Publisher
Maharshi Charaka Ayurveda
www.maharshicharaka.in

E-ISSN:2456-3110

Journal of Ayurveda and Integrated Medical Sciences

2025 Volume 10 Number 9 September

Review Article

Panchangula

Therapeutic and toxic effect of Panchangula (Ricinus communis Linn.) in Ayurveda

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DOI:10.21760/jaims.10.9.16

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Eranda (Ricinus communis), commonly known as castor, holds a prominent place in Ayurvedic medicine due to its therapeutic properties. Eranda (Castor oil plant) is highly regarded for its purgative, analgesic, and anti-inflammatory effects. This review aims to explore the traditional uses and pharmacological aspects of Eranda, highlighting its relevance in Agada Tantra for detoxification, healing, and its role in the management of various diseases, especially in the context of toxicity and poisoning. The paper examines the scientific evidence supporting these traditional uses and offers insights into the mechanism of action of Eranda and Ricin, a highly toxic protein isolated from the beans of the castor plant. Additionally, the review addresses the potential benefits and precautions associated with its use, emphasizing the importance of understanding its therapeutic potential in Ayurvedic practice while ensuring safety and efficacy. This comprehensive analysis intends to bridge the gap between ancient wisdom and modern scientific research, reinforcing the significance of Eranda in holistic healthcare.

Keywords: Vedic, Ayurveda, Agada, Eranda, Upavisha, Ricinus communis, Ricin, Toxic, Castor oil plant

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How to Cite this Article

Shakyawar A, Soni S, Shukla U, Rathi S, Malviya A, Therapeutic and toxic effect of Panchangula (Ricinus communis Linn.) in Ayurveda. J Ayu Int Med Sci. 2025;10(9):98-105.

Available From
https://jaims.in/jaims/article/view/4693/

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Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2025-07-10	2025-07-28	2025-08-08	2025-08-18	2025-08-28

Conflict of Interest	Funding	Ethical Approval	Plagiarism X-checker	Note
None	Nil	Not required	10.35	

Introduction

Ayurveda, the ancient system of natural healing, is based on the belief that health and wellness depend on the balance of mind, body, and spirit. One of its branches, *Agada Tantra*, focuses on the study and use of toxins, poisons, and their antidotes, aiming to restore balance and treat various ailments through detoxification. Among the numerous medicinal plants used in this branch, *Eranda* (Castor plant) holds a significant place due to its diverse therapeutic properties. *Eranda* (Family *Euphorbiaceae*) is known for its usefulness in treating a variety of health issues, ranging from digestive disorders to joint pain and skin conditions. However, like many potent medicinal plants, *Eranda* also carries certain negative aspects and potential risks if not used appropriately. This review aims to explore the positive and negative effects of *Eranda*, focusing on its role within *Agada Tantra* and its therapeutic potential in *Ayurveda*.

Image 1: Castor Plant (*Ricinus Communis*)

Image 2: Castor Seeds

Vernacular Names[1]

Language	Synonyms
Hindi	Erandai, Rendi
English	Castor Oil Plant
Telugu	Amudamu
Tamil	Amanakku
Bengali	Bherenda
Kannada	Haralu, Audala
Gujarati	Eranda, Diwelo
Marathi	Erandai
Malayalam	Chittamanakku

Other synonyms[2]: Castor, jara, reri, verends, arand, palma Christi

Classical Name[3]: *Gandharvhasta, Panchangul, Chitrabeeja, Vatari, Chitrak, Urubuk, Hastiparnak, Uttanpatrak, Hastikarna* etc.

Criteria[4]	Synonyms	Meaning
Prabhava (Main action)	Vātāri/Urubaka	Eranda is potent drug against Vātāja diseases.
	Śulaśatru	It is effective remedy against Sula (Abdominal pain)
Lakchana (Botanical features)	Vardhamāna	It germinates and develops very fast.
	Dīrghadanda	It posses long petioles.
	Uttānapatraka	Leaves are much wider and exposed upwards.
	Gandharva Hastaka	The leaves are looks like palm.
	Taruṇa	Plant is firm to touch.
	Amanda	Flowers when bloom plant looks very beautiful.
	Vyadamaka	Plant when moves infloresence looks like dancing.
	Citrabīja	Eranda seeds marked with spots.
	Rakta Eraṇda	Red variety of Eranda
	Śukla Eraṇda	White variety of Eranda.
Upama (Simile)	Pañcāngula/ Hastiparṇika/ Hastaparnika	Leaves of plant looks like palm refers to palmately compound leaf.
	Vyāgrapuccha	Plant inflorescence looks like tiger's tail.

Different Varieties[5]

Dhanvantari Nighantu, Sodhala Nighantu, Kaiyadeva Nighantu, Bhāva Prakāśa Nighantu and *Rāja Nighantu* described two varieties of *Eranda* i.e., *Sveta* (white) and *Rakta* (red) varieties. *Rāja Narahari* mentioned another variety in the name of *Sthüla Eranda*.

Classical Categorization[5]

Caraka	Bhedanīya, Angamardapraśamana, Svédõpaga
Suśruta	*Vidārigandhādi, Adhöbhāgahara, Vātasamśamana*
Vāgbhaṭa	*Vidārigandhādi*

Botanical Features[4]

It is extensive shrub reaches up to 2-3m high. Leaves palmately lobed, generally 7-8 serrated, acute apex, reticulate venation, stalk long 10-30 cm long. Flowers monoicous arranged in large elongated clusters crowded at the end of the branches. Female flowers arranged towards upper portion, male towards the lower part of inflorescence. Fruits are globose 1-2cm long, dichecent, 3- seeded picky capsule.

Part Used[4]: *Pańcānga* (Whole plant).

Explanation of useful part[4]

Shape and size: Roots are hard, cylindrical branched measures up to 1.5-3.5 cm across.

External features: Dull yellowish brown, slightly marked with longitudinal wrinkles, medullary rays.

Internal features: Longitudinal cut surface is creamish yellow coloured with distinct

Fracture: Fibrous

Odour: Odourless

Taste: Acrid.

Distribution: Cultivated throughout India and commonly found in the wild.

Major chemical constituents[5]

Seeds & Leaves: *Ricinine* (toxic alkaloid), 1-Methyl 1-3-cyano-4-methoxy-2-pyridone.

Seed coat: Lupeol, Lipids, phosphatides etc.

Seed oil: arachidic, ricinoluc, palmitic, stearic etc.,

Acids: hexa decanoic, hydrocyanic & uric acids, squalene & tocopherols etc.

Fixed oil, starch, mucilage, resin, bitter principals, pigments, Toxic elements ricin.

Active principle[4]

The seed contains castor oil which has medicinal value and is a pale yellow, viscid liquid with a faint odour and acrid taste. It contains *ricinoleic acid* [$C_{18}H_{34}O_3$].

The press cake left after extraction of the oil contains a toxalbumin called ricin. It is one of the most potent poisons known and is several times more poisonous than even *cobra venom*. Seeds must be crushed or chewed for toxicity to manifest. Swallowing whole seeds is harmless. Cooking or boiling also destroys the toxicity of *ricin*. Ricin is a lectin (Carbohydrate-binding protein) produced in the endosperm of the seeds of the castor oil plant. [6]Ricin toxin a chain can inactivate approximately 1500 ribosomes per minute. These are reports that a single molecule of ricin reaching the crystal can be lethal to a cell.[6]

Ayurvedic properties of *Eranda*[4]

Rasa	Madhura, Kasaya, Katu.
Anurasa	Katu, Kashaya
Guna	Guru, Snigdha, Tikshna
Veerya	Ushna
Vipaka	Madhura
Doshaghnata	Kapha-Vata Samaka
Rogaghna Karma	Sulahar, Sothahara, Yakrtplihahara, Gulmaghna, Bastirogahara, Vrsya, Katisulahara, Sirasulahara, Jwaraghna, Bhagnasandhanakrt, Swasahara, Kasahara, Kusthaghna, Krimiaghna, Savathuhara, Dipana, Pacana, Bhedaka, Arsohghna, Udararogahara, Mutrakrchraghna, Krimiaghna, Pramehahara, Angamardaprasamana
Agra Karma	Erandamula is the best among Vrushya-Vaatahara drugs.
Rogaghnata	Sula, Katisula, Sirasula, Bastiroga, Gulma, Jwara, Bhaghna, Arsas, Agnimandya, Anaha, Udavarta, Mutrakrchra, Krimi, Prameha, Angamardha, Udararoga, Savatu, Kustha, Krimi, Swasa, Kasa.

Toxalbumin or phytotoxin is toxic protein that disable ribosomes & thereby inhibit protein synthesis, & present in plants like in castor, croton or rati. It is antigenic in nature, agglutinates red cells, causes hemolysis & cell destruction. Toxalbumin are similar in structure to toxins found in cholera, tetanus, diptheria, pseudomonas & botulinum; & their physiological & toxic properties are similar to those of viperine snake venom.[7]

Toxic Parts[8]

1. Seed residue - *Ricin*

2. Oil - Triglecride of ricioleic acid

Traditional Uses

As evidence by archaeological findings, the castor plant has been known since immemorial times and its use dates to the prehistoric era.

Ricinoleic and ricinelaidic acid traces were found in wax on a wooden poison applicator, dating back to about 24000 years ago. Entire chapters are dedicated to pharmacology of the castor bean in the ancient Egyptian Ebers or Hearst Papyrus, dating back to before 1500 BCE. Castor bean is indicated as an abortifacient, a laxative, and a remedy for abscess illness or baldness, as well as an ingredient in prescriptions to expel fluid accumulation or promote diuresis. Around 400 BCE, Hippocrates prescribed castor bean oil as a laxative and for its detoxifying action. Similarily Pedanius Dioscorides (40-90 CE), the Greek herbalist and physician in "De Materia Medica", and Pliny the Elder (23-79 CE) in "Naturalis hisroria" described the expectorant, diuretic, emetic, laxative and anti-inflammatory uses of castor beans. In Chinese traditional medicine, Castor beans are also recommended for their anthelmintic properties or to treat ulcers and chronic wounds. In *Ayurveda* medicine, the Castor plant is recommended for rheumatic conditions, gastropathy, constipation, inflammation, fever, bronchitis, cough, skin diseases, colic and lumbago.[9] Although *Eranda* has been traditionally used as an herbal medicine, its modern uses, unfortunately, also encompass its exploitation as an easily produced bioweapon. Additionally, castor oil has been utilized for wound healing, as it helps keep the skin moist and aids in tissue regeneration. *Charaka* has mentioned *Erandamulam* is the best drug among *Vrusya* and *Vatahara drugs.*[10] Its leaves are beneficial in destroying intestinal worms, *Ratodhi*, ear disorders (*Karna Roga*), *Mutrakricchra* (painful urination), and urinary stones (*Pathri*). They increase *Pitta*. Its flowers help relieve glandular swellings, problems related to the anus and vaginal passage, *Gulma*, *Shoola*, and *Urdhvavata*. Its fruits are hot in potency, appetite-stimulating, *Vata-Nashak*, and useful in piles, liver, and spleen disorders. Its seed kernel (Mingi) is *Virechak* (purgative), *Dhatu Parivartak* (tissue transformer), *Krimi-Nashak* (anti-parasitic), aphrodisiac, and beneficial in heart diseases. It is also effective in *Jalodara* (ascites), *Visham Jwar* (intermittent fever), *Kutha*, *Akshep* (convulsions), and similar disorders. The bark of its root is *Virechak*, *Dhatu Parivartak*, helpful in skin diseases, and promotes lactation in women.[11]

Castor oil

Castor oil is categorized as a stimulant purgative. It is one of the oldest purgatives.

Castor oil is a bland vegetable oil obtained from the seeds of *Ricinus communis*. It mainly contains triglyceride of ricinoleic acid which is a polar long-chain fatty acid. Castor oil is hydrolyzed in the ileum by lipase to ricinoleic acid and glycerol. Ricinoleic acid, being polar, is poorly absorbed. It was believed to irritate the mucosa and stimulate intestinal contractions. The primary action is now shown to be decreased intestinal absorption of water and electrolytes, and enhanced secretion by a detergent like action on the mucosa. Structural damage to the villous tips has also been observed. Peristalsis is increased secondarily. Dose 15-25 ml (adults) 5-15 ml (children) is generally taken in the morning. Because the site of action is small intestine, purgation occurs in 2-3 hours-motion is semifluid and often accompanied by griping.

Due to its unpalatability, frequent cramping, a rather violent action, possibility of dehydration and after-constipation (due to complete evacuation of colon), it is no longer a favoured purgative. Regular use is particularly to be avoided-may damage intestinal mucosa.[12] *Eranda Taila* has *Vatanashak* and *Ushna* property[13] and according to *Harita Samhita Eranda tail* is *Ghana, Sheetal* and *Komal* in nature. It is useful in *Bastikarma* and alleviates pain occurring in the *Hridaya, Jangha, Kati* and *Uru*. It is also *Roga Nashaka* in conditions like *Aphara* and acts as a *Rechaka*.[14]

Exploitation of Ricin as a Bio-weapon

Due to its availability, toxicity, ease of production, and lack of treatments, ricin is classified by the CDC as a category B biological weapon and is banned under both the Chemical Weapons Convention (CWC, Schedule 1) and the Biological Weapons Convention (BWC). It is a prime example of a CDC category B agent. Possession or purification of ricin is strictly regulated by the Organization for the Prohibition of Chemical Weapons (OPCW). Even though ricin is 100 times less toxic than botulinum toxin, small-scale exposure events could cause public panic and economic disruption. Though not infectious and with a higher LD_{50} than some toxins, ricin is easily extracted from *Ricinus communis* seeds. Terrorists have successfully purified it, and extraction methods are shared online. Still, the low toxin content in these crude extracts makes large-scale attacks unlikely. Ricin has been considered for various weapon uses. During WWII, the USA and UK weaponized it under the name "compound W."

Its most famous use was in 1978, when Bulgarian dissident Georgi Markov was assassinated in London with a ricin pellet shot from an umbrella.

UN inspections in 1990 found Iraq had produced 10 L of ricin. In 2001, an Al-Qaeda chemist in France produced it, and in 2003 vials with traces were found in a train station. Between 2004 and 2018, ricin-laced letters were sent to U.S. figures like Bill Frist, Barack Obama, and Donald Trump. In 2018, Daesh-linked suspects in Italy and Germany were arrested for planning ricin-based attacks, including contamination of water tanks and explosive devices. These events highlight the ongoing need for ricin countermeasures and therapies.[9]

Mode of Action[15]

Ricin blocks protein synthesis through the inhibition of RNA polymerase. Ricin has a special binding protein that allows it to gain access to the endoplasmic reticulum in gastrointestinal mucosal cells causing severe diarrhoea. Ricin belongs to a group of poisons known as A-B toxin (protein virulence factors secreted by many bacteria pathogens).[11]

Common Formulations[5,16]

Singhanada Guggulu	Rasnairandadi Kasaya
Vatari Guggulu	*Erandadi Taila*
Gandharva-Haritki Churna	*Eranda Saptak Kwath*
Eranda Paka	*Eranda Muladi Kwath*

In *Mahakashaya*[17]

Angmardprash Mahakashaya
Swedopag Mahakashaya
Bhedaniya Mahakashaya

Toxicological Profile[16] (Type of Poison)

Ayurveda: *Sthavara Vanaspatik Visha, Upavisha Visha*

Modern: Irritant Vegetative Poison

Medicinal Dose[18]

1. Mula Churna - ¼ to ½ *Tola*
2. Tail - 1 to 2 Tola

Fatal Dose[16]

1. 5 to 10 seeds or 1 mg / kg body weight of ricin, if taken orally. Much less if injected.
2. Ricin - 6mg

Fatal Period[16] - 2 days to several days.

***Shodhana*[19] -** *Eranda Beej* is purified by cooking it in *Dola Yantra* with coconut water for one *Prahar*.

Toxic Features[7,20]

Inhalation is more potent than oral ingestion.

Dust of seeds may cause

- Watering of eyes and conjunctivitis
- Headache, pharyngitis
- Gastric upset
- Acute nasal inflammation and sneezing
- Asthmatic bronchitis
- Dermatitis

Inhalation causes

Non-cardiogenic pulmonary edema, diffuse necrotizing pneumonia, interstitial and alveolar inflammation and edema.

On ingestion [seen within 10 hours of ingestion]

GIT: Burning pain in throat, colicky abdominal pain/cramping, nausea, thirst, vomiting and diarrhea (often bloody) leading to volume depletion, hypovolemic shock and renal failure.

CNS: Vertigo, drowsiness, delirium, convulsions and coma.

Uremia, jaundice, rapid feeble pulse, cold clammy skin and dehydration.

Local injection induces erythema, induration, blisters and localized necrosis at injection site and swelling of regional lymph nodes. These symptoms may progress to seizure, hypotension, shock, organ failure, pulmonary edema and respiratory failure. Consciousness is retained till death in some cases. In severe cases, there is hemorrhagic gastritis and dehydration. Urea nitrogen, amino acid hydrogen, and inorganic phosphate levels are usually elevated. Delayed CNS toxicity may occur, especially involving cranial nerves. Optic nerve damage has been reported with ricin. Renal damage leads to acute renal failure. Hematuria is often seen. Serum creatinine is usually elevated. Liver damage may occur in serious overdoses.

Laboratory Diagnosis[6,7]

- Liquid chromatography - mass spectrometry and immunoassays.

- Ricinine, an alkaloid can be detected in serum and urine. Comprehensive untargeted urine drug screening testing is highly valuable.
- Ricin-antibody conjugates can be detected in surviving patients after 2 weeks.
- Laboratory studies may show leukocytosis, electrolyte abnormalities, liver failure, renal failure and coagulopathy.
- Chest radiography may be normal or may shows pulmonary edema or pneumonia in people with inhalation exposure.

Differential Diagnosis[6]

- Cellulitis
- Chemotherapeutic drugs
- Capillary leak syndrome
- CBRNE-Staphylococcal enterotoxin B
- Myocardial infraction
- Pneumonia
- Plagues
- Phosgene toxicity
- Q fever
- Salmonella infection
- Shigella infection
- Streptococcus aurea infection
- Tularemia
- Undifferentiated sepsis

Treatment Principle[6,7,20]

1. Decontamination (gastric lavage, activated char-coal).

2. After suspected ricin inhalation or exposure to powdered ricin, remove clothing and wash skin with water.

3. Patients exposed to ricin by inhalation may require airway management and positive-pressure ventilation.

4. In case of ingestion:

- Gastric lavage can be used if the patient ingested ricin within past hours.
- Activated charcoal can be given to patient who have ingested ricin if vomiting has not yet occurred and patient's airway has been secured.
- Emetics and demulcents.
- Administration of glucose and saline for dehydration.
- 2-5 g of sodium bicarbonate is given 8 hourly by mouth to alkalinize the urine.
- Blood transfusion may be needed in some patients.

5. Monitoring for hypoglycemia, hemolysis and complications of hypovolemia. Alkalinization of urine probably has a role in preventing crystallization of hemoglobin and should be considered in severe poisonings.

Ricin vaccine

1. Ricin vaccine is not available and for the general public, according to World Health Organization (WHO).

2. US Army Medical Research Institute of Infectious Diseases (USAMRIID) has been working on ricin vaccines since the late 1980s, exploring different approaches like ricin toxoid and chemically D-glycosylated ricin A subunit.[21]

Ayurvedic Antidote[8]

Cow milk or Cow *Ghrit, Shunthi Phant.*

Post- Mortem Appearance[16]

External - Not specific

Internal - Inflammation & congestion with erosion & sub mucosal hemorrhage in GIT. Fragment of seed residue may be found in stomach, hemorrhage in internal organ.

Ricin produces hemorrhagic inflammation of the gastrointestinal tract even when given subcutaneously. Dilation of the heart, hemorrhages in the pleura, oedema of the liver, kidneys, spleen and lungs are seen.**[15]**

Medico-Legal Aspects[15]

1. Accidental: poisoning may occur in children from eating the seeds.

2. Suicidal: Rare.

3. Homicidal: Rarely the powdered seeds are given for homicide otherwise Mixed with food.

4. The powder of seeds causes conjunctivitis when applied to the eye.

5. Ricin can be used an agent of biological warfare or a weapon of mass destruction (WMD).[7]

Discussion and Conclusion

In *Ayurvedic* literature, *Eranda* is primarily recognized for its ability to balance *Vata* and *Kapha Doshas*, offering therapeutic benefits in treating a wide range of conditions. The purgative and anti-inflammatory properties of *Eranda* make it a key herb in detoxifying the body. It supports the natural metabolic processes, aiding in the elimination of impurities by purgation and rejuvenating tissues. *Eranda* is described as a useful remedy for various ailments like *Jwara, Sula, Sopha, Vastisula, Sirahsula, Svasa, Kapharoga, Kustha, & Amavata.* **[5]** For the preparation of many *Ayurvedic* formulations like *Vatari Guggulu, Singhnada Guggulu, Erandadi Taila, Eranda* is used as one of the ingredients. In modern science, many previous reviews revealed that the plant shows various type of activities such as antioxidative activity, antinociceptive activity, Anti-asthmatic activity, Antifertility activity, Antimicrobial activity, Antihistaminic activity, Antidiabetic activity, Wound healing activity, Lipolytic activity, Hepatoprotective activity, Anti-inflammatory activity, Antiulcer activity, Insecticidal, Larvicidal activity**[22]** that may be due to the presence of the different active components like alkaloids, saponins, steroids, flavonoids, and glycosides have been reported to be present in different parts of *Eranda*.

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