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## AN OVERVIEW OF *RICINUS COMMUNIS*: PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE

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### Keywords:

*Ricinus communis*, Ricin, Ricinine, Purgative, Steroids, Glycosides, Alkaloids, Flavonoids, and saponins

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**ABSTRACT:** Medicinal flora is essential for the preservation of human existence. Many people believe that herbs, in their natural medicinal state, are a gift from God to humanity. The use of herbal remedies has skyrocketed in the past few decades. Nearly seven thousand five hundred species make up the vast family *Euphorbiaceae*. The *Ricinus communis* plant, more often known as castor oil, is abundant in India, typically growing wild on abandoned lots, and it has great traditional and therapeutic use for promoting health and warding off illness. Other names include "wonder tree" or "Palma Christi," are similar. Bark, leaves, blossoms, seeds, oil, and other component of a plant is valuable. Ayurveda, Unani, Homeopathy, and Allopathy all make heavy use of this plant's oil as a cathartic. As a purgative, resolvent, anti-arthritis, anti-inflammatory, analgesic, emmenagogue, antidote for *Datura* poisoning, anti-dysenteric, and many more medicinal uses, this plant also has beneficial effects as an antioxidant, antiulcer, immunomodulatory, antidiabetic, hepatoprotective, antimicrobial, stimulant of the central nervous system, wound healer, antifertility, and many more. The plant's action is a result of its significant phytochemical components, which include steroids, glycosides, alkaloids, flavonoids, and saponins. The focus of this article is on the pharmacological and phytochemical characteristics of the *Ricinus communis* Linn plant.

**INTRODUCTION:** Since ancient times, people have relied on natural remedies derived from plants, animals, and minerals to alleviate disease. The practice of medicine has been around for almost as long as humans. The scientific community and their careful observational work have contributed to the gradual expansion of modern medicine, often called allopathy. However, its expansion remains focused upon conventional medical practices and treatments<sup>1</sup>. The current study aims to provide the recent information on *Ricinus communis* (Family: *Euphorbiaceae*) by examining published research in this fields.

The castor plant *Ricinus communis* (Latin word *communis* means "common,") occurred across the globe, and was a native plant before the nomenclature. Mediterranean sheep ticks, *Carolus linnaeus* scientifically known as *Ixodec ricinus*, are called ricinus in Latin. Reason being, seeds resemble ticks quite a little. *Ricinus communis*, grows in every country with a warm or subtropical climate. Its original home was in the region of northeastern and central Africa. Many countries, including China, the United States, Brazil, India, the Soviet Union, and Thailand, are major producers.

Among the seventeen varieties, it can be classified as either annual herbs (which produce smaller seeds) or shrubs and trees (which produce larger seeds)<sup>1, 2</sup>. Healing and intestinal cleansing are two of the many uses for castor oil, a set oil. It is not readily consumable. The seed contains many dangerous compounds in addition to the oil.

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In all, 75% of castor seeds are grain and 25% are hull<sup>2</sup>. The yellowing, aging leaves of *Ricinus communis* convert exogenous ricinine into N-demethylrinine. The castor bean plant is toxic to humans, animals, and other wildlife. One of the primary proteins was dubbed "ricin" by Stillmark in 1888.

**Taxonomical Classification:**

**Kingdom:** Plantae, Plants

**Sub-kingdom:** Tracheophyta

**Super kingdom:** Spermatoph

**Division:** Angiosperms

**Class:** Dicotyledons

**Family:** Euphorbiaceae

**Genus:** Ricinus

**Species:** *communis*

**Morphological Description:** Castor oil is produced by a shrub that is tall, smooth, and branched. Long alternating leaves with 6-7 petiolate lobes that are pointed and palmately lobed. The roots are many and slender. Also, branches are few, hairless and hollow with finger-like leaf around 5–12 sometimes 7–9 in height. The leaves are usually simple, with large leaf blades and palmate shape (10–70 cm long and 15–60 cm wide). The color ranges from purple or dark red, green, or bluish-green color. Long creases run across the otherwise bland exterior, which may be either greenish or yellowish brown. The luscious, dark or purple tips are moist. Fat spikes topped with small, broad, greenish-yellow flowers emerge from the stem's uppermost parts.

There isn't much flare to the flower. The last raceme bloom appears in the late summer. The female flowers stand out on the upper part of the spike due to their delicate stigmas. The male flowers stand out with their vivid yellow anthers and are located on the lowest part of the spike. The fruits are triangular and contain seeds that are somewhat flattened and ellipsoidal or oval. On average, the seeds have a length of around 1 to 2 centimeters and a width of half a centimeter.

While one side has a flat surface, the other side has a single visible raphe and a slightly elevated raphe<sup>4,5</sup>.

**Vernacular Names<sup>6</sup>:**

**English:** Castor, Castor seed

**French:** Ricin

**Italian:** Ricino

**Spanish:** Eranda, Vatari, Rendi, Bofareia,

**Sanskrit:** Eranda, Vatari, Gandharvahasthah

**Hindi:** Rehri, Eranda

**Bengali:** Bharenda

**Tamil:** Amanakkum

**Marathi:** Erandi

**Kannad:** Haralu

**Unani:** Bendanjeer, Arand

**Siddha:** Ammanakku

**Ayurvedic:** Eranda, Chitrabija, Triputi



FIG. 1: *RICINUS COMMUNIS* WHOLE PLANT



FIG. 2: *RICINUS COMMUNIS* SEED

**Ethnomedical uses:** Nearly every part of the *Ricinus communis* plant is useful. A common purgative is the oil that is derived from the seeds. In Ayurveda, castor oil is known as the "King of Purgatives" and the "King of Vaayu disorders". Numerous ailments, such as abscesses, sores, enlarged liver and spleen, asthma, haemorrhoids, digestive problems, colic, fever, headache, lumbago, neurological disorders, joint pain, sciatica, the promotion of menstrual discharge, milk production, and a host of other issues unique to women, have long been treated with castor oil in traditional and alternative medicine. Castor oil, either by itself or in conjunction with quinine sulphate, may cause labour in a full-term pregnancy when taken orally. The oil facilitates the parenteral administration of steroidal hormone. Another use for ricinoleic acid is in contraceptive creams and jellies, as well as in the management of seborrheic dermatitis and other skin disorders. For mass peristalsis, constipation, and bloody or mucousy diarrhea, a combination of warm milk and eranda roots was administered. For rheumatic conditions, internal administration of the expressed oil containing triphala or haritaki was advised. In order to facilitate breastfeeding, nursing mothers would massage their breasts with leaves that had been heated over a fire. Clarified butter was combined with powdered Maatulgur and Eranda seeds as a traditional treatment for infertility<sup>7,8</sup>.

**Commercial uses:** Many diverse items have been made from the plant for a long time. Along with castor oil, which the Egyptians used in their lamps, tombs containing castor beans date back to 4000 B.C. The seeds of this plant, which is native to Africa and India, may be ground into a stable oil.

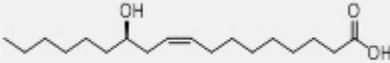
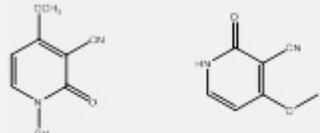
The ancient civilizations of Europe, Asia, Africa, Egypt, Greece, and Rome all made use of it medicinally and therapeutically in the 1600s. Bombs, hydraulic fluids, and aircraft lubricant are all products of castor oil's use by the US military. Its unique ricinoleic acid concentration has made it valuable in several scientific applications, including the production of oils, polymers, detergents, paints, dyes, and faux leather. The textile industry has long made use of sulphonated castor oil in the production of electrical insulations, dyes, and finishes for textiles. Nylon, linoleum, printing ink, enamel, soaps, and paints are among its many other uses.

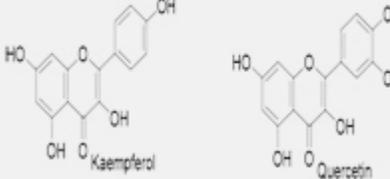
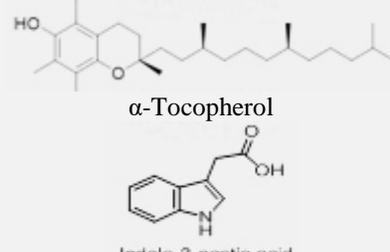
Castor oil is commonly used for the preparation of hair oils, hair fixers, hair lotions, aromatic perfumes, and lipsticks. Castor oil is the most significant product that may be extracted from the seeds. Its primary usage is in the manufacturing of several industrial items; however, it does have medicinal uses as a pain reliever. Fertilizer is the primary application for the leftover seed cake. Cattle are not given this because it contains toxic components. Because of the fat-splitting enzyme they contain, castor seeds have found commercial usage in the food and pharmaceutical industries.

Some parts of eastern Nigeria supposedly utilize castor seeds; however this might be due to their rarity. They need to be cooked and fermented to remove any toxicity before this can be done.

At the present time, no nation produces more castor oil than India. To manufacture gur, sugarcane juice is first clarified in Uttar Pradesh using a castor seed solution diluted in water<sup>9</sup>.

**TABLE 1: PHYTOCHEMICAL PROFILE<sup>10</sup>:**

Constituents	Structure	Plant parts
Carbohydrates (5-58%)		In almost all parts
1. Fatty oil (42-55%)		Mainly in seeds
2. Proteins (20-25%)		Leaves, Roots, Seeds
Triglyceride Ricinoleic acid (85-90%), Dihydrostearic acid, Linoleic acid, Oleic acid, and Stearic acids		Mainly in seeds
4. Alkaloids (Pyridine alkaloids) Ricinine and N demethylricinine		Leaves, Roots, Seeds and Seedlings

5. Toxic substance (Lectins) Ricin -D (RCA-60, RCA-120)		Mainly in seeds
6. Flavonoids (flavonol glycosides) Pairs of xylosides, glucosides and rutinoides of Kaempferol and Quercetin		In almost all parts
7. Coumarins $\beta$ -Amyrin		In leaves
8. Unsaponifiable matter Stigmasterol and $\beta$ -sitosterol		In almost all parts
9. Others IAA, HCN, Uric acid Pigments, Tocopherol		In seeds and other parts

**Pharmacological Profile:** Some of the many beneficial medical effects of *Ricinus communis* include the following: a halt to seizures; intestinal emptying; protection of the liver from carbon tetrachloride and galactosamine in rats; reduction of inflammation and pain; abortion; fights cancer and HIV; kills germs and insects; increases urine production; removes free radicals; improves memory; and acts as a galactagogue and lactagogue.

**Purgative Activity:** Separating the effects of castor oil on rat diarrhoea and tissue damage. It has been reported that giving rats 2 ml of castor oil by mouth caused diarrhoea 1 to 7 hours after the challenge. This was linked to major damage to the lining of the intestines and jejunum. Acid phosphatase was released into the gut cavity along with the damage, which shows that cells were hurt. A nitric oxide (NO) synthase inhibitor called NG-nitro-L-arginine methyl ester (2.5–50 mg kg<sup>-1</sup>, twice daily) was injected intraperitoneally and stopped the diarrhoea<sup>11</sup>.

**Anti-inflammatory Activity:** *Ricinus communis*, commonly known as the castor plant, has demonstrated notable anti-inflammatory properties in various experimental models. Petroleum ether extract of its root (150 mg/kg, p.o.) significantly reduced inflammation induced by agents such as carrageenan, serotonin (5-HT), dextran, and bradykinin in rat paw oedema models, showing comparable effects to standard drugs like phenylbutazone and betamethasone. However, no significant inhibition was observed against PGE1-induced oedema<sup>12, 13, 14</sup>.

Further phytochemical investigation revealed two triterpenes from the n-hexane fraction of methanolic root extract lupeol and a novel compound named erandone (urs-6-ene-3,16-dione). Both the crude extract and purified compounds (100 mg/kg, p.o.) significantly inhibited carrageenan-induced inflammation.<sup>15</sup> In another study, hydroalcoholic extract of *R. communis* leaves (RCE) exhibited dose-dependent anti-inflammatory effects.

At 500 mg/kg, RCE showed significant inhibition of xylene-induced ear oedema, comparable to indomethacin. RCE also significantly reduced carrageenan-induced paw oedema, outperforming chlorpheniramine and showing effects similar to diclofenac<sup>16</sup>.

**Free Radicals Scavenging and Antioxidant Activity:** Multiple studies have confirmed the antioxidant properties of *Ricinus communis* extracts. Methanolic extracts were shown to inhibit ferrous sulphate-induced lipid peroxidation in rat liver and kidney homogenates and scavenge free radicals such as DPPH, nitric oxide, and hydroxyl radicals<sup>11</sup>.

Ethanol extracts of the leaves and bark demonstrated strong DPPH radical scavenging and reducing power, comparable to standard antioxidant gallic acid, indicating the plant as a rich source of natural antioxidants<sup>17</sup>. A comparative solvent-based study using the ABTS assay showed that the methanol extract had the highest scavenging activity (95%), followed by acetone (91%), dichloromethane (62%), and n-hexane (50%)<sup>18</sup>.

**Antimicrobial Activity:** *Ricinus communis* leaf extracts, especially aqueous and acetone, showed strong antimicrobial activity against both gram-negative (*E. coli*, *Enterobacter agglomerans*, *K. pneumoniae*) and gram-positive bacteria (*Staphylococcus aureus*, *Bacillus polymixa*, *Streptococcus pyrogens*, *Streptomyces* spp.). Disc diffusion tests confirmed significant zones of inhibition, with acetone extracts being most effective. A 2% thymol solution was used for comparison<sup>19, 20, 21</sup>. Methanol-based *Ricinus communis* leaf extracts demonstrated stronger antimicrobial activity than ethanol or water extracts, particularly against gram-positive bacteria like *Klebsiella pneumoniae* and *Pseudomonas aeruginosa*, and fungi such as *Aspergillus fumigatus* and *A. flavus*<sup>22</sup>. Seed extracts also showed significant inhibition of *Bacillus subtilis*, *B. cereus*, *Staphylococcus aureus*, *E. coli*, and *Candida* species, with methanol extracts showing the largest zones of inhibition<sup>22</sup>. Similarly, crushed leaves extracted with organic solvents effectively inhibited *S. aureus* and *E. coli*, with *S. aureus* being the most common and virulent strain<sup>24</sup>.

Phytochemical analysis of methanolic and water extracts of *Ricinus communis* L. seeds revealed the presence of coumarins, terpenoids, flavonoids, steroids, reducing sugars, soluble compounds, and emodin's. Gold nanoparticles synthesized from the methanolic extract were confirmed by a UV-Vis peak at 550 nm. Antimicrobial tests showed that the water extract was more effective against *Pseudomonas aeruginosa*, while the methanolic extract was more effective against *Klebsiella pneumoniae*<sup>25</sup>.

**Insecticidal Activity:** Aqueous extracts of *Ricinus communis* leaves had shown strong insecticidal activity, effectively eliminating *Callosobruchus chinensis*, with flavonoids being studied for their potential antimicrobial and insecticidal roles<sup>26</sup>.

Hexane, acetone, and methanol extracts from various plant parts were tested against *Metarhizium sacchari*, with hexane leaf extract (RcLH) achieving 96% mortality after 72 hours, suggesting potential for new insecticide development<sup>27</sup>. Additionally, ethanol leaf extract exhibited hepatoprotective, Choleric, and anticholestatic effects in albino rats, protecting against galactosamine-induced liver damage<sup>11</sup>.

**Hepatoprotective Activity:** *Ricinus communis* leaf powder had shown hepatoprotective effects against carbon tetrachloride (CCl<sub>4</sub>)-induced liver toxicity, improving biochemical markers like GOT, GPT, ALP, glucose, cholesterol, bile, and total protein. Compared to silymarin, it effectively reduced liver damage, likely by inhibiting reactive oxygen species and preventing CCl<sub>4</sub> bioactivation. Microscopic studies confirmed its ability to promote liver cell regeneration and repair<sup>28</sup>.

Ethanol extracts of *Ricinus communis* leaves (250/500 mg/kg b.wt.) effectively protected rats from CCl<sub>4</sub>-induced liver damage by restoring serum enzymes, lipid peroxidation, protein, glycogen, and antioxidant levels, with histopathology confirming liver protection<sup>29</sup>. Similarly, in D-GalN-induced hepatitis, *Ricinus communis* was as effective as silymarin, reducing ALT, AST, ALP, and MDA levels, while improving antioxidant enzymes like catalase, GPx, GR, and GSH in infected rats<sup>30</sup>.

**Neuroprotective and Anticonvulsant Activity:**

*Ricinus communis* exhibits notable neuroprotective effects. Extracts from the pericarp showed dose-dependent CNS effects in mice, impairing reflexes and olfaction at higher doses but enhancing memory and reducing exploratory behaviour at lower doses. Ricinine, an alkaloid isolated from the plant, improved memory and showed anticonvulsant activity without neuroleptic effects<sup>31</sup>. Ethanol extracts of seed rich in phytochemicals significantly reduced MES-induced seizures in mice, supporting its potential use in epilepsy<sup>32</sup>. (Undecylenic acid (UDA) extracted from *R. communis* inhibited  $\beta$ -calpain, blocked A $\beta$  aggregation, and reduced ROS-mediated neuronal damage, indicating its promise for Alzheimer's therapy<sup>33</sup>. Leaf extracts enhanced antioxidant defences and showed protective effects against brain ischemia in rats<sup>34</sup>. Methanolic root extracts also demonstrated strong antiepileptic activity *in-vivo* and in molecular docking studies<sup>35</sup>.

**Antineoplastic Activity and Cytotoxic Activity:**

*Ricinus communis* exhibits notable antitumor and cytotoxic properties. Three seed protein fractions  $\alpha$ -RCL,  $\beta$ -RCL, and  $\psi$ -RCL were isolated, with  $\alpha$ -RCL showing the strongest anti-tumour activity against NK/Ly murine cancer cells with minimal toxicity at 1000  $\mu$ g/kg<sup>36, 37, 38</sup>. Essential oil from *R. communis* effectively killed HeLa cells and various pathogens, with IC<sub>50</sub> values below 2.63 mg/mL, indicating potent cytotoxicity<sup>39</sup>. Fruit extracts inhibited breast cancer cell migration, invasion, and MMP activation in MCF-7 and MDA-MB-231 lines, significantly reducing tumor size in a mouse model<sup>40</sup>. Ricinin, a component of *R. communis*, inhibits protein synthesis by depurinating 28S rRNA, contributing to its toxicity<sup>41</sup>. Cytotoxicity assays on human fibroblasts and macrophages showed low toxicity for dichloromethane and hexane extracts (>90% cell viability), with acetone extract having the lowest LC<sub>50</sub> (544.6  $\mu$ g/mL)<sup>42</sup>. Crude ricin from *R. communis* seeds exhibited cytotoxicity against A549 lung cancer cells with an IC<sub>50</sub> of 40.95 ppm and showed effects on cell migration and autophagy, suggesting chemotherapeutic potential<sup>43</sup>.

**Uterine Stimulant and Abortifacient Effect:**

*Ricinus communis* has demonstrated uterotonic activity. A 33 ml/L hot water extract of leaves and

stems showed mild uterine effects in rats<sup>44</sup>. Ricinoleic acid, a component of castor oil, activates EP3 prostanoid receptors, enhancing uterine contractions. Water extracts of castor seeds increased contraction frequency and force in isolated mouse uterine tissue in a dose-dependent manner effects comparable to oxytocin and stronger than acetylcholine<sup>45</sup>. Clinically, 60 ml of castor oil induced uterine contractions in pregnant women<sup>46</sup>.

**Anti-diabetic Activity:** *Ricinus communis* exhibits significant anti-diabetic potential. A 50% ethanol root extract reduced fasting blood glucose in normal and type 1 diabetic rats at 500 mg/kg, with no observed toxicity<sup>47</sup>. Ethanolic and aqueous-ethanolic leaf extracts improved metabolic and electrolyte profiles in streptozotocin-induced diabetic rats at 600 mg/kg<sup>48</sup>. The plant also showed strong antiglycation activity, with n-butanol root extract achieving up to 88% inhibition indicating potential to prevent diabetes-related complications. Additionally, methanolic extracts inhibited  $\alpha$ -amylase and  $\alpha$ -glucosidase *in-vitro* and reduced glucose absorption in *ex-vivo* intestinal sac models, confirming antihyperglycemic effects<sup>49</sup>.

**Larvicidal Activity:** *Ricinus communis* leaf and seed extracts (methanol, dichloromethane, hexane) showed strong larvicidal effects against *Aedes aegypti* and *Anopheles culicifacies*, with seed methanol extract showing peak activity at 24 hours<sup>50</sup>. Castor oil also demonstrated larvicidal and adulticidal effects against *Aedes aegypti*, with LC<sub>50</sub> values of 51.38 ppm (larvae) and 116.26 ppm (adults), confirming its effectiveness against mosquito vectors<sup>51</sup>. The larvicidal potential of *Ricinus communis* leaf extracts and their synthesized silver nanoparticles (AgNPs) was evaluated. Characterization of AgNPs was done using XRD, UV-Vis, and FTIR techniques. AgNPs showed higher toxicity than the crude extract, with LC<sub>50</sub> and LC<sub>90</sub> values of 46.22 ppm and 85.30 ppm, respectively. HPLC analysis identified active chemical constituents in the leaf extract, highlighting the enhanced larvicidal efficiency of the AgNP formulation<sup>52</sup>.

**Anti-leishmanial Activity:** *Ricinus communis* leaf extracts demonstrated strong anti-leishmanial activity. Chloroform and ethyl acetate fractions

were effective against *Leishmania infantum* amastigotes, with ethyl acetate showing low toxicity (83.5% RAW 264.7 cell viability), comparable to amphotericin B<sup>53</sup>. Methanol extracts of *R. communis* leaves also exhibited high activity against *L. donovani*<sup>54</sup>. Additionally, hydroalcoholic extracts showed potent effects against *L. major* promastigotes, outperforming *Capparis spinosa*<sup>55</sup>.

**Insectistatic and Insecticidal Activity:** Hexane leaf extract of *Ricinus communis*, analyzed by GC-MS, revealed four major fatty acids linolenic (47.76%), linoleic (15.28%), palmitic, and stearic acids. Linolenic and linoleic acids exhibited insecticidal and insectistatic effects against *Spodoptera frugiperda* larvae<sup>56</sup>. Additionally, castor oil, ricinine, and seed extracts (methanol, hexane, ethyl acetate) showed stronger insecticidal and herbicidal activity than leaf extracts against *S. frugiperda*<sup>57</sup>.

**Antiviral Activity:** Nanoparticles biosynthesized from *Ricinus communis* aqueous extracts demonstrated stronger antiviral activity than the crude extracts, inhibiting viral infectivity by 50% at concentrations of 344–375 µg/ml<sup>58</sup>. Leaf extracts showed moderate activity against COXB4 and strong anti-replicative effects against HAV. Methanol and ethyl acetate fractions were effective against HAV, while butanol extract showed mild activity against HSV-1, though less than acyclovir<sup>59</sup>.

**Anti-dandruff and Antifungal Activity:** *Ricinus communis* leaf extracts, especially methanolic ones, showed strong antifungal activity against *Malassezia* spp., the main cause of dandruff, with significant inhibition ( $8.20 \pm 0.3$ ), attributed to flavonoids, saponins, and tannins. Aqueous extracts also showed notable activity ( $5.74 \pm 0.8$ ), while chloroform and petroleum ether extracts were less effective, highlighting the importance of specific phytochemicals<sup>60</sup>. In a comparative study with *Saraca asoca*, *R. communis* extracts inhibited the growth of *Malassezia*, *E. coli*, and *Bacillus*, supporting its potential use in dandruff<sup>61</sup>.

**In Osteoporosis:** Castor-based polyurethane (PU) scaffolds derived from *Ricinus communis* were developed and evaluated for treating bone defects

in an osteoporotic rabbit model. The scaffolds, with an average pore size of  $209.5 \pm 98.2$  µm, showed no cytotoxicity and promoted strong stem cell adhesion *in-vitro*. *In-vivo*, bone regeneration was greatest in the castor PU scaffold group by week 8, with enhanced Oste inductive effects and biocompatibility, indicating its potential for osteoporosis-related bone repair<sup>62</sup>.

**Colorant Potential:** *Ricinus communis* plant parts, such as leaves and fruit coats, have been used to produce natural dyes for cotton and silk, yielding shades of green, brown, and yellow depending on the mordant used. Cotton treated with CuSO<sub>4</sub> produced a vibrant green shade. The dye showed good fastness properties, and the extraction process was found to be safe and cost-effective<sup>63</sup>.

**DISCUSSION:** In this review, the extensive pharmacological potential of *Ricinus communis* has been highlighted through findings reported by various studies. A broad spectrum of bioactivities has been attributed to different parts of the plant, and these activities have been validated using both *in-vitro* and *in-vivo* models. Antimicrobial and antifungal properties have been frequently reported, and strong inhibitory effects have been observed against a variety of pathogenic bacteria and fungi. Hepatoprotective activity has been well documented, particularly in models of chemically induced liver injury, where ethanol extracts of the plant were found to restore liver enzymes and histological architecture. Similarly, neuroprotective effects have been supported by behavioural, histological, and molecular evidence. The antidiabetic potential of *R. communis* has also been explored in several models, where reductions in blood glucose levels and improvements in metabolic profiles were achieved using leaf, root, and seed extracts.

Insecticidal and larvicidal activities have been shown to be highly effective against common vectors like *Aedes aegypti* and *Anopheles culicifacies*, with seed extracts often demonstrating stronger effects than leaf extracts. Nanoparticles synthesized using plant extracts have further enhanced larvicidal and antiviral effectiveness, indicating that biotechnological applications of *R. communis* are also promising. In the context of cancer, cytotoxic and anti-metastatic properties

have been demonstrated against various cell lines, with effectiveness against breast and cervical cancer cells. The use of ricin and ricinine has been shown to inhibit cell proliferation and induce apoptosis. Additionally, extracts have shown efficacy against parasitic infections such as leishmaniasis, offering an alternative to conventional therapies.

Beyond medicinal uses, the plant has been successfully used for natural dye production, showing good fastness and colour variation depending on mordants. Moreover, polyurethane scaffolds derived from *R. communis* oil have been applied in bone regeneration in osteoporotic models, demonstrating biocompatibility and osteoinductive properties.

Collectively, these findings suggest that *Ricinus communis* is a multipurpose plant whose pharmacological effects can be attributed to a diverse set of bioactive compounds. Further studies and clinical trials are recommended to validate its safety and efficacy in humans, and to explore standardized formulations for therapeutic use.

**CONCLUSION:** A wide range of pharmacological and biological activities has been demonstrated by *Ricinus communis* (castor plant). Various extracts derived from its leaves, seeds, roots, and oil have been shown to possess antimicrobial, antifungal, anti-inflammatory, antidiabetic, antileishmanial, and anticancer properties. Hepatoprotective, neuroprotective, larvicidal, insecticidal, and antiviral effects have also been observed. These bioactivities are attributed to the presence of compounds such as ricinoleic acid, flavonoids, and ricinine. Biosynthesized nanoparticles and castor-based polyurethane scaffolds have been utilized in modern applications, including bone regeneration. The plant has also been employed as a natural dye and in the management of dandruff. Overall, *Ricinus communis* is recognized as a plant of significant therapeutic and industrial potential.

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