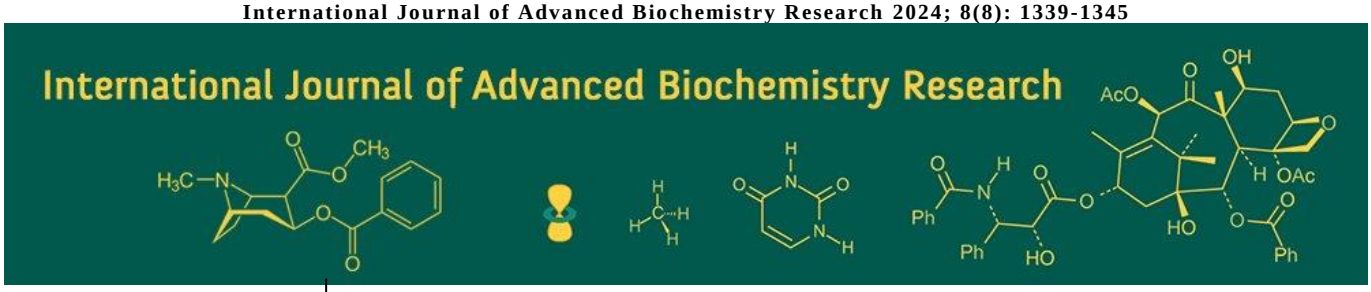

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(8): 1339-1345
www.biochemjournal.com
Received: 24-05-2024
Accepted: 28-06-2024

S Prabakaran
Ph.D. Scholar, Division of Plant Genetic Resources, ICAR-Indian Agricultural Research Institute, New Delhi, India

R Sowmyapriya
Ph.D. Scholar, Division of Molecular biology and Biotechnology, ICAR-Indian Agricultural Research Institute, New Delhi, India

Corresponding Author:
S Prabakaran
Ph.D. Scholar, Division of Plant Genetic Resources, ICAR-Indian Agricultural Research Institute, New Delhi, India

Abrus precatorius: A deep insight into ethnobotanical, phytochemical and potential application

S Prabakaran and R Sowmyapriya

DOI: https://doi.org/10.33545/26174693.2024.v8.i8q.1985

Abstract
Abrus precatorius, a medicinal plant native to Southeast Asia and India, holds significant therapeutic potential due to its rich phytochemical content across various parts of the plant. Leaves, seeds, and roots contain bioactive compounds such as flavonoids, alkaloids, and saponins, which exhibit antimicrobial, antioxidant, and anti-inflammatory properties. However, the plant's seeds contain abrin, a toxic protein requiring careful handling. Due to its widespread distribution and diverse medicinal uses, *Abrus precatorius* remains a valuable resource in pharmaceutical research and natural medicine.

Keywords: *Abrus precatorius*, medicinal plant, phytochemicals, flavonoids, alkaloids, antioxidant, anti-inflammatory, abrin, natural medicine, pharmaceutical research

Introduction
Plants generate a diverse array of phytochemical substances, rendering them valuable in the treatment of numerous ailments. Medicinal plants have been essential to maintaining human health since prehistoric times (Egbuna *et al* 2019) [1]. Since natural medicines derived from plants make up more than 40% of contemporary medications, medicinal plants are essential to the pharmaceutical industry and drug research. Recent years have seen a significant increase in public interest in naturally derived pharmaceuticals due to their high efficacy and low side effects. The current effort aims to examine and gather current data on a range of worldwide applications related to the *Abrus precatorius*.

Place of origin and range of distribution
Abrus precatorius L. (also known Indian liquorice) is a medicinal plant originated from Southeast Asia, China, South Africa, Brazil and native to India. It belongs to pea family, fabaceae and is the only representative genus of the tribe, Abreae. It is mostly found in drier areas in the tropical regions. It is widely distributed at an altitude of up to 1200 m above sea level in the outer Himalayan region. The plant is well adapted to a wide range of environmental conditions and commonly found as weeds throughout the plains and forest land.

Common names
This plant was known by different names in different languages, as the plant has a wide geographical distribution and it is known by different names in different regions and it is listed in table 1. **(**attal *et al* 2010) [3].

Taxonomy (Attal *et al* 2010) [3]

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

Table 1: *Abrus* sps –List of common names and their origin

S. No	Common names	Languages
1.	Jequirity bean, Rosary pea	English
2.	Loco bean, Pico de loro	Spanish
3.	Jiquiriti, Abrico-de-macaco	Portuguese
4.	Ratti, Gunja	Hindi
5.	Kunrimani, kundumani	Tamil
6.	Guriginja, Guruguni	Telugu
7.	Gunja, Ratti	Marathi
8.	Kunni,Kunnimani	Malayalam
	Common names	**Countries/ places**
1.	Rosary pea, Crab's eye	United states
2.	Ratti, Gunja	India
3.	Jeequirity, Maria-pretinha	Brazil
4.	Coralillo,Jiguilillo	Mexico
5.	Tento,Nga nga	Phillipines
6.	Saga, Cikal rambat	Indonesia
7.	Native liquorice, Crab's eye vine	Australia
8.	Crab's eye, Paternoster pea	Nigeria
9.	Li dou, Sha li dou	China
10.	Love pea, John crow bead	Jamaica

It was known by different names like precatory beans, Ratti, Crab's eye, Jequerity pea, Rosary pea, Lucky bean etc. Nearly, 18 species are found in the genus *Abrus*.

Table 2: List of different species in Abrus and their distribution

S. No	*Abrus* species	Distribution
1.	*Abrus diversifoliatus*	Madagascar
2.	*Abrus fruticulosus*	Guinea-Bissau, India, Andaman Isl.
3.	*Abrus gawenensis*	Somalia
4.	*Abrus kaokoensi*	Namibia
5.	*Abrus laevigatus*	Mozambique; Namibia; South Africa
6.	*Abrus longibracteatus*	Laos; Vietnam
7.	*Abrus canescens*	Senegal; Gambia
8.	*Abrus madagascariensis*	Madagascar
9.	*Abrus parvifolius*	Madagascar
10.	*Abrus precatorius*	China (Guangdong, Guangxi, Yunnan); Taiwan; Pakistan (Sind); Nepal; Bhutan; India
11.	*Abrus pulchellus,*	Nepal; Bhutan; India
12.	*Abrus sambiranensis*	NW-Madagascar (Sambirano)
13.	*Abrus bottae*	Saudi Arabia
14.	*Abrus somalensi*	Somalia
15.	*Abrus wittei*	D.R.Congo [Zaire]
16.	*Abrus aureus R. Vig.*	Madagascar
17.	*Abrus kaokoensis*	Namibia
18.	*Abrus baladensis*	Somalia

Botanical description

It is a perennial climbing plant with slender and twinning stem. The leaves are compound, alternate and pinnate consist of oblate leaf lets. There were mainly two different forms of plant growth habit observed *viz*. trailing habit and twinning habit. The roots are branched (Okhale *et al*) [5] and the flower of Ratti plant is papilionaceous i.e. with typical standard petal, wing petal and keel petal. The flower colour includes purple color, dull purple colour, yellow color and white color (Prabakaran *et al* 2021) [6]. The fruit is a legume containing 4-5 shiny, scarlet seeds. The seeds contain one toxic compound called abrin, which can be fatal if ingested into blood stream (Karthikeyan *et al* 2017) [7].

Fig 1: Different parts of *Abrus precatorius*. Variability in plant growth a) Trailing habit b) Twinning habit c) Flowers d) Different seed color e) pod f) leaves

Phytoconstituents in different parts of *Abrus precatorius*

Abrus precatorius contains various phytochemicals present in their different parts i.e. root, stem, leaves and seed. These chemical constituents plays a vital role in various medicinal properties to cure various disorders**.**

Leaves: It contain**s** various phytochemicals like flavonoids, triterpenoids and alkaloids. Around 28 phytochemicals were identified by analysis through GC-MS analysis of methanolic leaf extract of *Abrus precatorius*. Major compounds includes quercetin, kaemperol, rutin, lupeol, beta-sitosterol etc. The leaves of abrus contains other phytochemicals like triterpenes abrusgenic acid, methyl abrusgenate, liquirtiginin-7-monoglycosides. These compounds are having various therapeutic uses antimicrobial, antioxidant and chemo preventive properties (Nisha *et al* 2018) [9].

Seeds: The bioactive constituents present in seeds includes saponins, phenolic, alkaloids and flavonoids, eugenol, steroid, terpenoids (Iyekowa *et al*) [16]. Seeds contain abrin a toxic protein similar to ricin, when ingested it can cause acute poisoning. Other phytoconstituents include abric acid, which is having anti-inflammatory and antioxidant properties (Babu *et al*, 2018) [12]. Seed contains other secondary metabolites like lectins which is a carbohydrate binding protein. Handling of seeds should be done with extreme caution.

Roots: Roots contain Abrusgenic acid which is specific to *Abrus precatorius* and it is having cytotoxic and medicinal properties (Khaleqe *et al*) [13]. Roots contain alkaloid, triterpenoids, flavonoids, isoflavanquinones and these serves as an anti-inflammatory, antioxidant, anticancer and other huge medicinal value (Garaniya 2014) [15]. Some of the other phytochemicals present in *Abrus precatorius* is listed in the table 3

Table 3: List of phytoconstituents in different parts of *Abrus precatorius* and their properties

Parts	Phytoconstituents	Properties	References
Leaves	Flavonoids –quercetin, kaemperol, rutin Triterpenoids- lupeol and beta-sitosterol Alkaloids- abrine, precatorine and beta-guanine. Ritepenes abrusgenic acid, methyl abrusgenate, liquirtiginin-7-monoglycosides 3-Hexanone, Octanoic acid, Undecanal, Vinyl caprylate, n-tridecyl ester, Pentadecanal, Hexadecanoic acid, methyl ester, 3- Pyridinolf -Pyran-4-one,2,3,-diyddro-3,5-dihydroxy-6-jmethyl,Benzofuran, Isosorbide, isosorbide 5 2-methoxy-4-vinaylphenol, Methylparaben, D-allose, Octanal,2-(phenylmethylene), Hexadecanoic acid, Methyl ester, n-Hexadecanoic acid , Dibutyl phthalate, Abrusoside B ,Abrusoside D, Abrusoside E	Antioxidant properties, Anti-inflammatory, nematicidal, antioxidant and antitumour properties	(Al-Qurainy *et al* 2022 Ragasa *et al* 2013, (Caboni *et al* 2012) [8, 10, 11]
Seeds	Toxic protein- abrin, abric acid. Phytochemicals- 2- Undecenal Hexadecanoic acid, methyl ester Hexadecanoic acid, 9-Octadecenoic acid, methyl ester, Methyl stearate, Octadecanoic acid , 4-hydroxy methyl octadecanoate 6-hydroxy methyl-hexadecanoate, 9-Octadecenoic acid , Octadecanoic acid, 9-Octadecenoic acid, 9-Octadecenoic anhydride Octadecanoic acid, Hydroxypentadecanoic acid Octadecenoic acid, Oleic anhydride Octadecanoic acid, 2,3-dihydroxypropyl ester , Stigmastadiene-3-one	antinflammatory and antioxidant properties	Babu *et al.* 2018 [12]
Root	Isoflavanquinones, Abrusgenic acid, abraline, abricin, abrusgenic-acid-methyl-ester, abruslactone, abrussic-acid precasine and precool, anthocyanins, campesterol, gallic-acid, trigonelline, quinones-abruquinones A, B, C, D, E, F, Triterpenoids, saponins arabinose, galactose, xylose, choline, N, N dimethyl-tryptophan, P coumaroylgalloyl glucodelphinidin	Anti -inflammatory,analgesic, antipyretic,antidiabetic, anti-microbial and anti-cancer properties	Garaniya 2014 [15]

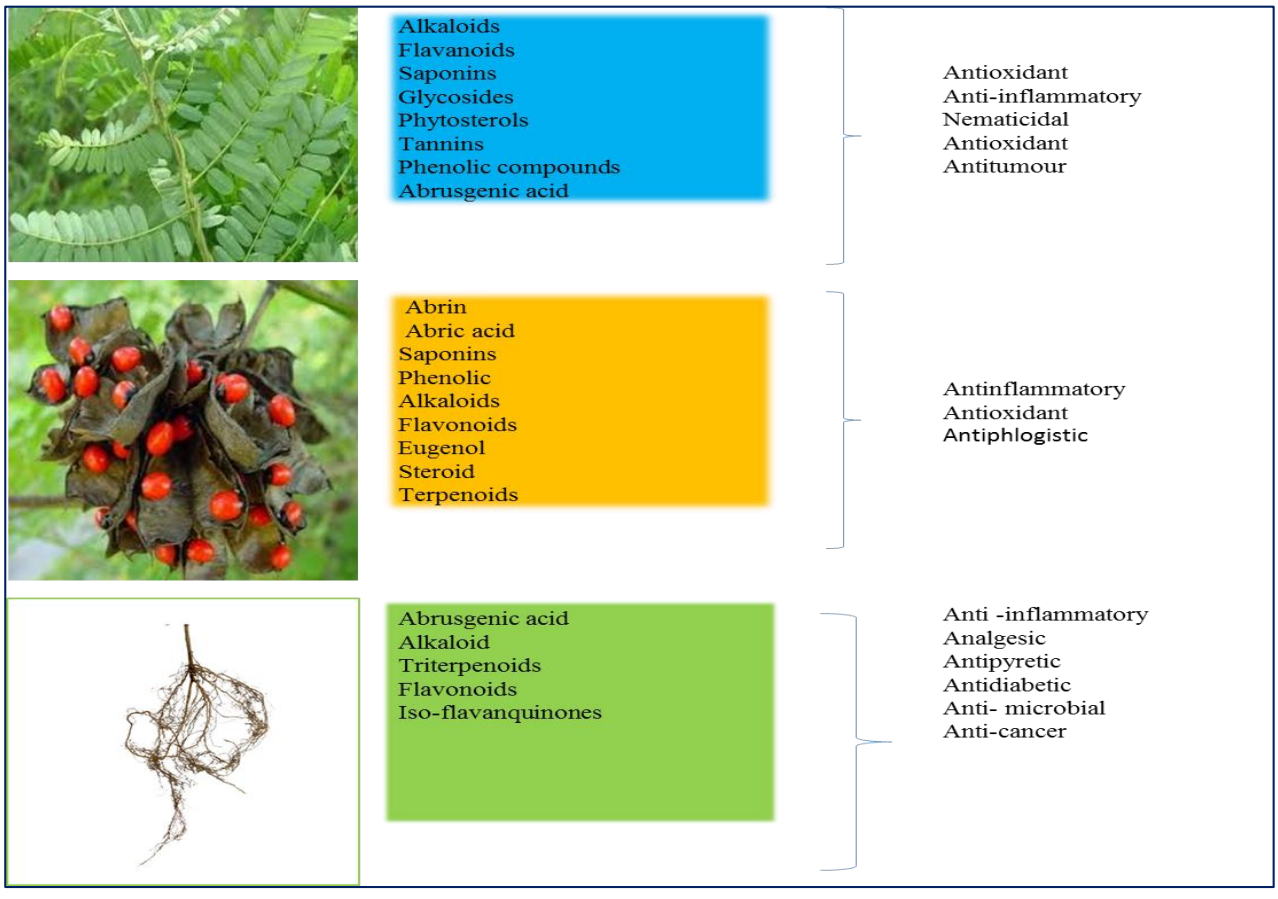

Fig 2: Phytoconstituents and their properties in different parts of *Abrus precatorius*

Application of *Abrus precatorius* in various fields

1. Traditional medicine: The entire plant, including the roots, leaves, and seeds, is utilized in traditional medicine. The petroleum ether extract from the seeds is believed to have anti-cancer qualities; fresh leaves are used as a nerve tonic and in skin cancer formulations. The leaves are used as a tonic, aphrodisiac, and to cure wounds, leucoderma, eye issues, and itching. They lessen biliousness as well. In addition, they cure thirst, asthma, stomatitis, fevers, tooth decay, headaches, and tuberculous glands. In addition, the leaves have diuretic properties and are used to treat gastritis, diarrhea, cardiac issues, kidney difficulties, cancer,

sleeplessness, and drowsiness of the central nervous system (Kubiatowicz 2003) [17]. When leaves are placed to the site of rheumatic discomfort and soaked in hot mustard oil, there will be a noticeable improvement. Localized pain appeared to be relieved by applying fresh leaf juice externally along with a tiny quantity of mix oil (Kirtikar *et al* 2005) [18]. They are used to cure illnesses such respiratory tract infections, hepatitis, and cough in Nigeria (Saganuwan and Onyeyili, 2010) [19]. The lethal toxin abrin, which is very poisonous to both people and animals, is mostly found in seeds. Abrin is not present in leaves in more concentration. For this reason, the leaves and their infusion are consumed orally Davis, 1979 [20]; Frohne and Pfander, 1983 [21]; Burkill, 1997 [22]; Adedapo et *et al*., 2007 [23]. Ratti seeds have been used for several medicinal purposes, including the treatment of baldness, according to the Indian Ayurvedic Pharmacopoeia. Despite being poisonous, the seeds do contain a number of vital amino acids, including serine, choline, alanine, and valine. This plant's roots are mostly used as a diuretic and to relieve coughs (Kubiatowicz). A. precatorius roots are used to treat heart disease, sleeplessness, heart and renal illness. For rheumatism and sore throats, roots are taken Chewing dried root helps to treat snakebite (Daniel M 2006) [24].

2. Biomedical research: Despite its toxic nature, *Abrus precatorius* has been used in various biomedical applications like antimicrobial activity, anticancerous property, Immunomodulatory effects, wound healing, anti-inflammatory activity and antioxidant effect. Extracts from Abrus has shown potential antimicrobial activity against many bacteria and fungi. The leaf extracts of *Abrus precatorius* has been used as antibacterial agent against *Staphylococcus aureus* (Adelowotan *et al*. (2008) [25]. The leaves of these *Abrus precatorius* plants were squeezed with water and given orally for treating the diabetes (Gbolade (2009) [26]. The methanolic leaf extracts (5, 10, 15 mg/ml) at different concentration shows anthelmintic activity against *Tubifex tubifex* (sewage worm) and *Pheretima posthuma* (Earthworm) Selvadurai *et al*. (2016) [27]. The root and stem extracts of Ratti plant possess antihelmintic property (ability to get rid of parasitic worms in the intestine) especially against cestodes and shistosomes (Molgaard *et al*. (2001) [28]. The aqueous extract from the stem of Indian liquorice can be used effectively in the treatment of kidney problems and shows nephroprotective activity Sohn *et al*. (2009) [29]. The different parts of *Abrus precatorius* have potent anti-tumour activity. The major components that was responsible for such activity includes abrin and abrus agglutinin (Qian *et al*. (2022) [30]. The leaf extracts can potentially chelate iron and prevent the free radical formation by lipid peroxidation and shows antioxidant potential. This helps in protecting the cells from oxidative damage caused by the free radicals. The main constituent responsible for this activity is flavonoid and polyphenols present in the leaves. Gul *et al*. (2013) [31]. Glycyrrhizin, a plant glycoside present in the root extract of *Abrus precatorius* found to be effective against 6lu7, protease responsible for COVID-19 virus analysed through molecular docking. Ratti plant can possibly serve as the natural drug inhibiting the effect of covid-19 virus and shows antiviral activity (Oladimeji and valan (2020) [32].

3. Natural dyes: During recent times synthetic dyes are replaced by natural dyes due to their cost effectiveness, ease of production, eco-friendly and ecological sustainability. The seeds of *Abrus precatorius* are deep red colour and it act as as a natural dying agent in textile industry. The dye produced from the seeds vary in colour from red, pink to deep crimpson color based on the method of processing and different mordant used in that process. The extracted dye from this plant helps in textile industry for dyeing cotton fabrics, silk and wool. In addition to this the dye extracted from the seeds are used in paint and coloring agent in handicrafts. The seeds are used for decorative purposes in traditional ceremony and in recreational activities (MacFoy, 2004) [33].

4. Ecological applications: The role of *Abrus precatorius* in ecology is multifaceted, with both positive and negative implications. In some parts Abrus sp are considered as an invasive species, because of its rapid growth and leads to displacement of native vegetation. Despite this nature, it plays an efficient role in enhancing soil fertility and restoring degraded ecosystem. *Abrus precatorius* facilitate easy seed dispersal of native species through attraction of pollinators like bees, butterflies and birds towards their bright colored seeds. Thus it maintains pollinator population and maintains ecosystem stability (Sen, 2018) [34].

5. Agriculture sector: In agriculture sector *Abrus precatorius* is having numerous insecticidal and soil fertility management properties. The roots, pollen and nodules of *Abrus precatorius* shows nitrogen reductase activity. *Abrus precatorius* accumulate nitrogen rich litter in soil and increase organic matter and nutrient profile of soil. Because of its extensive root system architecture it is used as an erosion control measure in various parts which is susceptible to adequate soil erosion. Various parts of *Abrus precatorius* is having promising role in agricultural pest management as it acts as a natural insecticide and pesticide. The extracts obtained from the seeds of this plant of exhibit insecticidal activity against Diamond Blackmoth larvae (Plutella xylostella) (Prasad, R *et al* 2015) [36]. All parts of this plant are effective in controlling various family of insects like coleopteran (Johri *et al*., 2004; Satyasree, 1999) [37, 44, 38], diptera (Bagavan & Rahuman, 2011, Sakthivadivel & Daniel, 2008; Nazar *et al*., 2009; Manimegalai *et al*., 2011) [39, 40, 41], Hemiptera (Johri *et al*., 2004) [37, 44], isopteran (Prasad *et al*., 2015) [36], lepidoptera (Johri *et al* ., 2004) [37, 44]. The seed extracts of *Abrus precatorius* has been used to synthesize green nanoparticles which possess anti-microbial and anti-oxidant properties (Selvam *et al* 2022) [44]. *Abrus precatorius* seed oil is not edible but it can be used as feedstock for biodiesel production (Obeta, *et al* 2014) [45].

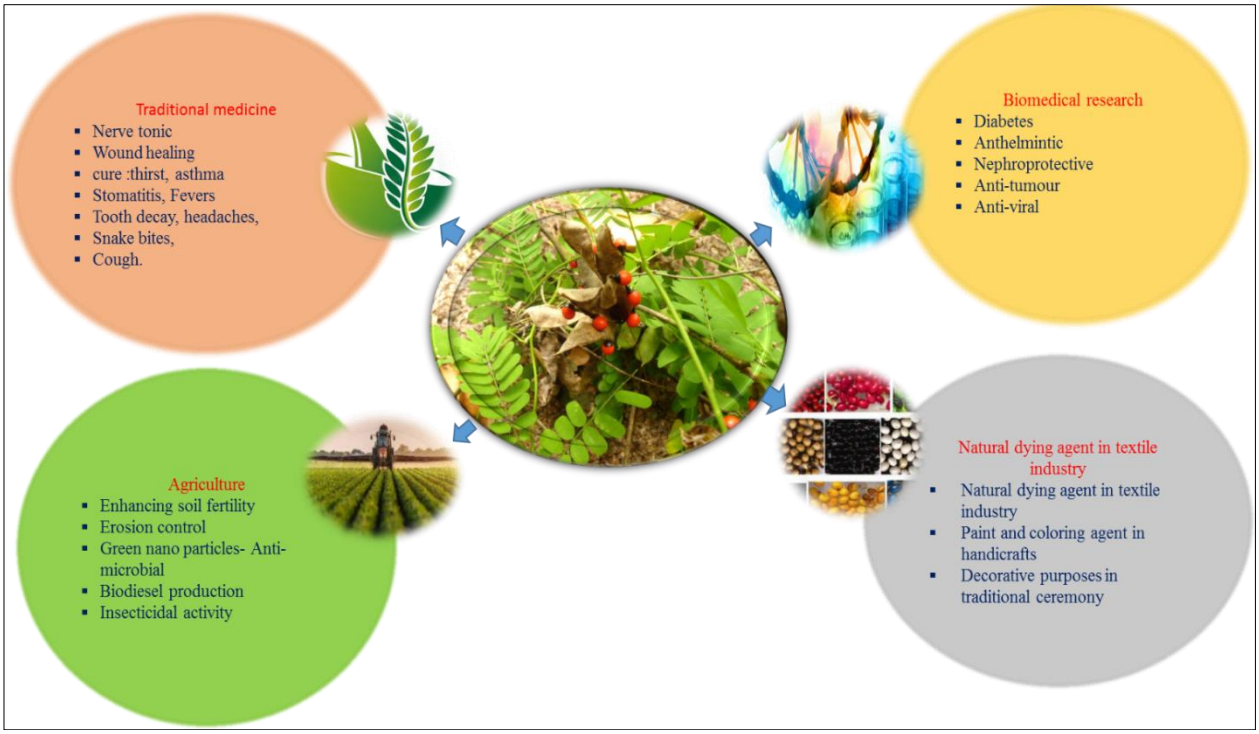

Fig 3: Application of *Abrus precatorius* in various sectors

Conclusion and Future perspective

Since the beginning, medicinal plants have been widely used in herbal medicine as a broad range of pharmacological activities, making them valuable resources for the fight against many illnesses. The diverse range of chemical components found in this adaptable medicinal plant are the only source of the plant's different functions. The present review shows the application of *A. precatorious* in various sectors like traditional medicine, biomedical research, agriculture sector, dyeing industry and ecological sector. The chemicals identified from *Abrus precatorius* L. should be used in a drug research program to create contemporary medications. Since non-toxic plant items with traditional therapeutic uses are becoming more prevalent worldwide, it is important to focus on developing contemporary medications derived from *Abrus precatorius* L. to manage a variety of ailments. Numerous medications have made their way into the global market as a result of research into ethnopharmacology and traditional medicine. According to the current review, *A. precatorius* is a special source of several potential phytochemicals, which makes it a highly significant and adaptable plant with a wide range of medical benefits, including neuroprotective, anti-microbial, analgesic, antimalarial etc. Because of its many therapeutic applications, *Abrus precatorius* L. has enormous potential and should get particular attention from the scientific community in order to become a significant contribution to medical research in the new millennium. In agriculture, this plant extracts are used as an insecticide and also this plant is having soil enrichment properties. It is necessary to do further research on *Abrus precatorius* L. to investigate its hidden regions and potential therapeutic uses for the benefit of humankind.

References

1. Egbuna C, Kumar S, Ifemeje JC, Ezzat SM, Kaliyaperumal S, editors. Phytochemicals as lead compounds for new drug discovery. Amsterdam: Elsevier; c2019.
2. Prabha M, Perumal C, Kumar P, Soundarrajan M, Srinivasan S. Review article: Pharmacological activities of *Abrus precatorius* (L.) seeds. Int J Pharm Med Res. 2015;3(2):195-200.
3. Attal AR, Otari KV, Shete RV, Upasani CD, Nandgude TD. *Abrus precatorius* Linnaeus: a phytopharmacological review. J Pharm Res. 2010;3(11):2585-7.
4. World Plants. Complete plant list. Available from: https://www.worldplants.de/world-plants-complete-list/complete-plant-list0.
5. Okhale SE, Emeka N. *Abrus precatorius* Linn (Fabaceae): phytochemistry, ethnomedicinal uses, ethnopharmacology and pharmacological activities. Int J Pharm Sci Res. 2016;1:37-43.
6. Prabakaran S, Bhardwaj R, Gupta V. Profiling total phenolic content of different seed coloured germplasm of Ratti (*Abrus precatorius*). Indian J Plant Genet Resour. 2021;34(01):90-92. doi: 10.5958/0976-1926.2021.00015.2.
7. Karthikeyan A, Amalnath SD. *Abrus precatorius* poisoning: a retrospective study of 112 patients. Indian J Crit Care Med. 2017;21(4):224.
8. Al-Qurainy F, Tarroum M, Khan S, Nadeem M, Gaafar ARZ, Alansi S, *et al*. Genome estimation and phytochemical compound identification in the leaves and callus of *Abrus precatorius*; c2022.
9. Nisha SR, Jeeva S, Paul Raj K. Chemical profiling and compound isolation of different extracts of Boucerosia pauciflora Wight using GC-MS analysis. J Emerg Technol Innov Res. 2018;5(6):.
10. Ragasa CY, Lorena GS, Mandia EH, Raga DD, Shen CC. Chemical constituents of *Abrus precatorius*. Am J Essent Oils Nat Prod. 2013;1(2):7-10.
11. Caboni P, Ntalli NG, Aissani N, Cavoski I, Angioni A. Nematicidal activity of (E, E)-2, 4-decadienal and (E)-

2-decenal from Ailanthus altissima against Meloidogyne javanica. J Agric Food Chem. 2012;60:1146-1151. doi: 10.1021/jf204019e.
12. Babu SR, Meena PK, Ramgopal D. Larvicidal activity of different solvent extracts from the seeds of *Abrus precatorius* (L.) against pod borer, *Helicoverpa armigera* (Hubner). J Entomol Zool Stud. 2018;6(2):496-499.
13. Khaleqe A, Aminuddin M, Mulk SAU. Investigations of *Abrus precatorius* L. constituents of dry root. Pak CSIR Bull Monogr. 1966;3:203.
14. Singh RB, Shelley. Polysaccharide structure of degraded glucomannan from *Abrus precatorius* Linn. seeds. J Environ Biol. 2007;28(2):461-464.
15. Garaniya N, Bapodra A. Ethno-botanical and phytopharmacological potential of *Abrus precatorius* L.: A review. Asian Pac J Trop Biomed. 2014;4(Suppl 1)
16. Iyekowa O, Ndubuisi OV. Phytochemical constituents, haematological activities, and GC-MS analysis of isolated oil of Rosary Pea (*Abrus precatorius*) in Wistar rats fed with high lipid diet. Tanzan J Sci. 2022;48(4):863-874.
17. Kubiatowicz Rose B, Benson Lori. Ethnobotany: The safe handling and storage of hazardous ethnobotanical artifacts. Allen Press; 2003;18(1-2):59-73.
18. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Dehradun: International Book Distributors; 2005;I:763-767.
19. Saganuwan SA, Onyeyili PA. Biochemical effects of aqueous leaf extract of *Abrus precatorius* (L.) (jequirity bean) in Swiss albino mice. Herba Pol. 2010;56(3):63-80.
20. Davis JH. *Abrus precatorius* (L.) (Rosary Pea): The most common lethal plant poison. J Fla Med Assoc. 1979;65:189-191.
21. Frohne D, Pfander HJ. A Colour Atlas of Poisonous Plants. Germany: Wolfe Publishing Ltd.; 1983. p. 291.
22. Burkill HM. The Useful Plants of West Tropical Africa. Kew: Royal Botanical Gardens; c1997, 2.
23. Adedapo AA, Omoloye OA, Ohore OG. Studies on the toxicity of an aqueous extract of the leaves of *Abrus precatorius* (L.) on rats. *Onderstepoort* J Vet Res. 2007;74:31-36.
24. Daniel M. Medicinal Plants: Chemistry and Properties. 1st ed. New Delhi: Oxford and IBH Publishing House Co. Pvt. Ltd.; c2006. p. 118-119.
25. Adelowotan O, Aibinu I, Aednipekun E, Odugbemi T. The in-vitro antimicrobial activity of *Abrus precatorius* (L.) Fabaceae extract on some clinical pathogens. Niger Postgrad Med J. 2008;15(1):32-37.
26. Gbolade AA. Inventory of antidiabetic plants in selected districts of Lagos State, Nigeria. J Ethnopharmacol. 2009;121:135-139.
27. Selvadurai S, Raju MDD, Rao AV. In-vitro anthelmintic activity of methanolic leaf extract of *Abrus precatorius* L. (Fabaceae). Int J Allied Med Sci Clin Res. 2016;4(3):344-348.
28. Molgaard P, Nielsen SB, Rasmussen DE, Drummond RB, Makaza N, Andreassen J. Anthelmintic screening of Zimbabwean plants traditionally used against schistosomiasis. J Ethnopharmacol. 2001;74(3):257-264.
29. Sohn SH, Lee EY, Lee JH, Kim Y, Shin M, Hong M, *et al*. Screening of herbal medicines for recovery of acetaminophen-induced nephrotoxicity. Environ Toxicol Pharmacol. 2009;27(2):225-230.
30. Qian H, Wang L, Li Y, Wang B, Li C, Fang L, Tang L. The traditional uses, phytochemistry, and pharmacology of *Abrus precatorius* (L.): A comprehensive review. J Ethnopharmacol. 2022;296:115432. doi: 10.1016/j.jep.2022.115432.
31. Gul MZ, Ahmad F, Kondapi AK, Qureshi IA, Ghazi IA. Antioxidant and antiproliferative activities of *Abrus precatorius* (L.) leaf extracts - an in-vitro study. BMC Complement Altern Med. 2013;13:226. doi: 10.1186/1472-6882-13-226.
32. Oladimeji AV, Valan MF. Molecular docking study of bioactive compounds of *Abrus precatorius* (L.) as potential drug inhibitors against COVID-19 protein 6LU7. Kala Sarovar. 2020;23:18-32.
33. MacFoy C. Ethnobotany and sustainable utilization of natural dye plants in Sierra Leone. Econ Bot. 2004;58(1)
34. Sen UK. Assessing the social, ecological, and economic impact on conservation activities within human-modified landscapes: a case study in Jhargram district of West Bengal, India. Int J Conserv Sci. 2018;9(2):391-406.
35. Bhattacharya AB. Studies on nitrate reductase activity in *Abrus precatorius* L. (Kunch).
36. Prasad R, Brodie G, Vanderwoude C, Hodge S. Potential of the weed *Abrus precatorius* Linnaeus (Fabales: Fabaceae) for control of insect pests in the South Pacific: A review. Int J Entomol Res. 2015;3(3):113-24.
37. Johri PK, Singh D, Mourya R, Tiwari D, Bajpai A, Johri R. Ovicidal action and feeding response of certain plant extracts against *Bagrada cruciferarum* (Kirk), *Pieris brassicae* (Linn.) and *Mylabris pustulata* (Thunb). J Appl Zool Res. 2004;15:37-42.
38. Satyasree JG. Biochemical characterization of Abrus lectins, toxins, and agglutinins. PhD thesis, University of Hyderabad, Hyderabad; c1999. p. 70.
39. Bagavan A, Rahuma AA. Evaluation of larvicidal activity of medicinal plant extracts against three mosquito vectors. Asian Pac J Trop Med. 2011;4:29-34.
40. Sakthivadivel M, Daniel T. Evaluation of certain insecticidal plants for the control of vector mosquitoes *viz*. *Culex quinquefasciatus*, *Anopheles stephensi*, and *Aedes aegypti*. Appl Entomol Zool. 2008;43:57-63.
41. Nazar S, Ravikumar S, Williams GP, Ali MS, Suganthi P. Screening of Indian coastal plant extracts for larvicidal activity against *Culex quinquefasciatus*. Indian J Sci Technol. 2009;2:24-27.
42. Manimegalai K, Annapoorani CA, Dhanalakshmi D. Evaluation of larvicidal activity of the leaf and seed extracts of *Abrus precatorius* against *Culex quinquefasciatus* (Diptera: Culicidae). Plant Arch. 2011;11:311-313.
43. Johri PK, Singh D, Mourya R, Tiwari D, Bajpai A, Johri R. Ovicidal action and feeding response of certain plant extracts against *Bagrada cruciferarum* (Kirk), *Pieris brassicae* (Linn.) and *Mylabris pustulata* (Thunb). J Appl Zool Res. 2004;15:37-42.
44. Selvam MS, Tresina PS, Beulah GP, Mohan VR. Phytofabrication of silver nanoparticles using *Abrus*

precatorius L. seed extract and their antioxidant and antibacterial activity. Int J Nano Dimens. 2022;13(2):244-255. doi: 10.22034/ijnd.2022.252558.
45. Obeta JC, Agu CV, Njoku OU, Okonkwo CC, Anaduaka EG. Potentials of non-edible *Abrus precatorius* seed oil towards biodiesel production. Afr J Biotechnol. 2014;13(44):4251-4258.