IN PRAISE OF THE MEDICINAL PLANT RICINUS COMMUNIS L.: A REVIEW

Sonali Bhakta¹ & Shonkor Kumar Das²*

¹²Bioresearch Laboratory (Cancer and Herbal Research Center), Dept. of Anatomy and Histology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh;
*Corresponding Author: Email: skdas76@yahoo.com/shonkor@gmail.com; Contact: +88-01716-855186/01616855186;

Received: 25/03/2015; Revised: 22/04/2015; Accepted: 05/05/2015

ABSTRACT

Medicinal plants have a vital role to take care of the healthy human life. The large family Euphorbiaceae contains nearly about 300 genera and 7,500 species. Amongst all, Ricinus communis L. or castor bean plant has high traditional and medicinal values towards a disease free community. The castor bean plant is effective as antifertility, antiimplantation, anticancer, antioxidant, antinociceptive, in vitro immunomodulatory, hepatoprotective, antidiabetic, antiulcer, antimicrobial and antifungal, insecticidal, bone regeneration, central angesic, antihistaminic, antiasthmatic, molluscicidal and larvicidal, lipolytic, antiinflammatory and wound healing. In addition, the constituents present in this plant are beneficial for the purpose of contraception leaving no detrimental effects on the body. The present review highlights the importance of this medicinal plant (Ricinus communis L.), also aiming to draw the necessary attention as a frontier one.

KEYWORDS: Medicinal plant, Ricinus communis L. (castor bean), biological effects, future prospects

Cite this article:
INTRODUCTION

It is true that without nature human life is not possible. The food, clothes and shelter are the three basic needs of human beings and the most important one is the sound health, which is chiefly provided by the plant kingdom (Jena et al., 2012). Plant kingdom is the richest source of organic compounds that have been used for medicinal purposes. In traditional medicine, there are many natural crude drugs that have the potentials to treat the diseases and disorders, such a mentionable one is **Ricinus communis** L. [Family: Euphorbiaceae, popularly known as 'castor plant' and commonly known as 'palm of Christ', Jada (Oriya), Verenda (Bengali), Endi (Hindi), Errandi (Marathi), and Diveli (Guajarati)] This plant is widespread throughout the tropical regions as an ornamental plant (Maman et al., 2005).

The active constituents present in the plant determine the medicinal or biological effects of that plant. There are many chemical constituents present in the castor bean plant (leaf, fruit, seed, stem and oil etc.); among them the most active ingredient is the ricin.

Ricin is chiefly present in the seed (Figure 1) and oil of castor bean plant. It is cytotoxic and inhibits the protein synthesis in eukaryotic cells. Each toxin consists of 2 polypeptide chains with different functions (Lin et al., 1972 and Olsnes et al., 1974). The B-chain, or "haptomer," binds the toxin to certain cell surface receptors carrying terminal galactose residues. After being bound to the cell surface, the toxin or its active part, the A-chain or "effectomer," which is attached to the B-chain by a disulfide bond, somehow penetrates into the cytoplasm where it inactivates the 60 S ribosomal subunits, thus inhibiting protein synthesis (Sperti et al., 1973 and Benson et al., 1975). A tumor-inhibiting effect of ricin was reported by Mosinger et al., (1951). Lin et al. (1972) found a strong protective effect of abrin and ricin against Ehrlich ascites tumor cells in mice. Others have found a growth-inhibiting effect of ricin on Ehrlich ascites tumor and sarcoma, but the effect was much less than as reported by Lin et al. (1972). A certain protective effect against experimental leukemia was also reported. In preliminary studies, the toxins have also been used in the treatment of certain forms of human cancers. In the few cases reported thus far, the results appear promising and a few side effects have been observed. These toxins had a clear inhibitory effect on tumor growth without a depressive effect on the level of WBC. Although there are many toxic effects of ricin, but from the very ancient times people use this plant seed for several purposes. This plant has many medicinal uses that are potential for the prevention of diseases leaving no baleful effects on the health if the dose is maintained properly (below the toxic level). In the following section, a comprehensive coverage of the literature covering the taxonomical classification, ancient uses, chemical constituent, biological effects/clinical uses and the remarkable prospects of **Ricinus communis** L. is presented.

**Taxonomical classification**

Kingdom: Plantae  
Order: Malpighiales  
Family: Euphorbiaceae  
Sub Family: Acalyphoideae  
Tribe: Acalypheae  
Sub Tribe: Ricininae  
Genus: Ricinus  
Species: **Ricinus communis** L.

![Figure 1: Seed of Ricinus communis L.](image-url)
THE ANCIENT USE OF RICINUS COMMUNIS L.

The castor beans are known for their high toxicity for centuries. In ancient times, farmers knew to keep their livestock away from the castor plant or else they would risk losing them. Their seeds have been also used in folk medicine against a wide variety of diseases (David et al., 2007). The use of these proteins of the castor bean seed is being reviewed for medical treatments since ancient times. Later, their important roles in the early days of immunological research and some of the fundamental principles of immunology were discovered. During the last three decades, the mechanism of action of the toxins was elucidated. This led to a major effort to target the toxins to malignant cells. Ricin has been used in bioterrorism also. Recently, the toxins have played important roles as experimental models to elucidate the intracellular trafficking of endocytosed proteins (Olsnes et al., 2004). Although the castor bean plant Ricinus communis L. originated from Asia and Africa, nowadays it can be found in Europe and America also (Olsnes et al., 1974). Castor oil is still produced in large quantities throughout the world and the toxin which remains in the castor meal after the oil has been extracted with hexane or carbon tetrachloride is easily removed through a simple salting-out procedure (David et al., 2007).

There are versatile uses of this plant (Oil, leaf, seed and fruit) in different aspects of life. Bulk of the commercial oil is generally processed in a number of ways and then used for different purposes. The treated oil can also be used as paints, enamels and varnishes, oiled fabrics, linoleum, patent leather, fly-paper, typewriting and printing inks, greases and special lubricants.

The leaves have also been recommended in the form of a decoction or poultice and as an application to the breasts of women to increase the secretion of milk (Bentley et al., 2007). Castor cake is used as manure in this sub-continent especially in India. It is rich in nitrogen and other minerals, and has been found to be suitable as a manure for paddy, sugarcane, tobacco etc.

The powdered leaves are used for repelling aphids, mosquitoes, white flies and rust mites. Leaves are said to be used in the form of a poultice or fomentation on sores, boils and swellings. Oil derived from the leaves is commonly applied over the abdomen to give relief in the flatulence in the children (The Wealth of India, 1972).

CHEMICAL CONSTITUENTS OF RICINUS COMMUNIS L.

The preliminary phytochemical study of R. communis revealed the presence of steroids, saponins, alkaloids, flavonoids, and glycosides in it.

The dried leaves of R. communis showed the presence of two alkaloids, ricinine (0.55%) (Figure 2C) and N-demethylricinine (0.016%) (Figure 2B) and six flavones: glycosides kaempferol-3-O-β-D-Xylopyranoside, kaempferol-3-O-β-D-glucopyranoside, quercetin-3-O-β-D-xlyopyranoside, quercetin-3-O-β-D-glucopyranoside, kaempferol-3-O-β-rutinoside and quercetin-3-O-β-rutinoside (Kang et al., 1985). The monoterpenoids (1, 8-cineole, camphor and α-pinene) and asesquiterpenoid (β-caryophyllene), gallic acid, quercetin, gentisic acid, rutin, epicatechin and ellagic acid are the major phenolic compounds isolated from leaves. Indole-3-acetic acid has been extracted from the roots (Darmanin et al., 2009 and Singh et al., 2009).

The seeds and fruits contain 45% of fixed oil, which consist glycosides of ricinoleic, isoricinoleic, stearic and dihydroxystearic acids and also lipases and a crystalline alkaloid, ricinine (Khogali et al., 2006). The GLC (Gas Liquid Chromatography) study of castor oil showed the presence of ester form of palmitic (1.2%), stearic (0.7%), arachidic (0.3%) hexadecenoic (0.2%), oleic (3.2%), linoleic (3.4%), linolenic (0.2%), ricinoleic (89.4%) and dihydroxy stearic acids.

The stem also contains ricinine. The ergost-5-en-3-o, stigmasterol, Y-sitosterolfucosterol;
and one probucol isolated from the ether extract of seeds. The GC-MS analyses of *R. communis* essential oil (using capillary columns) are identified compounds like α-thujone (31.71%) (Figure 2A) and 1, 8-cineole (30.98%), α-pinene (16.88%), camphor (12.92%) and camphene (7.48%). Lupeol and 30-Norlupan-3β-ol-20-one are obtained from coat of castor bean (Malcolm *et al*., 1968).

**Figure 2: Chemical structures of the active constituents of *Ricinus communis* L.**

![Fig 2A: Alpha thuzone](image1)
![Fig 2B: N-d methylene](image2)
![Fig 2C: Ricinine](image3)

**BIOLOGICAL ACTIVITY / CLINICAL USES**

**Antifertility effects of *Ricinus communis* L.**

The methanolic extract of *R. communis* seed possesses both steroids and alkaloids. The pituitary gland releases gonadotrophins due to the sex hormones by both positive and negative feedback mechanism and also the pituitary gland block the release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH) because of the combined effect of oestrogen and progesterone in the luteal phase of the menstrual cycle. Finally, it helps the inhibition of maturation of the follicle in the ovary and prevents ovulation. The sex hormone being steroidal compounds (phytosterols) and the presence of steroids in methanol extract of *Ricinus communis* seed produces antifertility effects (Sani *et al*., 2007 and Sandhyakumary *et al*., 2003) (Figure 3).

**Figure 3: Mechanism of antifertility effects of *Ricinus communis* L.**

![Diagram of antifertility effects](image4)
Recent studies showed that, the seed extract have been found to possess antifertility activity. The ether soluble portion of the methanol extract of seeds when administered subcutaneously to adult female rats and rabbits showed antimplantation and anticonceptive activity (Okwuasaba et al., 1991). The extract protected the animals from getting pregnant for over three gestation periods. Further, the extract did not show any long term effect on the pups that were born after the extract effect. The seed extract was found to possess antimplantation and abortifacent effects. It was also observed that the seed extract prolonged the estrus cycle of guinea pigs. The di-estrus phase was significantly prolonged as well. After stopping the administration of the extract, the normal di-estrus phase and estrus cycle started to resume. The seed extract also reduced the weight of the uterus without affecting that of the ovaries significantly. The antifertility effect of *R. communis* in female guinea pigs might be extrapolated to human beings. The 50% alcohol extract of the roots possess significant reversible antifertility effect. There was a drastic reduction in the epididymal sperm counts in male rats. The extract also caused changes in the motility, mode of movement and morphology of the sperms. The reductions in the fructose and testosterone levels further suggested the reduced reproductive performance (Ram & Geetanjali, 2015).

In the Bioresearch Laboratory of the Dept. of Anatomy and Histology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh, the efficacy of the aqueous extract of the castor bean seed for the antifertility activity in Swiss albino mice has been observed and evaluated. In this research, it was revealed that the aqueous extract of the seed of *Ricinus communis* is practically potential for the contraception. In addition, gross and histological studies showed that there were no adverse effects on the vital organs of the body. Also, the hematological parameters had a positive impact that is practically beneficial during the pregnancy period.

**Antiimplantation activity:**

The ether soluble portion of the methanol extract of *Ricinus communis* var. minor possesses antimplantation, anticonceptive and estrogenic activity in adult female rats and rabbits when administered subcutaneously at a dose upto 1.2 g/kg b. wt. and 600 mg/kg b. wt., in divided doses respectively (Okwuasaba et al., 1991).

**Anticancer activity:**

A lectin isolated from *R. communis* is ricin A, possesses antitumor activity, that was more toxic to tumor cells than to non-transformed cells, judged from the ED$_{50}$ of the lectin towards tumor cells and non-transformed cells (Lin et al., 1986).

**Antioxidant activity:**

*R. communis* seed extracts produce the antioxidant activity by using lipid per oxidation via ferric thiocynate method and free radical scavenging effect on 2,2 diphenyl-1-picrylhydrazyl radical (DPPH) and hydroxyl radical generated from hydrogen peroxide. The high antioxidant activity of the seed of *R. communis* at low concentration shows that it could be very useful for the treatment of disease resulting from oxidative stress. The responsible chemical constituent of *R. communis* which produces antioxidant activity is Methyl ricinoleate, Ricinoleic acid, 12-octadecadienoic acid and Methyl ester. The *Ricinus communis* stem and leaf extracts also produce antioxidant activity due to the presence of flavonoids in their extracts (Gupta et al., 2006 and Singh et al., 2010). Some studies revealed that gallic acid, quercetin, gastic acid, rutin, epicatechin and ellagic acid are the major phenolic compounds responsible for the antioxidant activity of the dry leaves of *Ricinus communis* (Singh et al., 2009).

**Antinociceptive activity:**

The methanol leaves extract of *R. communis* possesses significant antinociceptive activity against acetic acid induced writhing test, formalin induced paw licking and tail immersion methods in mice. The
antinociceptive activity showed due to the presence preliminary phyto-constituents like saponins, steroids and alkaloids (Dnyaneshwar et al., 2011).

**In vitro immunomodulatory activity:**

The plant and animal origin immunomodulatory agents generally increase the immune responsiveness of the human body against pathogens by activating the non-specific immune system. The presence of tannins in the leaves of *R. communis* significantly increased the phagocytic function of human neutrophils and resulted in production of a possible immunomodulatory effect (Kumar et al., 2007).

**Hepatoprotective activity:**

*Ricinus communis* leaves ethanolic extract 250–500 mg/kg b.wt. (The dose is below the toxic level) possesses hepatoprotective activity due to their inhibitory activities of an increase in the activities of serum transaminases and the level of liver lipid per oxidation, protein, glycogen and the activities of acid and alkaline phosphatase in liver induced by carbon tetrachloride (CCL₄). The *R. communis* ethanolic extract 250–500 mg/kg b.wt. also treated the depletion of glutathione level and adenosine triphosphatase activity which was observed in the CCL₄-induced rat liver. The presence of flavonoids in ethanol extract of *R. communis* produces beneficial effect as the flavonoids have the membrane stabilizing and antiperoxidative effects. Hence, *R. communis* increases the regenerative and reparative capacity of the liver due to the presence of flavonoids and tannins. The anticholestatic and hepatoprotective activity was seen against paracetamol-induced hepatic damage due to the presence of N-demethylricinine isolated from the leaves of *Ricinus communis*. The whole leaves of *Ricinus communis* showed the protective effect against liver necrosis as well as fatty changes induced by CCL₄ while the glycoside and cold aqueous extract provide protection only against liver necrosis and fatty changes, respectively (Natu et al., 1977; Shukla et al., 1992; Visen et al., 1992 and Princea et al., 2011).

**Antidiabetic activity:**

The ethanolic extract of roots of *Ricinus communis* (RCRE) was investigated along with its bioassay-guided purification. By the administration of the effective dose (500 mg/kg b.wt.) of RCRE to the diabetic rats for 20 days possess favorable effects not only on fasting blood glucose, but also on total lipid profile and liver and kidney functions. Amongst all fractions the R-18 fraction suggests the significant antihyperglycemic activity. RCRE showed no significant difference in alkaline phosphatase, serum bilirubin, creatinine, serum glutamate oxaloacetate transaminases, serum glutamate pyruvate transaminases and total protein which was observed even after the administration of the extract at a dose of 10 g/kg b.wt. Thus, *R. communis* is a potent phytomedicine for diabetes (Shokeen et al., 2008).

**Antiulcer activity:**

The castor oil of *R. communis* seed possesses significant antiulcer properties at a dose of 500 mg/kg b.wt. and 1000 mg/kg b.wt. (Below the toxic level), but at the dose 1000 mg/kg b.wt. was more potent against ulceration caused by pylorus ligation, aspirin and ethanol in rats. The result showed that the antiulcer activity of *R. communis* is due to the cytoprotective action of the drug or strengthening of gastric mucosa and thus enhancing the mucosal defence (Rachhadiya et al., 2011).

**Antimicrobial and antifungal activity:**

The secondary infections in the immune compromised oral cancer cases were due to the bacterial and fungal species. The co-administration *Ricinus communis* with the immunosuppressant drugs for the prevention of infection against oral cancer treatment patient showed a significant result (Panghal et al., 2011).
Insecticidal activity:

The insecticidal value of the castor oil plant (*Ricinus communis*) in controlling the termites which damage the wood of *Mangifera indica* and *Pinus longifolia* were examined. In comparative trials, the order of insecticidal activity was: DDT = BHC > castor oil + castor cake (1:1) > castor oil > castor leaves > castor cake > neem oil > neem leaves. All treatments significantly reduced weight loss in wood pieces exposed to termites (Sharma et al., 1990).

Bone regeneration activity:

*Ricinus communis* polyurethane (RCP) has been studied for its biocompatibility and its ability to stimulate the bone regeneration. Results showed that RCP blended with calcium carbonate or calcium phosphate could promote matrix mineralization and are biocompatible materials (Beloti et al., 2003). Incorporating alkaline phosphatase to RCP with subsequent incubation in synthetic body fluid could improve the biological properties of RCP (Darmanin et al., 2009). The advantage seen in RCP as compared to demineralized bone is that the former has a slower reabsorption process (Beloti et al., 2008).

Central analgesic activity:

The crude extract of root bark of *Ricinus communis* possesses central analgesic activity in tail flick response model to radiant heat at a dose of 250 mg/kg b.wt. The ethanolic extract of pericarp of fruit of *Ricinus communis* possesses typical CNS stimulant and neuroleptic effects (Almeida et al., 2009). The stimulant effects, such as exophthalmus, hyperreactivity (evidenced by tremors or by the pinna and grip-strength reaction), memory improvement, and clonic seizures, seem to be due to the presence of the alkaloid ricinine. The main toxic compound of the extract also seems to be ricinine, because animals that died after administration of extract or ricinine showed similar signs: they all died after the occurrence of clonic seizures followed by an apparent breathing arrest. On the other hand, compounds other than ricinine may be responsible for the neuroleptic-like effects of the extract, because ricinine did not cause reduction of locomotor activity or catalepsy in the mice (Ferraz et al., 1999).

Antihistaminic Activity:

The ethanolic extract of *R. communis* L. root has the antihistaminic activity at the dose 100, 125, and 150 mg/kg b.wt. when inserted in to the body intraperitoneally by using clonidine induced catalepsy in mice (Dnyaneshwark et al., 2011).

Antiasthmatic activity:

The ethanolic extract of root of *R. communis* is effective in treatment of asthma because of its antiallergic and mast cell stabilizing potential activity. Saponins has mast cell stabilizing effect and the flavonoids possess smooth muscle relaxant and bronchodilator activity; the apigenin and luteolin like flavonoids generally inhibit basophil from histamine release and neutrophils from beta glucuronidase release, and finally shows *in vivo* antiasthmatic activity. The ethanolic extract of *R. communis* decreases milk induced leucocytes and eosinophilia and possess antiasthmatic activity due to presence of flavonoids or saponins (Dnyaneshwar et al., 2011).

Molluscidal and larvicidal activity:

The leaf extract of *R. communis* possess molluscidal activity against *Lymnaea acuminata* and the seed extracts showed better molluscidal activity than the leaf extracts against *S. frugiperda* due to the active ingredients like castor oil and ricinine. The aqueous leaves extracts of *R. communis* possess suitable larvicidal activity against *Anopheles arabiensis*, *Callosobruchus chinensis* and *Culex quinquefasciatus* mosquitoes (Sharma et al., 2009, Upasani et al., 2003 and Ramos et al., 2010).

Lipolytic activity:

The ricin produces the lipolytic activity by using the various substrates: (i) one analogue of triacylglycerol, BAL-TG; (ii) various
Wound healing activity:

The Ricinus communis possess wound healing activity due to the active constituent of castor oil which produces antioxidant activity by inhibiting lipid peroxidation. The study of wound healing activity of castor oil was in terms of scar area, % closure of scar area and epithelization in excision wound model. Due to the astringent and antimicrobial property the tannins, flavonoids, triterpenoids and sesquiterpenes present in the castor oil, promote the wound healing process, which are responsible for wound contraction and increased rate of epithelialisation. The study resulted that the castor oil showed wound healing activity by reducing the scar area and also the epithelialisation time in excision wound model (Prasad et al., 2011).

POSSIBLE PROSPECTS

The castor bean (Ricinus communis) is a very useful medicinal plant having no adverse effects on the body. Nowadays, people are becoming more and more dependent on the herbal products rather than the chemical ones due to their residual effects on the long run (Das et al., 2010). The multidisciplinary use of the active constituents of the castor bean reveals that it will be possible to find out new herbal products in the field of medical science/ethno-botanical science for the better health of the human being. The contraceptive effect of the chemical constituent of the castor bean (Ricinus communis) has also added a new dimension in the field of birth control might be useful in the densely populated countries even having no baleful effects on the body as the chemical birth control pills do. The antioxidant and free radical scavenging activities of phytocomponents isolated from this plant give us an impression that the plant might be the future prospective target for diversified panel of tumors and cancers. A systematic scientific approach from phytochemicals either in pure or crude form to modern drug development can provide valuable drugs from traditional medicinal plants. Development of such medicines with international safety and efficacy can give better and satisfactory treatment of various diseases. To ensure ample production of phyto-constituents with in limited space and time, new approaches must be adopted. This is because the prospecting of bio-resources for economic development is emerging as a new economic venture.

CONCLUSION

The Ricinus communis or castor plant is a native plant of the Indian subcontinent. It has various pharmacological actions, some of them are reviewed here but still this plant has much novel potentials which are yet to explore. The pharmacological activities reported in the present review confirm that the therapeutic value of Ricinus communis is very high having a leading capacity for the development of a new, safe, effective and cheaper drug in future. But it needs more elaborative study,
pharmacological investigations, clinical trials, more exploration and public awareness for the best utilization of its medicinal properties. Hence, the industrial entrepreneurs also should come forward with new concepts and steps towards the best use of this potential medicinal plant.

REFERENCES


Source of Support: Ministry of Science and Technology, Govt. of Bangladesh

Conflict of Interest: None Declared