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Review Article

## *Abrus precatorius*: A comprehensive insight into the phytochemical, pharmacological, therapeutic activities and safety

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### Abstract

*Abrus precatorius* L., belonging to the family of Fabaceae is one of the potential herbal plants to be used as natural medicine. *A. precatorius* is capable of growing in tropical and subtropical areas of the world. The leaves of *A. precatorius* contain pinitol, triterpene glycosides, glycyrrhizin, and alkaloids. The leaves of *A. precatorius* can also treat leukoderma, skin diseases, itching, eye pain, and wounds. The seeds of *A. precatorius* contain flavonoids, steroids, alkaloids, anthocyanins, lectins, and fixed oils and can treat skin diseases, ulcers, and nervous system disorders. The roots of *A. precatorius* contain glycyrrhizin and alkaloid compounds and are able to treat rheumatism, alexiteric, sore throat, and vomiting. *A. precatorius* shows several therapeutic activities such as antimicrobial, anti-helminthics, antimalarial, antifungal, nephroprotective, immunomodulatory, neuromuscular, antidiabetic, anti-inflammatory, antifertility, antiserotonergic, antidiarrheal, antitumor, antispasmodic, and memory enhancing properties. Inappropriate dose of *A. precatorius* will cause toxic effects. Thus *A. precatorius* can be a good potential herbal plant to be used as a natural medicine.

**Keywords:** *Abrus precatorius*, Fabaceae, Medicine, Pharmacology, Phytochemistry.

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## Introduction

Since the beginning of human civilization, herbal plants have often been used to cure various diseases <sup>1-3</sup>. Herbal plants have been an ancient tradition much older than contemporary pharmacology, medicine, and chemistry <sup>4,5</sup>. The World Health Organization reported that around 75% of the world's population still uses medicinal methods derived from herbal plants <sup>6</sup>. In addition, medicines from herbal plants are widely used because they are cheaper, safer, and have various pharmacological activities <sup>7-9</sup>.

*A. precatorius*, a plant belonging to the Fabaceae family, has good potential to be used as herbal medicine <sup>10</sup>. This plant is commonly known as Indian licorice, Crab's eye, Jequirity, and Rosary pea. This plant is known as Gunja in Sanskrit and Ratti in Hindi <sup>11</sup>. *A. precatorius* is native to India; however, it can be found in all tropical and sub-tropical regions around the world <sup>12</sup>.

*A. precatorius* was first described as a medicinal plant by William Boericke in the Homoeopathic Materia Medica entitled Jequirity <sup>13</sup>. This plant is traditionally used to treat cuts, wounds from animal bites, and several other diseases such as rabies, tetanus, and leucoderma <sup>14</sup>. This plant is also effective in treating dysentery and diarrhea <sup>15</sup>. In addition, this plant also shows efficacy as a tonic, aphrodisiac, emetic, and laxative <sup>11</sup>. *A. precatorius* is believed to have various pharmacological activities such as antibacterial, antihelminthic, antidiabetic, and antitumor <sup>13</sup>.

Given the efficacious of the *A. precatorius* plant as a medicinal plant, this review offers a comprehensive insight into the phytochemical, pharmacological, therapeutic activities, and safety of *A. precatorius*, and demonstrates that it can be used as a reliable source for preparation of new drugs.

## Origin Names

This plant in Indonesia is called Saga or Weglis; in Philippines Jequirity; in Nepal Rati gedi or Crab's eye; in Egypt Rosary pea; in Pakistan Gunchi; in USA Precatory bean<sup>10</sup>.

## Taxonomy

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Fabales

Family: Fabaceae

Genus: Abrus

Species: *Abrus precatorius* L.<sup>16</sup>

## Plant description

*A. precatorius* is a twisted woody vine capable of growing up to 6 meters. The leaves resemble feathers, compound, alternate, pinnate with small oval leaflets. The branches are greenish-yellow. The flowers are abundant and appear in the leaf axils along the stem. The flowers are small and clustered with a length of 3 cm to 8 cm. The flowers are white or purple. The fruits have a nut-like shape with a length of about 3 cm containing hard ovoid shiny seed in black, dark red, with a length of about 1 cm. The seeds are red with a black spot covering one end. The roots are tortuous and branched<sup>17</sup>. The morphology of *A. precatorius* can be seen in Figure 1.



**Figure 1:** *Abrus precatorius* L.<sup>18</sup>

## Geographical distribution

*A. precatorius* grows in tropical and subtropical areas of the world. The plant can be found in China, India, South Africa, and Brazil, and commonly found throughout the plains of India, from the Himalayas to South India and Ceylon. This plant is able to grow at an altitude of 1200 m in the Himalayas<sup>11</sup>. In addition, it is also widely cultivated in Nigeria and Southeast Asian countries<sup>19</sup>.

## Phytochemistry

The phytochemical content of the parts of *A. precatorius* plant are as follows:

### Leaves

*A. precatorius* leaves contain pinitol, triterpene glycosides, glycyrrhizin up to 10%, and alkaloids such as hepaphotine, precatorine, abrine, choline<sup>11</sup>. Triterpene glycosides consist of abusosides A, B, C, and tree glycosides based on abrutigenin and cycloartane type aglycones<sup>20</sup>. Other active compounds found in *A. precatorius* leaves are abruslactone A, triterpenes abrusgenic acid, methyl abrusgenate,

liquirtiginin-7-diglycosides, liquirtiginin-7-monoglycosides, toxifolin-3-glucoside, and the flavonoid vitexin<sup>21</sup>.

### Seeds

*A. precatorius* seeds contain carbohydrates (42.42%), fat (3.92%), ash (5.38%), moisture (5.06%), crude protein (39.20%), and crude fiber (9.08%)<sup>22</sup>. The active compounds found in the seeds of *A. precatorius* are flavonoids, steroids, alkaloids, anthocyanins, lectins, and fixed oils<sup>23</sup>. Alkaloids from the seeds of *A. precatorius* contain choline, hepaphotine, precatorine, and abrine<sup>11</sup>. *A. precatorius* seed oil contains a lot of linoleic acid and oleic acid<sup>24</sup>. Steroids from the seeds of *A. precatorius* contain stigmasterol, -sitosterol, abricin, 5 $\beta$ -cholanic acid, cholesterol, and linoleic<sup>25</sup>. The red color of *A. precatorius* seeds is due to the presence of pelargonidin, delphinidin, abranin glycosides, and cyanide<sup>26</sup>. Several other compounds such as sophoradiol, sapogenol, hederagenin methyl ether, abrisapogenol J, kaikasaponin III methyl ester, flavones such as aknone and abrectorin are other major constituents of *A. precatorius* seeds<sup>27</sup>. The main constituents of *A. precatorius* seeds are lectins and abrins. Lectins are toxic (abrin) and non-toxic (abrus agglutinin). Abrin is denoted by abrin a, b, c, and d consisting a large  $\beta$ -polypeptide chain and a short polypeptide chain linked by disulfide bonds<sup>28</sup>.

### Root

The roots of *A. precatorius* contain glycyrrhizin compounds and alkaloids such as precasine and abrasives in addition to abrine and related bases<sup>29</sup>.

## Medicinal benefits

The medical benefits of parts of the *A. precatorius* plant are as follows:

### Leaves

The leaves of *A. precatorius* can be used as a tonic and aphrodisiac. The leaves of *A. precatorius* can also be used to treat leucoderma, skin diseases, itching, eye diseases, and wounds<sup>26</sup>. In addition, the leaves of *A. precatorius* are also efficacious to treat stomatitis, asthma, dental caries, migraine, fever, and tuberculosis<sup>30</sup>. *A. precatorius* leaves soaked in warm oil are applied to the surface of the skin, experiencing rheumatic pain<sup>26</sup>. *A. precatorius* leaves juice mixed with oil can be applied over a bloating stomach<sup>31</sup>. *A. precatorius* leaves powder mixed with sugar are used to treat menorrhagia and leucoderma<sup>32</sup>. *A. precatorius* leaves can also be used to treat gastritis, diarrhea, insomnia, cancer, kidney disease, and heart disease<sup>33</sup>.

### Seeds

*A. precatorius* seeds can be used to treat skin diseases, ulcers, and nervous system disorders<sup>34</sup>. *A. precatorius* seeds that are processed into a paste can be applied to the skin to treat shoulder joint stiffness, sciatica, bruises, and paralysis<sup>35</sup>. Seeds of *A. precatorius* can be used as a laxative, but it should be noted that in large doses, it will be toxic and cause cholera-like symptoms<sup>36</sup>. *A. precatorius* seeds can also be used as a natural contraceptive<sup>37</sup>.

### Root

*A. precatorius* roots can be used to treat rheumatism, alexiteria, laryngitis, and vomiting<sup>38</sup>. *A. precatorius* root extract can be used to treat coughs<sup>10</sup>. In addition, the root can also be used to treat cancer, gastritis, diarrhea, insomnia, kidney disease, and heart disease<sup>39</sup>. *A. precatorius* roots has its own uses in treating jaundice, gonorrhea, and other infections<sup>32</sup>.

## Traditional uses

*A. precatorius* has anti-suppurative properties; the *A. precatorius* plant ground with lime can be used to treat acne and abscesses<sup>10</sup>. Oral decoction of *A. precatorius* leaves can cure colds and coughs<sup>26</sup>. The root of *A. precatorius* is useful for treating hemoglobinuric bile and jaundice<sup>11</sup>. The root paste can be used to cure stomach aches, prevent abortion, and recover from tumors<sup>30</sup>. The roots of *A. precatorius* powder mixed with pure butter can be utilized to cure coughs<sup>26</sup>. The roots of *A. precatorius* can be utilized as medicine from snake bites by chewing<sup>40</sup>. *A. precatorius* roots extract in hot water can be given orally to use as an anticonvulsant and anti-malarial<sup>41</sup>. In addition, the liquid broth from the dried root of *A. precatorius* taken orally is efficacious for the treatment of bronchitis and hepatitis<sup>42</sup>. A paste of *A. precatorius* leaves and seeds can be rubbed on the head for gray hair<sup>11</sup>. Dry seeds of *A. precatorius* that are ground into a powder can be given orally to cure worm infestations in the digestive tract<sup>26</sup>.

The bright red color of *A. precatorius* seeds attracts children's attention, so there are cases when children in rural areas who do not have knowledge of the *A. precatorius* plant eat its seeds which are poisonous when consumed<sup>43</sup>. Boiled *A. precatorius* seeds are often eaten by residents in several parts of India<sup>44,45</sup>. *A. precatorius* seeds also have several active compounds that are a source of insecticides and antimicrobials<sup>46</sup>. *A. precatorius* is considered a diuretic, expectorant, antidote, laxative, febrifuge, anodyne, aphrodisiac, hemostat, refrigerant, vermifuge, antimicrobial, emollient, vomiting reliever, sedative, laxative, and abortifacient<sup>47,48</sup>. In addition, *A. precatorius* is also used to cure blennorrhoea, cancer, colic, seizures, diarrhea, diabetes, night blindness, snake bites, conjunctivitis, fever, rheumatism, jaundice, gonorrhoea, headaches, ulcers, gastritis, ophthalmia, malaria, and chronic nephritis<sup>49</sup>. Soaked in hot water, *A. precatorius* seed extract can be taken orally to treat malaria<sup>26</sup>. Dry *A. precatorius* seed powder is used by various African ethnic groups as a natural contraceptive<sup>11</sup>. In addition, *A. precatorius* seeds can also be used to treat tuberculosis and painful swelling<sup>50</sup>.

## Some of therapeutic uses

*A. precatorius* has many therapeutic activities as listed in below:

### Antimicrobial activity

The antimicrobial activity of the leaf, stem, and seed oil extracts of *A. precatorius* is quite effective in inhibiting the growth of several bacteria such as *Klebsiella pneumonia*, *Bacillus subtilis*, *Corynebacterium spp*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Streptococcus windosus*, *Staphylococcus epidermidis*, and *Escherichia coli* through agar well diffusion techniques. *A. precatorius* roots extract also showed antimicrobial activity on various types of bacteria tested. Different solvent concentrations or fractions showed inhibitory activity against thirteen gram-positive and gram-negative bacteria. Through bioautography tests, it has been established that the antimicrobial activity of the *A. precatorius* extract is localized to specific chromatophores in the chloroform fraction<sup>51</sup>.

### Antihelmintic activity

The aqueous extracts of the roots and stems of *A. precatorius* were observed for their antihelmintic activities against schistosomes and cestodes. The aqueous extract of *A. precatorius* root indicated lethal antihelmintic activity combating cestodes at a concentration of 103 mg/ml.

Meanwhile, aqueous extract of *A. precatorius* root at a concentration of 0.6 mg/ml and aqueous extract of *A. precatorius* stem at a dose of 1.5 mg/ml showed lethal antihelmintic activity against schistosomes. Tannins, steroids, terpenes, flavonoids, and alkaloids from *A. precatorius* may play a role in this antihelmintic activity<sup>52</sup>.

### Antimalarial activity

Isoflavaquinone-abruquinone compound isolated from *A. precatorius* extract showed antimalarial activity. Assessment of antimalarial activity was then carried out based on cytotoxicity and antiplasmodial activity. Cytotoxicity activity was evaluated in melanoma cells (A375), whereas antiplasmodial activity was evaluated by micro-radioactive methods. The assay of the *A. precatorius* extract was carried out at three diverse times in triplicate in 96-plate culture with the culture mostly at the ring stage at 0.5-1% parasitemia. *A. precatorius* extract showed IC<sub>50</sub> values below 20 g / ml<sup>53</sup>.

### Antifungal activity

Dry *A. precatorius* seed extract at a concentration of 1% effectively inhibited the growth of *Cryptococcus neoformans*<sup>54</sup>.

### Nephroprotective activity

The evaluation of the nephroprotective activity of the aqueous extract of the stem of *A. precatorius* was carried out to specify the restoring effect of acetaminophen and cisplatin-induced nephrotoxicity. The restoring effect of *A. precatorius* on HEK 293 cells damaged by acetaminophen and cisplatin was evaluated by the mitochondrial activity assay of MTS. The test results indicated that the water extract of the *A. precatorius* stem had the best recovery effect and could be utilized for the prevention or medication of kidney distraction<sup>55,56</sup>.

### Immunomodulatory activity

Abrus agglutinin is one of the compounds dissociated from the seed extract of *A. precatorius*. This compound is similar to ML-1 with regard to the specificity of carbohydrates [gal (β1 → 3) gal / Nac], observed both in native (NA) and heat denatured (HDA) conditions for NK cell activation, cytokine secretion, murine splenocyte proliferation, and thymocyte proliferation in vitro with the aim of assessing its potential as an immunomodulator. HDA and NA activated splenocytes and induced the production of cytokines such as IFN-γ, IL-2, TNF-α, and TNF-β, which could exhibit a type of Th1 immune response. Native agglutinin abrasive and HDA-induced conditioned media of adherent splenocytes can stimulate non-adherent splenocytes and vice versa. Heat denatured abrasive agglutinin and induced NK cell activation at a much lower concentration than NA concentration, but the rate of NK cell activation was higher for NA. Thymocyte proliferation by HDA and NA was also evaluated. This study showed that Abrus agglutinin could be a potential immunomodulator in the original form as well as in the hot form<sup>57,58</sup>.

### Neuromuscular activity

The neuromuscular activity of the ethanol extract of *A. precatorius* leaves was evaluated using isolated frog abdominal rectus muscles and phrenic nerve-diaphragm muscle preparations of rats and chicks. Ethanol extract of *A. precatorius* leaves hampered acetylcholine-induced contraction in rectus abdominis toad and rat phrenic nerve diaphragm muscle preparations. The effect depended on the dose of the ethanol extract of *A. precatorius* leaves. In



addition, the ethanolic extract of *A. precatorius* leaves caused paralysis when injected intravenously into chicks and had no effect on direct electrical stimulation of the diaphragms of mice. The inhibitory effect on the diaphragm preparation of rat phrenic nerves from ethanol extract of *A. precatorius* leaves is strengthened in the presence of increased magnesium ions, reduced calcium ions, or decreased potassium ions. Thus, the ethanolic extract of *A. precatorius* leaves shows similarity to D-tubocurarine chloride in terms of the neuromuscular block pattern. Neither the petroleum ether nor the aqueous extract of the leaves of *A. precatorius* showed any significant changes in the skeletal muscle used in this study. Therefore, the nerve toxic component of *A. precatorius* leaves is particularly in the ethanol extract of *A. precatorius* <sup>59</sup>.

### Antidiabetic activity

An ethnobotany survey in five districts of the Nigerian state of Lagos was carried out by filling out a well-known semi-structured questionnaire for diabetes treatment <sup>60,61</sup>. In the survey, about 100 people answered, most of the respondents came from the Yoruba tribe <sup>62</sup>. About half of the respondents had 20-30 years of experience in medicating diabetes by utilizing herbal plants (96%) without conventional treatment for diabetes. Among them, most of the men (76%) had knowledge of traditional diabetes treatment. They also developed an effective and easily recognizable diagnostic tool for diabetes. In the survey, fifty multi-component herbal recipes were covered, consisting mostly of liquid preparations. The drug in liquid form was often given orally without showing any serious side effects (92%). The main antidiabetic plants <sup>63</sup> include *A. precatorius*, *Blighia sapida*, and *Alchornea cordifolia*. The leaves of these plants must be well squeezed in water until they release the juice, then the decoction can be used as a treatment for diabetes by using it as an infusion <sup>64</sup>.

### Anti-inflammatory activity

Two triterpenoid compounds, namely saponin 1 and saponin 2, and their derivatives namely acetate 3 and acetate 4 isolated from the *A. precatorius* plant were evaluated for their anti-inflammatory activity utilizing the croton oil ear model. The ear tissue parts of mice treated with anti-inflammatory agents were compared with the test treatment group. The results showed reduced inflammation in the ears of the mice tested. Triterpenoid compounds from *A. precatorius* showed anti-inflammatory activity but acetate indicated greater inhibition at concentrations of 300 µg and 600 µg. The acetate derivative of triterpenoid compounds was more effective at a concentration of 600 µg among all test treatment groups <sup>65</sup>.

### Antifertility activity

Evaluation of the antifertility activity of *A. precatorius* seed extract managed intraperitoneally to adult male albino mice BALB/c strain on the integrity of spermatozoa DNA and sperm production. Daily sperm production was measured by calculating testicular spermatids in the Horwell chamber while DNA decay to epididymal spermatozoa was specified by comet test within 20 days of the experimental procedure. The administration of ethanol seed extract of *A. precatorius* (20 and 60 mg/kg) intraperitoneally caused a very significant mitigation in daily sperm production. Reversal in sperm production was monitored in all medicated animals after 20 days of therapy interruption. Similarly, a very significant increase in DNA damage was monitored in all medicated mice and no significant reversibility in DNA damage was monitored during the therapy period. This

study proved that *precatorius* seed extract acted as an anti-fertility or contraceptive agent with a risk of DNA decay to spermatozoa and could cause teratogenic effects <sup>66</sup>.

### Antiserotonergic activity

The antiserotonergic activity of the ethyl acetate extract of *A. precatorius* leaves was examined on frog fundus strips utilizing sumatriptan as the standard drug. The ethyl acetate extract of *A. precatorius* leaves was effective in treating migraine headaches. The leaves of *A. precatorius* on soxhlet extraction with ethyl acetate showed the appearance of protein, saponins, amino acids, carbohydrates, tannins, alkaloids, as well as antiserotonergic activity on the frog fundus strips, which were shown (Graded dose response) compared to sumatriptan as a standard drug <sup>67</sup>. In another research, the anti-migraine activity of *A. precatorius* was demonstrated using fundus muscle preparations of Wister albino mice and male frogs using a Sherrington rotating drum. The muscle contraction influence of crude ethyl acetate and petroleum ether *A. precatorius* extract was carried out on both muscle preparations <sup>68</sup>.

### Antidiarrheal activity

Dry seed chromatography fraction of *A. precatorius* (10 mg/kg) was administered intragastrically to castor oil induced rats. This chromatographic fraction showed significant antidiarrheal activity <sup>69</sup>.

### Antitumor activity

Ethanol extract of *A. precatorius* leaves given intraperitoneally to mice showed inactive results in Sarcoma 180 (ASC) AP074 <sup>70</sup>. Aqueous extract of *A. precatorius* seeds administered intraperitoneally to mice showed active results in Sarcoma (Yoshida solid and ASC) <sup>71</sup>. Aqueous extract of *A. precatorius* seeds given subcutaneously to mice indicated inactive results in Sarcoma (Yoshida ASC) AP012 <sup>72</sup>.

### Antispasmodic activity

The chromatographic fraction of *A. precatorius* seeds at a dose of 0.2 mg/ml given to epinephrine-induced mice actively affected ACh-, PGE-2-, oxytocin- and epinephrine-induced contractions <sup>73</sup>.

### Memory enhancer activity

The therapeutic potential of *A. precatorius* has been studied in a model of Alzheimer's illness by identifying glycochemical microglial cell activation (MGC) in autaptic brain samples. *A. precatorius* agglutinin confers MGC in the white matter of the brain, which exhibits stem-like cells and appears very dense in the proximal region of oligodendroglial cells. Lectin compounds from the *A. precatorius* plant have been studied to identify histochemically the activation of microglia cells in autaptic brain samples from Alzheimer's illness subjects <sup>10</sup>.

### Toxicological

Although *A. precatorius* has many therapeutic properties, it should be noted that inaccurate dosage or intake can lead to life-threatening toxicity <sup>74</sup>. *A. precatorius* seeds could cause toxic effects at doses of 90 to 120 mg <sup>75</sup>. In addition, *A. precatorius* seeds contain abrin, which in doses of 0.0001 to 0.0002 mg/kg could be a natural poison <sup>76</sup>. The poisoning effects of ingested *A. precatorius* seeds can influence the kidneys, gastrointestinal tract, spleen, lymphatic and liver system <sup>77</sup>. Exposure to *A. precatorius* seed extract causes conjunctivitis, eye damage, and blindness <sup>78</sup>. Another symptom of poisoning is acute gastroenteritis with vomiting,

nausea and diarrhea leading to shock, seizures, and dehydration <sup>79</sup>.

## Conclusion

*A. precatorius* is a potential herbal plant that is good for use as a natural medicine. The stems, seeds, and roots of the *A. precatorius* plant each has their own traditional uses. In addition, the use of *A. precatorius* with an incorrect dose will cause toxic effects.

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