



A review on phytochemical and pharmacological activity of *Ricinus communis* (castor) plant

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Abstract

Medicinal plants have a most important role to preserve the human healthy life. The plant *Ricinus communis* belonging to family Euphorbiaceae, commonly known as castor plant. It is a small tree which is found throughout the India in dry place. All parts of the plant is medicinally important such as root, leaves, fruits, seeds and flowers. Amongst all, the castor plant has high traditional and medicinal value for maintain the disease-free healthy life. Traditionally the plant is used as laxative, purgative and fungicide etc. whereas the plant possesses beneficial effects such as antihistamine, anti-oxidant, anti-asthmatic, antiulcer, immunomodulator, Antifertility, anti-inflammatory, antimicrobial, wound healing, larvicidal, Demulcent and many other medicinal properties. The present research aims to review the medicinal and pharmacological properties of one of such common medicinal plants, *Ricinus communis*. This activity of the plant possess due to the important phytochemical constituents like flavonoids, saponins, glycosides, alkaloids, and steroids etc. The aim of this paper is to explain the details of Phyto-pharmacological properties of *Ricinus communis* for the future research work.

Keywords: *Ricinus communis*, pharmacology, Phytochemical constituent, Euphorbiaceae

Introduction

Herbal plants have always been a viable source of medicine since prehistoric ages. Traditional medicinal plants being easily available are used by many people to treat numerous illnesses. In India, the plant is found all over the India. The plant has medicinally important in traditionally and ayurvedic system of medicine. *Ricinus communis* is commonly known as Errand in Hindi. The plant is widespread throughout tropical regions as ornamental plants. In traditional medicine, there are many natural crude drugs that have the potential to treat many diseases and disorders one of them is *Ricinus communis*; Family: Euphorbiaceae popularly known as castor plant' and commonly known as 'palm of Christ', Jada (Oriya), Verenda (Bengali), Endi (Marathi), Diveli (Gujarati). Not only in India, but the margin of herbal medicine utilization has become quite fascinating worldwide. Herbal components are considered more effective and less risky than conventional chemical derivatives. Still, the absolute absence of any adverse effect might not be possible. Current research work aims to review the medicinal properties of one of such common herbal plants *Ricinus communis*, its possible role as herbal medicine, and assessment for pharmacological properties of Ricinus, an evergreen, fast-growing small tree (shrub) belonging to the Euphorbiaceous family. Thus, it was decided to review some of its major medicinal and pharmacological properties in this article.



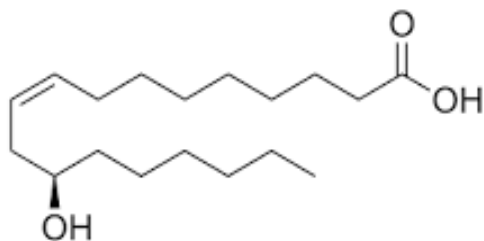
Fig 1: Whole plant



Fig 2: Fruits & Seeds

Phytochemical Constituents

The Preliminary Phytochemical study of *R. communis* presence of steroids, saponins, alkaloids, flavonoids, and glycosides. The dried leaves showed the presence of alkaloids, ricinine (0.55%), N-demethylricinine, flavones, glycosides, kaempferol, kaempferol-3-o- β -D-glucopyranoside, quercetin-3-O- β -monoterpenoids, 1, 8-cineole, camphor, α sesquiterpenoid (β -caryophyllene), gallic acid, quercetin, rutin, epicatechin, ellagic acid ricinoleic, isoricinoleic, stearic, dihydroxy stearic acids, palmitic, arachidic, hexadecenoic, oleic, linoleic and also contain ricinine.



Ricinoleic acid

Pharmacological Activity

Antioxidant activity

It is concluded that *R. communis* antioxidant activity by using lipid method and free radical scavenging effect on 2,2 picrylhydrazyl radical (DPPH) and hydroxyl hydrogen peroxide. The high antioxidant activity of the seed of

communis at low concentration shows that it could be very useful for the treatment of disease resulting from oxidative stress. The responsible chemical constituent of antioxidant activity is Methyl ricinoleate, Ricinoleic acid, 12 octadecadienoic acid and methyl ester stem and leave extracts also produce antioxidant activity due to the presence of flavonoids in their extracts.

Antiasthmatic activity

The ethanolic root extract of *R. communis* is effective in treatment of asthma because of its antiallergic and mast cell stabilizing potential effect. Saponins has mast cell stabilizing effect and the flavonoids possess smooth muscle relaxant and bronchodilator activity; the apigenin and luteolin like flavonoids were generally inhibit basophil histamine release and neutrophils beta glucuronidase release, and finally shows in-vivo antiallergic activity. The *R. communis* ethanolic extract decreases milk induced leucocytosis and eosinophilia and possess antiasthmatic activity due to presence of flavonoids or saponins.

Anti-fertility activity

The methanol extracts of *R. communis* seed possess positive preliminarily Phytochemical tests for both steroids and alkaloids. The pituitary gland releases gonadotrophins due to Sex hormones by both positive and negative feedback mechanism and also the pituitary gland blocks the release of luteinizing hormone (LH) and the follicle-stimulating hormone (FSH) because of the effect of combined oestrogen and progesterone in the luteal phase of the menstrual cycle. Finally, it helps the inhibition of maturation of the follicle in the ovary and prevents ovulation. The sex hormone being steroidal compound's (phytosterols) and the presence of steroids in methanol extract of *Ricinus communis* seed produces anti-fertility effects.

Antihistaminic Activity

The ethanol extract of *R. communis* root resulted anti-histaminic activity at the dose 100, 125, and 150 mg/kg intraperitoneally by using clonidine induced catalepsy in mice.

In vitro immunomodulatory activity

The plant and animal origin immunomodulatory agents generally increase the immune responsiveness of the human body against pathogens by activating the non-specific immune system. The phagocytosis is the engulfment of microorganism by leucocytes. In last the phagocytosis is the intracellular killing of microorganisms by the neutrophils. The presence of tannins in the leaves of *R. communis* significantly increased the phagocytic function of human neutrophils and resulted produces a possible immunomodulatory effect.

Hepatoprotective activity

Ricinus communis leaves ethanolic extract 250/500mg/kg body weight possesses hepatoprotective activity due to their inhibitory activities of an increase in the activities of serum transaminases and the level of liver lipid per oxidation, protein, glycogen, and the activities of acid and alkaline phosphatase in liver induced by carbon tetrachloride (CCL4). The *R. communis* ethanolic extract 250/500mg/kg body weight also treated the depletion of glutathione level and adenosine triphosphatase activity which was observed in the

CCL4-induced rat liver. The presence of flavonoids in ethanol extract of *R. communis* produces beneficial effect the flavonoids have the membrane stabilizing and antiperoxidative effects. Hence the *R. communis* increase the regenerative and reparative capacity of the liver due to the presence of flavonoids and tannins. The anticholestatic and hepatoprotective activity was seen against paracetamol-induced hepatic damage due to the presence of N-demethyl ricinine isolated from the leaves of *Ricinus communis* Linn. The whole leaves of *Ricinus communis* showed the protective effect against liver necrosis as well as fatty changes induced by CCL4 while the glycoside and cold aqueous extract provide protection only against liver necrosis and fatty changes respectively.

Anti-inflammatory activity

Anti-inflammatory activities of the leaves and root extract were studied in Wistar albino rats in acute and chronic inflammatory models. The study indicated that the paw edema formation due to sub plantar administration of carrageenan, characterizing the cellular events of acute inflammation. The 250 and 500 mg/kg dose of *R. communis* methanolic leaves extract possess protective effect in prevention of cellular events during edema formation and in all the stages of acute inflammation. The anti-inflammatory activity of *R. communis* methanolic extract was due to the presence of flavonoids because the flavonoids have the protective effect against carrageenan-induced paw edema in rats.

Antimicrobial activity

The antimicrobial activities of *Ricinus communis* were good against dermatophytic and pathogenic bacterial strains *Streptococcus progenies*, *Staphylococcus aureus* as well as *Klebsiella pneumonia*, *Escherichia coli*. The result showed that the petroleum ether and acetone extracts possess good zone of inhibition whereas ethanolic extract having antibacterial activity only on higher concentration³⁰. The different solvent extracts of roots of *Ricinus communis* (200mg/ml) possess antimicrobial activity by using well diffusion method against pathogenic microorganisms such as *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella typhimurium*, *Proteus vulgaris*, *Bacillus subtilis*, *Candida albicans* and *Aspergillus niger*. The hexane and methanol extracts showed maximum antimicrobial activity where the aqueous extracts have no significant antimicrobial properties.

Antidiabetic activity

The ethanolic extract of roots of *Ricinus communis* (RCRE) was investigated along with its bioassay-guided purification. By Administration of the effective dose (500mg/kg b. w) of RCRE to the diabetic rats for 20 days possess favorable effects not only on fasting blood glucose, but also on total lipid profile and liver and kidney functions. Amongst all fractions the R-18 fraction suggests the significant antihyperglycemic activity. RCRE showed no significant difference in alkaline phosphatase, serum bilirubin, creatinine, serum glutamate oxaloacetate transaminases, serum glutamate pyruvate transaminases and total protein which was observed even after the administration of the extract at a dose of 10 g/kg b.wt. Thus *R. communis* is a potent phytomedicine for diabetes.

Wound healing activity

The *Ricinus communis* possess wound healing activity due to the active constituent of castor oil which produce antioxidant activity and inhibit lipid per oxidation. Those agents whose inhibits lipid per oxidation is believed to increase the viability of collagen fibrils by increasing the strength of collagen fibres, increasing the circulation, preventing the cell damage and by promoting the DNA synthesis. The study of wound healing activity of castor oil was in terms of scar area, % closure of scar area and epithelization in excision wound model. Due to the astringent and antimicrobial property the tannins, flavonoids, triterpenoids and sesquiterpenes promotes the wound healing process, which are responsible for wound contraction and increased rate of epithelialisation. The study resulted that the Castor oil showed wound healing activity by reducing the scar area and also the epithelization time in excision wound model. The comparison study of two different concentrations (5% w/w and 10% w/w) of castor oil was resulted that the 10 % w/w Castor oil ointment possesses better wound-healing property.

Lipolytic activity

The ricin produces the lipolytic activity by using the various substrates: (i) one analogue of triacylglycerol, BAL-TC4; (ii) various chromogenic substrates such as *p*-NP esters of aliphatic short to medium chain acids, and (iii) monomolecular films of a pure natural diacylglycerol, DC10 in emulsion and in a Membrane-like model. The study concluded that ricin from *R. communis* act as a lipase and has the capability of hydrolyzing different lipid classes. Ricin also hydrolyses phospholipids which are the major components of cellular membranes. The lipolytic activities are maximal at pH 7.0 in the presence of 0.2 M galactose. The action of ricin on membrane phospholipids could occur through a phospholipase A1 activity which is very often a minor activity of lipases.

Molluscicidal, Insecticidal and Larvicidal activity

The leaf extract of *R. communis* possess molluscicidal activity against *Lymnaea acuminata* and the seed extracts showed better insecticidal and insectistatic activity than the leaf extracts against *S. frugiperda* due to the active ingredients like castor oil and ricinine^{35, 36, 37}. The aqueous leaves extracts of *R. communis* possess suitable Larvicidal activity against *Anopheles arabiensis*, *Callosobruchus chinensis* and *Culex Quinquifasciatus* mosquitoes.

Antiulcer activity

The castor oil of *R. communis* seed possess significant antiulcer properties at a dose of 500 mg/kg and 1000 mg/kg, but at the dose 1000 mg/kg was more potent against the ulceration caused by pylorus ligation, aspirin, and ethanol in rats. The result showed that the antiulcer activity of *R. communis* is due to the cytoprotective action of the drug or strengthening of gastric mucosa and thus enhancing the mucosal defence.

Leishamicrobial

The extracts of *Ricinus communis* have significant antileishmanial properties. The combination of *Ricinus communis* and *Azadirachta indica* extracts has synergistic

effects in the therapy of leishmaniasis. The optimal antiparasitic efficacy of *Ricinus communis* and *A. indica* is 59.5% and 72%, respectively, while the combination of both mixtures has 88% efficacy. The inhibitory concentration *i.e.*, IC50 of *Ricinus communis* and *A. indica* is 16.5 $\mu\text{g mL}^{-1}$ and 11.5 $\mu\text{g mL}^{-1}$, respectively, while a mixture of both has IC50 of 9.0 $\mu\text{g mL}^{-1}$. The combination treatment of both plant extract can be used for isolation of bioactive compounds, their fortification and bioassay-guided fractionation, and this could serve as new medicinal lead structures.

Anticancer

The fruit extract of *Ricinus communis* is a potent contender for the treatment of breast cancer. *Ricinus communis* fruit extract has high efficacy on estrogens-positive MCF-7 and extremely aggressive, triple-negative breast cancer cells (MDA-MB-231 cell line). The extract has anti-metastatic property; it remarkably inhibits the adhesion, invasion, migration, and expression of a metalloproteinase from the matrix of both cell lines. Further, the extract induces apoptosis in such cells. The four detected compounds of *Ricinus communis* fruit extract- Ricinine, Epigallocatechin, p- Coumaric acid, and Ricinoleic acid individually have migration-inhibitory and cytotoxic properties 8. The Zinc oxide characterizes the anti-cancer feature of *R. Communis* that has been demonstrated by the crystalline hexagonal stage of the plant extracts. Here, the syntheses of the nano-particles create the high surface zone for the evaluation of anticancer activity. In regards to this, the hexagonal Wurtzite type of zinc oxide has been confirmed by The HRTEM that is the core reason behind the extensive use of the *Ricinus communis* against cancer treatment. Further, the antioxidant activity and free radical scavenging promote the anti-cancer feature of the *Ricinus communis*.

Laxative and uterine contracting

With changing lifestyle and eating habits, constipation has become a common abdominal issue which every 3 out of 5 individuals face in the world. Consumption of unhealthy food and irregular meal times are some common reasons that affect the digestion activity of the body. *Ricinus communis* acts as a magical drug in increasing bowel movement. Proper bowel movements help in easing constipation issues. Constipation issues are more common in developing countries due to less exposure to medical assistance and knowledge. Castor oil activates uterus contraction and laxation by combining ricinoleic acid, which activates prostaglandin receptors 2. Castor oil and ricinoleic acid bring contraction of the intestinal smooth muscle, which affects gut and uterus motility. Prostaglandin receptors 2 are proved to be effective drugs that help in inducing laxation. *Ricinus communis* not only acts as a laxative but is also a well-known purgative used to treat severe abdominal pain and constipation problems. Doctors usually advise patients with constipation to consume a glass full of lukewarm water mixed with a small quantity of *Ricinus communis* juice extract. The juice of *Ricinus communis* is also available in the form of castor oil available in a chemist shop. The leaf extract of *Ricinus communis* contains remarkable contraction properties, which allow the uterine movements to take place normally. Due to the contraction properties of *Ricinus Communis*, it is also used in radio diagnosis and sonography of males and females before surgical procedures. The drug also plays an important role in inducing labor pains in pregnant ladies. The uterine

contraction property of *Ricinus communis* is the same as that of oxytocin drug that helps in inducing labor pains.

Anticonvulsant Activity

Researchers were screened for *Ricinus communis* leaves for anticonvulsant and Analgesic activity. Epilepsy is a pervading disorder that results in seizure formation because of neuronal discharges of the brain. Various secluded compounds of *Ricinus communis* have shown positive results for anticonvulsant activity and proved to be upright epileptic after the tests were conducted. All the animals showed convulsions after receiving electric shock treatment. Dosage of 60 mg/kg of a compound from *Ricinus communis* seeds was given to the animals, which showed inhibition of seizure to about 80% as compared to the normal drug, which showed 8.89% seizure inhibition. Researchers reveal that epilepsy is a neurological disorder that is commonly seen in the UK, United States, India, and Africa. Until 1940, it was not known that *Ricinus communis* can be used to treat seizures caused in different parts of the brain. Exclusive research on *Ricinus communis* suggested that it contained an enormous level of anticonvulsant properties that can easily reduce the after-effects of seizures. Though many people do not consider the anticonvulsant properties of *Ricinus communis* as beneficial, doctors and other medical professionals widely use this drug to treat multiple epilepsy cases. *Ricinus communis* is not only considered effective in treating seizures and epileptic attacks but is also used to treat other neurological problems such as headaches due to sinusitis and migraine. Indian researchers claim that consuming castor oil mixed with lukewarm treats headaches and a state of confusion. It is advisable to drink castor oil with warm water to treat headaches, watery eyes, and epilepsy.

Larvicidal and Mosquitocidal Activity

Larvicidal activity of *Ricinus communis* extract was found against different mosquito larvae. Studies were carried out on different species of mosquitoes such as *Anopheles gambiae*, *Anopheles stephensi*, *Anopheles salbopictus*, and *Culex quinquefasciatus*, with a fatality rate of 100%. The poisonous concentration of seed extracts of *R. communis* is shown on different larval species 29. Malaria is one of the life-threatening diseases which are caused by bites of certain species of infected *Anopheles* mosquitoes, which transmit parasites to the human body. Malaria is considered being a worldwide contagious disease which is resulting in hundreds of thousands of deaths annually. *Plasmodium falciparum* is commonly known to show resistance to different available anti-malarial medications. Among all, *Ricinus communis* is found to have the maximum activity against the *Anopheles gambiae* which is a route to malaria. Male and female larvae of *Anopheles gambiae* are persuadable to *Ricinus communis* extracts. With the increase in Larvae exposure, it was found that the larvicidal activity of the different extracts was also increasing. The extraction from *Ricinus* was found to be useful against *Anopheles arabiensis* and *Culex quinquefasciatus* 30. An important study based on *Ricinus communis* suggests that the leaves and stems of *Ricinus communis* were mainly used to reduce the infection and fever caused by mosquito bites in European countries. The juice extracted and stored after neutralization is highly beneficial in treating body rashes and redness caused due to mosquito bites. *Ricinus communis* is useful in treating malaria caused due to any species of the female *Anopheles* mosquito. The

Indian community is well aware of the medicinal properties associated with *Ricinus communis*. Since 1900, *Ricinus communis* is one of the most widely used medicine in treating bacterial infections, fever, and skin problems.

Bone Regeneration

Ohio State University depicted that bone regeneration and bone repairs required adequate time to heal and shape the bone normally. In the early years, when there was no effective treatment was used to address bone-related issues, the ancient people used the extracted oil of *Ricinus communis* to repair the bone deformities. Oil of *Ricinus communis* was known to be used in treating different bone-related diseases in ancient times as herbal and mythic medicine. Bone deformities, acute osteomyelitis, articular pains and afflicted limbs are some bone-related diseases that were treated by *R. communis*. *Ricinus communis* has the unique property of bone regeneration without leaving any scar following its damage. Polyurethane resin formation promotes fibroblastic neof ormation which effectively replaces the bone from inside and around the porosities of the biomaterial in which delayed inflammatory reaction is absent. Due to this absence, no signs of systematic toxic effects were observed both in rabbit skulls and rat alveolus. Subsequently, incubating in synthetic body fluids can improve the biological properties of *Ricinus communis* polythene. Calcium phosphate, when mixed with *R. communis* polyurethane could be helpful in matrix mineralization and can be of immense interest while preparing biocompatible material in comparison to the demineralized bone. The slower re-absorption process is one of the benefits of *Ricinus communis* polythene. *Ricinus communis* oil does not contain a lot of medicinal properties such as anticonvulsant, anti-inflammatory, anti-asthmatic, laxative, purgative, antibacterial, and bone regeneration; hence it is widely used across the world.

Ophthalmic Properties

The eyes are one of the most sensitive organs in a body that needs to be taken care of. Irritation, burning, redness, and swelling are some of the issues that can cause various reasons. As eyes make our world look colourful, it is important to maintain the ophthalmic properties of eyes. *Ricinus communis* was studied for more than 50 years to identify its medicinal properties. Researchers suggest that *Ricinus communis* contains oil that can be used as a lubricant to treat dry eyes. The lubrication property not only maintains the hydration level in the eyes but also reduces muscle strain in them. Proper eye muscle contraction and expansion lead to better vision in an individual. *Ricinus communis* oil is also used to remove foreign body particles present in the eye due to accidental reasons. The oil not only soothes eye muscles but also cleans the eyes for better visualization. Usually, ophthalmic solutions are very costly and need regular doses if a person is dealing with an eye infection or retinal trauma. But due to the low cost of oil of *Ricinus Communis*, people prefer this drug against other lubricants available on the market. An eye drop containing the oil of *Ricinus communis* is generally used to cure dry eyes, inflammation, redness, swelling, and watery eyes. Various allopathic drugs such as carboxymethyl cellulose, sodium hyaluronate, polyethylene glycol 400 are some common eye lubricants that can treat eye ailments and dryness.

Conclusion

R. communis or castor plant is a widely traditionally used and potent medicinal plant amongst all the thousands of medicinal plants. The pharmacological activities reported in the present review confirm that the therapeutic value of *R. communis* is much more. It is an important source of compounds with their chemical structures as well as pharmacological properties. The presence of phytochemical constituents and pharmacological activities proved that the plant has a leading capacity for the development of new good efficacy drugs in future.

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