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The medicinal values of *Abrus precatorius*: a review study

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ABSTRACT: Herbal medicines are in great demand for preliminary health care due to their wide medicinal values without any side effects. Since many species are used in the system of traditional medicine, scientists have great opportunities to develop appropriate packages of practices for their multiplication and conservation. It is reported that the plant has a broad range of therapeutic potentials, like anti-bacterial, anti-fungal, anti-tumor, analgesic, anti-spasmodic, anti-diabetic, anti-serotonergic, anti-migraine, including treatment of inflammation, ulcers, wounds, throat scratches and sores. *Abrus precatorius* is the native plant of this Indian subcontinent and used in many ways in the traditional system of medicine considered as Ayurveda treatment. Ayurveda recommends the administration of the *Abrus precatorius* in disease like alopecia, edema, helminths, skin diseases, itching, urinary disorders, and anti-fertility. This review will help to explore the medicinal effects of the *Abrus precatorius* especially in the field of contraception which might be a remarkable activity in this realm. Therefore the present review is aimed to compile up the updated data and highlighting the special features on its pharmacological activities in various diseases.

KEYWORDS: Herbal medicine, *Abrus precatorius*, *medicinal values*, pharmacological activities.

INTRODUCTION

Now a days, people are believing in the traditional medicine such as Ayurveda or others than that of the commercially available synthetic medicines. Ancient, natural health care, tribal practices, Ayurveda, sidha and unani are the part of traditional medicine [1]. People of this subcontinent have been using the ayurvedic systems of medicine for many generations [2]. Medicinal plants are so important for health care of human beings in respect to ancient medicine system. Most of the traditional medicines are based on herbs, which are used by almost 80% of the world's populations. *Abrus precatorius* L. (family - leguminoseae and subfamily-Papilionaceae) is a native plant of India subcontinent and the East and West Indies [3], in Hindi, it is known as Ratti or Gumchi. Plant parts such as leaf extracts is used for leucoderma, the seed having abrin is used as a purgative and abortive and the root extract used against coughs in the ayurvedic system of medicine [4].

The background of the discovery of many clinically useful drugs having medicinal values over the last two decades was the research of the scientists for finding out the new pharmacologically active ingredients from natural sources such as plants, animals and microbes. *Abrus precatorius* plant has been utilized as medicine from very ancient times not only in this subcontinent but also in China and other prehistoric cultures. In certain tribal regions people chew leaf of *Abrus precatorius* for the relief of the mouth ulcer. It also contains tri-terpenoid saponins and used in the treatment of inflammation, ulcers, wounds, throat scratches and sores [5].

CHEMICAL COMPOSITION

For the *Abrus precatorious* plant, different parts of it could be used and they have different sources of chemical constituents which have different medicinal effects on the body. Such as root, leaf and the seed of

the fruit of the Abrus plant have different types of chemical constituents which help to explore the different biological effects for the treatment of different diseases. For example:

Leaf: Abrine, Abruslactone, Abrusoside A, B C, D, Inositol etc.

Root: Abrol, Abrasine, Precasine, Precol etc.

Seed: Abrine, Abrin A, B, C, I, II, III, Abrus agglutinin, Saponin, Flavonoids, Abrectorin, Precatorin, Lectin, campestanol etc.

Figure 1. Seed of *Abrus precatorius.*

ETHNOBOTANICAL USES

Abrus precatorius has anti-suppurative properties. They are grinded with lime and poured on acne, sore and abscess. Decoction of leaves are taken orally for cough and flu [6, 7, 8]. The roots of *Abrus precatorius* herb are useful for the treatment of jaundice and bile haemoglobinuric. Root paste is administered for the curation abdominal pains, recovery from tumors and also for inhibiting abortion. Grinded powder of roots of *Abrus precatorius* are taken with pure clarified butter thrice a day for four days to cure cough [9, 10]. Root can be used as a remedy from snake bite by chewing [11]. However, for using as an anti-malarial and anti-convulsant the extract of fresh root in hot water can be administered orally [12], on the other hand liquid broth of dried root is taken orally for the treatment of bronchitis and hepatitis [13]. Paste of leaves and seeds are applicable on head for graying of hair. Dried seeds of *Abrus precatorius* are grinded to powder and administered orally one teaspoonful once a day to cure the worm infestation for two days [9, 10]. In veterinary section of medicine, dried seed powder of Abrus is used for the treatment of fractures. The brightly-colored seed of Abrus attracts the children, as a result sometimes the children at the rural villages who don't have any knowledge about the plant and the origin of the seed they eat the seed and got attacked by the toxic effect of the seed of *Abrus precatorious* if the dose cross the safety limit. Boiled seeds are eaten in certain parts of India [14, 15]. They have a weight of 1/10th of a gram which is almost uniform, hence used as weighing unit [16]. Seeds also have some potential ingredients which are of good source of insecticide [17] and antimicrobial [18]. They are considered abortifacient [19, 20], anodyne, aphrodisiac, antimicrobial, diuretic, emetic, expectorant, emollient, febrifuge, hemostat, laxative, purgative, refrigerant, sedative, vermifuge, antidote and used in various ailments to cure headache, snakebite, blennorrhagia, boil, cancer, cold, colic, conjunctivitis, convulsion, cough, diarrhea, fever, gastritis, gonorrhea, jaundice, malaria, night-blindness, ophthalmia, rheumatism, diabetes and chronic nephritis [9]. Dry form of seeds are administered orally as an aphrodisiac [21, 22]. Extract of seeds in hot water is taken orally for malaria [23]. Dried seed powder are used by various African tribal groups as oral contraceptives [6, 7, 8, 24, 25, 26]. Whereas, the Abrus seeds are also used to rid of tuberculosis and painful swellings [27]

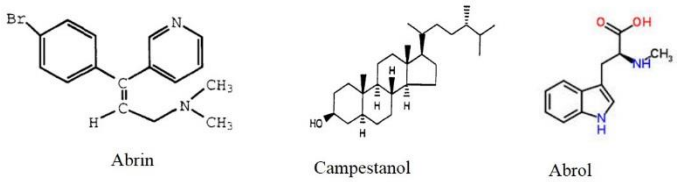

Figure 2. Some chemical compounds for which *Abrus precatorius* disclaim the medicinal effects.

ANCIENT USES

In the ayurvedic medicine leaf of *A. precatorius* has the potential as laxative, expectorant and aphrodisiac medicines. Seed is said to be purgative, emetic, tonic, antiphlogistic, aphrodisiac and antiopthalmic. For indigenous people, they are potent phytomedicines, many of them in mixtures with other plants. Their toxicity is underestimated. They are even sold via internet (Tan-Hord Exports List of herbs). In some countries of Asia beans are used as weights and jewellery is made from them by drilling. In Tanzania traditional healers claim the competence in the treatment of epilepsy. *A. precatorius* can be found between 60 plants commonly used against this illness [28]. In Zimbabwe extracts of 58 plants popularly known to be effective against schistosomiasis were tested in vitro against excysted cysticercoids. Extracts of stem and root of *A. precatorius* were under the ten most effective samples [29, 30]. In the Indian Central Drug Research Institute in Lucknow discussions about an antifertility program are going on. One of the plants with priority is *A. precatorius* because of its "estrogenicityî", nor because of its lectins [31]. In Germany necklaces from

India were sold in the seventies, but soon warnings were propagated because of toxicity of the components. Investigations resulted that they were made with *A. precatorius* beans and warnings were propagated [32]. In Christian countries the beans are used for wreaths of roses (precatory beans), for necklaces and for ornamentals together with other flowers in garlands. In China, the herb of *A. precatorius* is used as a form of folk-medicine or local medicine as a therapy of bronchitis, laryngitis and hepatitis. Because of their platelet inhibiting activity abruquinones are supposed to be the active substances [33].

Ricin originated from *Ricinus communis*, abrin originated from *Abrus precatorious* and other related toxins from different plant origins have played captivating and vital roles in the history of biomedical researches and clinical medicines. Utilization of these proteins in medical therapy since ancient times has been reviewed. Later on the proteins originated from those toxins, played important roles in the early days of immunological research. By using these toxin derived proteins of this group, some of the basic principles of immunological studies were discovered. *Abrus precatorius* was formerly used to weigh gems and precious stones. As per factual recordings the *Abrus precatorius* plant was used to weigh the famous Kohinoor Diamond as well. In a few parts of South America the seeds of this plant are used as necklaces for protecting children against illnesses particularly [34, 35].

This plant is native to the Himalayas in India and is also found in a few parts of Southern India. Today, the *Abrus precatorius* is also being harvested from Hawaii, southern parts of America, West Indies, as well as Africa.

The seeds of this plant are small, scarlet in color with black spots around the hilum. The stout of the plant is rectangular in shape and has brownish pods that usually ripen after the winter season. The root of *Abrus precatorius* is woody and has a lot of branches [36, 37].

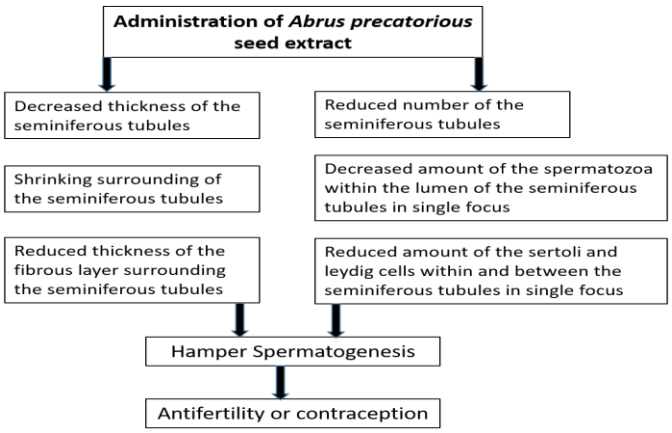

Figure 4. Schematic diagram of probable mechanism of antifertility or contraceptive effects of Abrus Precatorious.

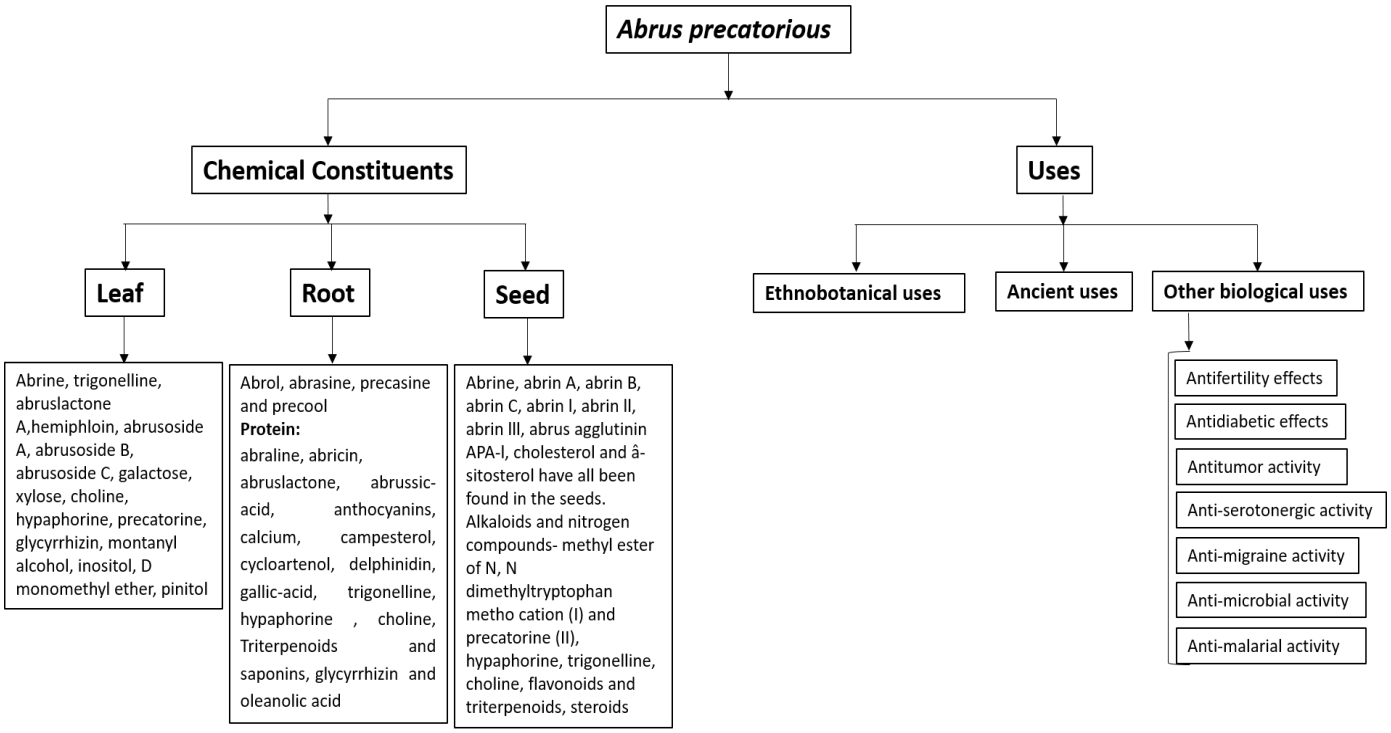

Figure 3: Schematic diagram of the sumamry of the chemical constituents and different uses of the leaf , root and seed of *Abrus Precatorious.*

ANTI-FERTILITY EFFECTS

In an antifertility program three indigenous plants (*Piper longum, Lawsonia inermis Abrus precatorius*) were studied with pregnant rats. Between these plants *Abrus precatorius* was the most effective one. A daily dose of 300mg showed a 40-60 % retardation of pregnancy of rats [38]. An extract of *Abrus precatori*us seeds by using methanol, deteriorated the motility of washed human spermatozoa with an EC 50 of 2.29 mg/ml, irreversibly. The highest concentration which was tested was 20.0.mg/ml, which resulted the onset of the motility almost immediately. In contrary, this and other effects were not evident at a lower concentration than 5 mg/ml. Scientists of University of Colombo, Sri Lanka confirmed these results [39]. Male albino rats treated with 50% methanol extract 250 mg/kg for 30 and 60 days became absolutely infertile. This was reversible. This treatment met the energy metabolism of the cauda epididymidis. Levels of acid succinic hydrogenase and phosphatase were significantly reduced, while protein and sialic acid appeared normal [40]. The probable mechanism how the chemical constituents of *Abrus precatorious* worked as a potential for contraceptive issue is expressed as a schematic diagram in Figure 4.

In a similar investigation male albino rats were treated with an ethanolic or methanolic seed extract of seeds of *Abrus precatorius* at a dose of 100 mg/kg for 60 days. The data of the experiment explained that cauda-epididymal sperm motility was significantly decreased. Although, there was no effect in the sperm concentration after 60 days of feeding with the alcoholic extract. Electron microscopic observation of morphology of sperm presented decapitation, damage of acrosome and bulging on sperm at the midpiece region, in treated rats. Energy metabolism altered due to the reduction in ATPase and succinate dehydrogenase activity for the extract allocation. Contrarily, after 60 days of administration testosterone levels in serum was noted significantly increased. Authors conclude that the decreased fertility rate was correlated with the reduction in the sperm motility, and altered morphology of the sperm in epididymis [41].

In testes of rats which were treated with the steroidal fraction of seeds of *Abrus precatorius,* the degenerative changes were observed, such as in case of weight of testis, sperm counting and spermatogenesis at later stages and Leydig cell counting. All of these observations are related to dose dependent reduction in enzymatic activity of hydroxysteroid dehydrogenase, glucose-6-phosphatdehydrogenase, sorbitol deydrogenase and leucin amino-peptidase.

The steroidal fraction may exert their influence indirectly by a feedback reaction decreasing the production and release of testosterone, additionally [42].

Oil and crystalline steroidal fraction from the seeds of Abrus possess significant antifertility activity which has been reported by many scientists [43, 44]. The leaf and root of this plant contain glycyrrhizin the active principle constituent of liquor ice. Seeds contain both water soluble –albumin and insoluble –globulin proteins. In case of Abrus, the active component ruptures histological frame due to which a large number of degenerative enzymes results in follicular atresia [45, 46]. After revealing its importance as an antifertility agent, an attempt was made to investigate alteration in ovarian histo-architecture directed by Abrus for fertility regulation and control on Swiss Albino mice.

Normal function of male reproductive system is entirely dependent on the conventional functioning of the male reproductive organs and other accessory structures. The most important male reproductive organ is the testis, which is fundamentally responsible for the production of spermatozoa. The production of sperm occurs in the seminiferous tubules part of the testis, under the control of testosterone hormone, produced by the interstitial cells of the testis named Leydig cells. Testosterone production is directly proportional with the concentration (or activity) of leutinizing hormone (LH), in the milieu secreted by the anterior pituitary gland. Another type of hormone Follicular stimulating hormone (FSH), which is released also from the anterior pituitary, which stimulates another type of interstitial cells named the Sertoli cells of the testis, the function of whose is to give support and nourishment to developing spermatozoa. The quality and quantity of the produced spermatozoa will therefore depend on normal functioning of the structures testicles and associated reproductive hormones [47].

Our group has worked on a combination herbal extract (*Ricinus communis*, *Abrus precatorius* and *Syzygium cumini*) which was applied on the male Swiss albino mice where we have found that the number of leydig and sertoli cells were reduced as a result the production of LH, FSH and testosterone is hindered and cause reduction in the sperm production [48]. Some previous studies have mentioned that Oral administration of herbal extract over 4 weeks, caused significant ($p \leq 0.05$) effects on the levels of testosterone, LH and FSH in serum.

Research conducted on the *Abrus precatorius* seeds concluded that the plant suppresses male reproductive functions reversibly [49, 50, 51]. The extract affected oxidative metabolism of cauda epididymis, where levels of protein, sialic acid, acid phosphatase and succinic

dehydroginase were significantly depleted. [52, 53, 54] Jahan and his group detected an irreversible damage in sperm DNA integrity, thus suggested possible teratogenicity. [55, 56].

OTHER BIOLOGICAL EFFECTS

Anti-diabetic activity

An ethno botanical survey of medicinal plants in five districts of Lagos State of Nigeria was conducted with the help of semi-structured questionnaire, which was reputed for the treatment of diabetes [57, 58]. In the survey around 100 people responded, the respondents were from the predominantly Yoruba tribe [59]. Among them mostly males (76%) were possessing knowledge regarding the traditional treatment of diabetes. About half of the respondents had experience of 20–30 years in treating diabetes by using mainly herbs (96%) unlikely the conventional treatment for diabetes. They also developed an effective and easily recognized diagnostic tool for diabetes. In the survey, fifty multi-component herbal recipes were covered which consisted of mainly liquid preparations. Those liquid form of the medications were often administered orally without any serious toxic or harmful side effects (92%). The principal antidiabetic plants [60] include *Abrus precatorius*, leaf of *Abrus precatorius*, *Alchornea cordifoli*a and *Blighia sapida*. The leaves of the plants should be squeezed properly in water until the juice comes out, that prepared decoction can be used as a therapeutic approach for diabetes by using it as infusion [61].

Anti-tumor activity

The ethanolic (95%) extract [62] of dried leaves which was administered intra-peritoneal to mice, was observed inactive on Sarcoma 180 (ASC) AP07452. Whereas, the water extract of seeds, administered intra-peritoneal to mice was found active on Sarcoma (Yoshida solid and ASC) [63]. But again when it was administered subcutaneously it was found inactive on Sarcoma (Yoshida ASC) AP01254.

Anti-serotonergic activity

Ethyl acetate extract of *Abrus precatorius* leaves had anti-serotonergic activity on a frog fundus strip by using sumatriptan as a standard [64]. This plant also use as an abortifacient, anodyne, aphrodisiac, antimicrobial, antibacterial, diuretic, emetic, expectorant, febrifuge, hemostat, laxative, purgative, refrigerant, sedative, vermifuge [65]. Studies indicated that their propensity to develop migraine61 headache. Moreover, fluctuating hormone levels indicate a migraine relation. The leaves of *Abrus precatorius* was on soxhlet extraction with ethyl acetate shown presence of alkaloids, carbohydrate, proteins, tannins, saponins and amino acids and antiserotonergic activity on frog fundus strip shown [66] (Graded dose response) comparison with sumatriptan as a standard.

Anti-migraine activity

Anti-migraine activity of Abrus precatorius proved by using male Wister albino rat and frog fundus muscle preparations using Sherrington rotating drum [67]. Muscle contraction effect of petroleum ether and ethyl acetate crude extracts of *Abrus precatorius* performed on both muscle preparations.

Anti-microbial activity

The anti-microbial effects of *Abrus precatorius* extracts from leaves, stem and the seed oil were applied against some of the microorganisms *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Enterococcus faecalis*, *Streptococcus anginosus*, *Bacillus subtilis*, *Corynebacterium spp*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa* and *Candida albicans* by using the agar well diffusion technique. It was observed that the extract of *A. precatorius* in aqueous, inhibited all the bacteria of test but had no effect on the fungal strain. The root extracts of the *Abrus precatorius L* also showed the anti-bacterial activity on various types of tested bacteria. Different solvent fractions or concentrations showed inhibitory activity against thirteen gram-positive and gram-negative bacteria. Through the bioautography assay it was observed that the antibacterial activity was localized to specific chromatophores in the chloroform fraction [68]. Almost all the parts of the *Abrus precatorius* has the anti-bacterial activity.

Anti-malarial activity

Isoflavanquinone and abruquinone was segregated from the extract of aerial parts of Abrus plant and demonstrated the anti-malarial activity. From the similar type of extract the antiplasmodial activity and cytotoxicity was also investigated during the assessment of antimalarial activity and *A. precatorius* extract also showed an IC 50 value below 20 g/ml74, which proves that the extract is quite highly potent for inhibiting some biological entities such as bacteria.

SAFETY

There is an observation regarding the effect of the extract of *A. precatorius* on the hematology of the body. The study showed that the extract of the [69] caused reduction in the levels of packed cell volume, concentration of Hemoglobin, Red Blood Cell (RBC) counts and also white blood cell (WBC) count. Beside that it was also demonstrated that the extract of caused decreased mean corpuscular volume and mean corpuscular haemoglobin [70, 71]. Also the biochemical properties of the treated animal was observed which was administered with the extract of the *Abrus precatorious*. It was observed that the extract also resulted in increased levels of total serum protein, albumin, alanine amino transaminase, aspartate amino transferase, alkaline phosphatase and total bilirubin. Aqueous extract of *Abrus precatorius* showed that it was toxic and special care should be taken during the usage of the extract. Fatal poisoning in children has been reported after the thorough chewing of one seed. They were highly toxic and cause severe stomach cramping accompanied by nausea, severe diarrhea, cold sweats, tachycardia, coma and circulatory collapse. The loss of abrin (IP) in mice was found to be 8.34 mg/kg. Prolonged administration of abrin in mice produced initial anemia, which normalized at the end of the experiment, and an increase in white blood cell count. Intra-peritoneal injection of abrin to pregnant rats produced both maternal and fetal changes, whereas abrin given orally produced significant fetal effects. It was observed that the ethanol-water proportional (1:1) extract of the aerial parts of Abrus was much less toxic and whereas the only ethanolic (95%) extract of the dried leaves, produced a loss of 12 mg/kg body weight in the chickens where the extract was administered.

FUTURE PROSPECTS

People are becoming more and more dependent on the natural sources of medicine which is increasing the use of Abrus L. like such type of medicinal plants, which has a handful use in the form of medicine. Already many researchers have worked on the different biological effects of this herbal plant for the cure of different diseases, which has proven its medicinal value. More researches should be conducted to make this plant extract commercially available in near future and make it the most reliable form of medicine for the treatment different diseases. Hopefully in the near future commercial products of *Abrus precatorious* will be found which will render no toxic or side effects to the consumers and will explore a new era of medicine.

CONCLUSION

Herbal medicine is the use of plants (herbs) to treat disease and enhance wellbeing. Herbal medicine is used to treat a range of disorders including anxiety, arthritis, depression, high blood pressure, insomnia, hormonal imbalances, migraines, skin problems such as eczema and other disorders. Herbs can act on the body as powerfully as pharmaceutical drugs and need to be treated with care. Herbs are administered by a herbalist or herbal therapist.

While some people may dismiss herbal remedies as quackery, the use of botanicals is well rooted in medical practice. Ancient doctors methodically collected information about herbs and developed well-defined pharmacopoeias to treat a variety of ailments. In the recent times more than a quarter of all drugs of the commercially available synthetic medicines contain active ingredients which are derived from the plants which were available since the ancient time.

Many drugs are available there which have got the entrance in to the international market by the exploration of ethno-pharmacological activity, and considered as the traditional medicine. This review article exposes that *A. precatorius* is an exclusive source of many vital phytochemicals which makes this plant very unique and versatile for its large number of pharmaceutical properties i.e. antidiabetic, neuro-protective, anti-microbial, analgesic and some others. Hence comprehensive researches are in demand of the recent times with this highly medicinal quality contained plant material. It is high time to exploit the therapeutic utility of *Abrus precatorius* to combat against various diseases. It can be concluded by analyzing the above collected literature that *Abrus precatorius* is a promising candidate as a multipurpose medicinal agent because it possesses a high potential pharmacognostical and pharmacological applications.

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AUTHOR CONTRIBUTIONS

Sonali Bhakta carried out the study and wrote the initial draft of the manuscript. Shonkor Kumar Das designed and supervised the research work and revised the manuscript. The manuscript was carefully read by both the authors before the submission process.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest towards the publication of this article.

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