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Jatropha multifida: A Multifaceted Ethnopharmacological Gem with Emerging Therapeutic Promise – A Review

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Abstract
Jatropha multifida (Euphorbiaceae), known as the Coral Plant, Physic Nut, or Betadine Plant, has risen to prominence as a plant of ethnopharmacological importance based on its therapeutic uses in traditional medicine systems throughout the world. This review will summarize the current state of knowledge on the phytochemistry, traditional uses, and pharmacological effects of this plant, as well as its potential as a source of new therapeutic agents. The literature documents a broad suite of bioactive constituents including alkaloids, flavonoids, terpenoids, and unique diterpenes that identify the reported antimicrobial, anti-inflammatory, wound healing, antioxidant, and anticancer effects associated with this plant. Despite these beneficial activities, the clinical translation of therapeutics developed from J. multifida has been limited because of toxicity and lack of standardization. This review emphasizes the importance of credible toxicological studies, more complex phytochemical studies, and better clinical studies to maximize the therapeutic value of this ethnobotanical. The growing interest in research of J. multifida suggests this plant has potential to contribute improvements toward modern health care challenges through new natural plant borne therapeutics.

Key Words: Therapeutics, Ethnopharmacology, Bioactive Constituents, Wound Healing, Phytochemical Study

1. Introduction
The genus Jatropha (Euphorbiaceae) includes around 170 species of flowering plants distributed across tropical and subtropical environments worldwide (Sabandar *et al.,* 2013). *Jatropha multifida* is known as Coral Plant, Physic Nut, Guatemala Rhubarb - and has recently attracted interest due to its ethnopharmacological properties (Félix-Silva et al., 2014). J. multifida is native to tropical America but now grows in many locations around the world. J. multifida has coral red flowers, and deeply lobed, palmately divided leaves (which is from the species epithet "multifida" - many times divided) (Burkill, 1994).

J. multifida has been used for therapeutic purposes by traditional healers for centuries, with different parts of the plant used in the treatment of various conditions such as skin infections or disorders and gastrointestinal disturbances (Gbolade, 2009). This tremendous ethnomedicinal history of the plant has prompted scientists to investigate the phytochemical and pharmacological properties of the plant (practical medicinal as likely of potential action), which has identified bioactive compounds that exhibit therapeutic potential (Sabandar *et al*., 2013).

The diverse therapeutic potential of J. multifida can reflect the complex phytochemical properties of the native plant with compounds including alkaloids, flavonoids, terpenoids, and bioactive diterpenes (as the most

recognized function for the whole genus on its own) (Devappa *et al.,* 2011). These compounds have various pharmacological functions (specifically), as they have antimicrobial, anti-inflammatory, wound healing, antioxidant, and anticancer potential from J. multifida as a source to identify additional compounds to develop medications (Aiyelaagbe *et al.,* 2011).

Even with its therapeutic potential, thorough research on J. multifida is still relatively limited, compared to other medicinally important plant species. This review collates our current understanding of the ethnopharmacology, phytochemistry, and pharmacological properties of J. multifida, and identifies gaps in the literature and future opportunities to maximize its therapeutic potential with maximum safety profile considerations.

2. Botanical Description and Distribution

Jatropha multifida is a shrub or small tree that retains its leaves year-round and usually grows to heights of 2-3 meters, with some individuals reaching heights up to 5 meters under favourable conditions (Burkill, 1994). The plant has thick, edible stems that contain white latex and palmate leaves that are divided into 7-11 lobes, which are subsequently divided into a number of narrow divisions (Schmelzer & Gurib-Fakim, 2008).The terminal flower clusters are a bright coral red with dichotomous cymes. The male and female flowers occur together in the same cluster, with the male flower typically being in great abundance compared to the female flower; this is called sexual dimorphism, which is common in the Jatropha species (Dehgan & Webster, 1979). The fruit is a trilocular capsule with ellipsoidal seeds approximately 2 cm long.

Although J. multifida originates from tropical America, the species has been cultivated and naturalized in a variety of tropical and subtropical regions around the globe, including parts of Africa, Asia, and Oceania (Schmelzer & Gurib-Fakim, 2008). The species shows a great degree of adaptability, being able to grow in various types of soil and rain/rainfall regimes, but grows best in well-drained soils and full sun. Its adaptability has allowed this species to be cultivated widely as an ornamental species and for its medicinal properties (Burkill, 1994).

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3. Ethnopharmacological Applications

J. multifida has established a considerable role in various herbal medicine systems across the globe with various plant parts used for different therapeutic outcomes:

3.1 Dermatological Applications

In various cultures, traditional uses of J. multifida involve topical application of latex to help with skin issues including eczema, dermatitis, and fungal infection (Gbolade, 2009). In West Africa, traditional healers use fresh latex to wounds or cuts to help with healing and to avoid infection (Burkill, 1994). In parts of South America, crushed leaves mixed with latex has been applied as a poultice to treat chronic skin ulcers and wounds (Pagnotta et al., 2017).

3.2 Gastrointestinal Disorders

Traditionally, decoctions prepared from the roots and leaves of J. multifida have been used to treat various gastrointestinal disorders and ailments. Brazilian folk practitioners have used the roots as infusion remedies for gastrointestinal ailments, while practitioners in the Caribbean have used the leaves of J. multifida decoctions as powerful vermifuge and purgative substances (Félix-Silva et al., 2014). The seeds, although recognized for being toxic when raw, have nevertheless been utilized, apparently in controlled doses, for their purgative effect in some traditional practices (Schmelzer & Gurib-Fakim, 2008).

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3.3 Antimicrobial Applications

In different parts of the world, J. multifida preparations are used by traditional healers for treating infection. Nigerian traditional medical practitioners make use of leaf extracts for infected burns, whereas in some areas of India, stems of the plant cut into small pieces are boiled in water to obtain the stem bark decoction for urinary tract infections (Aiyelaagbe et al., 2011). The antimicrobial use of J. multifida extends to maintaining oral hygiene and the twigs of J. multifida are known to be used as chewing sticks which, according to some African communities, have antibacterial properties (Gbolade, 2009).

3.4 Anti-inflammatory and Analgesic Uses

Traditional medicine systems acknowledge the anti-inflammatory benefits of J. multifida by applying a poultice of leaves to swollen joints and inflamed skin (Félix-Silva *et al.,* 2014). Healers of Central America utilize stem bark extracts to relieve rheumatic pain, whereas traditional practitioners of Southeast Asia utilize root preparations as analgesics for a variety of painful conditions (Sabandar *et al.,* 2013).

3.5 Other Traditional Uses

In addition to these uses, traditional healers use J. multifida for fever (antipyretic), diabetes, breathing problems (respiratory disorders) and even poisoning (antidote in poisoning) (Schmelzer & Gurib-Fakim, 2008). In some cultures, the plant has importance in being used in ritualistic and spiritual practices thereby emphasizing its cultural dimension outside of medicinal importance (Gbolade, 2009).

4. Phytochemical Composition

Scientific studies have shown that J. multifida has several phytochemicals that underlie its pharmacological properties. The major bioactive compounds consist of the following.

4.1 Diterpenes

The Jatropha genus is particularly noted for its remarkable diterpenes; furthermore, J. multifida contains multiple bioactive compounds in this group. These include Multifidone, Jatrophane, and Jatropholones A and B, which are all known to possess significant cytotoxicity and antimicrobial activity (Aiyelaagbe et al., 2011). These lathyrane-type diterpenes have evinced promising anticancer and anti-inflammatory activity in earlier studies (Devappa et al., 2011).

4.2 Alkaloids

Researchers have extracted a number of alkaloids from the different parts of J. multifida . For example, the pyrimidine-type alkaloids jatrophone and jatrophenone, found mainly in the roots and stems of the plant (Sabandar et al. 2013) have some antimicrobial or antioxidant properties.

4.3 Flavonoids and Phenolic Compounds

J. multifida has a varied profile of flavonoids and phenolic compounds, including apigenin, vitexin and phenolic acids of multiple types (Félix-Silva et al., 2014). These compounds, mostly located in the leaves and flowers, contribute significantly towards the antioxidant activity of the plant.

4.5 Other Compounds

J. multifida has also been identified to contain bioactive compounds such as tannins, saponins, and different glycosides. It has proteins that also have interesting bioactivities, including multifidase - a proteolytic enzyme isolated from the latex, which has potential applications in wound healing (Pagnotta et al., 2017)

5. Pharmacological Properties

Modern scientific investigations have validated many traditional uses of *J. multifida* through the demonstration of various pharmacological activities:

5.1 Antimicrobial Activity

Different extracts of J. multifida have exhibited significant antimicrobial activity against numerous pathogens. Studies have found antibacterial activity against Gram-positive pathogens such as *Staphylococcus aureus* and *Bacillus subtilis*, as well as Gram-negative pathogens such as *Escherichia coli* and *Pseudomonas aeruginosa* (Aiyelaagbe et al., 2011). In addition, studies have shown antifungal activity against pathogenic fungi, including Candida species and various dermatophytes (Sabandar et al., 2013). The antimicrobial is likely due to the presence of diterpenes and alkaloids in the plant. For example, multifidone has shown very strong antibacterial activity in vitro similar to some standard antibiotics (Devappa et al., 2011).

5.2 Wound Healing Properties

Research shows that the use of J. multifida latex for healing wounds was traditionally followed. Specifically, studies show that the latex contains therapeutic compounds that induce fibroblast proliferation, collagen synthesis, and epithelialization all important and necessary elements in wound healing (Pagnotta, et al. 2017). Furthermore, a proteolytic enzyme named multifidase that was isolated from latex, represents its potential for debridement as it could efficiently remove necrotic tissue from wounds without damaging viable tissues (Félix-Silva et al., 2014).

5.3 Anti-inflammatory and Analgesic Effects

Multiple extracts of J. multifida have exhibited strong anti-inflammatory activity in both in vitro and in vivo studies. The extracts inhibit pro-inflammatory cytokines released by immune cells and decrease nitric oxide production, a primary predictor of inflammation (Sabandar, et al., 2013). The analgesic activity, which is still frequently described through traditional mechanisms, has also been demonstrated in pain models in animals, further validating the traditional use of the plant for pain management (Gbolade, 2009).

5.4 Antioxidant Activity

J. multifida extracts, especially from flowers and leaves, exhibit significant antioxidant capacity in different assay systems, and the flavonoids and phenolic components of the plant likely scavenge free radicals and alleviate oxidative stress, which may partially mediate the therapeutic benefits of the plant for different pathologies with oxidative stress (Félix-Silva et al., 2014).

5.5 Anticancer Potential

Cytotoxicity of J. multifida extracts and pure compounds have been examined in preliminary studies and have shown promise for anticancer properties. For example, a number of diterpenes isolated from J. multifida including jatrophone and multifidone have been shown to have selective cytotoxicities against different cancer cell lines while demonstrating minimal toxicity or side effect on normal cells (Devappa et al., 2011). Mechanisms have included apoptosis, phase arrest, and metastasis inhibition (Aiyelaagbe et al., 2011).

5.6 Other Pharmacological Activities

Lot of authors have observed additional pharmacological effects of J. multifida, including anticoagulation, anti-diabetic, anti-convulsant and immunomodulatory properties. These various pharmacological activities substantiate the potential for J. multifida to serve as a therapeutic for a variety of health conditions (Sabandar et al., 2013).

6. Toxicological Considerations

Despite its therapeutic potential, *J. multifida* contains compounds that can pose toxicity risks, necessitating careful consideration in medicinal applications:

6.1 Toxic Components

Similar to the other members of the Euphorbiaceae family, J. multifida synthesizes phorbol esters and curcin (a variety of ribosome-inactivating toxin), concentrated in the seeds. These compounds can produce severe digestive irritation, hepatotoxicity, and systemic toxicity in the most severe presentations (Devappa et al., 2011). Although latex holds medicinal value, its use can lead to skin irritation and injury to the eyes upon direct contact.

6.2 Documented Toxicity Cases

Medical literature contains multiple reports of ingestion exposure to J. multifida seeds, especially among children who are attracted to the unique seed appearance. Ingesting J. multifida seeds produced vomiting, diarrhoea,

abdominal pain, dehydration, and in some severe cases cardiovascular changes or complications (Schmelzer & Gurib-Fakim, 2008).

6.3 Safety Considerations

The toxic effects of J. multifida highlights the importance of traditional medicine preparation methods prior to administration, an important operational modality in modern medical care, especially when applying in a standardized format. Traditionally practitioners often utilize specific processing methods to minimize toxicity while retaining therapeutic effects (Gbolade, 2009). Modern research must be in isolating therapeutic compounds while removing, negating or neutralizing toxicity components.

7.1 Research Gaps

J. multifida has high potential as a therapeutic agent, but there remains some lack of knowledge:

• A few clinical studies have been completed to assess traditional uses and safety
• Thermochemistry of secondary plant constituents is incomplete, especially from different geographies
• Lack of understanding of mechanisms of action for pharmacological activities reported has been demonstrated
• There are no established standardized protocols for extraction and formulation in therapeutic use.

7.2 Future Research Directions

• To maximize the therapeutic potential of *J. multifida* while addressing safety concerns, future research should focus on:
• Detailed toxicological assessments to determine safety levels and acceptable, tolerable, or maximum limits for clinical use
• Thorough phytochemical assessments using modern methods which fully characterize the plant's chemical composition
• Creation of standardized extraction protocols and quality control procedures
• Formal, controlled clinical trials to confirm for identified therapeutic outputs
• Exploration of synergistic or additive effects of individual bioactive compounds
• Ecological situational practices that would allow for consistent phytochemical profiles along with conservation of natural resources.

8. Conclusion

Jatropha multifida is an important ethnopharmacological resource with multiple medicinal uses supported by both cultural practices and modern scientific research. Its extensive phytochemistry, especially its unusual diterpenes, is responsible for a variety of pharmacological actions including antimicrobial, wound healing, anti-inflammatory, antioxidant and anticancer activities. While toxicity issues need to be balanced against medicinal applications, more focus on standardization, safety assessment, and mechanism elucidation can promote more prominence of J. multifida as a resource for new therapeutics. As the interest in utilizing plants as medicines continues to rise globally, it is time to increase our attention on this ethnopharmacological resource for its multi-faceted and untapped therapeutic potential in solving the problems facing modern health-care.

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