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PHYTO AND PHARMACOLOGICAL VALUE OF *RICINUS COMMUNIS* L: A REVIEW

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ABSTRACT
In the last few decades there has been an exponential growth in the field of Herbal medicine. It is getting popularized in developing and developed countries owing to its natural origin and lesser side effects. The large family Euphorbiaceae contains nearly about 300 genera and 7,500 species. Amongst all, the Ricinus communis or castor plant has high traditional and medicinal value for maintaining the disease free healthy life. Traditionally the plant is used as laxative, purgative, fertilizer and fungicide etc. Whereas the plant possess beneficial effects such as antioxidant, antihistamic, Antinociceptive, antiasthmatic, antiulcer, immunemodulatory, antidiabetic, hepatoprotective, antifertility, antiinflammatory, antimicrobial, central nervous system stimulant, lipolytic, wound healing, insecticidal and Larvicidal and many other medicinal properties. This activity of the plant possess due to the important phytochemical constituents like flavonoids, saponins, glycosides, alkaloids and steroids etc. The major phytoconstituent reported in this plant are rutin, gentistic acid, quercetin, gallic acid, kaempferol-3-O-beta-d-rutinoside, kaempferol-3-O-beta-d-xylopyranoid, tannins, Ricin A, B & C, ricinus agglutinin, Indole-3-acetic acid and an alkaloid ricinine. The aim of present article is to explain the phyto and pharmacological value of Ricinus communis L.

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INTRODUCTION

It is truth that without nature human being life is not possible. The food, clothes and shelter are three basic necessity of human beings and an important one necessity is good health, which provided by plant kingdom. Plant kingdoms are the rich source of organic compounds, many of which have been used for medicinal purposes. In traditional medicine, there are many natural crude drugs that have the potential to treat many disease and disorders. One of them is *Ricinus communis.* The plant *Ricinus communis* Linn (Euphorbiaceae), commonly known as Castor oil plant, palm of Christ or Eranda (Hindi), Jada (Oriya),Verenda (Bengali),

Endi (Hindi), Errandi (Marathi), Diveli (Guajarati), is a soft wooden tree widespread throughout tropics and warm regions of the world. It belongs to a monotypic genus, Ricinus and Sub tribe, Ricininae. The Evolution of castor and its relation to other species are currently being investigated. [1, 2] The plant is widespread throughout tropical regions as ornamental plants.

Taxonomic position of *Ricinus communis* L.

Kingdom:	Plantae
Subkingdom:	Tracheobionta
Super division:	Spermatophyta
Division:	Magnoliophyta
Class:	Magnoliopsida
Subclass:	Rosidae
Order:	Malpighiales
Family:	Euphorbiaceae
Subfamily:	Acalyphoideae
Tribe:	Acalypheae
Sub tribe:	Ricininae
Genus:	Ricinus
Species:	communis
Binomial name:	Ricinus communis L.

Morphology:

The castor oil plant can vary greatly in its growth habit and appearance. The variability has been increased by breeders who have selected a range of cultivars for leaf and flower colours, and for oil production. It is a fast-growing, suckering perennial shrub which can reach the size of a small tree (around 12 metres / 39 feet), but it is not cold hardy. The glossy leaves are 15–45 centimetres (5.9–18 in) long, long-stalked, alternate and palmate with 5–12 deep lobes with coarsely toothed segments. In some varieties they start off dark reddish purple or bronze when young, gradually changing to a dark green, sometimes with a reddish tinge, as they mature. The leaves of some other varieties are green practically from the start, whereas in yet others a pigment masks the green colour of all the chlorophyll-bearing parts, leaves, stems and young fruit, so that they remain a dramatic purple-to-reddish-brown throughout the life of the plant. Plants with the dark leaves can be found growing next to those with green leaves, so there probably is only a single gene controlling the production of the pigment in some varieties at least [3]. The stems (and the spherical, spiny seed capsules) also vary in pigmentation. The fruit capsules of some varieties are more showy than the flowers.

The flowers are borne in terminal panicle-like inflorescences of green or, in some varieties, shades of red monoecious flowers without petals. The male flowers are yellowish-green with prominent creamy stamens and are carried in ovoid spikes up to 15 centimetres (5.9 in) long; the female flowers, born at the tips of the spikes, have prominent red stigmas.[4] The fruit is a spiny, greenish (to reddish-purple) capsule containing large, oval, shiny, bean-like, highly poisonous seeds with variable brownish mottling. Castor seeds have a warty appendage called the caruncle, which is a type of elaiosome. The caruncle promotes the dispersal of the seed by ants (myrmecochory).

Distribution:

- In open waste places near settled areas throughout the Philippines.
-Prehistoric introduction; native of the old World.
-Pantropic in distribution.

Parts utilized:

·Roots, leaves, seeds.
·The leaves and seeds, externally; the oil, both inter nal and external.
·Collected year-round, but seeds are best collected from May to August.

Properties:

-Roots plain-tasting, neutral-natured; leaves and stems sweet-pungent tasting, neutral natured, slightly toxic.
-Seeds are exceedingly pungent in taste, warming-natured, purgative; antirheumatic soothes and regulates the gastrointestinal tract.
-Antidote, antiphlogistic, antirheumatic.

Chemistry:

Per 100 g, the leaves are reported to contain on a zero-moisture basis, 24.8 g protein, 5.4 g fat, 57.4 g total carbohydrate, 10.3 g fiber, 12.4 g ash, 2,670 mg Ca, and 460 mg P. The seed contains 5.1–5.6% moisture, 12.0–16.0% protein, 45.0–50.6% oil, 3.1–7.0 NFE, 23.1–27.2% CF, and 2.0–2.2% ash. Seeds are high in phosphorus, 90% in the phytic form.

The castor oil consists principally of ricinoleic acid with only small amounts of dihydroxystearic, linoleic, oleic, and stearic acids. The unsaponifiable matter contains b-sitosterol. The oil-cake from crushing whole seeds contain 9.0% moisture, 6.5% oil, 20.5% protein, 49.0% total carbohydrate and 15.0% ash. The manural value is 6.6% N, 2.6% P_2O_5, and 1.2% K_2O. [5] There are 60 mg/kg uric acid and 7 ppm HCN in the seed. The seeds contain a powerful lipase, employed for commercial hydrolysis of fats, also amylase, invertase, maltase, endotrypsin, glycolic acid, oxidase, ribonuclease, and a fat-soluble zymogen. Sprouting seeds contain catalase, peroxidase and reductase.

Toxicity:

The seeds contain 2.8–3% toxic substances, 2.5–20 seed killing a man, 4 a rabbit, 5 a sheep, 6 an ox, 6 a horse, 7 a pig, 11 a dog, but 80 for cocks and ducks. The principal toxin is the albumin, ricin. However, it produces antigenic or immunizing activity, producing in small doses an antitoxin analagous to that produced against bacteria.

Habitat and growth:

Although castor is indigenous to the southeastern Mediterranean Basin, Eastern Africa, and India, today it is widespread throughout tropical regions.[6] In areas with a suitable climate, castor establishes itself easily as an apparently "native" plant and can often be found on wasteland. It is also used extensively as a decorative plant in parks and other public areas, particularly as a "dot plant" in traditional bedding schemes. If sown early, under glass, and kept at a temperature of around 20 °C (68 °F) until planted out, the castor oil plant can reach a height of 2–3 metres (6.6–9.8 ft) in a year. In areas prone to frost it is usually shorter, and grown as if it were an annual. [6]

Ecology:

Ranging from Cool Temperate Moist to Wet through Tropical Desert to Wet Forest Life Zones, castorbean is reported to tolerate annual precipitation of 2.0 to 42.9 dm (mean of 68 cases = 12.7) annual temperature of 7.0 to 27.8°C (mean of 68 cases = 20.4) and pH of 4.5 to 8.3 (mean of 29 cases = 6.5). Grows best where temperatures are rather high throughout the season, but seed may fail to set if it is above 38°C for an extended period. Plant requires 140–180 day growing season and is readily killed by frost. Irrigated crops require 2–3.5 acre-feet of water to produce satisfactory yields. High humidity contributes to the development of diseases. Plants do best on fertile, well-drained soils which neither alkaline nor saline; sandy and clayey loams are being best.

Phytochemical constituents of *Ricinus communis* L:

The Preliminary Phytochemical study of *Ricinus Communis* presence of steroids, saponins, alkaloids, flavonoids, and glycosides. The dried leaves of R. communis showed the presence of two alkaloids, ricinine(0.55%) and N-demethylricinine flavones (0.016%) and six flavones glycosides kaempferol-3-O-β-D-xylopyranoside, kaempferol-3-O-β-D-glucopyranoside, quercetin-3-0-β-D-xylopyranoside, quercetin-3-O-β-D-glucopyranoside, kaempferol-3-O-β-rutinoside and quercetin-3-O-β- rutinoside.[7] The monoterpenoids (1, 8-cineole, camphor and α-pinene) and a sesquiterpenoid (β-caryophyllene), gallic acid, quercetin, gentisic acid, rutin, epicatechin and ellagic acid are the major phenolic compounds isolated from leaves. Indole-3-acetic acid has been extracted from the roots. [8, 9] The seeds contain 45% of fixed oil, which consist glycosides of ricinoleic, isoricinoleic, stearic and dihydroxystearic acids and also lipases and a ricinine. [10] The GLC study of castor oil showed the presence of ester form of palmitic (1.2%), stearic (0.7%), arachidic (0.3%), hexadecenoic (0.2%), oleic (3.2%), linoleic (3.4%), ricinoleic (89.4%) and dihydroxy stearic acids.[11] The stem also contains ricinine. The ergo-5-en-3-ol, stigma sterol, Y-sitosterol, fucosterol; and one probucol isolated from ether extract of seeds.The GC-MS analyses of *R. Communis* essential oil using capillary columns are identified compounds like α-thujone (31.71%) and 1, 8-cineole (30.98%), α-pinene (16.88%), camphor (12.92%) and camphene (7.48%).[12] Lupeol and 30-Norlupan-3β-ol-20-one are obtained from coat of castor bean.[13]

Pharmacological importance of *Ricinus communis* L.

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 *Ricinus 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 *Ricinus communis* produces beneficial effect the flavonoids have the membrane stabilizing and antiperoxidative effects. Hence the *Ricinus 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. [14, 15, 16, 17]

Anti-Inflammatory:

Anti-inflammatory and free radical scavenging activities of the methanolic extract of root of Ricinus communis (Euphorbiaceae) Linn. was studied in Wistar albino rats. The methanolic extract at doses 250 and 500 mg/kg *p.o.* exhibited significant ($P < 0.001$) anti-inflammatory activity in carrageen in induced hind paw edema model. The extract at the dose of 500 mg/kg *p.o.* also exhibited significant ($P < 0.001$) antiinflammatory activity in cotton pellet granuloma model.[18]

Anti-Implantation activity:

The ether soluble portion of the methanol extract of *Ricinus communis* var. minor possesses anti-implantation, anticonceptive and estrogenic activity in adult female rats and rabbits when administered subcutaneously at a dose upto 1.2g/kg and 600mg/kg respectively in divided doses. [19]

Molluscicidal and Insecticidal:

The leaf extract of *Ricinus 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. [20, 21, 22]

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 where as ethanolic extract having anti bacterial activity only on higher concentration.[23] 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 has no significant antimicrobial properties.[24]

Anti-fungal:

The secondary infections in the immunocompromised oral cancer cases were due to fungal species.The co-adminstration *Ricinus communis* with the immunosuppressant drugs for the prevention of infection against oral cancer treatment patient show significant result.[25]

Larvicidal and adult emergence inhibition activity:

The *Ricinus communis* seed extract exhibited larvicidal effects with 100 % killing activities at Concentrations 32-64 µg/mL, and with LC50 values 7.10, 11.64 and 16.84 µg/mL for *Culex Quinquefasciatus, Anopheles stephensi* and *Aedes albopictus* larvae respectively. This activity may be due to the synergistic activity of the mixture of bioactive constituents present in the extract. These

finding suggest that *Ricinus communis* seed extracts provided an excellent potential against the Culex quinquefasciatus, Anopheles stephensi and Aedes albopictus mosquitoes vector. [26]

Antioxidant activity:

It is concluded that *Ricinus Communis* seed extracts produced the antioxidant activity by using lipid per oxidation by ferric thiocyanate method and free radical scavenging effect on 2,2-diphenyl-1-picrylhydrazyl radical (DPPH) and hydroxyl radical generated from hydrogen peroxide. The high antioxidant activity of the seed of Ricinus 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 *Ricinus communis* which produce antioxidant activity are Methyl ricinoleate, Ricinoleic acid, 12- octadecadienoic acid and methyl ester. [27] The *Ricinus communis* stem and leave extracts also produce antioxidant activity due to the presence of flavonoids in their extracts. [28, 29]

Analgesic activity:

The crude extract of root bark of *R. communis* possesses central analgesic activity in tail flick response model to radiant heat at a dose of 250mg/kg. [30] The ethanolic extract of pericarp of fruit *of Ricinus communis* possesses typical CNS stimulant and neuroleptic effects. The stimulant effects, such as exophthamus, hyperreactivity (evidenced by tremors or by the pinna and grip-strength reaction), memory improvement, and clonic seizures, seem to be due to the presence of the alkaloid ricinine. The main toxic compound of the extract also seems to be ricinine, because animals that died after administration of extract or ricinine showed similar signs: they all died after the occurrence of clonic seizures followed by an apparent breathing arrest. On the other hand, compounds other than ricinine may be responsible for the neuroleptic-like effects of the extract, because ricinine did not cause reduction of locomotor activity or catalepsy in the mice.[31]

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. [32]

Antitumour activity:

Ricin A, a lectin isolated from *R. communis* possess antitumor activity, it was more toxic to tumor cells than to non transformed cells, judged from the ED50 of the lectin towards tumor cells and non-transformed cells. [33]

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 favourable 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. [34]

Antinociceptive activity:

The methanol extract of *Ricinus communis* leaves possesses antinociceptive activity in writhing test, formalin induced paw licking and tail immersion method in mice. [35]

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 block 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. [36, 37]

Antiasthmatic activity:

The ethanol extract of *Ricinus communis* roots possess antiasthmatic activity. It significantly decreases milk induced leucocytosis and eosinophilia and protect degranulations of mast cells in mice. [38]

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 properties. [39]

Cytotoxic activity:

Ricin is a heterodimeric protein from the seeds of Ricinus communis. It has cytotoxic activity by virtue of its ability to fatally disrupt protein synthesis. The cell entry process by ricin is postulated to be a 10 step process, which culminate into the protein synthesis disruption. A single molecule of ricin reaching the cytosol can kill the cell due to this. Therapeutically, it can be used to specifically target and destroy cancer cells. [40] The leaves on the other hand, have another range of cytotoxic phytochemicals which induces apoptosis via translocation of phosphatidyl serine to the external surface of cell membrane and loss of mitochondrial potential. These compounds included three monoterpenoids: 1, 8-cineole, camphor and alpha-pinene and a sesquiterpenoid: beta caryophyllene.[41] The *Ricinus communis* agglutinin I (RCA I), was found to preferentially binds to and is internalized by tumour endothelial cells leading to VEGFR-2 down-regulation, endothelial cells apoptosis and tumour vessel regression. It has no effect on normal blood vessels. [42]

Antiulcer activity:

The castor oil of *Ricinus 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 *Ricinus communis* is due to the cytoprotective action of the drug or strengthening of gastric mucosa and thus enhancing the mucosal defence. [43]

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 *Ricinus 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. [44]

Bone regeneration activity:

Ricinus communis polyurethane (RCP) has been studied for its biocompatibility and its ability to stimulate bone regeneration. Results showed that RCP blended with calcium carbonate or calcium phosphate could promote matrix mineralization and are biocompatible materials.[45] Incorporating alkaline phosphatase to RCP with subsequent incubation in Synthetic body fluid could improve the biological properties of RCP. [46] The advantage

seen in RCP as compared to demineralized bone is that the former has a slower reabsorption process. [47]

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 *Ricinus communis* significantly increased the phagocytic function of human neutrophils and resulted produces a possible immunomodulatory effect. [48]

Fig: *Ricinus communis* whole plant and fruit

Fig: *Ricinus communis* as for decorative purposes

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CONCLUSION

Ricinus communis L. is native plant of India. It has various pharmacological actions some of them are reported above. *Ricinus 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 *Ricinus communis* is much more. It is an important source of compounds due to its 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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