IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 5, November 2024

Jatropha Curcas: A Dual Purpose Plant for Bio Fuel and Medicinal Applications

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Abstract: *Jatropha curcas, commonly known as the physic nut or purging nut, is a member of the Euphorbiaceae family that has garnered significant interest due to its potential as a sustainable biofuel source and its diverse medicinal applications. This hardy, drought-resistant shrub thrives in arid and semi-arid regions, making it suitable for cultivation in poor soils and harsh climates. The plant's seeds, containing approximately 30-40% oil, are primarily utilized for biodiesel production, providing an alternative energy source that does not compete with food crops. Traditionally, various parts of Jatropha curcas, including its leaves, seeds, bark, and roots, have been employed in folk medicine to treat ailments ranging from wounds and digestive disorders to skin diseases. The therapeutic properties of Jatropha curcas are attributed to its rich phytoconstituents, including alkaloids, flavonoids, saponins, and tannins, which exhibit anti-inflammatory, antimicrobial, and anticancer activities. Notably, the latex derived from the plant contains compounds such as jatrophine, which have shown promising results in cancer treatment and wound healing. This abstract highlights the multifunctional nature of Jatropha curcas, emphasizing its potential in both sustainable agriculture and as a valuable resource in traditional medicine, while underscoring the need for further research to fully explore its therapeutic applications.*

Keywords: Jatropha curcas, Medicinal, Biofuel, Alkaloids, Antimicrobial, Drought-resistant

I. INTRODUCTION

The name "Jatropha" originates from the Greek words “iatros,” meaning doctor, and “trophe,” meaning food, reflecting its historical medicinal applications. This plant has gained significant attention as an alternative source of vegetable oil, particularly in developing regions where it can thrive in tropical and subtropical climates. Unlike many oilseed crops that compete with food production, Jatropha curcas is grown primarily for its seeds, making it a sustainable choice for biofuel production. Jatropha curcas is a hardy, drought-resistant shrub or small tree that can reach heights of up to 5 meters.*(1)* It possesses a fleshy stem and attractive, green, lobed leaves, which can grow to about 15 to 20 centimeters in length. The plant produces small, yellow-green flowers that bloom in clusters and can develop into seed capsules containing several seeds. Each seed is oval-shaped and dark brown, containing about 30-40% Debnath M, Gulab ST, Bisen PS. Propagation of Jatropha Curcas and J. Curcas: A potential stress resistant plant. 2008.The adaptability of Jatropha curcas to poor soils and harsh climates contributes to its appeal. It can thrive in arid and semi-arid regions, requiring minimal water and nutrient input compared to traditional food crops. This makes it an ideal candidate for cultivation in areas where agriculture is limited due to environmental constraints.*(3)*

Medicinal Uses:

Traditionally, Jatropha curcas has been utilized in various medicinal practices. Different parts of the plant, including leaves, seeds, and bark, have been employed in folk medicine to treat various ailments such as wounds, digestive disorders, and skin diseases. The leaves are sometimes crushed and applied to wounds for their purported healing properties, while the seeds are known for their laxative effects. Despite these uses, it is important to note that some components of Jatropha curcas can be toxic, emphasizing the need for caution in its application.*(4)*

DOI: 10.48175/IJARSCT-22460

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Taxonomical Classification:

Taxonomic	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta
Superdivision	Spermatophyta
Division	Magnoliophyta (Angiosperms)
Class	Magnoliopsida (Dicotyledons)
Subclass	Rosidae
Order	Malpighiales
Family	Euphorbiaceae (Spurge family)
Genus	*Jatropha*
Species	*Jatropha curcas*

Other Species of Jatropha:

The Jatropha genus contains several species, each with unique characteristics:

Jatropha glanduliferaRoxb.
Jatropha gossypifolia Linn.
Jatropha multifida Linn.
Jatropha nana Dalz. and Gibs.
Jatropha panduraefolia Andr.
Jatropha podagrica Hook.

These species differ slightly in terms of size, structure, and use, but all belong to the Euphorbiaceae family, contributing to their shared significance in biofuel and medicinal applications.*(5)*

Botanical Description of Jatropha curcas

Plant Characteristics

Jatropha curcas is a large shrub or small tree, typically growing between 3 to 4 meters in height. It is widespread throughout India and many other tropical countries, thriving in regions with a wide range of climatic conditions.*(6)*

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Leaves

The leaves of Jatropha curcas are arranged alternately along the stem, measuring 10 to 15 cm in length and 7.5 to 12.5 cm in width. They are broadly ovate, with a conate, acute shape. Typically, the leaves are palmately lobed, with 3 to 5 lobes, and have a smooth, glabrous surface. The leaf structure provides an aesthetic appearance and plays a crucial role in the plant's photosynthesis and transpiration processes.*(7)*

Flowers

The flowers of Jatropha curcas appear in loose panicles of cymes, showcasing a yellowish-green color. The flowers are unisexual, and both male and female flowers can be found on the same plant. This dioecious nature is advantageous for propagation, as it ensures higher chances of fertilization and seed production.*(8)*

Fruits and Seeds

The fruits of Jatropha curcas are approximately 2.5 cm long, ovoid in shape, and black when mature. Each fruit contains three seeds, which are the primary source of oil extraction. The seeds are ovoid-oblong in shape and dark brown to black in color. Although they resemble castor seeds in appearance, they are smaller and distinct in their oil content. These seeds are rich in oil, which is inedible but ideal for producing biodies *(9)*

Cultivation and Collection of Jatropha curcas

Jatropha curcas is known for its low maintenance and ability to grow in poor soils, making it a popular crop for marginal lands that are otherwise unsuitable for food production. Here's a detailed look at its cultivation requirements *(10)*

Soil and Climate

Jatropha curcas is highly adaptable to a variety of soil conditions. It can grow in sandy, acidic, or alkaline soils with a pH range of 5.5 to 8.5. Due to its resilient nature, the plant does not require special soil preparation or management for successful growth. It can thrive in areas with minimal rainfall, poor fertility, and even degraded soils. This makes it an ideal candidate for cultivation in arid and semi-arid regions where other crops may fail.The plant prefers warm climates, as hot and humid conditions promote better germination and growth. However, Jatropha curcas can tolerate periods of drought and can survive in regions where rainfall is inconsistent.*(11)*

Propagation

Propagation of Jatropha curcas can be carried out through seeds or stem cuttings. Commercial cultivation typically relies on seeds, as it is a more scalable approach for large-scale plantations. The seeds used for propagation should be well-developed and plump to ensure a high germination rate.*(12)*

Seed Propagation

Before sowing, the seeds are soaked in a solution of cow dung for 12 hours, which helps enhance their ability to germinate. After soaking, the seeds are kept under wet jute or gummy bags for another 12 hours to stimulate sprouting. This pre-germination treatment ensures faster and more uniform seedling emergence. For optimal growth, the seeds should be sown in hot and humid weather conditions. Once sown, the seeds typically take a few days to sprout, and after a few weeks, the seedlings can be transplanted into the field.*(13)*

Stem Propagation

Stem cuttings can also be used for propagation, especially when the objective is to accelerate the growth cycle. Propagation through cuttings results in earlier fruiting, typically starting in the second year of growth, whereas seed propagation generally results in fruiting by the third year.*(14)*

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Seed Rate

In a field of one hectare, about 5 to 7.5 kg of seeds are required for plantation. If the plant is propagated through stem cuttings, the fruiting starts from the second year. However, if propagated from seeds, it takes one additional year for fruiting..*(15)*

Field Preparation

Before planting, the land should be plowed once or twice, depending on the nature of the soil. Plowing helps in loosening the soil, improving aeration and water infiltration. Proper field preparation is critical for healthy root development and overall plant vigor. For direct planting of seeds or cuttings, it is advisable to wait for the onset of the monsoon season, as the moist conditions are conducive to germination and early growth. The recommended spacing between the plants is 3 x 2 meters, though actual spacing may vary depending on the soil conditions and intended use of the plantation. .*(16)*

Organic Matter

One interesting feature of Jatropha curcas is its deciduous nature. As the leaves fall, they add organic matter to the soil, which increases its fertility over time. This natural process helps to enrich the soil, making it more suitable for future plantings or intercrops. .*(17)*

Manuring and Fertilization

While Jatropha curcas can grow in nutrient-poor soils, applying fertilizers can improve growth and yield. The NPK (Nitrogen, Phosphorus, Potassium) ratio should be applied based on soil testing, and it is typically recommended to use the ring method for fertilizer application. Fertilizers should be applied before planting to ensure that the seeds or cuttings have adequate nutrients for early growth. Manure, particularly organic compost or cow dung, can also be used to improve soil fertility. Organic fertilizers are especially useful in organic farming practices, where chemical inputs are minimized (18)

Medicinal uses of different parts of Jatropha curcas L.:

Part of Jatropha curcas	Medicinal Uses
Leaves	- Used in poultices for treating wounds and cuts.
	- Traditionally applied for reducing fever and inflammation.
	- Infusions made from leaves are used for digestive issues.
Seeds	- Seeds are known for their laxative effects when consumed.
	- Oil extracted from seeds is used topically for skin ailments.
	- Seeds are used in traditional medicine for various ailments, including rheumatism.
Bark	- Bark extracts are used to treat skin diseases and infections.
Roots	- Root extracts are used for their anti-inflammatory properties.
	- Used in folk medicine for pain relief and to treat ailments related to the gastrointestinal tract.
Flowers	- Infusions of flowers are sometimes used to treat respiratory issues.
	- Flowers are believed to have antiseptic properties.

Therapeutic Properties of Jatropha curcas:

1. Latex

The genus name Jatropha is derived from the Greek words “jatros,” meaning doctor, and “trophe,” meaning food, which underscores the plant's reputation as a medicinal herb. One of the most significant therapeutic aspects of Jatropha

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curcas is its latex, which contains an alkaloid known as jatrophine. This latex has gained attention for its anticancer properties, as highlighted in various studies. It is also recognized for its disinfectant qualities, making it valuable in traditional medicine. Research has identified four primary compounds in the latex of various Jatropha species: jatrophine, jatropham, jatrophone, and curcain. Both jatrophine and jatropham have demonstrated anti-cancer effects in scientific studies, reinforcing the potential of Jatropha curcas in cancer treatment. The latex is applied topically for relief from bee and wasp stings, providing an immediate remedy for pain and swelling.In countries like Cuba and various regions worldwide, the latex is employed to treat a variety of ailments, including toothaches, burns, hemorrhoids, ringworm, and ulcers. Its versatility as a treatment option is a testament to its efficacy in traditional healing practices. Furthermore, the latex has been shown to possess haemostatic properties, which can aid in stopping bleeding and promoting wound healing.*(19)*

A study conducted by Nath and Dutta in 1992 demonstrated the wound healing properties of curcain, a proteolytic enzyme isolated from the latex, using mouse models. In their research, curcain was incorporated into two ointments at concentrations of 0.5% and 1.0% (w/w) into a washable ointment base. The findings revealed that healing of the wounds treated with curcain ointments was more effective than those treated with nitrofurazone ointment and propamidine isothionate cream in mice. This highlights the potential of curcain as a natural alternative for wound care.Additionally, the latex exhibits antimicrobial properties, showing effectiveness against various pathogens, including Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Streptococcus pyogenes, and Candida albicans. These findings underscore the broad-spectrum antimicrobial activity of Jatropha curcas latex, making it a valuable resource for treating infections.*(20)*

2. Oil

The oil extracted from the seeds of Jatropha curcas is another therapeutic component of the plant. Freshly extracted oil appears yellowish and has a fairly viscous texture. The physicochemical properties of Jatropha seed oil have been documented, providing insights into its potential medicinal applications. Externally, Jatropha curcas oil is beneficial for various skin diseases and conditions such as rheumatism. Its application can provide relief from skin irritations and promote overall skin health. In parts of Java and Indonesia, this oil is regarded as a hair growth stimulant, further showcasing its diverse applications in traditional medicine. The therapeutic properties of Jatropha oil extend beyond dermatological uses. It has been reported to possess arborificient, emetic, and laxative qualities. This means that the oil can stimulate tree growth (arborificient), induce vomiting (emetic), and promote bowel movements (laxative). Such properties contribute to the oil's utility in treating a range of health conditions.*(21)*

Moreover, the efficacy of Jatropha oil has been demonstrated against conditions like dropsy, sciatica, paralysis, and sores in animals. This broad range of therapeutic effects indicates that Jatropha curcas oil may hold promise as a natural remedy for both human and animal health issues. The therapeutic values of Jatropha curcas extend through its latex and oil, both of which exhibit a variety of medicinal properties. The latex contains significant compounds that demonstrate anticancer and antimicrobial properties, making it a valuable resource in traditional medicine for treating wounds, infections, and various ailments. Meanwhile, the oil extracted from the seeds has therapeutic applications in dermatology and overall health, showing efficacy in treating skin diseases, promoting hair growth, and providing relief from rheumatism and other conditions. As research continues, the potential of Jatropha curcas as a versatile medicinal plant becomes increasingly evident, supporting its use in both traditional and modern medical practices.*(22)*

Phytoconstituents Present in Jatropha curcas Plant:

Jatropha curcas, commonly known as physic nut or purging nut, is a perennial shrub belonging to the Euphorbiaceae family. Known for its diverse medicinal applications, the plant is rich in various phytoconstituents that contribute to its therapeutic efficacy. The phytochemicals found in Jatropha curcas include alkaloids, flavonoids, saponins, tannins, phenols, and terpenoids, among others. These compounds play a significant role in the plant's biological activities and medicinal properties.

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1. Alkaloids

Alkaloids are nitrogen-containing compounds that are often associated with pharmacological effects. In Jatropha curcas, notable alkaloids include jatrophine and jatropham. Jatrophine has been shown to exhibit anticancer properties, making it a focus of research in cancer treatment. These alkaloids also contribute to the plant's ability to serve as a natural disinfectant..*(23)*

2. Flavonoids

Flavonoids are a group of polyphenolic compounds known for their antioxidant properties. In Jatropha curcas, flavonoids contribute to the plant's protective effects against oxidative stress. They are also recognized for their anti-inflammatory and antimicrobial activities. The presence of flavonoids enhances the plant's therapeutic potential, particularly in treating conditions related to inflammation and infection.*(24)*

3. Saponins

Saponins are glycoside compounds that have been found to possess immune-boosting properties. The saponins in Jatropha curcas contribute to the plant's ability to enhance the body's defense mechanisms. Additionally, saponins have been known to exhibit antimicrobial activity, which adds to the plant's value as a natural remedy for infections.*(25)*

4. Tannins

Tannins are polyphenolic compounds that are widely recognized for their astringent properties. In Jatropha curcas, tannins play a crucial role in wound healing and tissue repair. They are effective in reducing inflammation and promoting the healing of wounds. Moreover, tannins contribute to the plant's antimicrobial properties, helping to inhibit the growth of pathogens.*(26)*

5. Phenolic Compounds

Phenolic compounds are known for their antioxidant activity, which helps to combat oxidative stress and prevent cellular damage. In Jatropha curcas, these compounds contribute to the plant's anti-inflammatory and antidiabetic effects. The presence of phenolic compounds enhances the overall health benefits associated with the consumption of the plant or its extracts.*(27)*

6. Terpenoids

Terpenoids are a large class of organic chemicals derived from plants, known for their aromatic qualities. In Jatropha curcas, terpenoids contribute to the plant's antifungal and antimicrobial properties. These compounds can also enhance the plant's resistance to pests and diseases, making it an important species in agricultural settings.*(28)*

7. Glycosides

Glycosides are compounds formed from a sugar and another functional group, which may contribute to various biological activities. In Jatropha curcas, glycosides may play a role in enhancing the plant's medicinal properties, particularly in relation to its anti-inflammatory and analgesic effects.*(29)*

Therapeutic Activities of Jatropha curcas

Jatropha curcas, a plant known for its medicinal properties, exhibits a variety of pharmacological activities. Its extracts have been studied for their anti-ulcer, anthelmintic, anti-diabetic, anti-diarrheal, and anticoagulant effects. This section provides a comprehensive overview of these therapeutic activities.

1. Anti-Ulcer Activity

The anti-ulcer properties of Jatropha curcas have been demonstrated through studies using methanolic extracts. In a specific study involving Whister rats, the methanolic extract was tested for its efficacy in preventing gastric lesions induced by aspirin. Aspirin, a non-steroidal anti-inflammatory drug (NSAID), is known to cause gastric mucosal damage. The administration of the methanolic extract showed promising results in mitigating the gastric lesions caused by aspirin, indicating its potential as a natural remedy for ulcer prevention. The underlying mechanism of this anti-ulcer activity may involve the modulation of prostaglandin biosynthesis, which plays a crucial role in maintaining gastric mucosal integrity and reducing inflammation.*(30)*

2. Anthelmintic Activity

The aqueous extract of the leaves of Jatropha curcas has been reported to exhibit significant anthelmintic activity against Pheritimaposthuma, a species of earthworm commonly used in laboratory studies to assess the effectiveness of

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anthelmintic agents. In vitro assays showed that varying concentrations of the leaf extract caused paralysis and eventual death of the worms, suggesting that Jatropha curcas could serve as a natural anthelmintic agent. The active compounds responsible for this effect may include phytochemicals that disrupt the nervous or muscular systems of the worms, leading to their elimination.*(31)*

3. Anti-Diabetic Activity

The chloroform extract of Jatropha curcas leaves has demonstrated significant anti-diabetic effects in albino rats. In studies where diabetic rats were treated with this extract at different doses, there was a notable decrease in serum glucose levels. Furthermore, the extract helped in reversing the elevated levels of cholesterol and triglycerides typically associated with diabetes. These findings suggest that Jatropha curcas may contain bioactive compounds that enhance insulin sensitivity or stimulate insulin secretion, thereby contributing to glycemic control. The potential for using Jatropha curcas as a therapeutic agent for managing diabetes highlights its importance in traditional medicine and the need for further pharmacological investigations.*(32)*

4. Anti-Diarrheal Activity

The methanolic extract of the roots of Jatropha curcas has been evaluated for its anti-diarrheal activity in various species of albino mice. The extract demonstrated significant efficacy in reducing the frequency and severity of diarrhea. The mechanisms by which Jatropha curcas exerts its anti-diarrheal effects may involve the modulation of intestinal motility, as well as the inhibition of gastrointestinal secretions. Specifically, the extract may reduce propulsive movement within the small intestine, contributing to increased water absorption and decreased stool frequency. This is particularly important in managing diarrheal diseases, which can lead to dehydration and electrolyte imbalance.*(33)*

5. Anticoagulant Activity

Jatropha curcas also exhibits anticoagulant properties, as indicated by studies involving its latex. When tested in albino mice, a 1 ml (1.05 g) dose of whole latex significantly reduced the mean clotting time from 5.83 ± 1.25 minutes to 3.83 ± 1.01 minutes. This result was statistically significant ($P < 0.01$), indicating a potent effect. In contrast, the use of phosphate-buffered saline (PBS) as a control resulted in an increased mean clotting time of 6.29 ± 1.28 minutes. Notably, the clotting time appeared to be inversely proportional to the dilution of the latex, suggesting that higher concentrations of latex lead to shorter clotting times. This anticoagulant effect may be attributed to the presence of specific proteins or enzymes within the latex that enhance the coagulation cascade.*(34)*

II. CONCLUSION

In summary, Jatropha curcas stands out as a versatile and resilient plant, offering substantial benefits both as a sustainable source of biofuel and as a valuable medicinal resource. Its ability to thrive in challenging environmental conditions, coupled with its low maintenance requirements, positions it as a promising crop for marginal lands. The diverse phytoconstituents present in Jatropha curcas—including alkaloids, flavonoids, and saponins—contribute to its therapeutic potential, providing various health benefits such as anti-inflammatory, antimicrobial, and anticancer properties. Furthermore, its traditional uses in folk medicine underscore the importance of Jatropha curcas in addressing both modern and historical healthcare needs. As research continues to uncover its full range of capabilities, Jatropha curcas may play a crucial role in both sustainable agriculture and medicinal practices, supporting the health and well-being of communities worldwide.

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