the stem and seed oil were potent against some of the gram-positive bacteria and *Candida albicans* but not against *S. anginosus*, *E. faecalis* and some gram-negative bacteria [20]. The presence of flavonoids, alkaloids and saponins in the methanolic extract may be responsible for the antibacterial and antifungal activity [27]. Antimicrobial activity of *Abrus precatorius* seed methanol extract was investigated against ten bacterial species. The extract exhibited antibacterial activity towards almost all the bacterial microorganisms [76].

Antioxidant activity

An ethanol seed extract of *Abrus precatorius* was evaluated for antioxidant activity. The extract possessed potent antioxidant activity in different enzymes levels when compared with reference compound butylated hydroxytoluene (BHT) [52].

Antidiabetic and antiglycation effect

Chloroform- methanol extract of seeds of *Abrus precatorius* produce antidiabetic effect in alloxan-induced diabetic in rabbits [32]. Ethanol-water extract of the aerial parts of *A. precatorius* at a dose of 250 mg/kg was shown to reduce 30% blood sugar level in rabbit model [77].

Hepatoprotective activity

The hydroalcoholic extract of *Abrus precatorius* (100 and 200 mg/kg) was administered orally to rats with hepatotoxicity induced by paracetamol (3 g/kg). Silymarin (25 mg/kg) was given as reference standard. All the test drugs were administered orally. Results showed that the extract possessed hepatoprotective activity as there was significant reduction in serum enzymes alanine aminotransferase (ALT), aspartate amminotransferase (AST), alkaline phosphatase (ALP) and bilirubin [65].

Toxicity

Abrus precatorius seeds contain abrin, one of the most potent toxins known to man. However, because of the seed's outer hard coat the vast majority of ingestions cause only mild symptoms and typically results in complete recovery. If the seeds are crushed and then ingested, more serious toxicity, including death, can occur [12]. The unripe seed has a soft and easily broken seed coat and is very harmful due to its abrin content. It has been reported that poisoning has been experienced through a finger prick when stringing the seed. Symptoms may develop after a few hours to several days after ingestion. They include severe gastroenteritis with pronounced nausea and vomiting. Mydriasis will occur, as well, as muscular weakness, tachycardia, cold sweat, and trembling. There is no known physiological antidote. The treatment is essentially symptomatic. Since there is a long latent period associated with abrin poisoning, little value can be placed on induction of emesis or gastric lavage; these measures are useful only if ingestion has just occurred. Bismuth trisilicate may be given during poisoning by *A. precatorius* to reduce the degree of gastrointestinal damage. If the emesis and/or diarrhea become excessive, replacement fluids and electrolytes are advocated [3]. If hemorrhage occurs, blood transfusion may be necessary.

Antiinflammatory and healing of wound

Abrus precatorius is known to possess antiseptic and antiinflammatory activity, which makes it useful in treatment of wounds. In a study, different concentrations of ethanolic extracts of *A. precatorius* stem were investigated for evaluation of wound healing activity in rats. Results demonstrated the potential of *A. precatorius* in accelerating the wound healing process using excision wound model. The ethanolic extract applied in the form of ointment showed significant reduction in epithelization period and wound contraction time, which can be due to several effects, direct or indirect [41].

Antimalarial activity

Antiplasmodial activity assessment of *Abrus precatorius* extract

presented an IC 50 value below 20 g/ml. abruquinone, isolated from the extract of aerial parts, was found to exhibit the antimalarial activity [57].

Conclusion

Abrus precatorius has been explored exhaustively for its ethnomedicinal, phytochemical, pharmacological, and ethnopharmacological applications. From the foregoing, it is evident that *Abrus precatorius* has been used ethnomedicinally as a valuable therapeutic agent for a variety of diseases. Myriads of phytocompounds found in this plant are responsible for its pharmacological activities. However numerous therapeutic claims have been reported as the plant is gaining widespread popularity in terms of traditional medicinal uses. Therefore more investigations are proposed to validate these claims and even identify new bioactive components with potential therapeutic benefits.

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