

REVIEW ARTICLE

A Review on Castor/Eranda (*Ricinus communis*) from Medicinal Plant to Potential Biodiesel w.s.r Seed Oil Farming - A Growing Venture

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ABSTRACT

In order to survive, man relies on plants, which provide him with food, fuel, and medicine from eras before the development of civilization. Throughout the ages, societies all around the world have turned to account the use of medicinal herbs to serve as a cogent source to the society. Traditional medicines have been a cornerstone of an accessible and inexpensive healthcare system and are a crucial source of income for rural and indigenous populations. With increased industrialization and motorization, one of the world's most serious problems is the depletion of medicinal flora and fossil resources. Furthermore, the combustion of transportation fuels, contributes to the greenhouse effect due to the carbon emission. In order to curtail this and to find efficient means to balance the ecology we need to explore the ways for the utilization of plant based fuels which will not only help in promoting reforestation but will also serve as a better environmental footprint. They can prove to be renewable, sustainable and efficient energy sources. This paper highlights the role of *Ricinus communis* as a potential Biofuel and medicinal plant with millions of worth. The paper discusses the review on the uses of the plant in ancient *Ayurveda* literature as well as its present day utility as a Biofuel. Thereby promoting the farming and cultivation practices of such plants.

Key Words *Ayurveda, Biofuel, Castor oil, Eranda, Ricinoelic acid, Ricinus communis*

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INTRODUCTION

Since primordial times, herbal plants have been a reliable source of medicine. In order to survive, man relies on plants, which provide him with food, fuel, and medicine from eras before the development of civilization. Throughout the ages, societies all around the world have turned to account the use of medicinal herbs to serve as a

cogent source to the society. Traditional medicines have been a cornerstone of an accessible and inexpensive healthcare system and are a crucial source of income for rural and indigenous populations. India occupies a special place in the globe in the ancient system of medicine and has a great diversity of medicinal and aromatic plants. Numerous studies have

REVIEW ARTICLE

highlighted the socioeconomic uses of plants, including both therapeutic and non-medical benefits. Traditional knowledge based on plants has gained acceptance as a technique for the discovery of pharmaceuticals and nutraceuticals. With increased industrialization and motorization, one of the world's most serious problems is the depletion of medicinal flora and fossil resources. Furthermore, the combustion of transportation fuels, contributes to the greenhouse effect due to the carbon emission. In order to curtail this and to find efficient means to balance the ecology we need to explore the ways for the utilization of plant based fuels which will not only help in promoting reforestation but will also serve as a better environmental footprint. They can prove to be renewable, sustainable and efficient energy sources.

Vegetable oil based biofuels have shown a promising potential when it comes to manufacturing liquid fuels. There are many natural crude drugs such as *Raphanus sativus* (radish), *Jatropha curcas* (physic nut), *Cyperus esculentus* (tiger nut), *Simmondsia chinensis* (jojoba), *Gratissima persea* (avocado), *Lupinus albus* (white lupin), *Mauritia flexuosa*, *Syagrus coronata*, *Attalea speciosa*, and *Ricinus communis* (castor seeds) that have the potential which can fulfill this purpose¹.

One of such medicinal plant is *Ricinus communis* (*Eranda* or castor plant), Euphorbiaceae family. *Ricinus communis* is one of many natural crude drug used in traditional medicine that has the

potential to cure a wide range of illnesses and conditions. The plant is well known traditionally and has been used ethnobotanically for various medical and household purposes the plant is used. Castor has attracted attention recently due to its positive impact on human health and is one of the effective plants mentioned in *Ayurveda*, which offer a solution to several kinds of ailments. Castor is a kind of widely cultivated most promising nonedible oil crops known for its high annual seed production and yield, its inexpensive, environmental friendly industrial oil plant with medicinal value and an ingredient in the oleo chemical industry.



Figure 1 *Ricinus communis* (plant and seeds)

MATERIALS AND METHODS

Historic review: Although *Ricinus communis* is still common throughout tropical areas, it is

REVIEW ARTICLE

originally from the Southeast Mediterranean Basin, Eastern Africa, and India. Castor is a plant that quickly grows where it can become invasive and is frequently seen on wasteland in regions with a suitable environment².

Taxonomical classification³:

Kingdom: Plantae

Order: Malpighiales

Family: Euphorbiaceae

Sub Family: Acalyphoideae

Tribe: Acalypheae

Sub Tribe: Riciniinae

Genus: Ricinus

Species: Communis

Ayurvedic review: Castor is commonly found by the name of *Eranda* in Sanskrit literature with synonyms related to its morphology and actions like are *Gandharvahastha* (leaf resembles with *hastha* of *mriga* i.e. leaves having hand like projections), *Vatari* (it alleviates *Vata dosha*), *Panchangula* (leaf resembles like that of palm having five fingers), *Chitra* (seeds are having characteristic texture and color), *Vyagrapuccha* (inflorescence is similar as that of tiger's tail), *Urubuka* (one which removes aggravated *Vata dosha*)⁴.

Description in classical texts: It has been described vividly in various *Samhitas* and *Nighantus*. *Acharya Charaka* has described it in *Bhedaniya*, *Angamardaprasamana* and *Svedopaga Mahakshaya*⁵.

In *Sushruta Samhita*, it has been mentioned in *Vidarigandhadi*, *Adhobhagahara* and

*Vatasamsamana Gana*⁶. *Ashtang hridaya* has described it in *Vidarigandhadi Gana*⁷.

Eradamula has been considered as *Vrishya* and *Vatahara* in *Charaka Samhita*⁸. *Acharya Sushruta* emphasized the role of *Eranda taila* in the diet⁹.

Classical texts (*Nighantus*) of *Ayurveda* have mentioned its two varieties - *Shweta* (White) and *Rakta* (Red)¹⁰. There is two known variety of plant one bushy perennial shrub with large red seeds and large fruits, seeds yielding about 40% oil; another comparatively much shorter annual shrub having grey-white seeds with brown spots over them which yield about 37% of oil¹¹.

Habitat and Distribution: Although it is considered native to northeast Africa (probably Somalia), it is widely naturalized across Asia, (sub) tropical America, and temperate Europe. It is widely distributed throughout tropics and warm temperate areas. It is found throughout the hotter parts of India about 1000-2000 meters altitude from the sea level. It's distributed in the scrubby jungles of outer Himalayas, cultivated in the fields and gardens and also frequently found run wild near habitations by roadsides and waste land. The species is drought resistant, very well adaptable to diverse climatic conditions, highly prolific. The plant can withstand dry arid climates, as also heavy rains and floods; it is however, susceptible to damage by frost¹².

Morphology: *Ricinus communis* is a perennial soft-wooded shrub with remarkably developed lateral and strong tap roots. It grows quickly and can reach heights of 1 to 5 m¹³. The outside

REVIEW ARTICLE

surface of the roots is dull yellowish brown, virtually smooth, and marked with longitudinal wrinkles. The roots are light in weight and fairly straight with few rootlets¹⁴. The leaves are alternate, cylindrically curved deciduous with purplish petioles, blade 6-8 inches across, palmately cut for three quarters of its depth into 7- 11 lanceolate, acute, coarsely serrate segments, smooth blue green, paler beneath, red and shining when young; stipules are large ovate united into a cap enclosing the buds. Large monoecious flowers are arranged on the thick rachis of an oblong that is initially terminal but later becomes lateral as a result of the development of an axillary bud beneath it. Male flowers are shortly stalked and present at the base of the panicle on branched peduncles; female flowers are sessile with broad triangular bracts. Fruit is a 3-celled, blunt, greenish, deeply grooved, tricoccus capsule that dehisces loculicidally and septicidally into six valves. Its prominences are less than an inch long. The pinkish-gray, flattened, almost 5/8 inch long by 1/4 inch wide, smooth, shiny, and prettily speckled with dark brown seeds are ovoid in shape¹⁵.

Cultivation: *Castor* is generally grown on sandy or clay of deep red loams and on good light alluvial loams. Castor is one of the crops which can be grown economically even on gravelly and poor soils which makes it more viable for easy production for better yield. It is a perennial crop that is harvested from March to June depending

on when it was sown, which corresponds with the kharif season from June to August and the monsoon rains. It is primarily grown in semi-arid regions of India like Gujarat, Telangana, and Kadha under rain-fed conditions¹².

Phytochemical Constituents: The medicinal properties of the plant are due to the presence of key phytochemical constituents like saponins, flavonoids, alkaloids, steroids, and glucosides. Leaves of the plant have shown the presence of major phenolic compounds such as monoterpenoids, camphor, and α sesquiterpenoid (gallic acid), quercetin, gentilic acid, rutin, epicatechin, and ellagic acid. Whereas roots test has presented the Indole-3-acetic and the several forms of ester have been identified in the form of palmitic, stearic, arachidic-hexadecenoic, oleic, linoleic (3.4) ricinoleic, and dihydroxy stearic acids through the study of castor oil. Moreover, the α -thujone and 30-Norlupan-3 β -of20-one are beans have been identified^{3,16}.

Ayurvedic properties of castor⁴:

- *Rasa* (Taste) – *Madhura* (sweet), *Katu* (pungent), *Kshaya* (astringent)
- *Guna* (Qualities) – *Snigdha* (oily), *Teekshna* (strong), *Sookshma* (minute)
- *Veerya* (Potency)– *Ushna* (Hot)
- *Vipaka* (Post digestive effect) – *Madhura* (Sweet)
- Effect on *Dosha* (Bioenergies) – Balances *Kapha* and *Vata dosha*

Pharmacological actions: As per the researches done on *Ricinus communis*, it shows vivid

REVIEW ARTICLE

pharmacological actions like Anti-microbial and anti-fungal, Antioxidant activity, Anti-Inflammatory and free radical scavenging activity, Central analgesic activity, Antitumour activity, Antifertility activity, Bone Regeneration Activity, Anti diabetic activity, Cytotoxic Activity, Antihistaminic activity¹⁷.

Uses:

Medicinal uses - In *Ayurveda* different parts of the plant are used for medicinal purposes like root, leaves, seed and oil. These parts are used in different forms with different formulations both externally and internally. *Ricinus communis* is a renowned herb for *Vataja* disorders and is used in diseases such as Gout, Rheumatoid arthritis, Sciatica, Lumbago in the form of oil, decoction as a single herb formulation or compound formulations such as *Simhanada guggulu*, *Vatari guggulu*, *Erandadi taila*. Its root bark is powerful purgative and its paste is used for toothache. Ethnobotanically its oil is used as abortifacient and its leaves are used for external application on boils and swellings on joints and lactiferous ducts¹⁸.

General uses – Apart from its time tested ethnobotanical and medicinal uses the oil derived from the castor seeds has shown variety of uses for making washing soap, as lubricant, grease, surfactants, in rubber chemicals, nylons, hydraulic brake fluid, paints and polymers, perfumery products, biodiesel. Moreover the residue left during its processing for biofuel is used as organic manure in agricultural industry.

Biodiesel:

The term "biodiesel" refers to a variety of oxygenated fuels with ester bases that come from sustainable biological sources. It can be produced using refined organic oils and fats. In technical terms, biodiesel is a diesel engine fuel comprised of monoalkyl esters of long-chain fatty acids that is derived from vegetable oils or animal fats¹⁹. For this different feedstock and vegetable substances are used to produce biodiesel, such as glycerides or oils as they have a high calorific value. Additionally, the use of feedstock as vegetable oils can contribute to decrease in greenhouses gases such as carbon dioxide, because these oils are obtained from crops which have previously captured this gas during their photosynthetic process²⁰.

Though there are wide variety of methods to obtain the biofuel however, the most common is through transesterification. Studies show that Biodiesel can be obtained by transesterification of plant oil using either ethanol or methanol as the transesterification agents (Figure 2). Biodiesel is an environmental friendly biofuel as the net greenhouse gas emission is lower than that of fossil fuels²¹. Biodiesel is produced from renewable sources, is biodegradable, non-toxic, free of aromatic compounds. The high oxygen content (>10%) of biodiesel, which encourages and enhances combustion processes in diesel engines, is one of its key advantages. In addition, it does not contain sulphur, therefore no harmful sulphur oxides are generated during its

REVIEW ARTICLE

combustion and released into the environment^{22, 23}.

Castor as potential medicine and Biofuel:

Recent studies on *Ricinus communis* have revealed that methyl esters of its seed oil is used as a Biofuel²⁴ due to the phytoconstituents present in the seed oil. The oil extracted from its seeds through transesterification has a lower cetane number (43.7) than that of conventional diesel (51) which makes it more viable to use as a Biofuel compared to other Biofuels²⁵. This property has also made it as an efficient fuel for Aviation industry. From the various phytoconstituents found in *Ricinus communis*,

Ricinoleic acid is the major component which is an unsaturated omega-9 fatty acid and a hydroxy acid.^[26] The hydroxyl group in ricinoleate makes it a good lubricant and good/double effective as biodiesel. Furthermore, the ricinoleic fatty acid offers advantages to the transesterification process such as high miscibility in alcohol, low reaction temperature, low iodine content, and low freezing point. Further, Biodiesel from castor oil offers a wide range of benefits, as its biodegradable, non-toxic, renewable, and safe handling, it can be used alone, and it presents low greenhouse gas emission, high flash point, and similar energetic content to fossil diesel²⁰.

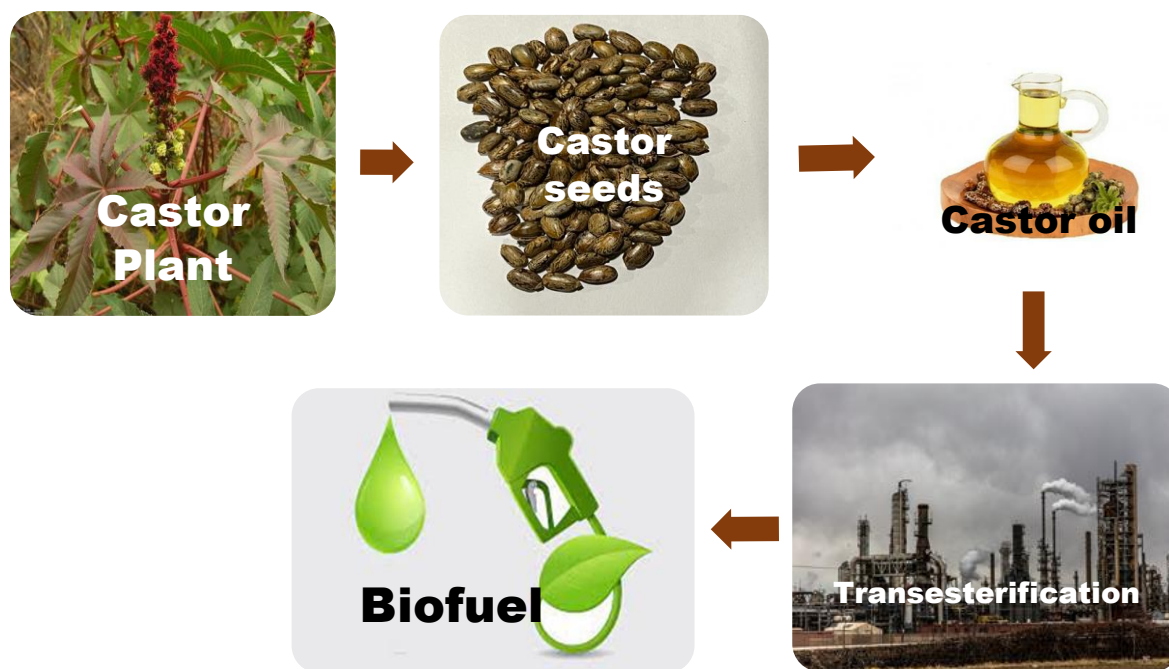


Figure 2 Process of biofuel production from castor plant

The use of biodiesel from castor seed oil in a compression ignition engine is a viable alternative to diesel. Ricinoleic acid is used to produce cosmetics, plastics, surfactants, deodorants, plasticizers, diesel lubricants and coatings due to its effective drying properties²⁷.

Pharmaceutically Ricinoleic acid shows anti-inflammatory & analgesic properties. Ricinoleic acid specifically activates the EP3 prostanoid receptor for prostaglandin E2. This is the mechanism responsible for the laxative and labor-inducing effects of castor

REVIEW ARTICLE

oil²⁸. Chemically Ricinoleic acid shows a carbon chain with 34 molecules of hydrogen and oxygen bonds (table 1).

Table 1

RICINOELIC ACID ²⁸	
IUPAC Name	12-Hydroxyoctadec-9-enoic acid
Chemical Formula	C ₁₈ H ₃₄ O ₃
Chemical structure	

DISCUSSION

Ayurvedic science describes variety of plants that have shown medicinal and ethno botanical potential for the use and utilization by the common man for wellbeing. With the advancement of science and technology and the depletion of fossil fuels due to global warming and environmental factors have made scientists to find its substitutes. Finding better alternatives through biofuels scientists are now heading towards sources to make fuel from biological provenience. In regards to this many plants and seed oils have been researched to find worthier alternative. Seed oil of *Ricinus communis* plant has manifested properties of a potential biofuel based on its chemical structure. As this plant has a strong adaptation to different weather, and is being able to be grown in marginal soils that makes it easy to cultivate and procure. These

characteristic contributes directly to decrease land use for biofuel production.

Ricinus communis is a well-known plant in the science of *Ayurveda*. It is of great medicinal value due to the phytoconstituents present in the plant seed. Though plants leaves, root, seeds and oil are used in different formulations in *Ayurveda*, its seed oil has delve special attention for its role for utility in wide range that varies from being used as cosmetics to anticancerous drug to Aviation biofuel. This utilisation of a plant product as per the requirement of the changing time has opened a new ground for wide research to open new venture for the better utilisation of plant products and promoting its plantation and conservation for not only saving the medicinal plant wealth of ancient times but also making a better utility of the same.

CONCLUSION

Castor oil is an excellent raw material that offers environmental and technical benefits moreover, it's a non-edible vegetable oil that does not have any issues with food security, in terms of price and quality. Additionally, biodiesel from castor oil has different advantages over conventional diesel which is an add on advantage for its better application. Its ability to be grown on wide range of soil types and easy cultivation practices makes it more acceptable for farming and cultivation. Especially in the present time when the world is facing global warming crisis such alternatives that are biodegradable, non-toxic, and renewable

REVIEW ARTICLE

with low greenhouse gas emission can be cherry on the cake. Though a lot more has to be done to explore such plants that are multipurpose vividly beneficial and economically workable. Further research is open for considering such plant products that can be used in pharmaceutical and renewable biofuel industry as a viable alternative in the present and future times which will not only conserve our medicinal plant wealth but will also promote the cultivation, conservation and propagation of medicinal plants for appropriate implementation.

REVIEW ARTICLE

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REVIEW ARTICLE

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