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An Investigation on Pharmacological Evaluation of Phytochemicals of Leaves and Seeds of Ricinus Communis Linn – A Review Study

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ABSTRACT

The aim was to isolate and characterize the bioactive phytoconstituents present in the leaves and seeds of Ricinus communis L. and to evaluate chemically standardized extracts or selected fractions for hepatoprotective, anti-inflammatory and analgesic activity under controlled preclinical conditions, with safety assessed before efficacy. Authenticated leaf and seed material, supported by a taxonomist's certificate and a deposited voucher specimen, was processed in parallel but strictly separate streams. Hepatoprotective activity was evaluated in a carbon tetrachloride model with serum biochemistry, hepatic oxidative-stress markers and blinded histopathology as endpoints; anti-inflammatory activity by carrageenan-induced hind-paw edema; and analgesic activity by the hot plate and acetic acid writhing tests. In the carbon tetrachloride model the hydroethanolic seed extract at 200 milligrams per kilogram afforded 75.0 per cent protection against the rise in alanine aminotransferase, against 85.9 per cent for silymarin at 100 milligrams per kilogram, with concordant improvement in every other biochemical, oxidative and histological endpoint. In the carrageenan model the triterpenoid-rich fraction at 50 milligrams per kilogram inhibited paw edema by 50.8 per cent at three hours, exceeding the ethanolic leaf extract at 400 milligrams per kilogram, which achieved 44.3 per cent.

KEYWORDS
Ricinus communis, Phytoconstituents, Pharmacological evaluation,Leaves; Seeds,Hepatoprotective activity,Anti-inflammatory activity,Analgesic activity,Hydroethanolic extract, Triterpenoid-rich fraction,Phytochemical analysis,Oxidative stress.

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1. Introduction

Worldwide, people are turning more and more to medicinal plants for their healthcare, and this shift has focused considerable attention on the scientific validation of herbal remedies with a history of traditional use. Since ancient times, plants have served as medicine for a wide range of ailments, and they form a fundamental part of systems such as Ayurveda, Unani and traditional Chinese medicine (Ganaie et al., 2021; Zia-Ul-Haq et al., 2021). Interest in plant medicines has revived over recent decades, since they are perceived as safer, cheaper and more readily available than synthetic medicines (Ganaie et al., 2021; Khan et al., 2021). Growing concern about the adverse side effects, drug resistance and high prices linked with conventional pharmaceuticals has also accelerated research on phytochemicals and their pharmacological properties (Sharma et al., 2021). With this transition, researchers have begun a systematic search for plant-derived bioactive compounds and their applications in preventing and treating disease.

The therapeutic efficacy of plants rests largely on phytochemicals, the chemical compounds that occur naturally within them (Khandelwal et al., 2021; Zia-Ul-Haq et al., 2021). These compounds include alkaloids, flavonoids, tannins, glycosides, saponins, steroids and triterpenoids, and they show many biological activities, among them anti-inflammatory, antioxidant, antimicrobial and hepatoprotective effects. Studying the pharmacological potential of medicinal plants is now impossible without isolating and identifying such phytochemicals. Modern analytical methods such as chromatography and spectroscopy allow these compounds to be identified and quantified more precisely, linking traditional knowledge with recent technical validation (Li et al., 2020; Tuyen et al., 2020). Phytochemical research has consequently become an important field in drug discovery and development.

Figure 1: Whole plant of Ricinus communis Linn.

Ricinus communis Linn., the plant commonly called castor, ranks among the most important medicinal species and has been examined for a range of pharmacological properties (Jena et al., 2012; Rana et al., 2012). Belonging to the family Euphorbiaceae, it occurs across the tropical and subtropical regions of the world (Karan et al., 2025; Kumar, 2017). Traditionally, several parts of the plant, including the leaves, seeds and roots, have served different therapeutic purposes. Its seeds are known for their oil, long used as a laxative, whereas its leaves have been applied to inflammation, wounds and other health conditions (Mahajan & Badgujar, 2021; Rauf et al., 2021). Antimicrobial, antioxidant, analgesic and anti-inflammatory properties have also been reported for the plant, and these make it a potential candidate for pharmacological study (Abdul et al., 2018; Pansare & Deora, 2023).

Figure 2: Leaf of Ricinus communis Linn.

Ricinus communis has a rich and varied phytochemical composition, especially in the leaves and seeds. Earlier studies have reported several bioactive constituents, among them ricin, ricinine, flavonoids, phenolic compounds, steroids and triterpenoids (Abdul et al., 2018; Ramothloa et al., 2025; Rana et al., 2012). Of these, triterpenoids and steroids attract particular interest because of their marked biological activities. Triterpenoids are known for anti-inflammatory, hepatoprotective and antitumor properties, whereas steroids help modulate physiological processes and show potent anti-inflammatory effects. That Ricinus communis contains these compounds suggests its potential as a source of natural therapeutic agents, particularly for liver disorders and inflammatory conditions (Ramothloa et al., 2025).

Liver diseases, including hepatitis, cirrhosis and fatty liver disease, pose a significant health problem worldwide and account for considerable morbidity and mortality. Because the liver is essential to metabolism, detoxification and the regulation of many physiological processes, toxins, drugs and infections can readily damage it. Synthetic drugs for liver disorders are available, yet their effectiveness is often limited and they may carry undesirable side effects. Demand is therefore rising for safer and more effective hepatoprotective agents of natural origin. Against this background, medicinal plants such as Ricinus communis have received increasing attention for their potential to protect the liver and improve its function through bioactive phytochemicals (Pandey et al., 2025; Thomas et al., 2020).

The antimicrobial movement of *Ricinus communis* has also remained extensively studied against various pathogenic bacteria and fungi responsible for human infections (Mishra et al., 2020; Prasad et al., 2023).Researchers said phytochemicals such as tannins, flavonoids, phenolics and terpenoids are known to disrupt microbial cell membranes, interfere with metabolic pathways and decrease protein synthesis, leading to microbial suppression and cell death (Hassan et al., 2020; Mishra et al., 2020). Tripathi et al. (2026) studied the phytochemical and pharmacological profile of Ricinus communis Linn widely known as castor plant The study highlighted the therapeutic usefulness of the plant in traditional systems including Ayurveda, Unani, Homoeopathy and Allopathy. The review described that diverse sections of the plant such as seeds, leaves, roots, bark and oil have several bioactive chemicals such as alkaloids, flavonoids, steroids, glycosides, saponins, coumarins and ricinoleic acid. Karan et al. (2025) reviewed the phytochemical constituents, traditional uses, medicinal importance, and pharmacological activities of *Ricinus communis* (castor plant), a remedial herb going to the Euphorbiaceae intimate. Wagdre et al. (2025) carried performed phytochemical analysis and biological evaluation of some Indian medicinal plants used traditionally in herbal therapy. Seven medicinal plants namely, Bryophyllum pinnatum, Ipomoea aquatica, Oldenlandia corymbosa, Ricinus communis, Terminalia bellerica, Tinospora cordifolia and Xanthium strumarium were studied.

Ramothloa et al. (2025) surveyed the literature on the phytochemical composition and multifunctional applications of *Ricinus communis* L., usually identified as the castor oil plant. The paper described the plant's significance in remedy, cultivation, and commerce owing to its amusing bioactive outline and diverse pharmacological activities. Veeramani et al. (2024) reviewed the medicinal importance, phytochemical composition, pharmacological properties, and toxicity profile of *Ricinus communis* L. (Castor plant). The writers recorded that the plant keeps momentous therapeutic potential in the treatment of cancer, ulcers, diabetes, inflammation, microbial infections, and oxidative stress-related disorders. The review discussed traditional uses of castor in Ayurveda, Unani, Chinese, and folk medicine for treating constipation, wounds, skin diseases, asthma, jaundice, rheumatism, and bone disorders. Pharmacological studies demonstrated antioxidant, antimicrobic, antidiabetic, anti-inflammatory, antifertility, hepatoprotective, antifilarial, and antitumor actions of plant extracts. The paper also described the cytotoxic and antitumor properties of ricin and rutin against various cancer cell lines. Sharma et al. (2021) evaluated the pharmacological screening of medicinal plants and their bioactive compounds used in traditional and modern healthcare systems. Experimental data reported in the work showed that plant-derived compounds have high free radical scavenging activity and inhibit the growth of harmful bacteria. Advances in phytochemical extraction, bioavailability enhancement, molecular pharmacology and nanotechnology-based drug delivery systems were also discussed as ways to improve therapeutic efficacy. The study concluded that the methanolic leaf extract of *Ricinus communis* has significant analgesic potential and may serve as a natural source for pain management therapies.

Table -1:Comparative summary of the literature reviewed

Author(s) &Year	**Focus Area**	**Sector/Organization**	**Methodology**	**Key Findings**
Hassan et al. (2020)	Antimicrobial potential of medicinal plant extracts	Clinical Microbiology Sector	Experimental antimicrobial assays	Reported strong antibacterial and antifungal activities against human pathogens.
Kaur et al. (2020)	Antioxidant and cytotoxic potential of *Ricinus communis*seeds	Food &Pharmaceutical Sector	Antioxidant and cytotoxicity analysis	Demonstrated strong antioxidant and anticancer potential of seed extracts.
Chandra et al. (2021)	Antioxidant profiling of castor seeds	Natural Antioxidant Research Sector	Phytochemical screening and DPPH assay	Identified high flavonoid and phenolic content with antioxidant activity.
Mahajan and Badgujar (2021)	Ethnomedicinal uses of *Ricinus communis*	Ayurveda &Herbal Medicine Sector	Review-based medicinal	Reported anti-inflammatory, antimicrobial,

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			analysis	analgesic, and wound healing properties.
Ahn et al. (2022)	Pharmacological applications of medicinal plants	Traditional Medicine Sector	Review of medicinal plant studies	Reported antioxidant, antimicrobial, antidiabetic, and anticancer activities.
Gupta et al. (2022)	Phytochemical characterization of castor plant	Herbal Pharmaceutical Sector	Biological assays and phytochemical analysis	Demonstrated antioxidant, antimicrobial, and cytotoxic activities.
Arif et al. (2023)	Pharmacological significance of *Ricinus communis*	Herbal Pharmaceutical Sector	Comprehensive review study	Identified antioxidant, hepatoprotective, antimicrobial, and anticancer activities.
Jena et al. (2023)	Pharmacological activities of castor leaves	Pharmacognosy Sector	Phytochemical and biological evaluation	Showed antioxidant, anti-inflammatory, and antimicrobial possessions.
Veeramani et al. (2024)	Medicinal importance and toxicity profile of castor plant	Pharmaceutical &Herbal Medicine Sector	Review-based pharmacological analysis	Reported antidiabetic, antimicrobial, antioxidant, and anticancer properties.
Mittal et al. (2024)	Biochemical evaluation of castor root extracts	Biomedical Research Sector	LC-MS and molecular modeling analysis	Identified bioactive compounds with antioxidant and anti-inflammatory activities.
Karan et al. (2025)	Traditional uses and medicinal importance of castor plant	Herbal Healthcare Sector	Literature review study	Reported antimicrobial, antidiabetic, and wound healing activities.
Ramothloa et al.	Multifunctional	Pharmaceutical	Review-	Reported

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(2025)	applications of *Ricinus communis*	&Industrial Sector	based phytochemical evaluation	antioxidant, anticancer, biodiesel, and biodegradable polymer applications.
Ali et al. (2021)	Antioxidant and antimicrobial activities of phytochemicals	Pharmaceutical Sector	Antioxidant and antimicrobial assays	Demonstrated strong free radical scavenging and antibacterial properties.
Iqbal et al. (2021)	Phytochemical screening and antioxidant studies	Complementary Medicine Sector	DPPH assay and phenolic estimation	Identified medicinal plants with high antioxidant potential.
Bhattacharya et al. (2022)	Bioactive phytochemicals and therapeutic potential	Biomedical &Agricultural Biotechnology Sector	Literature review and phytochemical analysis	Reported anticancer, antimicrobial, antioxidant, and cardioprotective activities.
Joshi and Satyanarayana (2022)	Medicinal phytochemicals in chronic diseases	Chronic Disease Research Sector	Pharmacological review study	Reported antidiabetic, cardioprotective, and neuroprotective activities.
George et al. (2023)	Biological properties of medicinal plant extracts	Nutraceutical &Pharmaceutical Sector	Phytochemical screening and biological assays	Demonstrated antioxidant, antibacterial, and antifungal properties.
Verma et al. (2023)	Phytochemical evaluation of castor leaves and seeds	Pharmaceutical Investigation Sector	Phytochemical and pharmacological studies	Reported antioxidant, antimicrobial, and anti-inflammatory activities.
Gassim et al. (2024)	Antioxidant activity of castor extracts	Natural Product Research Sector	DPPH assay and GC-MS analysis	Methanolic extracts showed highest antioxidant

				activity.
Neha et al. (2024)	Therapeutic use of *Ricinus communis*	Herbal Medicine Sector	Review-based medicinal evaluation	Reported antibacterial, antifungal, antioxidant, and anticancer activities.

Taken together, the reviewed literature shows that *Ricinus communis* and other medicinal plants are rich in phytochemicals and have broad pharmacological significance across the pharmaceutical, biomedical, nutraceutical, agricultural and traditional healthcare sectors.

Conclusion

The first is chemical. The leaf of *Ricinus communis* yields, on sequential polarity-graded extraction, a nonpolar fraction dominated by pentacyclic triterpenes and sterols and a polar fraction dominated by flavonoids and phenolic acids, and the two fractions are separable cleanly enough to be tested independently. Nine constituents of these classes were isolated and identified. That separability is what gives the pharmacological comparisons their interpretive value, and it is the principal chemical outcome of the work.

The second is pharmacological. Both plant parts produced measurable activity in all three therapeutic domains examined, with dose-related responses wherever two doses were tested. The hepatoprotective and antioxidant effects tracked the phenol-rich fraction, whose constituents are established chain-breaking antioxidants (Rice-Evans et al., 1996); the anti-inflammatory and analgesic effects tracked the triterpenoid-rich fraction, whose constituents are established modulators of inflammatory signalling (Fernández et al., 2001; Otuki et al., 2005; Saleem, 2009); and the cross-associations were weak. That divergence is more informative than either association considered alone, because a preparation that was simply more potent in every respect would have produced uniform associations along every axis.

The third is toxicological, and it qualifies the second. The preparation that produced the strongest hepatoprotective effect per unit dose also produced mortality at 2000 milligrams per kilogram, and delivered its effect within a margin of less than twofold. The preparation that produced the strongest anti-inflammatory and analgesic effects per unit dose was tolerated at 2000 milligrams per kilogram, a margin of fortyfold above the dose at which it was active. Considered together, these findings identify the leaf-derived triterpenoid fraction, and not the seed extract around which the fourth objective was framed, as the preparation that merits further investigation.

The study does not establish that *Ricinus communis*, or any preparation of it, is safe or effective in human beings, and nothing in this chapter should be read as suggesting otherwise. What it establishes is a chemically defined starting point for the work that would be required to answer that question.

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