RICINUS COMMUNIS LINN. (ERANDA) – AN AYURVEDIC AND RESEARCH PERSPECTIVES

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Keywords:
Eranda, Ricinus communis Linn., Castor oil, Castor Root

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ABSTRACT

Ricinus communis Linn. commonly known as Eranda in Ayurvedic classics, is a potent classical as well as useful modern herbal medicine. As an Ayurvedic classical drug, it is indicated for many ailments, mostly for Vataj Vikara (in various painful conditions and nervine disfunctions), and all the parts viz. Root and root bark, Stem, Leaves, Seeds and Seeds Oil are being used in different formulations. New advance research studies also show many biological and pharmacological activities like Analgesic, Anti inflammatory, Anti asthematic, Liver Disorders, Anti Bacterial, Fungicidal, Larvicidal, Insecticidal etc. of different herbecious parts of the Ricinus communis Linn. These studies also revalidated the reported activities in Ayurvedic classics.
INTRODUCTION

Eranda (*Ricinus communis* Linn.) is a classical drug of Ayurvedic Materia Medica. Charak classified Eranda under the group of drugs which relieve bodyaches (Angamarda). He further prefers this drug as aphrodisiac and drug of choice to relieve Vata related disorders. One of the famous Rasayana formulation (Rejuvenating recipes) namely *Bramhirasayan*, contains the root of Eranda. The seed oil as suggested for purgation and medieval Ayurvedic texts prescribed *Castor oil* as the prime drug in management of Amavata (Arthritis).

In Ayurveda umpteen numbers of references have been described about *Ricinus communis* Linn. with Root, Leaves, Seeds and Seed oil as useful medicinal part. It is known as Erand in Ayurvedic classics. The oldest references are available in Charak (1000 BC) & Sushrut (200 AD). Bhavprakash (1600 AD) enumerated synonyms such as Gandharvhast, Panchangula, Vardhamaan, Deerghadandak, Vyambadak, Uttanpatrak, Vyaghrapuchchha, Uroobak etc. for Eranda which deal with taxonomical features and medicinal values.

In areas with a suitable climate, castor establishes itself easily as an apparently "native" plant and can often be found on wasteland. Castor seeds have been found in Egyptian tombs dating back to 4000 BC. The slow burning oil was used mostly to fuel lamps. Herodotus and other Greek travelers noted the use of castor seed oil for lighting, body ointments, and improving hair growth and texture. Cleopatra is reputed to have used it to brighten the whites of her eyes. The Ebers Papyrus is an ancient Egyptian medical treatise believed to date from 1552 BC which was translated in 1872, quotes castor oil as a laxative.

An annual to perennial evergreen bush or small tree go up to the height of 18feet or more. Leaves greenish or reddish, 30 – 60 cm diameter, membranous, 5-11 lobed, lobes from oblong linear acute or acuminate, lobe margin dentate, petioled 4-12 inch with gland - serrated, racemes stout, erect, red, monocious, apetale flowers, male flower ½ inch in diameter, female calyx nearly as long, styles often highly coloured, fruits are spiny large capsule, greenish (Some times reddish-purple colour) with poisonous oval, hard coat, mottling, caruncled seeds. The plant is native to Southeastern Mediterranean basin, Eastern Africa and India; now it is available in throughout tropical region.

MATERIALS AND METHODS

Ayurvedic literature consisting of major classical works, lexicons and compendia are referred to note down the details about Eranda with regards to therapeutic claims. The recent research
studies about various parts of the plant are compiled from published data in various journals and web pages. A thorough scan of the therapeutic claims recorded in various Ayurvedic texts clearly indicate that the drug has been projected as one of the important drug weapons of armamentarium of the Ayurvedic physician.

**Ayurvedic perspective:**
Ayurvedic classics namely *Charaksamhita, Sushrutasamhita, Ashtanghridayam, Sharangdharasamhita, Bhavaprakasamhita* and other compendia like *Chakradatta, Gadanighraha* are referred for documentation of the therapeutic claims with regard to various parts of *Eranda* indicated in the management of various conditions.

<table>
<thead>
<tr>
<th>Part Used</th>
<th>Indication</th>
<th>Source</th>
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<tbody>
<tr>
<td>Root</td>
<td>Jwar with Pavikastika (Fever with Tenesmus), Pravahika (Amoebiasis), Udarroga (Ascites).</td>
<td>Charak Samhita</td>
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<td></td>
<td>Shoula (Colic), Sthoulya (Obesity), Vatabhishyandi (Conjunctivitis).</td>
<td>Bhavprakasamhita</td>
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<td>Kamala (Jaundice).</td>
<td>Gadanighraha</td>
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<td></td>
<td>Yuktaradhavasti (Enemata), Parshvashoola (Pain in the Intercostal regions), Amavata (Arthritis)</td>
<td>Sharangdharasamhita</td>
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<tr>
<td>Leaf</td>
<td>Kasa (Cough), Arsha (Piles).</td>
<td>Charaksamhita</td>
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<td></td>
<td>Vata Abhishyandi</td>
<td>Sushrutasamhita</td>
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<td></td>
<td>Naktandhya (Nightblindness).</td>
<td>Ashtanghridaya</td>
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<td></td>
<td>Medovridhi (Obesity), Karnashoola (Ear ach), Drikkapa (Inflamed Eye)</td>
<td>Vangsena</td>
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<td>Mashaka (Melanosma)</td>
<td>Gadanighraha</td>
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<td>Oil</td>
<td>Vatarakta (Gouty Arthritis), Udaverta (Flatulence), Gulma (Tumor).</td>
<td>Charaksamhita</td>
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<td></td>
<td>Apatanak (Convulsions), Vridh (Hernia), Swayathu (Odema).</td>
<td>Sushrutasamhita</td>
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<td>Shleepada (Filariasis),</td>
<td>Ashtanghridaya</td>
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<td>Amavata (Arthritis)</td>
<td>Bhavprakasamhita</td>
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<td></td>
<td>Shoola &amp; Gulma (Colic &amp; Tumors).</td>
<td>Chakradatta</td>
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<td></td>
<td>Yonishula (Vaginismus), Vatakantaka (Calcaned Spur), Arsha (Piles).</td>
<td>Gadanighraha</td>
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<td></td>
<td>Virechana (Purgation)</td>
<td>Sharangdharasamhita</td>
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<tr>
<td>Root, Fruit, Tender Leaf</td>
<td>Vatarakta (Gouty arthritis).</td>
<td>Gadanighraha</td>
</tr>
<tr>
<td>Leaf &amp; Root Bark</td>
<td>Vata Abhishyandi (Conjunctivitis).</td>
<td>Sharangdharasamhita</td>
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**Modern Research studies:**

Scientific validation for different parts of *Ricinus communis* Linn. are documented.

1) **Root**

A significant anti-inflammatory activity of methanolic extract of root of *Ricinus communis* Linn. was observed in Wistar albino rats. Study was performed in carrageenan-induced hind paw edema model at the dose of 250 and 500mg p.o. Significant Anti-inflammatory activity also observed in cotton pellet granuloma model at the dose of 500 mg/kg p.o. The results of the study
indicate that the methanolic extract of *Ricinus communis* Linn. root possess significant anti-inflammatory activity in acute and chronic inflammatory models in rats. The observed pharmacological activity may be due to the presence of phytochemicals like flavonoids, alkaloids and tannins present in the plant extract with various biological activities. Anti-inflammatory effect of ethanolic extract of root bark of *Ricinus communis* Linn. using chicken skin as model. Inflammatory lesions were induced by intradermal injection of histamine and carrageenan in different group of birds. Extract exhibited significant decrease in permeability response at an early stage of histamine as well as in carrageenan induced inflammatory lesions. There was a significant suppression in the emigration of heterophils, monocyteid cells, basophils and total leukocytosis in *Ricinus communis* Linn. root bark ethanolic extract pretreated chicken skin lesions as compared to the control. The present study suggested antihistamine and anti-inflammatory properties of ethanolic extract of root bark of *Ricinus communis* Linn.

Methanolic extract of roots of *Ricinus communis* Linn. showed significant free radical scavenging activity by inhibiting lipid peroxidation initiated by carbon tetrachloride and ferrous sulphate in rat liver and kidney homogenates. The extract enhanced free radical scavenging activity of stable radical 2,2-diphenyl-1-picryl-hydrazyl (DPPH), nitric oxide and hydroxyl radical in *in vitro* assay methods. The observed pharmacological activity may be due to the presence of phytochemicals like flavonoids, alkaloids and tannins present in the plant extract with various biological activities.

The antiasthmatic activity of ethanol extract of *Ricinus communis* Linn. root (ERCR) was evaluated on milk induced leucocytosis and eosinophilia in mice, mast cell degranulations in mice and passive cutaneous anaphylaxis in rats at (100-150 mg/kg.). The ECR significantly decreases milk induced leucocytosis and eosinophilia and protect degranulations of mast cells in mice. At the same dose ECR inhibited passive cutaneous anaphylaxis in rats. Phytochemical study revealed the presence of steroids, saponin, alkaloids, flavonoids and glycosides. The study was concluded that the flavonoids and saponins are reported to posses mast cell stabilizing and antianaphylactic activity. ECR showed antiasthmatic activity may be due to presence of flavonoids and/or saponins.

The ethanol extract of *R. communis* Linn. root resulted anti histaminic activity at the dose 100, 125, and 150 mg/kg intraperitoneally by using clonidine induced catalepsy in mice.
50% ethanolic extract of roots of *Ricinus communis* Linn. along with its bioassay-guided purification was investigated for anti-diabetic activity. Administration of extract ineffective dose to diabetic rats for 20 days showed favorable effects not only on fasting blood glucose, but also on total lipid profile and liver and kidney functions. A fraction (R-18) separated by silica gel column chromatography from extract showed significant antihyperglycemic activity.xii

Cold and hot water, methanol, ethanol, ethyl acetate, acetone, and hexane extracts of leaves, stem and root of *Ricinus communis* Linn. in a final concentration of 500mg/ml were evaluated for their antibacterial properties against pathogenic microorganisms such as *Pseudomonas aeruginosa, Staphylococcus aureus, and Escherichia coli* using agar well diffusion method. In case of leaf methanolic extract was most effective followed by ethanolic and acetone extracts. Hexane extract of stem was most effective followed by acetone and cold aqueous extracts. Acetone, hexane and ethyl acetate extracts of root were most effective.xiii

Cold and Hot water, methanol, ethanol, ethyl acetate, acetone and hexane extracts of leaves, stem and roots of *Ricinus communis* Linn. in a final concentration of 500mg/ml were evaluated for their antifungal properties against pathogenic microorganisms such as *Trycophyton rubrum, Candida albicans, Microsporum spp.* Using agar well diffusion method. In case of leaf; cold aqueous, methanolic and acetone extracts were effective against *Candida albicans* and the most effective being the cold aqueous extract. Only cold aqueous extract of stem was found to be effective against *Trycophyton rubrum*. Cold aqueous extract of root was most effective followed by acetone, ethyl acetate and hexane extracts; cold aqueous extract was effective against *Candida albicans* and *Microsporum Spp.*, ethyl acetate was effective against *Trycophyton rubrum* and *Microsporum Spp.*, acetone extract was effective the all the used pathogens but shows most effective against *Trycophyton rubrum*. Minimum Inhibitory Concentration (MIC) was also calculated for the most effective extracts and it was found to be 31.25mg/ml.xiv

The leaf, stem and root powder extracts of *Ricinus communis* Linn. (Euphorbiaceae) were tested against three different bacteria by disc diffusion method. It was found that acetone and hexane extract possess good zone of inhibition where as ethanolic extract having antibacterial activity only on higher concentration.xv

The different solvent extracts of roots of *Ricinus communis* Linn. (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 has no significant antimicrobial properties.xvi

A 62 kDa protein (Rp) isolated from 50% ethanolic extract of the root of Ricinus communis Linn. Was evaluated for the effect on spermatogenesis in mice (Swiss strain mature male mice). The study showed that sperm motility and count were decreased significantly in the treated group as compared to the control. Hence this study can be concluded that Rp impaired spermatogenesis in vivo by suppressing the production of testosterone.11 Further this study was compared the spermicidal effect of this Rp with nonoxynol-9 (N-9) in vitro. It is concluded that the protein Rp possesses spermicidal activity in vitro and its effects are similar to that of nonoxynol.xvii

Toxicological assessment sought to determine the safety of Ricinus communis Linn. root aqueous and methanol extracts. The extracts were evaluated in the acute toxicity study (OECD-423 guidelines) and 90 days repeated dose toxicological assessment in Wistar albino rats. The acute oral toxicity of the aqueous (AE) and methanol (ME) extracts did not produce any toxic symptoms or mortality at the dose level of 2000 mg/kg in rats. In the 90 days (sub-chronic toxicity) repeated dose toxicity study the extracts (AE and ME) were administered 1000 mg/kg daily through oral route. The sub-chronic toxicity study demonstrated no significant changes in body weight, food, and water intake. Hematology parameters RBC, WBC, DLC, Hb, blood clotting time, and the biochemical parameters glucose, blood urea nitrogen, creatinine, total cholesterol, total protein, total bilirubin AST, ALT, and ALP were estimated. Histopathology observations of the major vital organs (liver, kidney, heart, spleen, lungs, ovary, testis, and brain) were tested. The hematology, biochemical and histopathology evaluations did not show any adverse effects in any of the organs tested. These results demonstrate the non-toxic nature of the root extracts AE and ME can be used for long-term usage in clinical practice.xviii

2) Leaf:

Antinociceptive activity was evaluated of methanol extract of leaves of Ricinus communis Linn. using acetic acid induce writhing test, formalin induce paw licking and tail immersion methods in Albino mice. It exhibited considerable antinociceptive activity and it was concluded that activity potential due to saponin, steroids and alkaloids present in it.xix The protective effects of ethanol extract of Ricinus communis Linn. leaves on carbon tetrachloride (CCl4) induced liver
damage were investigated in rats. Results were compared those for silymarin, a standard hepatoprotective drug. It was found that an increase in the activities of serum transaminases and the level of liver lipid peroxidation, protein, glycogen and the activities of acid and alkaline phosphatase in liver induced by CCl4 were significantly inhibited by treatment with *Ricinus communis* Linn. ethanol extract (250/500mg/kg/b. wt). In addition, the depletion of glutathione level and adenosine triphosphatase activity observed in the CCl4-induced rat liver were effectively prevented by treatment with *Ricinus communis* Linn. ethanol extract (250/500mg/kg b. wt). Histopathological examination further confirmed the hepatoprotective activity of *Ricinus communis* Linn. ethanol extract when compared with the CCl4-induced control rats. In conclusion, these results indicate that the ethanol extract of *Ricinus communis* Linn. exhibits hepatoprotective action.xx

Investigation of hepatoprotective activity of the ethanolic leaf extract of *Ricinus communis* against carbon tetra chloride (Ccl4) induced hepatotoxicity in albino rats. Two different doses of *Ricinus communis* Linn. leaf extract were administered orally for 5 days. The hepatoprotective activity was studied in liver by measuring the parameters like serum levels of Glutamic oxaloacetate transaminase (SGOT), Glutamic pyruvic transaminase (SGPT), Bilirubin, Alkaline phosphatase (ALP) and histological changes in liver of different groups of animals were observed. Ethanol leaf extract of *Ricinus communis* Linn. has reduced all biochemical parameters in comparison with silymarin. The protective effect of the extract on Ccl4 induced damage was confirmed by histopathological examination of the liver. The results were strongly supports the protective effect of ethanolic leaf extract of *Ricinus communis* Linn. against acute liver injury.xxii

Antibacterial activity of the aqueous leaf extract using four bacteria; two Gram-positive bacteria (*Bacillus subtillis*, and *Staphylococcus aureus*) and two Gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) was also carried out, with zone of growth inhibition ranging between 14 and 24 mm.xxii

Antibacterial activity of various leaf extracts of petroleum ether, acetone and ethanol of *Ricinus communis* Linn. Were screened against dermatophytic and pathogenic bacteria such as *Escherichia coli*, *Staphylococcus aureus*, *K. pneumoneae*, *Streptococcus progens* using disc diffusion method. All the extract showed significant anti bacterial properties. The acetone extracts revealed maximum zone of inhibition. These findings established the potential of the
selected leaves of *Ricinus communis* Linn. as an effective anti-bacterial agent. However, further studies are needed to evaluate active compounds and probable medicinal benefits in chemotherapy among humans.\textsuperscript{xxiii}

Hot and cold, ethanol and methanol extract of leaf of *Ricinus communis* Linn. evaluated for antibacterial activity *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*) using agar well diffusion and macro broth dilution methods. All the four test extracts showed inhibition on both *S. aureus* and *E. coli*. Hot and cold ethanol extracts revealed significantly higher inhibition on *S. aureus* than methanol extracts and the hot ethanol extract had the lowest minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) values (5 mg/ml and 10 mg/ml respectively). *E. coli* was highly inhibited by hot extracts of both ethanol and methanol with the MIC and MBC of 40 mg/ml and 80 mg/ml, respectively. This study demonstrate that the hot and cold methanol and ethanol extracts are potential sources for control of *S. aureus* and *E. coli*. Especially, the hot and cold ethanol extracts of leaf of *Ricinus communis* Linn. are more inhibitive against *S. aureus* even at the lower concentration.\textsuperscript{xxiv}

Antibacterial activity of the aqueous leaf extract using four bacteria; two Gram-positive bacteria (*Bacillus subtillis*, and *Staphylococcus aureus*) and two Gram-negative bacteria (*Escherichia coli* and *Pseudomonas aeruginosa*) was carried out and found effective with zone of growth inhibition ranging between 14 and 24 mm.\textsuperscript{xxv}

The antimicrobial activity of the essential oil from *Ricinus communis* Linn. was investigated in order to evaluate its efficacy against twelve bacteria and four fungi species, using disc diffusion and minimum inhibitory concentration methods. The essential oil showed strong antimicrobial activity against all microorganisms tested with higher sensitivity for *Bacillus subtillis*, *Staphylococcus aureus* and *Enterobacter cloaceae*. The cytotoxic and apoptotic effects of the essential oil on HeLa cell lines were examined by MTT assay. The cytotoxicity of the oil was quite strong with IC50 values less than 2.63 mg/ml for both cell lines. The study showed the potential antimicrobial and anti-carcinogenic properties of the essential oil of *Ricinus communis* Linn., indicating the possibilities of its potential use in the formula of natural remedies for the topical treatment of infections.\textsuperscript{xxvi}

The *in vitro* antimicrobial and antifungal activities of the leaf extract in different solvents *viz.*, methanol, ethanol and water extracts of the *Ricinus communis* Linn. investigated with Agar well diffusion method and agar tube dilution method. Methanol leaf extracts were found to be
more active against Gram positive bacteria (*Bacillus subtilis*: ATCC 6059 and *Staphylococcus aureus*: ATCC 6538) as well as Gram negative bacteria (*Pseudomonas aeruginosa*: ATCC 7221 and *Klebsiella pneumoniae*) than ethanol and aqueous leaf extracts. Antifungal activity of methanol and aqueous leaf extracts were also found to be effective against selected fungal strains as *Aspergillus fumigatus* and *Aspergillus flavus*. Methanolic as well as aqueous leaf extracts of *Ricinus communis Linn.* were effective in inhibiting the fungal growth.xxvii

The leaf extracts are active against *Callosobruchus chinensis* L. xxviii Crude extracts have larvicidal activity against *Anopheles arabiensis* and *Culex quinquefasciatus*. xxix The *in vitro* anti-leishmanial activity of the acetone and methanol leaf and seed of *Ricinus communis* Linn., against promastigotes form of *Leishmania donovani* were evaluated. Antiparasitic evaluations of extracts were performed on 96 well plates at 37°C for 24-48 h.the leaf methanol extracts of *R. communis* Linn. showed good anti-leishmanial activity against promastigotes.

3) Seed and Seed Oil:

The seed extract has strong antioxidant activity. It produces an inhibition of aryl hydrocarbon hydroxylase (AHH) activity and H2O2 production by lindane-induced mouse hepatic microsomes, indicating the antioxidant activity of the plant.xxx

The fat-storing endosperm of *Ricinus communis* Linn. was found to contain an ascorbate peroxidase (EC 1.11.1.11), which is nearly as active as catalase (EC 1.11.1.6) in degradation of hydrogen peroxide (H2O2) at its physiological concentrations. This ascorbate peroxidase probably functions together with monodehydroascorbatereductase (EC 1.6.5.4) or dehydroascorbatereductase (EC 1.8.5.1) and glutathione reductase (EC 1.6.4.2) to remove the H2O2 produced during the transformation of fat to carbohydrate in the glyoxysomes.xxxi

It is concluded that *R. communis* Linn. seed extracts produce the antioxidant activity by using lipid per oxidation by ferric thyocynate method and free radical scavenging effect on 2,2 ‐ diphenyl-1picrylhydrazyl radical (DPPH) and hydroxyl radical generated from hydrogen peroxide. The high antioxidant activity of the seed of *R. communis* Linn. at low concentration shows that it could be very useful for the treatment of disease resulting from oxidative stress. The responsible chemical constituent of *R. communis* Linn. which produce antioxidant activity are methyl ricinoleate, ricinoleic acid, 12octadecadienoic acid and methyl ester. The *Ricinus*
*Ricinus communis* Linn. stem and leaf extracts also produce antioxidant activity due to the presence of flavonoids in their extracts.xxxii,xxxiii

The castor oil of *R. communis* seed possess significant anti-ulcer 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* Linn. is due to the cytoprotective action of the drug or strengthening of gastric mucosa and thus enhancing the mucosal defence.xxxiv

Seed extract has been reported to possess high antifertility activity in female reproductive system. This is due to progestational activity and alternation in oestrogen/progesterone balance as well as a direct effect on the uterus and fallopian tube. These results indicate a novel contraceptive effect of seed extract of castor plant due to both hormonal and direct effects on the reproductive system.xxxv

When female rabbits were treated with castor beans of 7.5 mg.kg-1 body weight, it resulted in a 4.3 fold decrease in pregnancy of treated female rabbits compared to the control animals.xxxvi

Castor bean extract and Ricin-A chain has known to have abortifacient effect in rabbits. Rabbits, when treated with both castor bean extract and ricin-A chain (intraperitoneally) for three consecutive days resulted in terminated pregnancy. A significant reduction in progesterone, but not estrogen from plasma level was detected in all treated rabbits compared to control rabbits.xxxvii

Furthermore, a significant reduction in the protein contents of the placenta occurred in rabbits treated with ricin-A chain. Laparotomized rabbits exhibited dead fetuses, separation of placenta and blood clots.39 The anti-implantation and anti-ovulation effects of castor bean extract (CBE) and ricin A-chain (RAC) were evaluated in rabbits and this exhibited a pronounced decrease in maternal body weight gain and in death of all fetuses.xxxviii

The effect of natural substances on spermatozoa motility in rabbits was described in a previous study.xxxix A significant decrease (*P* < 0.01) in the weight of the reproductive organs, sperm functions and serum levels of testosterone was observed in rats when they were treated with *Ricinus communis* Linn. seed extract (RCE). It had been found that there was disorganization in the cytoarchitecture of the testes, disruption of the seminiferous tubules and erosion of the germinal epithelium. RCE has a reversible negative impact on male reproductive functions, which appears to be mediated via gonadal disruption in testosterone secretion.xl
In an in silico study conducted with ricinoleic acid showed that, this acid acts as an inhibitor of human acrosin and thus it is acting as a contraceptive which has spermicidal property.\\n\\nRicinine, a neutral alkaloid isolated from the extract of pericarp of castor bean shows typical central nervous system stimulant effect when administered to mice and the results shows an improved memory consolidation, decrease in exploratory behaviour and catalepsy similar properties.\\nThe Ricinus communis Linn. 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 peroxidation 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 scararea, % 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.\\nThe 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 Linn. 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.\\nThree toxic proteins and one agglutinin were purified from the seeds of Ricinus communis Linn. by a simple and fast method using Sepharose 4-B affinity chromatography followed by Sephadex G-100 gel filtration. The weakly adsorbed ricins A and B were retarded and eluted with the buffer from the affinity chromatographic column, while ricin C and ricinus agglutinin had to be eluted with 0.1 M galactose. Their LD<sub>50</sub> values were 4, 28, 14 and 112 μg per
kg body weight of mice for ricins A, B and C and ricinus agglutinin, respectively. Ricin A is a newly isolated lectin which has a strong inhibitory effect on the growth of tumor cells.41

Seeds have insecticidal activity42, against *Spodoptera frugiperda*43.

4) **Reported activities not mention the parts of *Ricinus communis* Linn.**

A natural polyurethane resin obtained by polymerization of the polyester polyol is derived from the castor bean plant (*Ricinus communis* Linn.) used in endodontics shows anti-inflammatory activity by various models. Male Wistar rats and male Swiss mice were used for the study. In vivo anti-inflammatory activity of *Ricinus communis* Linn. polymer was assessed in the mouse ear edema model using arachidonic acid to induce inflammation. Significant inhibition of the inflammatory response was noted. In granulomatous tissue formation models polymer also show anti-inflammatory activity. Oral administration of the *Ricinus communis* Linn. polymer inhibited of formalin-induced paw edema inflammation. Topical administration of the polymer on oral lesions of mice showed that the oral mucosa was recovered. In *in vitro* assay, the phospholipase A2 enzyme was inhibited by the *Ricinus communis* Linn. polymer in a dose-dependent manner.44

The plant has antibacterial activity against *Escherichia coli*, *Salmonella newport*, *Serratia amarcescens*, *Streptococcus proogens* and *Shigella flexneri*,45 *1 Bacillus subtilis* and *Staphylococcus aureus*,23 *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus vulgaris*, and *Pseudomonas aeruginosa*.46

The antimicrobial activities of *Ricinus communis* were good against Dermatophytic and pathogenic bacterial strains *Streptococcus progenes*, *Staphylococcus aureus* as well as *Klebsiella pneumonia*, *Escherichia coli*. The result showed that the petroleum ether and Acetone extracts possess good zone of inhibition where as ethanolic extract having anti bacterial activity only on higher concentration.47

The selectivity of the neurotoxic lesion of *Ricinus communis* agglutinin I (RCAI) in rat dorsal root ganglia was examined. RCAI was injected in the sural nerve on one side. It concluded that RCAI does not diffuse into and destroy ganglion cells adjacent to those that have transported the substance. Then this selectivity in the effect of RCAI to determine indirectly the relative number of neurons in dorsal root ganglia L4-L6 which contribute to the sciatic nerve and it is concluded that the sciatic nerve receives on average of 64%, 85% and 36%, respectively of its sensory contribution from these ganglia.48
The key neuropathological features of Alzheimer’s disease are abnormal deposition of Aβ plaques and insoluble Aβ peptides in extracellular brain and intracellular neurofibril tangles induced by abnormal tau hyperphosphorylation. μ-Calpain is one of the factors that bridge these Aβ- and hyperphosphorylated tau-mediated pathological pathways. Undecylenic acid (UDA), a naturally occurring unsaturated fatty acid, was discovered as a μ-calpain inhibitor by screening a chemical library using a substrate specific μ-calpain assay method. UDA inhibited Aβ oligomerization and Aβ fibrillation and reversed Aβ-induced neuronal cell death. In addition, UDA scavenged ROS and reversed the levels of proapoptotic proteins induced by ROS in SH-SY5Y cells. UDA inhibited μ-calpain activity with better potency than the known peptide-like μ-calpain inhibitor, MDL28170, in SH-SY5Y and HEK293T cells transfected with the catalytic subunit of μ-calpain. These results suggest that UDA is a novel non-peptide-like μ-calpain inhibitor with good cell permeability and potent neuroprotective effect.

*Ricinus communis* Linn. phytoagglutinin having a high cytotoxicity toward rat ascites tumor cells inhibited the protein and DNA synthesis, but not RNA synthesis, of the cultured cells *in vitro*. Phytoagglutinin covalently attached to large polymers of Sepharose also showed the inhibition of DNA synthesis and the inhibition was counteracted by addition of galactose. The results indicate that interaction of *Ricinus communis* Linn. agglutinin with surface membrane may cause the cellular metabolic alterations.

*Ricinus communis* Linn. agglutinin 1 (RCA-1) can be used as a specific marker to study the development and differentiation of microglial cells in human embryogenesis.

**CONCLUSION**

*Ricinus communis* Linn. is a medicinal herb used from ancient time period till the new scientific era not only in India but also beyond the boundaries e.g. middle east etc. *Eranda* (*Ricinus communis* Linn.) is one of the important medicinal plants included in to Ayurvedic materia medica. All the parts of the plant are utilized in the management of several diseases. In India the castor oil expressed out of seeds are popularly used in the pediatric as well as geriatric population. Modern pediatricians discourage the administration of it to new born and infants as it comes paralytic ileus. It lacks proper documentary evidence and Indians are still following this practice. The medieval Ayurvedic compendia recorded that castor oil is the sheet anchoror head remedy for arthritis (Amavata). The root is suggested in the treatment of Jwar (Fever), Pravahika (Amoebiasis), Shoola (Colic), Sthaulya (Obesity), Abhisyandi (Conjectevitis), Parshvashtool
(Pain in flanks), Amavata (Rheumatoid Arthritis) which clearly indicate that *Erand Moola* (*Castor root*) is possessing analgesic, antipyretic, antispasmodic and anti-inflammatory activities. Castor leaf is indicated in Kasa (Cough), Arsha (Piles), Sthaulya (Obesity), Naktandhya (Night Blindness), Navadrikkopa (Inflammation of eye), Abhishyandi (Conjunctivitis). Castor oil is indicated in the condition like Vatarakta (Gouty arthritis & Vascular disease), Udaverta (Flatulance), Gulma (Tumors), Amavata (Rheumatoid arthritis), Yonishoola (Vaginismus), Vatakantaka (Calneal spur) and Katishoola (Lumbago). *Charak* attributes aphrodisiac property to the root of *Eranda* and vaidya Bapalal suggests that the root may be having some activity on sexual hormones which to be confirmed by research. The root as well as oil help in maintaining the integrity of blood vessels and prevent ischemic changes in all the organs including kidney, heart and brain by their immune-modulatory activity may be useful in the treatment of autoimmune diseases.


The activities mentioned in research communication where in part used was not furnished are anti-inflammatory activity of a polyurethane resin obtained by polymerization of the polyester polyol is derived from *Ricinus communis* Linn., antibacterial and antimicrobial activity, neuroprotective effect of undecylenic acid (UDA), however the undecylenic acid are reported in castor seeds, anti-tumor activity of phytoagglutinin obtained from *Ricinus communis* Linn. Most of the activities documented in Ayurvedic literature are revalidated scientifically by modern researches.
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