# Botany, ethnopharmacology, phytochemistry and toxicology of Ricinus communis L. A comprehensive review

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# Abstract

The Euphorbiaceae plant *Ricinus communis* L. is used to cure many types of illnesses. There are 7,500 species and almost 300 genera in the broad family Euphorbiaceae. Of all plants, *Ricinus communis* L., sometimes termed as the castor bean plant, has significant therapeutic as well as traditional benefits for a population free from illness. The plant has anti-fertility, anti-implantation, antinociceptive, antioxidant, immunomodulatory, anti-cancer, hepatoprotective, anti-diabetic, anti-ulcer, anti-microbial, insecticidal, molluscicidal, anti-asthmatic, cytotoxic, and lipolytic effects. Moreover, preliminary phytochemical analysis of *R. communis* found that it included Glycosides, Alkaloids, Saponins, Steroids, and Saponin-like compounds. *R. communis* performs a vast range of functions that are unique to this common plant, including antimicrobial, smooth muscle relaxant, and anti-asthmatic. This plant's entire life cycle is utilized in traditional medicine. Although its seeds are hazardous, when utilized in certain amounts, they have powerful pharmacological effect. The goal of this review is to give researchers advance information about *R. communis's* traditional usage, pharmacognostic properties, and pharmacological nature so they can more easily examine the variety of its active chemical components.

Key words: Ricinus communis, Traditional value, Pharmacology, Phytochemistry, Toxicology

# **1. INTRODUCTION**

Plants are necessary for survival of man because they provide him with medicine, fuel and food from the times before development of culture. Plants are still a significant source of medicine today as they have been for the entirety of human history. Natural products are becoming more and more important for the treatment of disease because of their natural origin, relatively lack of adverse effects when compared to the difficulty of producing chemically based prescription treatments, along with their rising cost. This has caused researchers all across the world to concentrate on the study of medicinal plants. These easily accessible, culturally relevant traditional medicines serve as the cornerstone of an affordable, available healthcare system and are a crucial source of income for rural and indigenous populations. Over 50,000–80,000 flowering plants are utilized medicinally worldwide [1].

Uncultivated plant species have long been used to treat illness and stave it off. More than 80% of South Asians rely on traditional medication made from local species instead of having access to modern medical care. Large repositories of rich traditional knowledge are actually held by numerous indigenous and local groups that can aid in the development of biotechnology, agriculture, pharmaceuticals, and healthcare. Many physiologically active substances found in plants have the best potential to develop into therapeutic medicines. In developing nations, herbal remedies have long served as the cornerstone of therapeutic use; but, in more recent years, the industrialized world has also seen a rise in use of herbal remedies. With almost 40% of the community reporting using herbs to treat medical conditions in the past year, the usage of medicinal herbs is rapidly increasing throughout the western world. Pakistan maintains a special place in the traditional medical system of the world because of its enormous diversity of aromatic and medicinal plants. Many studies have already documented many socio-cultural uses of plants, including both therapeutic and non-medical functions. Traditional knowledge based on plants is now a respected resource when looking for pharmaceuticals and nut raceuticals. According to the WHO, up to 80% of people globally, depend on traditional medicine for their most basic medical requirements today. Comparatively speaking, herbal remedies are safer than synthetic ones [2].

Herbal plants have been employed as a unmarkable source of medication from the ancient times. Practically all herbal medicinal systems adopt a holistic strategy in which an individual's mental, physical, and social welfare are taken into consideration in tandem for a cure of a specific medical

issue. Traditional medicine, especially herbal medicine, implies herbal remedy for the preventative, diagnostic measures and eradication of bodily, social, or mental imbalance [3].

The use of herbal medicines has spread beyond Pakistan and has become extremely fascinating on a global scale. The estimated market for herbal products was 63.05 billion United States dollars in 2014 and increased to 71.19 billion US dollars in 2016. The herbal medicine trade market expands globally at a pace of 10–15% per year. Compared to typical chemical equivalents, herbal components are thought to be safer and more effective. Still, it might not be able to completely eliminate any negative effects [4].

*Ricinus communis* L. is one of several natural, non-prescription drugs used in conventional medicine that can be used to cure a variety of illnesses and issues. Carlous Linnaeus, a Swedish naturalist, developed the botanical name *Ricinus communis* in the eighteenth century. The Latin word ricinus, which literally means "common," refers to the Mediterranean sheep tick (Ixodes ricinus), to which the seed of Castor plant bears an uncanny similarity [5]. The sole species of its genus, R. communis, has 22 subspecies and variations, as well as a few cultivars developed by botanical breeders and ornamental horticulturists [6].

Castor oil has been utilized as a healing agent in conventional medicines all around the globe since earlier times. The plant's seeds were discovered in tombs in Egypt about BC 4000. According to historical documents, castor oil was used as medication in Egypt to cure eye irritations. *R. communis* is employed in many aspects of daily life, including the varnishing of clothes and armour using the oil from the plant's seeds and the production of wide range of products like candles, wax, polish, colored chalks, and carbon paper. Convulsions, asthma, chancre, burns, cholera, cancer, carbuncles, arthritis, colds, and craw-craw (a condition of skin that itches) have all been successfully treated with it [7].

There has been a significant amount of research on the phytochemical, pharmacological, toxicological, and to a certain level biological activity of *R. communis* [6, 8-48]. However, additional research is still required to fully understand its therapeutic value (especially through the exploration of medicinal recipes) and the most active chemicals that are responsible for its wide range of functions. Thus, the current review highlights the botanical, ethno-pharmacological, toxicological, phytochemical, and pharmacological reports on *Ricinus communis*.

# **1. METHODOLOGY**

Several searching engines which include PubMed, Medline, Google Scholar, Web of Science, Scopus, Phytochemistry, Science Direct Bentham, and Science Publishers Pubchem, were used to generate data on *R. communis*. To explore the literature for *Ricinus communis*, the terms ethnobotany, ethno-pharmacology, traditional usage, phytochemistry, and toxicology were used. However, databases, such as those at www.theplantlist.org, were used to confirm the accurate taxonomic names and synonyms. Using the widely used scientific program PubChem, chemical structures of bioactive substances were depicted. All the databases mentioned above were utilized to gather comprehensive data on *Ricinus communis*, including information on its taxonomic reliability (correct common names, taxonomic names, identification, distribution, Herbarium, etc.), ethno-pharmacology (part of plant that is used, traditional uses with recipes, preparation and administration, etc.), pharmacology (plant extract preparation, dosage, time, model organism, clinical trials, etc.), and phytochemistry (bioactive substances, extraction, isolation, structural elucidation along with their formulas).

### Vernacular Names:

Names	Language	References
Castor oil plant	English	[49]
Veranda	Bengali	
Arandi	Hindi	
Era-gach	Assamese	
Wonderboom	Dutch	
Ricin	French	
Rizinus/ Palma Christi	Danish/ German	
Fico d' inferno	Italian	
Ricino	Spanish	
Ritsin	Russian	
Rikinusu and Rishin	Japanese	
Era ogi	Bini	

Table 1 Vernacular names of Ricinus communis L.

Kpamfini gulu	Nupe	
Laraa	Yoruba	
Jongo	Tiv	
Ogilisi	Igbo	
Zurman	Hausa	

# **Taxonomic Classification:**

Table 2 Taxonomic classification of Ricinus communis L.

Kingdom	Plantae
Phylum	Spermatophyta
Sub Phylum	Angiospermae
Class	Dicotyledonae
Order	Malpighiales/ Euphorbiales
Family	Euphorbiaceae
Sub Family	Acalyphoideae
Tribe	Acalypheae
Sub Tribe	Ricininae
Genus	Ricinus
Species	Ricinus communis L.

# 2. BOTANY

### **Plant Occurrence:**

Tropical, subtropical, as well as warm-temperate areas around the globe are where castor is most commonly found. It is widespread on fellow land, along roadsides, and in neighborhoods in both rural and urban areas. It is especially prevalent near rivers that are dry for part of the year at altitude between 400 and 2700 m. Northern Africa, including Ethiopia and Somalia, is the likely region where castor originated [50]. There are four centers of diversity for this plant, including China, the Arabian Peninsula, Northwest and Southwest Asia, and the Ethiopian-Eastern African region [51].

Currently, it is naturalized throughout the Atlantic shore to a Red Sea, the African continent, Tunisia to Southern Africa, and islands in the Indian Ocean. Moreover, it is widely farmed, naturalized in temperate sections of Europe as well as subtropical and tropical regions of Asia and America [52].

### Morphology:

Castor plant cultivation began as early as 6,000 years ago. The plant is perennial shrub that grows quickly and suckeringly and can occasionally develop to be a small, soft-wooded tree up to 6 meters or more in height. However, it is not a hardy plant. The plant was grown for the oil it produced as well as the colors of its leaves and flowers. About 30–60 cm in diameter, the leaves are green or reddish in tint. The palmate leaves have alternate segments with 5–12 deep lobes that are coarsely serrated. Pigmentation on the stems varies. The monoecious, 30–60 cm long flowers have one ovary [24]. A three-celled prickly capsule serves as the fruit. The fruit capsule splits into three 2-valved cocci and is coated in soft spin-like processes. The size and color of the seeds differ significantly. The testa is extremely smooth, fragile, and thin. The caruncle, a warty appendage on castor seeds, is often found at one end of the seed, from which the raphe extends to culminate in a somewhat elevated chalaza at the other end [53]. Epigeal seed germination, cotyledons petioled, broadly rectangular up to 7 cm long, flat with whole borders, as well as initial leaves opposite are the methods used to produce seedlings [54].



Figure 1 Ricinus communis L. (plant)



Figure 2 Seeds of Ricinus communis L.

### **Reproductive Biology:**

Flowers are the reproductive organs in angiosperms that vary the most physically and exhibit a correspondingly wide range of reproductive strategies. It develops by a mixed pollination technique that encourages selfing through geitonogamy while also outcrossing through anemophily and entomophily [75]. Cross-pollination occurs more than 80% of the time in a natural environment. Within six months of seed germination, flowering may take place. Flowers of plant are staminate on the bottom half of raceme and pistillate on the upper part, making it a typical monoecious flower [55]. Raceme composition can differ both within and across genotypes, and the environment can also have an impact on the ratio of staminate and pistillate flowers. In typical monoecious types, the proportion of pistillate flowers is largest on earliest racemes, and gradually declines on the developed racemes. As the numbering of pistillate blooms declines, the number of staminate flowers rises proportionately [56]. The temperature in different seasons is the most likely source of this variance. Whereas male flowers are encouraged by high temperatures in the middle and late summer, female flowers are encouraged by moderate temperatures in the spring and early summer. In emerging plants with high amount of nutrition, femaleness is very high, and in mature plants with low amount of nutrition, maleness is highest [57]. Male flowers shed pollen in the morning after they have released viable pollens for one to two days. The ideal climatic parameters for pollen distribution, which can vary depending on cultivar, are a temperature within 26 and 29°C and a relative humidity of 60%. Male flowers mature prior to the female flowers open, and anthesis typically takes place quickly [58]. As a result, a lot of pollen is available to pistillate

flowers once they open and start to turn receptive. The stigma may continue to be responsive for 5 to 10 days, depending on the surrounding circumstances [32].

# 3. TRADITIONAL USES/ ETHNOPHARMACOLOGY

The plant *R. communis* was indicated to have an essential function in the treatment of numerous ailments through its ethnomedical applications. The paste made from roots, leaves, and fruits of *R. communis* is utilized locally in traditional medical system for the treatment of inflammation. Castor oil, which is made from seed of plant, is still frequently used in herbal as well as traditional medicine. When oil was removed from the plant seed, boiled to remove toxicity, and added to animal feed, the plant's seed was utilized as fertilizer. Castor oil is mainly utilized as a laxative and purgative. It also serves as a lamp fuel, lubricant and as an ingredient of cosmetics. In India, stalks are used as fuel and leaves are fed to eri silkworms. This plant was introduced because of its capacity to stabilize dunes.

Disorders	Part of	Treatment / Recipe	References
	Plant		
	Used		
Aching feet	Castor oil	For sore feet, try castor oil. For quick relief, just	[6]
		spread some hand-warmed castor oil over the feet.	
		For acute discomfort in the foot, enough castor oil	
		is applied to the trouble spots on the feet, which	
		are then covered in plastic, and socks are put on	
		before bed. The majority of foot discomfort will	
		eventually disappear totally with consistent	
		administration of this for a few weeks. Castor oil	
		can be used to treat extremely painful heel spurs	
		(calcium deposits).	
Abdominal	Root	In Tanzania, oral administration of a warm-water	[6]
diseases		extract of dried out root is used to treat stomach	
		pain, stomach ulcers, and diarrhoea.	

Table 3 Traditional uses of Ricinus communis L.

	Aerial	Oral intake of hot water extract of aerial portions	[6]
	part	is used as a diuretic and purgative in Saudi Arabia.	
Chronic	Seed	A well-known home cure for the Sciatica-	[6]
backache and		Lumbago Syndrome is the kheer of erand seeds,	
sciatica		which is made by boiling them in milk. Patients	
		suffering from other vata disorders are also treated	
		with a same recipe.	
Boils, sores and	Leaves	Leaves can be applied as a poultice to wounds,	[6]
swellings		boils and swells.	
Bilharziasis	Leaves	A decoction of dried leaves is given topically for	[6]
		the treatment of bilharziasis in Senegal.	
Arthritis,	Castor oil	Applying castor oil topically can provide	[6]
backache,		significant relief from rheumatoid arthritis, back	
muscle aches		pain, and general muscle pains. Castor oil-soaked	
		cloth is placed over the sore joint and wrapped	
		with plastic (like cling film). a hot water bottle on	
		top of it (this technique is often referred to as a	
		"castor oil pack"). The castor oil will be better	
		able to reach the sore tissues and joints with the	
		help of the heat. A castor oil pack will still be	
		effective even without additional heat. This is	
		accomplished simply by applying the castor oil	
		pack before bed and letting it operate all night.	
Chronic	Leaves	In Somalia, a cup of olive oil is combined with a	[6]
headache		handful of crushed leaves. To cure a chronic	
		headache, the combination is applied topically	
		and one drop is inserted into each nostril. Up till	
		the patient is pain-free, the treatment is continued.	
Constipation	Castor oil	Castor oil is a straightforward and risk-free	[6]
		purgative, varies in dosage from person to person.	
		Typically, 20 to 60 cc of it along with lukewarm	

		milk can be consumed before bed. If castor oil is	
		consumed during the day, it will work more	
		quickly.	
	Castor oil	Castor oil, when consumed internally, has a rapid	[6]
		and mild laxative effect that relieves constipation.	
		To enhance its flavour, try floating the oil in a	
		glass of warm milk or mix it with a freshly beaten	
		egg yolk.	
Conjunctivitis	Castor oil	For three days, apply one to two drops of castor	[6]
		oil two times daily. It may initially hurt a little, but	
		over time, it calms eyes and cures conjunctivitis.	
Expulsion of	Root	In Kenya, raw root's decoction is ingested orally	[6]
placenta		to speed up parturition or encourage placental	
		ejection.	
	Seed	To expedite parturition or placenta discharge, the	[6]
		foot soles are massaged with the seed in	
		Philippine.	
Gallbladder pain	Castor oil	Utilizing hot castor oil can help with gallstone	[6]
		pain relief. For gallbladder attacks, apply a castor	
		oil pack to affected area.	
Flatulence	Leaves	Oil-coated leaves that have been warmed up are	[6]
		frequently placed to the abdomen to relieve	
		children's flatulence.	
Hair growth	Seed	To encourage hair development, seeds are diluted	[6]
		in water and applied topically in Japan.	
Lumbago	Root	Roots are used as a decoction to treat lumbago and	[6]
		related ailments.	
Paralyzed Limb	Leaves	In Somalia, a cup of olive oil is combined with a	[6]
		handful of crushed leaves. To regain movement,	
		the oily extract is applied twice daily to the skin	
		of the paralysed limb.	

Muscular	Leaves	Boiling the leaves in water creates a decoction	[6]
distortion		that is used to cure twisted muscles.	
Period pain	Castor oil	For menstrual cramp relief, apply some warm	[6]
menstrual		castor oil on your lower abdomen by hand.	
cramps		Menstrual abnormalities, uterine and ovarian	
		cysts, and other conditions can all be improved by	
		using the pack of castor oil treatment to the lower	
		abdomen. When a castor oil pack is administered,	
		it's normal to feel fluttering around ovaries.	
Repellent	Leaves	The powdered leaves can be utilised to ward off	[6]
		rust mites, white flies, mosquitoes, aphids, and	
		other pests.	
Poisoning	Leaves	According to reports, fresh leaf juice can be	[6]
		utilised as an emetic in many cases of drug	
		atilised as an emetic in many cases of drug poisoning from substances like opium.[6]Additionally, applying the leaves as a poultice or[6]	
Secretion of Leaves		Additionally, applying the leaves as a poultice or	[6]
milk		decoction to a woman's breasts has been	
		suggested as a way to encourage milk production.	
Sleeplessness,	Castor oil	A small amount of castor oil is applied to the	[6]
insomnia		eyelids before night to cure sleeplessness. This	
		method of applying castor oil will result in a	
		feeling of profound relaxation and a restful sleep	
		devoid of the usage of medicines.	
Rigid knees	Leaves	In Somalia, a cup of sesame oil is combined with	[6]
		a few handfuls of crushed leaves. Knees are	
		treated after the liquid has been filtered.	
Skin diseases	Castor	Many poultices that are used to inflamed states of	[6]
	oil,	joints, boils, and enlarged lymph nodes contain	
	Leaves	castor oil and the leaves of the plant. If applied to	
		the cracked skin on the feet, it has additional	
		advantages.	

	Castor oil	Add few drops of castor oil to a bandage or plaster	[6]
		and place it over the affected region each day to	
		cure minor skin infections. Take a clean piece of	
		cloth dipped in castor oil to treat bigger skin	
		infections instead.	
Rheumatism	Castor oil	Castor oil is the mainstay of ayurvedic treatment	[6]
		for rheumatoid arthritis. In addition to reducing	
		the disease's characteristic early-morning joint	
		stiffness, taking 10 to 20 ml of castor oil and 2	
		grammes of powdered dry ginger with a cup of	
		warm milk every day for two weeks before going	
		to bed also reduces inflammation.	
Sexual diseases	Leaves	In South Africa, a leaf extract prepared in hot	[6]
		water is ingested as an emmenagogue. As a	
		vaginal antibacterial, the powdered, dried out root	
		is used topically.	
	Seed	In South Korea, an oral warm water extract of	[6]
		seeds is administered as an emmenagogue.	
	Leaves	In Mauritius, dried leaf extract diluted in hot water	[6]
		is ingested to act as an emmenagogue.	
Tapeworms,	Castor oil	It is known that using castor oil internally can	[6]
intestinal worms		successfully rid the body of tape worms. Both in	
		the morning and at night, consume one tablespoon	
		of castor oil in one glass of warm milk. The	
		worms will be eliminated from the body.	
	Root	A cup is left after boiling 50 grams of root in two	[6]
		cups of water. Next, drink 1 cup every day for	
		three days. To treat intestinal worms, use this.	
Weakened	Castor oil	Castor oil has the amazing capacity to enhance the	[6]
immune system		lymphocytes in our body. White blood cells called	
		lymphocytes control how well wounds heal.	

			According to studies, T cells could be crucial to	
			the healing process. Applications of castor oil	
			therefore seem to be beneficial for those with	
			compromised immune systems.	
Stomach	ache,	Castor oil	Hand-heated castor oil is gently rubbed over the	[6]
colic			abdomen to treat stomach-aches. This helps	
			release trapped gas and eases stomach discomfort.	
			This method of using castor oil also aids in the	
			sleep and relief of colic in newborns.	
		Leaves	Leaf infusions are used to treat stomach aches.	[6]
Tumour		Leaves	In Italy, fresh leaves are utilized to be applied to	[6]
			the affected area to treat tumours and to the breast	
			as a galactagogue.	
Swollen 1	ymph	Castor oil	The enlarged lymph nodes will eventually go	[6]
nodes			smaller if you apply castor oil to them every day.	
			Castor oil works by enhancing lymphatic system	
			circulation.	

# 4. PHARMACOLOGICAL ACTIVITIES

*R. communis* is useful folkloric medicinal plant with therapeutic characteristics; these characteristics are connected to either the immediate use of extract of crude plant as an antibiotic in a variety of diseases or by inhibiting harmful pathogens, which have been linked to a variety of infections. Many of the already described activities of R. communis are related to its crude extract, which is then followed by other fractions that may contain solvents including ethanol, methanol, chloroform, toluene, benzene, ethyl acetate, and butanol.

# **Antioxidant activity:**

The 2,2,2-diphenyl-1-picrylhydrazyl (DPPH) and hydroxyl radicals created by hydrogen peroxide and the free radical-scavenging impact on them were the sources of antioxidant activity provided by *R. communis* seed extracts. The *R. communis* seed exhibits considerable antioxidant activity

even at lower concentrations, indicating that it may be particularly effective in treating diseases brought on by oxidative stress. Methyl ricinoleate, 12 octadecadienoic acid, ricinoleic acid, and methyl ester are the molecular components that give antioxidant action its name. Because the stem and leaf extracts include flavonoids, they exhibit antioxidant activity [44].

### Anti-inflammatory activity:

Wistar albino rats were utilized to study the leaves and root extract's anti-inflammatory effects in both chronic and acute inflammatory conditions. According to the study, sub-plantar administration of Carragennan caused the paw edoema, which represents the cellular manifestations of acute inflammation. The methanolic leaves of *R. communis* at doses of 250 and 500 mg/kg have a shielding effect in stopping biological processes during the production of edoema and in all phases of severe inflammation. The existence of flavonoids in the *R. communis* methanol extracts was responsible for its anti-inflammatory properties since they protect rats' paws from edoema caused by carraghenan [21].

### **Anti-fertility Property:**

Male rats treated with 50% extracts of ethanol of *Ricinus communis* displayed a significant decrease in epididymal sperm count. The morphological motility, and manner of movement of sperm cells were altered. The author made the claim that a decrease in the levels of fructose and testosterone resulted in a decrease in the ability of rats to reproduce. *Ricinus communis's* antifertility effect was completely reversible upon drug withdrawal, and it doesn't result in hepatotoxicity as evidenced by the fact that the levels of GOT and GPT levels were unchanged [37]. In a different investigation, three different *Ricinus communis* seed kinds were discovered to be possible oral contraceptives because they had an anti-implantation impact on white albino mice [38].

### **Hepatoprotective Property:**

*Ricinus communis* methanolic extracts were investigated for their potential to protect albino rats' livers against acute hepatitis brought on by D-galactosamine. D-galactosamine (800 mg/kg.BW) was administered intraperitoneally once to cause hepatitis in rats. The therapeutic and preventive consequences of methanol-derived extracts from the leaves of *R. communis* from D-galactosamine

intoxication were also demonstrated by histopathological findings. This finding shows that the castor plant's methanolic extract effectively defended the liver from hepatitis, enhanced the liver's ability to heal itself, and may someday be employed as a hepatoprotective drug [10].

The antiperoxidative and membrane-stabilizing properties of flavonoids in *Ricinus communis* contribute to the plant's hepatoprotective function by enhancing the liver's ability for regeneration and repair. Additionally, *Ricinus communis's* hepatoprotective properties guard against both fatty changes and liver necrosis [42].

# Antimicrobial activity:

*R. communis* had effective antibacterial properties against the dermatophytic and pathogenic bacterial strains *Klebsiella pneumonia*, *Staphylococcus aureus*, and *Streptococcus progenies*. As a result, it was shown that the extracts of acetone and petroleum ether had favorable zones of inhibition, while ethanol extract only exhibits antibacterial activity at increased ratios [23]. The antibacterial activity of the hexane and methanolic extracts was at its peak, while that of the aqueous extracts was minimal [48].

# **Immunomodulatory activity:**

Immunomodulatory substances of both plant and animal origin typically boost up the body's immunological response to disorders by engaging the non-specific immune system. Human neutrophils' phagocytic activity was markedly enhanced by the tannins found in the *R. communis* leaves, possibly producing an immunomodulatory impact [11].

### Anti-asthmatic activity:

Due to its possible anti-allergic and mast cell stabilizing effects, *R. communis* ethanolic root extract is beneficial in treating asthma. Mast cells are stabilized by saponins, and flavonoids have bronchodilator and smooth muscle relaxant properties. Apigenin and luteolin-like flavonoids often suppress the release of basophil histamine and neutrophil beta glucuronidase, and they also exhibit in-vivo antiallergic activity. Due to the inclusion of saponins or flavonoids, the *R. communis* ethanol extract has anti-asthmatic effect and reduces the leukocytosis and eosinophilia caused by milk [59].

# Antidiabetic activity:

Ethanolic extract of *R. communis* roots (RCRE) and its bioassay-directed purification were studied. By giving diabetic rats the efficacious dose (500 mg/kg b. w) of RCRE for 20 days, the rats' liver and kidney functions, total lipid profiles, and fasting blood glucose levels all improved. The R-18 fraction outperforms the other fractions in terms of antihyperglycemic activity. Alkaline phosphatase, serum creatinine, serum bilirubin, SGPT, SGOT and total protein did not significantly alter in the RCRE even after the extract was administered. *R. communis* is therefore an effective herbal treatment for diabetes [41].

### **Antihistaminic Activity:**

By employing Clonidine-induced catalepsy in mice, the ethanol extract of *R. communis* root produced anti-histaminic action at different doses of 100, 125, and 150 mg per kg intraperitoneally [60].

### **Central analgesic activity:**

In a tail flick response model to radiant heat, the extract of crude root bark of *Ricinus communis* exhibits central analgesic action at a dose of 250 mg/kg body weight. The *R. communis* fruit extract in ethanol has typical stimulating and neuroleptic effects on the CNS [11].

The alkaloid ricinine appears to be responsible for the stimulant results, including exophthamus, hyperreactivity, memory enhancement, and clonic convulsions. Animals died after receiving the extract or ricinine both displayed similar symptoms, including clonic convulsions and apparent respiration arrest. This suggests that ricinine is the primary poisonous component of the extract [18].

### **Antiulcer** activity:

At doses of 500 mg/kg and 1000 mg/kg, the castor oil of *R. communis* seed had considerable antiulcer effects, however the 1000 mg/kg dose was more effective against the ulceration brought on by pylorus ligation, aspirin, and ethanol in rats. The outcome demonstrated that *R. communis'* antiulcer efficacy is a result of either the drug's cytoprotective properties or the thickening of the stomach mucosa, which improves mucosal defense [34].

# Antinociceptive activity:

The methanolic leaf extract of *R. communis* exhibits considerable antinociceptive action against the formalin-induced paw licking, acetic acid-induced writhing tests, and tail immersion in mice. The preliminary phytoconstituents such saponins, steroids, and alkaloids were present, and this caused the antinociceptive activity to manifest [46].

# **Anti-cancer activity:**

A strong candidate for the breast cancer treatment is the extract of *Ricinus communis*. Highaggressive, triple-negative breast cancer cells and estrogen-positive MCF-7 respond well to *Ricinus communis* fruit extract (MDA-MB-231 cell line). Moreover, the extract causes these cells to undergo apoptosis. Each of the four *Ricinus communis* fruit extract compounds that have been identified, including Ricinine, p-Coumaric acid, Epigallocatechin, and Ricinoleic acid, has cytotoxic and migration-inhibitory properties [31].

The Zinc oxide depicts the anti-cancer attribute of *R*. *Communis* that has been illustrated by the crystalline hexagonal phase of the plant extract. Thus, the nanoparticle synthesis produce a large surface area for the assessment of anticancer activity. About this, the HRTEM has proven that the hexagonal Wurtzite form of zinc oxide is the primary cause of the widespread usage of *Ricinus communis* as a cancer treatment. Moreover, the anti-cancer properties of *Ricinus communis* are promoted by its antioxidant potential and free radical scavenging capacity [40].

### **Anticonvulsant Activity:**

Researchers tested the anticonvulsant and analgesic properties of *Ricinus communis* leaves. Neuronal discharges in the brain induce seizures in people with epilepsy, a widespread condition. Many isolated *Ricinus communis* compounds have demonstrated anticonvulsant effect in the tests and were found to be upright epileptics. Following the application of electric shock, all of the animals displayed convulsions. The rats were given a dose of a chemical derived from the *Ricinus communis* seeds at the rate of 60 mg/kg, and this caused an inhibition of seizures of roughly 80% as opposed to 8.89% with the standard medication.

According to researchers, epilepsy is a nervous disorder that is frequently observed in the UK, the US, India, and Africa. The ability of *Ricinus communis* to treat seizures brought on by various

brain disorders was unknown until 1940. *Ricinus communis* has been the subject of exclusive research, which revealed that it has a significant amount of anticonvulsant characteristics that can readily lessen the symptoms of seizures. *Ricinus communis* has anticonvulsant qualities, which many individuals do not view as advantageous, however physicians and other healthcare professionals frequently utilize this medication to treat various epileptic conditions [29].

# Anti-implantation activity:

When given subcutaneously to the female rabbits and rats at doses up to 1.2 g/kg body mass and 600 mg/kg body weight, respectively, the ether soluble part of methanolic extracts of *R. communis* var. minor exhibits anticonceptive, anti-implantation, and estrogenic activity [33].

### Leishamicidial activity:

*Ricinus communis* extracts have potent antileishmanial qualities. In the treatment of leishmaniasis, extracts of *Ricinus communis* and *A. indica* work in concert. *Ricinus communis* and *A. indica* have optimal antiparasitic effectiveness of 59.5% and 72%, accordingly, whereas the mixture of both mixes has 88% efficacy. *Ricinus communis* and *Azadirachta indica* have different inhibitory concentrations, or IC50s, of 16.5 gmL-1 and 11.5 gmL-1, respectively, whereas a combination of both gives an IC50 of 9.0 gmL-1. Combining both plant extracts enables the separation of bioactive molecules as well as their fortification and bioassay-guided separation, which may result in the synthesis of novel pharmaceutical lead structures [25].

### **Anthelmintic property:**

Due to ineffective management techniques, helminthiasis is one of the most common worm diseases in the world. Using a different kind of solvent, the anthelmintic activity of leaves of *Ricinus communis* was investigated. Three different concentrations i.e 50, 75, and 100 mg/ml of aqueous, ethanol, methanol, ethyl acetate, and chloroform extracts from *Ricinus communis* leaves were examined on *Pheretimaposthuma* in an effort to create a cost-effective anthelmintic medication. All of the extracts revealed a sizable worm death rate. It was discovered that the increase in concentration considerably increased the worms' paralysis and mortality. At higher doses (100 mg/ml), methanol, aqueous, and ethanol extract were discovered to be the more efficient and to paralyze worms in the shortest amount of time [13].

# **Lipolytic Activity:**

On neutral lipids, ricin from *Ricinus communis* and *Ricinus sanguineous* was examined for its lipolytic activity. In the membrane-like model, lipolytic activity was tested on a variety of subtracts. The study came to the conclusion that *Ricinus communis* functions as a lipase with the ability to hydrolyze several lipid types. At pH 7.0 and 0.2 M galactose at the leaf surface, the highest level of lipolytic activity was observed. Also, it's possible that the lipolytic phase contributed to ricin's poisoning of the cell [30].

# Wound healing activity:

Due to most active ingredient in castor oil, which generates antioxidant activity and provoke lipid peroxidation, *R. communis* has the capability to heal wounds. Substances that inhibit lipid peroxidation promote survival of collagen fibrils by making collagen fibers stronger, boosting up circulation, reducing cell damage, and encouraging DNA production. Castor oil's ability to treat wounds was examined in terms of scar size, scar area closure rate, and epithelialization in an excision wound model. According to the study's findings, castor oil has the ability to speed up the epithelialization process and reduce scarring in excision wound models. The 10% w/w Castor oil ointment has higher wound-healing property, according to a comparison study of two distinct castor oil concentrations (5% w/w and 10% w/w) [24].

# **Cytotoxic activity:**

*R. communis* leaf extract has a cytotoxic impact on SK-MEL-28 human melanoma cells, according to Darmanin et al. The existence of cytotoxic phytochemicals in the leaves was evident, and these compounds cause apoptosis by causing phosphatidyl serine to move to the cell membrane's outer surface and resulting in the degradation of mitochondrial potential. These substances included a sesquiterpenoid called caryophyllene as well as three monoterpenoids: 1, 8-cineole, camphor, and -pinene [14].

# Larvicidal activity:

*R. communis's* aqueous leaf extract has effective larvicidal action against the mosquitoes *A. arabiensis*, *C. chinensis*, and *C. quinquefasciatus*. Immunomodulatory drugs typically boost up the body's immunological reactivity to diseases by stimulating the generalized immune system.

Leucocytes engulfing microorganisms is known as phagocytosis. Last but not least, phagocytosis is the intracellular eradication of microbes by neutrophils. The existence of tannins in *R. communis* leaves considerably enhances the phagocytic activity of human neutrophils, which may have an immunomodulatory effect [28].

Ricinus communis extract was discovered to have larvicidal effects on several mosquito larvae. Studies on many mosquito species, with a 100% fatality rate, including A. gambiae, A. stephens, A. salbopictus, and C. quefasciatus, were conducted. The toxic dosage of R. communis seed extracts is displayed on various larval species [48]. One of the potentially fatal diseases brought on by the bitings of infected Anopheles mosquitoes, which transfer parasites to humans, is malaria. Hundreds of thousands of people die each year as a result of malaria, which is regarded as a contagious disease that affects the entire world. It is well known that Plasmodium falciparum exhibits resistance to a variety of anti-malarial drugs. Ricinus Communis is discovered to have the most activities of all against the A. gambiae, a vector of malaria. Anopheles gambiae male and female larvae are more susceptible to extracts of *Ricinus communis*. It was discovered that the Ricinus extraction was effective against Culex quinquefasciatus and Anopheles arabiensis. According to a significant study on *Ricinus Communis*, the plant's leaves and stems were mostly employed in European nations to lessen fever and infection brought on by mosquito bites. When treating body rashes and redness brought on by mosquito bites, the juice that has been removed and preserved after neutralization is extremely helpful. Treatment for malaria brought on by any type of the female Anopheles mosquito is helped by *Ricinus communis*. The medical benefits of Ricinus communis are widely known in the Indian society. Ricinus communis has been one of the most frequently used medications since 1900 for the treatment of bacterial disorders, fever, and dermal conditions [17].

# Acaricidal activity:

Leaf extracts of *Ricinus communis* and other medicinal herbs were evaluated for their acaricidal abilities against *Rhipicephalus pulchelus* and *Rhipicephalus decoloratus* for environmentally sustainable herbal control of ticks. It was determined that more ticks were destroyed with longer exposure times. This is currently promoting sustainable growth for the immunological command of vector and vector-borne illness that develop the risk for production of the leather [19].

# **Insecticidal activity:**

When applied to *Callosobruchus maculatus* adult, the extract of crude methanols (Coleoptera: Brauchidae) from *Ricinus communis* has a considerable insecticidal impact. The mature insect *Callosobruchus maculatus* (Coleoptera: Brauchidae) is dramatically affected by the methanol extracts of *Ricinus communis* at 100%. With a p-value of 0.05, the relationship between exposure and treatment time is highly significant. The 31 active phytoconstituents in the methanol extracts show pharmacological effects. The most of the flavonoids are concentrated in these hydrolyzed watery leaves, however the castor oil seeds are deadly to humans, animals, and insects because they contain toxic proteins [20, 45].

# Hypolipidmic activity:

The capability of extract to lessen atherosclerosis, a consequence of diabetes, is suggested by a considerable decrease in the ratio of High Density Lipoprotein to Low Density Lipoprotein as compared to the diabetic untreated rats [61].

### **Anti-dandruff activity:**

Due to its possible bioactive components, *R. commuis* leaf extracts have anti-dandruff properties. A phytochemical analysis of different solvent extracts of *R. communis* leaves found the presence of terpenoids, saponins, and phlobatannins [62]. Significant activity was shown by methanolic extracts (8.20  $\pm$  0.3). The ineffectiveness of the ether extract of petroleum was demonstrated by the mean zone of inhibition it produced, which was 0.90  $\pm$  0.3 mm [63].

# **Antitumor activity:**

According to the ED50 of the lectin towards tumour cells and non-transformed cells, ricin A, a lectin separated from *R. communis*, has anticancer action. It is more hazardous to tumour cells as compared to non-transformed cells [64].

# **Ophthalmic Properties:**

Among the most delicate organs in the body that need care are the eyes. The symptoms of irritation, scorching, and swelling are only a few of the many potential causes. Because eyes give our world color, it's crucial to preserve their ophthalmic qualities. For even more than 50 years, researchers

looked into the therapeutic potential of *Ricinus Communis*. *Ricinus Communis* may contain oil that can be applied as eye lubricant, according to research. The lubricating characteristic not only keeps the eyes' moisture levels stable but also eases strain on their muscles. Better vision results from proper eye muscular contraction and expansion. *Ricinus Communis* oil also serves to eliminate inadvertent foreign body particles that end up in the eyes. The oil not only relaxes the muscles in the eyes but also cleanses them to improve vision. If a person has an infection in eyes or retinal injuries, ophthalmic treatments are typically quite expensive and require regular doses. Yet, individuals favor *Ricinus communis* oil over other lubricants sold on the market since it is less expensive. *Ricinus communis* oil eye drops are typically utilized to treat dry eyes, irritation, redness, edoema, and watery eyes. Several allopathic medications, including sodium hyaluronate, carboxymethyl cellulose, and polyethylene glycol 400, can cure eye conditions including dryness [35, 36].

### **Bone Regeneration activity:**

According to research from Ohio State University, repairs and bone regeneration needed enough time to recover and reshape the bone normally. The oil extracted from Ricinus communis was utilized by the ancient people to heal bone abnormalities in the initial years, when there was no successful remedy for bone-related problems. Many bone-related disorders were reported to be treated with Ricinus communis oil in the past as a herbal and mythical medicine. R. communis treated a variety of conditions associated to the bones, including limb afflictions, acute osteomyelitis, articular aches, and bone abnormalities. Ricinus communis seems to have the unusual ability to regenerate bone after damage without leaving any scars. Due to this lack, neither rat alveoli nor rabbit skulls showed any indications of a systemic harmful effect [65]. Hence, culturing *Ricinus communis* polythene in artificial bodily fluids can enhance its biological attributes. When combined with *R. communis* polyurethane, calcium phosphate may aid in matrix mineralization and be extremely valuable for creating biocompatible material as opposed to demineralized bone. One advantage of *Ricinus communis* polythene is the slower resorption process. Ricinus communis oil is used widely over the world because it has few medical characteristics. such as anticonvulsant, anti-asthmatic, anti-inflammatory, purgative, and regeneration of bones [16, 39, 66].

# **Laxative and Uterine Contracting:**

Every third person in five worldwide experiences constipation as a result of altering diet and lifestyle habits. Unhealthy food consumption and inconsistent meal times are two frequent causes that interfere with the body's digesting process. The herb Ricinus communis works like a magic medication to promote bowel movement. Constipation problems can be relieved by having regular bowel movements [67]. Due to a lack of access to healthcare resources and information, constipation problems are more prevalent in underdeveloped nations. Castor oil combines ricinoleic acid, which stimulates prostaglandin receptors, to cause uterine contraction and laxation. The tightening of the smooth muscle of intestine caused by castor oil and ricinoleic acid affects the motility of the uterus and stomach. Prostaglandin receptors 2 have been shown to work well as laxative inducers. In addition to its laxative effects, Ricinus communis is an effective purgative often used to treat acute abdominal pain and constipation issues. Constipation patients are frequently told by doctors to drink one glass of lukewarm water blended with a tiny amount of juicy extract of *Ricinus communis* [68]. Castor oil, which is sold at chemist stores, is another type of *Ricinus communis* juice. The uterine movements might occur normally thanks to the extraordinary contraction capabilities found in the Ricinus communis leaf extract. The medication also has a significant impact on how pregnant women experience labor pains. Ricinus communis has the same uterine contraction-inducing properties as the oxytocin medication used to start labor [8, 47].

# **Toxicological Property:**

Research on the therapeutic and toxicological effects of leaf extracts from Cajanuscajan, *Ricinus communis*, and *Thymus vulgaris* have been conducted. The essential bioactive components of all medicinal plants, including tannins, flavonoids, steroids, saponins, phlorotannis, and terpenoids, are found in *Ricinus communis* leaves. When tested on rats, the methanolic extract of leaves from *Ricinus communis* demonstrated that the extract was not toxic and also did not harm any essential organs. The plant's leaves are safe to eat and, when ingested in moderation, also contain antibacterial effects. When breathed or consumed orally, seeds are extremely poisonous, in contrast to leaves and other plant parts. Ricin toxin, a Type-II ribosome-inactivating agent and well-known bioterrorism agent, is present in *Ricinus communis* seeds [69-71].

Sr.No	Pharmacological Activity	Extract used in this Study	References
1	Antioxidant Activity	Extract of seed, leaves and stem	[44]
2	Antianxiety Activity	Methanolic extract of seeds pericarp of <i>R</i> . <i>communis</i>	[72]
3	Anti-inflammatory activity	Leaves and root extract	[21]
4	Anti-fertility activity	Ricinus communis seed	[37, 38]
5	Hepatoprotective activity	Leaves ethanolic extract	[42]
6	Antimicrobial Activity	Petroleum ether and acetone extracts	[23, 48]
7	Immunomodulatory activity	Leaves of <i>R. communis</i>	[11]
8	Anti-asthmatic Activity	Ethanolic root extract of <i>R</i> . <i>communis</i>	[59]
9	Antidiabetic Activity	Ethanolic extract of roots	[41]
10	Antihistaminic Activity	Ethanol extract root	[59]
11	Central analgesic activity	extract of crude root bark of <i>R. communis</i>	[11, 18]

Table 4 Pharmacological studies of Ricinus communis L.

12	Antiulcer activity	Castor oil seed	[34]
13	Antinociceptive activity	Methanolic leaf extract of <i>R. communis</i>	[46]
14	Anti-cancer activity	fruit extract of R. communis	[31, 40]
15	Anticonvulsant Activity	Leaf extracts of <i>R. communis</i>	[29]
16	Anti-implantation activity	methanolic extracts of <i>R. communis</i>	[33]
17	Leishamicidial activity	extracts of <i>R. communis</i> and <i>A. indica</i>	[25]
18	Anthelmintic activity	methanolic, aqueous, and ethanolic extract of <i>R. communis</i> leaves	[13]
19	Lipolytic activity	Ricin from <i>R. communis</i>	[30]
20	Wound healing activity	Castor oil seed	[24]
21	Cytotoxic activity	leaves extract of R. communis	[14]
22	Larvicidal activity	Extract of leaves and stem	[17, 28]
23	Acaricidal activity	Leaf extracts of <i>R. communis</i>	[19]
24	Insecticidal activity	methanolic seeds extract of <i>R</i> . communis	[20, 45]
25	Hypolipidmic activity	Root / Aqueous extract	[61]

26	Anti-dandruff activity	Leaves / Aqueous, methanolic, chloroform as well as petroleum ether extract	[63]
27	Antitumor activity	Ricinus communis seed	[64]
28	<b>Ophthalmic Properties</b>	<i>Ricinus communis</i> oil	[35, 36]
29	Bone Regeneration activity	<i>Ricinus communis</i> oil	[16, 39, 66]
30	Laxative and Uterine Contracting	Castor oil	[8, 47]
31	Toxicological Property	leaves extract of R. communis	[69-71]

# 5. PHYTOCHEMICAL STUIDES

Steroids, saponins, flavonoids, alkaloids, and glycosides are all present in *R. communis*, according to the preliminary phytochemical analysis. Two alkaloids, ricinine (0.55%) and N-demethylricinine (0.016%), and six flavones, glycosides, were detected in the dried leaves of *R. communis*. The GLC investigation of castor oil revealed the existence of ester forms of the following fatty acids: oleic (3.2%), linoleic (3.4%), linolenic (0.2%), ricinoleic (89.4%), and dihydroxy stearic. The seeds contain 45% fixed oil, which is composed of the crystalline alkaloid ricinine as well as the glycosides of the many compounds [27]. Ricinine is also present in the stem. From an ether extract of seeds, the ergost-5-en-3-ol, stigmasterol, y-sitosterol, fucosterol, and 1-probucol were extracted. When *R. communis* essential oil was analyzed by GC-MS using capillary columns, chemicals such as Thujone (31.71%) and 1,8-Cineole (30.98%) etc were discovered.

Pla	Phytoconst	Chemic	al Structure		Molecu	Molecu	Strut	Refere
nt	ituents				lar	lar	ure	nces
part					Formul	weight	ID	
					a			
Flo	Ricinine				$\underline{C_8}\underline{H_8}\underline{N_2}$	164.16	10666	[11]
wer					<u>O</u> <sub>2</sub>	g/mol		
			0	/				
			N <sub>≷C</sub>					
			$\square$					
			0 N	<u></u>				
Lea	Alkaloids	Alkalo	Ricinine	_	$\underline{C_8H_8N_2}$	164.16	10666	[9, 14,
ves	(0.55% of	ids		N <sub>s</sub>	$O_2$	g/mol		22, 26,
	ricinine and							43]
	0.016% of			0				
	demethylric							
	inine)		N-		$C_7H_6N_2$	150.13	27867	
	Flavones,		demethylri	N <sub>N</sub>	<u>O</u> <sub>2</sub>	g/mol	02	
	Phenolic		cinine			-		
	compounds			U. I				
	(gallic acid,							
	asesquiterpe	Flavon	kaempferol	20	$\underline{C}_{20}\underline{H}_{18}$	418.3 g/	21310	
	noid,	es	-3-O-β-D-	1. Dr	<u><b>U</b>10</u>	mol	440	
	gentistic		Xylopyran	· hand				
			oside	2.5				

Table 5 Phytochemical studies of Ricinus communis L.

acid, ellagic		kaempferol	Ţ	$C_{21}H_{20}$	448.4 g/	52821	
acid,		-3-O-β-D-	- The	$O_{11}$	mol	02	1
epicatechin,		glucopyran	· YY V				1
saponins,		oside	L				1
tannins,		quercetin-	L.	<u>C<sub>20</sub>H<sub>18</sub></u>	434.3 g/	53208	l
methyl		3-O-β-D-	200	<u>O<sub>11</sub></u>	mol	61	l
gallate,		xylopyrano	المحملية المحملية الم المحمد				l
chlorogenic		side	1. 1				l
acid		quercetin3-	₹-{	C21H2	464.379	68352	l
		Ο-β-D-	"TIT	0012			l
		glucopyran					1
		oside	<b>.</b>				l
		kaempferol		<u>C<sub>27</sub>H<sub>30</sub></u>	594.5 g/	53187	l
		-3-O-	C.C.	<u>O<sub>15</sub></u>	mol	67	1
		βrutinoside	- A to				l
			" And the second				1
		quercetin-		<u>C<sub>27</sub>H<sub>30</sub></u>	610.5 g/	49857	1
		3-Ο-β-	가운	<u>O</u> 16	mol	143	l
		rutinoside	J.				l
			* 1				1
	Phenol	1, 8-		$\underline{C}_{10}\underline{H}_{18}$	170.25	68573	1
	ic	cineole	v⊁.	<u>O</u> <sub>2</sub>	g/mol	83	l
	compo	(Monoterp					1
	unds	enoids)					1
		Camphor		<u>C<sub>10</sub>H<sub>16</sub></u>	152.23	2537	1
		(Monoterp	$\checkmark$	<u>O</u>	g/mol		l
		enoids)	TH.				l
							l
					1		1

	α-pinene		$C_{10}H_{16}$	136.23	57393	
	(Monoterp			g/mol	761	
	enoids)	M				
	β-	1	C15H24	204.35	52815	
	caryophyll	H		g/mol	15	
	ene					
	(sesquiterp	V Y				
	enoid)					
	gallic acid	o- <sup>H</sup>	$\underline{C_7H_6O_5}$	170.12	370	
		H.O		g/mol		
		$\square$				
		9 <b>~</b> 0				
	quercetin	"e g	$\underline{C}_{15}\underline{H}_{10}$	302.23	52803	
		"	$\mathbf{O}_7$	g/mol	43	
		اسیا پ				
	gentisic	а, <mark>н</mark>	C <sub>7</sub> H <sub>6</sub> O	154.12	3469	
	acid	H O	4	g/mol		
		L.				
		н				
	rutin	L	C <sub>27</sub> H <sub>30</sub>	610.5 g/	52808	
		"Ch	O <sub>16</sub>	mol	05	
		in the second				
	epicatechin		<u>C15H</u> 14	290.27	72276	
	-		<u>O</u> <sub>6</sub>	g/mol		
		H g And a Angel		-		
		, b				

			ellagic acid	н а. 	$\underline{C}_{14}\underline{H}_{6}\underline{O}$	302.19	52818	
				s,CL,	<u>8</u>	g/mol	55	
				* a.,				
Roo	Indole -3-	Indole -	3-acetic acid		<u>C<sub>10</sub>H<sub>9</sub>N</u>	175.18	802	[9, 14,
ts	acetic acid,			- Charles	$\underline{O}_2$	g/mol		22, 26,
	tannins,			Look				43]
	Ricin,							
	phenols,	Phenols		×	$\frac{C_{11}H_{13}}{N_2O}$	203.24	2151	
	flavonoids				<u>1130</u>	g/mol		
				_				
		Ricin			<u>C<sub>19</sub>H<sub>36</sub></u>	312.5 g/	60328	
					<u>O</u> <sub>3</sub>	mol	67	
Ste	Ricinine,	ricinine			$\underline{C_8H_8N_2}$	164.16	10666	[9, 11]
ms	flavonoids,			N <sub>R</sub> C	<u>O</u> 2	g/mol		
	tannins			ON				
See	Fixed oil	Glycos	Ricinoleic		<u>C<sub>18</sub>H<sub>34</sub></u>	298.5 g/	64368	[9, 11,
ds	45%,	ides	acid	م ر	<u>O</u> <sub>3</sub>	mol	4	22]
	glycosides,							
	lipases,		<b>.</b>	_	<b>a </b>		50000	
	ricinine, Y-		Isoricinolei	نى مى مى مى مى مى قى ا	$\frac{C_{18}H_{34}}{O_3}$	298.5 g/	52829	
	sitosterolfuc		c acid	i i i C	<u></u> 2	mol	41	
	osterol,							
	stigmasterol		Stearic		C <sub>18</sub> H <sub>36</sub>	284.5 g/	5281	
	, probucol,		acid		$O_2$	mol		
	Ricin,							

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flavonoids,		dihydroxys		<u>C<sub>18</sub>H<sub>36</sub></u>	316.5 g/	89377	
tannins		tearic acid		<u>O</u> <sub>4</sub>	mol		
	crystal	ricinine	/	$\underline{C_8H_8N_2}$	164.16	10666	
	line		N <sub>M</sub> c	<u>O</u> <sub>2</sub>	g/mol		
	alkaloi		o star				
	d						

Thus, the castor bean plant has pharmacological properties including anti-fertility, antiimplantation, antinociceptive, anti-cancer, antioxidant, immunomodulatory, hepatoprotective, anti-diabetic, anti-ulcer, anti-microbial, insecticidal, molluscicidal, anti-asthmatic, cytotoxic, and lipolytic activities etc. The pharmacological review depicts phytochemical analysis of *R*. *communis* in which Glycosides, Alkaloids, Saponins, Steroids, and Saponin-like compounds are included.



Figure 3 Phytochemistry and Pharmacology of Ricinus communis L.

# 2. TOXICITY

The seed may kill a man, four rabbits, five sheep, six oxen, six horses, seven pigs, eleven dogs, and 80 cocks and ducks, however it contains 2.8–3% poisonous chemicals. Albumin, or ricin, is the main toxin. The antigenic or immunizing activity it produces, however, results in the production of an antitoxin similar to that resulted against bacteria in tiny doses. *R. communis* seeds

are toxic to humans, animals, and insects. When Still Mark examined the bean extract on red blood cells in 1988, he gave it the name "ricin," which is one of the key harmful proteins. The seed travels through the digestive system without harm if it is swallowed without chewing. The ricin dangerous substance will, however, be ingested by the intestines if it is chopped or broken before being ingested. It has been reported that even one seed can kill a child. A milligram of ricin might be sufficient to kill an adult. Abdominal discomfort, vomiting, and diarrhea—often bloody—come on within a few hours of consumption and are the main signs of human poisoning. Severe dehydration results in a lesser production of urine and a drop in blood pressure within a few days [60].

### **FUTURE PERSPECTIVES**

*R. communis* is a highly beneficial medicinal herb with no harmful side effects. Due to the longterm impacts of chemical products, individuals are now becoming increasingly dependent on herbal remedies [15]. It is feasible to discover new herbal remedies in the fields of medical research and ethnobotany for improving human health, according to the interdisciplinary use of the castor bean's active ingredients. The castor bean's chemical component, which has a contraceptive effect, has also introduced a innovative scale to area of birth control. It may be effective in densely populated nations even if it has no adverse effects on body like chemical contraceptives do. We have the notion that this plant could one day serve as a potential target for a wider range of tumors and malignancies due to the antioxidant as well as free radical scavenging properties of phytochemical elements extracted from it. A methodical scientific approach from pure or crude phytochemicals to contemporary development of drugs can provide useful medicines from ancient medicinal plants [73]. The creation of such medications with global effectiveness and safety might offer better and more effective treatment for a variety of ailments. New strategies must be used to ensure enough phytoconstituent production in a constrained amount of time and space [74]. This is due to the fact that bio-resource prospecting is becoming a more popular form of business.

### CONCLUSION

From the prehistoric era to the present, the medicinal properties of the *R. communis* plant have played a vital role in life of mankind and have helped to provide light on the utilization of plants or plant-derived products as medicines. It has many different pharmacological effects, some of

which are discussed here, but this plant still has a lot of untapped potential that has to be discovered. The pharmacological activities discussed in this review's findings demonstrate that *R. communis* has a very high therapeutic value and the potential to generate future medications that are innovative, safe, efficient, and less expensive. To optimally utilize its medical qualities, more thorough research, pharmacological studies, clinical trials, exploration, and public education are required. Overall, the pharmacological effects and phytochemical components displayed by *R. communis* have considerable value for studying medicinal plants. Therefore, the industrial entrepreneurs must also propose fresh ideas and strategies for making the most beneficial use of this potential therapeutic plant. However, due to their toxic qualities, the seeds that are part of this plant are extremely dangerous for both humans and animals. Fever, depression of the CNS, and other health problems in living things are possible outcomes. The only harmful component of *Ricinus communis* is its seeds; other from that, the entire plant with its other components is useful in a variety of ways.

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