



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPA S)**
'A Bridge Between Laboratory and Reader'

www.ijbpas.com

PHYTOPHARMACOLOGICAL REVIEW ON ANTICANCER ACTIVITY OF *ABRUS PRECATORIUS*

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Received 24th Oct. 2024; Revised 19th Dec. 2024; Accepted 18th Feb. 2025; Available online 1st March 2026

<https://doi.org/10.31032/IJBPA S/2026/15.3.9764>

ABSTRACT

Abrus precatorius L. is spread widely across the Himalayas to Southern India and Ceylon. Each part of the plant has different medicinal purposes. A thorough search of the literature was done to find scientific research that had been published in electronic databases. More than 200 scientific publications from different global resources, such as Scopus, Google Scholar, and PubMed, were searched using the following keywords: "*Abrus precatorius*", "chemical composition", "pharmacological effects," and "anti-cancer." The main activities linked to the seed include antioxidant, antiplatelet, and anticancer. The plant has been shown to include a wide range of phytochemicals with varying therapeutic effects on the body. Moreover, the plant has drawn interest as an anti-cancer drug because of its unique characteristic of lectin, which results from varying glycosylation on the cell surface linked to invasion, metastasis, and malignancy.

Keywords: *Abrus precatorius*, abrin, abrectorin, anti-cancer, aknone, in vitro tests, in vivo screening

INTRODUCTION

In recent years, several strategies have been explored to fight cancer in addition to surgery, radiotherapy, and chemotherapy. It is well known that the onset of most types of cancer is preventable through a healthy

lifestyle, avoiding smoking and alcohol, and maintaining a healthy weight and diet. This type of strategy is defined as "best buy" and prevents and manages cancer and other non-communicable diseases [1].

Conversely, unhealthy lifestyles, including exposure to tobacco smoke, alcohol consumption, high body mass index (BMI), physical inactivity, and poor dietary customs, are linked to an increased risk of cancer. Current evidence shows that a change in behaviour in relation to modifiable risk factors, such as diet, large numbers of cancer cases can be prevented [2, 3].

Though several synthetic medicines are useful in treating cancer, they are inefficient and unsafe. However, plants have been proven to be useful against cancer. Moreover, natural compounds from plants and their derivatives are safe and effective in the treatment and management of several types of cancer [3].

The anticancer plants such as *Catharanthus roseus* [4], *Podophyllum peltatum* [5], *Taxus brevifolia* [6], *Camptotheca acuminata* [7], *Andrographis paniculata* [8], *Crateva nurvala* [9], *Croton tonkinensis*, *Oplopanax horridus* [10], *Abrus precatorius* [11, 12] etc., are an important source of chemotherapeutic compounds. These plants have proven their significance in the treatment of cancer and various other infectious diseases. Nowadays, several well-known anticancer compounds such as Taxol, podophyllotoxins, camptothecin, vinblastine, vincristine, homoharringtonine, etc. have been isolated and purified from

these medicinal plants. Many of them are used effectively to combat cancer and other related diseases [11].

Medicinal plants may be a valuable source of chemicals that have not yet been discovered but may have therapeutic applications. Popularly known as Gunja or Jequirity, *Abrus precatorius* L. is widely distributed across the plains of India, extending from the Himalayas to Southern India and Ceylon [13]. This plant has medicinal potential to cure various diseases. The roots, leaves, and seeds of *Abrus precatorius* are used for medicinal purposes. It contains flavonoids, triterpene glycosides, abrin, and alkaloids. Ayurveda recommends the administration of the *Abrus precatorius* in diseases like alopecia, oedema, helminths, skin diseases, itching, urinary disorders, and antifertility [14].

There are several portions of the *Abrus precatorius* plant that may be employed, and each component has a unique source of chemical elements with varying therapeutic effects on the body. The fruit, leaf, and root of the *Abrus* plant contain various chemical elements that can be used to investigate the potential biological impacts of various treatments for various illnesses [3].

In Ayurvedic medicine, the leaves of *A. precatorius* are laxative, expectorant, and aphrodisiac medicines and are used in urticaria, eczema, stomatitis, conjunctivitis, alopecia areata, migraine, lymphomas,

leukemia, and dysmenorrhoea [15]. Leaves and seeds are nutritious as boiled seeds are eaten in certain parts of India. It is said that cooking destroys the poison of seeds. Seeds have uniform weight of 1/10th of a gram, hence used as a weighing unit [16].

Abrus precatorius has been shown to include a wide range of phytochemicals with a wide range of pharmacological effects. It has been demonstrated that several phytochemicals from the leaves of *A. precatorius* can trigger apoptosis on diverse types of cells, the plant has drawn interest for possible anti-cancer activity [16].

Methods:

A thorough search of literature was done to find scientific research articles that had been published in electronic databases. More than

200 scientific publications from different global resources, such as Scopus, Google Scholar, and PubMed were explored using the following keywords: “*Abrus precatorius*”, chemical composition, "pharmacological effects," and "anti-cancer."

Results

Abrus precatorius - Plant profile:

This climbing plant is part of the *Abrus* genus in the Leguminosae family and is widely distributed over China, India, and Nigeria.

It is a lovely, multi-branched, slender, perennial, deciduous, thorny climbing herb. (Figure 1). The synonyms and taxonomical profile [17] of *Abrus precatorius* were given in Table 1.



Figure 1



Figure 2

Table 1: Taxonomical classification

Kingdom	Plantae
Phylum	Tracheophyta
Class	Magnoliopsida
Order	Fabales
Family	Fabaceae
Genus	<i>Abrus</i>
Species	<i>precatorius</i>
Synonyms	<i>Abrus precatorius</i> L., <i>Abrus acutifolius</i> Blume ex Miq., <i>Abrus precatorius</i> L. var. <i>villosula</i> Miq., <i>Abrus schimperi</i> Baker, <i>Abrus schimperi</i> Baker subsp. <i>africanus</i> (Vatke) Verdc., <i>Abrus schimperi</i> Baker subsp. <i>oblongus</i> Verdc., <i>Hoepfneria africana</i> Vatke [18]

Possessing young branches that are primarily greenish-yellow, this deciduous climber can reach heights up to 4.5 meters and a diameter of 1.2 centimetres. It has robust, slender, and flexible branches. Leaflets are typically 9–12 pairs, linear or linear-oblong, 2 – 2.4 cm tall and 0.5 cm wide, whole, rounded ends, glabrous on top and, stipules deciduous. Leaves are of 5–12 cm long, pinnate, and possess a rachis culminating in a soft bristle (Table 2). White, pink, pale purple, or yellow-tinged,

1-1.3 cm flowers are carried in fascicles on bent axillary racemes with 5–10 cm long axillary branches [11].

Pods are rectangular, thick, hard, wrinkled, pubescent, 2.6-4.3 cm long and 1-1.3 cm wide with pointed beaks; seeds 3-6, oval-shaped, scarlet with a black spot, or uniformly black or white, polished, attached to the pod by a small white seed covering. Flowering is from September and October months, and fruits around central India [11, 18].

Table 2

Part of the plant	Description	Parameter
Branches	Slender, flexible, and tough	-
Stems	Young branches are mostly greenish-yellow	4.5 m high and 1.2 cm in diameter
Leaves	Long, pinnate, rachis ending in a soft bristle	5-12 cm long
Leaflets	Usually 9-12 pairs, linear or linear-oblong, rounded at both ends, glabrous above and thinly appressed-silky beneath	2.5 cm long and 0.6 cm wide
Flowers	White, tinged with pink, pale purple, or yellow	1-1.3 cm long
Fruit (pod)	Rectangular, thick, hard, wrinkled, pubescent	2.5-4.3 cm long and 1-1.3 cm wide with a sharp deflexed beak;
Seeds	3-6 in a pod, ovoid, scarlet with a black spot, or uniformly black or white, polished, attached to the pod by a small white aril	A single seed is about 8 mm long, 6 mm wide, and weighs about 0.1 gm
Stipules	Deciduous	-
Axillary branches	Curved or short	5-10 cm long

Flavones such as aklone and abrectorin are included in the seeds, as well as sapogenin, kaikasaponin III methyl ester, abrisapogenol J, its 22-O-acetate, sophoradiol, hederagenin methyl ester. Abrin is the principal lectin, and the major constituents of seeds are lectins. Some lectins are non-toxic (*abrus* agglutinin) and poisonous (like abrin). Abrins, denoted by the letters abrin a, b, c, and d, are composed of a long polypeptide chain (MW 35,000)

and a short polypeptide chain joined by a disulfide bond. A trace quantity of abrusin and its 2' O-apioside is also present in the seeds. The main activities linked to the seed include antioxidant, antiplatelet, and anticancer. Because lectins bind to different types of cells differently, they can be used to differentiate between malignant tumor cells and healthy ones. This unique characteristic of the lectin results from varying

glycosylation on the cell surface linked to invasion, metastasis, and malignancy [18].

In vitro Anti-Cancer studies reported in *Abrus precatorius*

Abrus precatorius is widely used in herbal medicine for its varied pharmacological properties. Sofi *et al.* conducted an experimental study on the mechanism of anticancer action of *A. precatorius* leaf extracts, which provides novel support for *A. precatorius* in the therapy of breast tumors in clinical settings. The MTT test was used to measure cell mortality (with a value of IC₅₀ of 50-150 µg/ml). Further research was carried out by DNA laddering, PARP cleavage, FACS, semi-quantitative RT-PCR, and then the identification of cellular reactive oxygen species (ROS) by Dichlorohydrofluoresin diacetate (DCFDA) assay [12].

Anamika Das *et al.*, observed that fresh seed water extract at a concentration of 2 µl/ml did not affect human lymphocyte mitogenic activity. The ED₅₀ values for methanol extract were noted at 10 mg/ml and ethanol (95%) extract (30 mcg/ml). Likewise, the aqueous and methanolic extract demonstrate encouraging outcomes when applied to the Sarcoma Yoshida ASC and cell culture strain CA-9KB. By inducing apoptosis, the extracted chemical abrin from *Abrusprecatorius* seeds showed anticancer effects both in vitro and in vivo. Regarding virus-avian myeloblastosis, negative results

were seen at IC₅₀ >1000 mg/ml (Anamika Das, *et al*) [13].

In a study by Mohammed Shafi Sofi. *et al.*, MDA-MB-231 cells were tested for 48 hours to determine the IC₅₀ value of the sub-fractions C3 and C4 were found to be 74.2 and 13.2 µg/ml, respectively, indicating a highly significant cytotoxic effect [19].

A study by Amritpal Kuytaur, et.al, concluded that the most effective extract was *A. precatorius* ethyl acetate seed extract (APE (mac)), which showed an IC₅₀ value of 85.90±0.93 µg/mL in Hep2c cell lines. The results of the HPLC analysis showed the presence of quercetin, tannic acid, and piperine implying its potential as an antioxidant and anticancer medications [20, 21].

Furthermore, S Dharmaraj Santhosam reported the antioxidant and cytotoxicity activity of the methanolic extract of *Abrus precatorius* seeds, and its isolated compounds were assessed. The fractions, CMME, CMME I, CMME II, and CMME III exhibited good percentage suppression of MCF-7 breast cancer cell lines at concentrations of 10, 40, and 100µg/mL. The percentage inhibition at maximum concentration was 45.34 (CMME), 37.42 (CMME I), 50.63 (CMME II), 50.63(CMME III) respectively [18].

Table 3: *In vitro* Anti-cancer studies of *Abrus precatorius*

Entry	Study	Abrus species	Part	Extract	Methods/Assay	Cell lines	Action
1.	Invitro study	<i>A. precatorius</i>	Leaves	Aqueous extract	<ul style="list-style-type: none"> • Cytotoxic and pro-apoptotic study • Agarose gel electrophoresis for DNA fragmentation • Western blot analysis • Analysis of Cell cycle • Gene expression levels 	Human metastatic breast cancer cell line, MDA-MB-231	10, 40 and 100µg/ mL (IC ₅₀ value)[12]
2.		<i>Abrus precatorius</i> L.	Leaves	Ethyl Acetate extract	MTT assay	MDA-MB-231 breast cancer cell lines	> 75 % inhibition of cell growth at 600 µg/ml after 48 h of incubation [13]
3.		<i>Abrus precatorius</i>	Seeds	Ethyl acetate extract and 70% ethanol extract	MTT assay	Hep2C cells	APE (mac) seed extract IC50 value 85.90±0.93µg/mL in the Hep2c cell line [19]
4.		<i>Abrus precatorius</i>	Seeds	Methanolic extract and its eluted fractions CMME-I, CMME- II and CMME-III	MTT assay	<ul style="list-style-type: none"> • MCF-7 Breast cancer cell line • COLO 205M Cancer Cell Line 	<ul style="list-style-type: none"> • IC50 value: 36.98 µg/ml (Methanolic extract), 46.82 µg/ml (CMME I), 36.23 µg/ml (CMME II), 42.55 µg/ml (CMME III) [20]
						<ul style="list-style-type: none"> • COLO 205M Cancer Cell Line 	<ul style="list-style-type: none"> • IC50 value: 38.76 µg/ml (Methanolic extract), 31.02 µg/ml (CMME I), 34.96 µg/ml (CMME II), 32.95 µg/ml (CMME III) [18]

***In vivo* Anti-cancer study of *Abrus precatorius* species**

Anbu J, *et al.* conducted a study to evaluate the anti-tumor activity of the petroleum ether extract of *Abrus precatorius* Linn (PEEAP) using the Ehrlich Ascites Carcinoma (EAC) tumor model. They performed a preliminary phytochemical analysis of the extract using standard chemical methods, identifying flavonoids, alkaloids, tannins, phenolic compounds, saponins, and triterpenoids. Myelosuppression is a frequent and serious side effect of cancer treatment. Compared to the EAC control group, PEEAP treatment showed significant tumor reduction and improvements in hemoglobin levels and RBC count. In the control group, the average survival time was 18.16 ± 0.4773 days, which increased to 20.5 ± 0.6009 (250 mg/kg), 20.33 ± 0.4944 (500 mg/kg), and 21.166 ± 0.6009 (1000 mg/kg) in treated groups. (Anbu J, *et al*) [22].

M. Z. Gul, *et al.* conducted a study encouraging the production of apoptosis in orospheres. Reactive oxygen species (ROS) were identified as the key regulators of Wnt signaling and apoptosis, as evidenced by the accumulation of ROS in orospheres induced by *Abrus* agglutinin. This was further supported by the effects of N-acetyl cysteine pretreatment, which reduced caspase-3 activity and β -catenin expression through the use of an ROS scavenger. In conclusion,

Abrus agglutinin affects the self-renewal capacity of orospheres by inducing ROS-mediated apoptosis, indicating its potential as part of a combined treatment strategy for oral cancer. (M. Z. GUL, *et al.*) [23].

In 2008, Sujit K. Bhutia, *et al.* set a goal to determine whether 10 kMPPs demonstrated strong *in vitro* cytotoxicity and which might be translated into an *in vivo* therapeutic benefit in a model of Dalton's lymphoma (DL) in mice. Monitoring was done on tumor development and overall toxicity after 10 kMPP was administered. When compared to the control group, the AGG-treated group displayed significant decreases in CD-31 and Ki-67 staining along with increased TUNEL expression. (Sujit K. Bhutia, *et al*) [24].

Niharika Sinha, *et al.* The study demonstrated that *Abrus* agglutinin induced apoptosis and inhibited the proliferation of cancer stem cells derived from FaDu cells in a dose-dependent manner. Western blot analysis revealed that *Abrus* agglutinin activated caspase-3 and poly (ADP-ribose) polymerase, leading to an increased Bax/Bcl-2 ratio. This was the first *in vitro* documentation of AGG's antineoplastic effect on oral cancer stem cells (CSCs). Additionally, the findings showed that AGG downregulated p53 in FaDu cells with a mutation, and oral CSC maintenance was regulated by the Wnt/ β -catenin signalling pathway, triggering apoptosis. The research

also indicated that AGG induced stress and ROS production, leading to apoptosis in hypopharyngeal CSCs. By targeting both anti-apoptotic signalling in orospheres and Wnt/ β -catenin, AGG holds potential as a promising alternative treatment for oral cancer. (Niharika Sinha, *et al*) [25].

In a study by Wan-Ibrahim W S, *et al.*, The increased expression of caspase-3 protein indicated apoptotic activity in MDA-MB-231 cells treated with APME. Caspase-3 can be activated through either the extrinsic or intrinsic pathways, and once triggered, it cleaves numerous proteins, leading to the key biochemical and

morphological signs of apoptosis, such as DNA fragmentation, plasma membrane blebbing, and phosphatidylserine exposure. In the apoptosis assay, phosphatidylserine exposure was detected by Annexin V-FITC, marking an early apoptotic event. The study revealed that APME reduced the growth of MDA-MB-231 cells by arresting the cell cycle in the G0/G1 phase and inducing apoptosis through the regulation of Bax/Bcl-2 and caspase-3 proteins. These findings suggest that APME effectively induces apoptosis in MDA-MB-231 breast cancer cells. (Wan Suriyani Wan-Ibrahim, *et al*) [15].

Table 4: *In vivo* Anti-cancer studies of *Abrus precatorius*

Entry	Species	Part	Extract	Dosage	Experimental Models	Experimental animals	Reference
1.	<i>Abrus precatorius</i>	Seeds	Petroleum extract	250,500,1000mg/kg/day	Ehrlich Ascites Carcinoma (EAC) tumor model	Adult Swiss male albino mice	J. Anbu, ravichandiran, sumithra, Sudheer chowdary, swaroop kumar.s.l.v.v.s.n, kannadhasan and satheesh kumar [22]
2.	<i>Abrus precatorius</i>	Leaves	Hexane, Ethyl acetate and APA methanol extract	40–400 µg/mL	Antiproliferative and Apoptosis-inducing Effects of <i>Abrus precatorius</i> Against Human Monocytic Leukaemia (THP-1) Cell Line	Albino rats	M. Z. Gul, s. Chandrasekaran, k. Manjulatha, m. Y. Bhat, r. Maurya, qureshi and. Ghazi [23]
3.	<i>Abrus precatorius</i>	Seeds	Agglutinin (AGG) peptide fractions	10 mg/ml	Dalton's lymphoma tumor model	Athymic nude Mice	K. Bhutia, Sanjaya K. Mallick, Swatilekha Maiti, Tapas K. Maiti [24]
4.	<i>Abrus precatorius</i>	Plants Irctin		5mg/kg	HNSCC cancer xenograft mouse model	Female albino rats	Niharika Sinha, Prashanta Kumar Panda, Prajna Paramita Naik, Tapas K Maiti and Sujit K Bhutia [25]
1.	<i>Abrus precatorius</i>	Leaves	Methanolic extract Aqueous extract	-	MDA-MB-231	Human breast cancer cell lines, MDA-MB-231 and MCF-7; human liver cancer cell lines, HepG2; human colon cancer cell lines, SW480; human cervical cancer cell line, SiHa and HeLa; human normal breast cell, MCF-10a and mouse normal fibroblast cell, NIH	Wan Suriyani Wan-Ibrahim, Norzila Ismail, Siti Farhanah Mohd-Salleh, Aidy Irman Yajid , Michael Pak-Kai Wong , Mohd Nizam Md Hashim [26]

CONCLUSION:

Abrus precatorius is regarded as a powerful source of distinctive natural compounds for the development of medications or treatments against a range of dangerous illnesses. Traditional folkloric medicine makes use of roots, seeds, and leaves. The poisonous lectins found in abrin (ABR)A-D, which is lethal to humans, are found in abrin seeds. The administration of supportive measures together with prompt stomach washing is the treatment for *abrus* poisoning.

In conclusion, the Anticancer activity of *Abrus precatorius* was reviewed. The results obtained from *in vitro* and *in vivo* studies confirmed the efficacy of *Abrus precatorius* for the treatment of Various cancer and related diseases.

It is critical to recognize that abusing or overusing plant-based therapeutic components can be dangerous.

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