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Review

Jatropha curcas: Plant of medical benefits

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Plants are a rich source of many natural products most of which have been extensively used for human welfare, and treatment of various diseases. *Jatropha curcas*, a multipurpose, drought resistant, perennial plant belonging to Euphorbiaceae family is gaining a lot of economic importance because of its several potentials in industrial application and medicinal values. *J. curcas* has been used as traditional medicine to cure various infections. Researchers had isolated and characterized numerous biologically active compounds from all parts of this plant. In addition, the mechanisms of action of these active compounds have been studied in relation to the applications in traditional medicine. Before exploiting any plant for medicinal application, it is crucial to have complete information about the medicinal uses of each part of the plant. The medicinal uses of the leaves, fruit, seed, stem bark, branches, twigs, latex and root of *J. curcas* are discussed in this review. If the full potential of the plant is to be revealed, much more research is required to develop herbal medicine using modern science and technology. A potential aspect based on markets for all of its medicinal products should be conducted thoroughly, to promote the ability of this plant to cure so many illnesses.

Key words: Medicinal plant, traditional medicine, active compounds, diseases, treatment.

INTRODUCTION

Medicinal plants have been used as a source of medicine to treat illness since time immemorial. For a long time, plants have provided a source of emerging modern medicines and drug compounds, as plant derived medicines have made large contributions to human health. Their role is twofold in the development of new drugs. They may become the base for development of a medicine, a natural blue print for the development of the new drugs or a phytomedicine to be used for the treatment of diseases (Iwu, 1993). Active compound present in the medicinal plants provide the bountiful resource of active compounds for the pharmaceutical, cosmetics and food industries, and more recently in agriculture for pest control (Rice, 1995). Herbal products from medicinal plants are preferred because of less testing time, higher safety, efficiency, cultural acceptability and lesser side effects. The chemical compounds present in herbal products are a part of the physiological functions of living organisms, and hence they are believed to have better compatibility with the human body (Khanna et al., 1986). Medicinal plants like *Jatropha curcas* have played major role in the treatment of various diseases, including bacterial and fungal infections. The scientific name of physic nut is "*Jatropha curcas."* The genus name Jatropha derives from the Greek word *jatr´os* (doctor) and *troph´e* (food), which implies medicinal uses (Kumar and Sharma, 2008). This plant belongs to the Euphorbiaceae family, a drought resistant shrub or tree which is widely distributed in the wild or semi-cultivated areas in Central and South America, Africa, India and South East Asia (Schmook and Seralta-Peraza, 1997; Gübitz et al., 1999; Mart´ınez-Herrera et al., 2006). All parts of Jatropha (seeds, leaves, bark, etc) have been used in traditional medicine and for veterinary purposes for a long time (Dalziel, 1955; Duke, 1988). Extensive public interest and expansion in the use of herbal medicine have led to new emphasis and drive in medical plant research. The research approaches taken recently include activities to develop herbal medicines

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Table 1. Chemicals isolated from different parts of the plant.

Various part	Chemical compositions	References
Leaves	• Flavanoids, apigenin, vitexin, isovitexin, sterol stigmasterol. β-D-sitosterol, β-D-glucoside, sapogenins, alkaloids, triterpenae alcohol and 1-triacontanol	Chhabra et al. (1990)
	• Also contain a dimer of a tripene alcohol	Neuwinger (1994)
	• A complex of 5-hydrxypyrrolidin-2-one and pyrimidine-2,4-dione isolated from the leave	Staubmann et al. (1999)
	• Stigmast-5-en-3β, 7 β-diol, stigmast-5-en-3β, 7α-diol, cholest-5-en-3β, 7β-diol, cholest-5-en-3fl, campesterol and 7-keto-β-sitosterol	Mitra et al. (1970), Khafagy et al. (1977), Hufford and Oguntimein (1987)
Stem bark	• Saponins, steroids, tannins, glycosides, alkaloids and flavonoids	Igbinosa et al. (2009)
	• B-amyrin, β-sitosterol and taraxerol	Mitra et al. (1970)
Latex	• Tannins, saponins, wax and resin	Perry et al. (1980), Watt et al. (1962)
	• Curcacycline A (a cyclic octapeptide)	Van den Berg et al. (1995)
	• Curcacycline B (a cyclic nonapeptide)	Catherine et al. (1997)
	• Curcain (a protease)	Nath and Dutta (1994)
Seeds	• Curcin (a lectin)	Stirpe et al. (1976)
	• Phorbol esters	Adolf et al. (1984); Makkar et al. (1997)
	• Esterases (JEA and JEB) and lipase (JL)	Staubmann et al. (1999)
Roots	• Steroids, alkaloids, saponins	Aiyelaagbe et al. (2007)
	• Jatropholone A and B (diterpenoids), Jatropholol (diterpenoid)	Chen et al. (1988)
	• β-Sitosterol and its β-d-glucoside, marmesin, propacin, the curculathyranes A and B and the curcusones A–D. the coumarin tomentin, the coumarino-lignan jatrophin as well as taraxerol	Naengchomnong et al. (1986,1994)

into quality, efficacious and safe products for human consumption. This can be an advantage for *J. curcas* to expand its potential as herbal medicines to cure many illnesses and diseases. The cure for these illnesses and diseases lies in the chemical compositions isolated from different parts of the plant. The chemical compositions in different parts of this plant are presented in Table 1. The purpose of this review is to provide information about *J. curcas* medicinal uses on each part of this plant that could contribute to the field of research and pharmacological applications. *J. curcas* is a versatile plant with many potential uses. If the potentials of the plant are to be revealed, much more research is required to develop herbal medicine using modern science and technology approach.

A potential aspect based on markets for all its medicinal products should be conducted vigorously to promote the ability of this plant to cure so many illnesses. The summary of the medicinal uses from different parts of *J. curcas* are shown in Table 2.

MEDICINAL BENEFITS

Leaves

The leaves and other parts of the plant are used for the treatment of various diseases. Compounds

Table 2. Summary of medicinal uses from different parts of *Jatropha curcas.*

Plant part	Therapeutic indications	Plant part and form of remedy	References
Leaves	Treatment of vaginal bleeding	Prepare an infusion from the leaves	Singh et al. (1984)
	Wound healing	Leaves applied to wounds	Staubmann et al. (1999)
	Fever	Decoction is used internally and externally	Staubmann et al. (1999)
	Rheumatism	Leaf decoction is applied externally	Staubmann et al. (1999)
	Jaundice	Application of the leaves	Staubmann et al. (1999)
	Lymphocytic leukemia	Ethanolic extract defatted leaves and twigs	Thomas 1989
	Anti-parasitic activity	Sap and crushed leaves	Hufford and Oguntimein (1978)
	Malaria	Application of the leaves	Henning (1997)
	Mouth infections, guinea worm sores	Application of the leaves	Irvine (1961), Oliver (1986)
	Promote lactation	Crushed leaves applied to the breast	Parveen et al. (2007)
	Dysentery and colic	The juice of the leaves is used	Parveen et al. (2007)
Stem barks, branches, twigs	Gumboils and strengthen the gums	Twigs are used as toothbrush	Parveen et al. (2007)
	Inhibits HIV induces cytopathic effects with low cytotoxicity	Water extract of the branches	Matsuse et al. (1999)
	Strong antimicrobial agents	Extract from the branches	Igbinosa et al. (2009)
	Aid antimicrobial activities	Secondary metabolites extract from the stem bark exert antimicrobial activities through different mechanisms	Igbinosa et al. (2009)
	Gumboils and strengthen the gums	Twigs are used as toothbrush	Parveen et al. (2007)
	Inhibits HIV induces cytopathic effects with low cytotoxicity	Water extract of the branches	Matsuse et al. (1999)
Latex	Treat gum bleeding, toothache, sooth baby's inflamed tongue	The latex is used as mouth rinse. A little latex on absorbent cotton to cure toothache	Fazwishni and Kristiani (2007), Perry et al. (1980), Watt et al. (1962), Burkill (1935), Heyne (1987), Suwondo (1993), Nath and Dutta (1991)
	Wound healing	Applied latex to the wound, protease curcain isolated from the latex responsible to heal wounds	Nath and Dutta (1991)
	Inhibits classical pathway of human complement and proliferation of human T-cells	Curcacycline A isolated from latex	Van den Berg et al. (1995)

Table 2. Contd.

	Enhanced rotamase activity of cyclophilin B	Curcacycline B isolated from latex	Catherine et al. (1997)
	Fungal infections in the mouth, wasp and bee stings and digestive troubles in children	Application of latex	Watt and Breyer-Brandwijk (1962), Schmook and Serralta-Peraza (1997)
	Procoagulant and anticoagulant activities of blood	Latex of *Jatropha curcas* reducing the clotting time of human blood	Omolaja and Funmi (2003)
	Anti-inflammation	Massaging the latex to the traumatic area	De Feo (1989)
	Exhibited antibacterial activity against *Staphylococcus aureus*	Application of latex	Thomas (1989)
Fruits and seeds	Arthritis, gout and jaundice	Application of the seeds	Khafagy et al. (1977)
	Burns, convulsions, fever and inflammation	Application of the seeds	Mujumdar et al. (2000)
	Eczema, skin diseases, to sooth rheumatic pain and purgative action	Application of seed oil	Heller (1996)
	Sciatica, dropsy and paralysis	Application of seed oil	Mujumdar et al., 2000
	Pregnancy-terminating effects in rats, contraceptive, abortifacient and syphilis	Application of seed oil and the fruits	List and Horhammer (1979)
Roots	Eczema, scabies, ringworm and gonorrhea	The root is used as decoction	Aiyelaagbe et al. (2007)
	Antimicrobial activity	Extracts from roots	Dekker et al. (1986); Aiyelaagbe et al. (2000, 2001),
	Sexually transmitted diseases (STD)	The hexane, ethyl acetate and methanol extracts of the roots	Aiyelaagbe et al. (2007)
	Antihelmintic properties	Extraction of yellow oil from the roots	Sirisomboon et al. (2007)
	Dysentery and diarrhea	A dose of two tablespoons of root suspension with butter milk	Mujamdar et al. (2000)

Table 2. Contd.

Dyspepsia and diarrhea	The root is triturated with a little asafetida and given with butter milk	Desai (1975), Dymock et al. (1976), Nadkarni (1976)
Antidiarrheal activity in albino mice	Root extract from this plant	Mujamdar et al. (2000)
Inflammation	Applied locally in paste form after crushing	Joshi (1995)
Anti-inflammatory activity in albino mice	Topical application of the root powder in paste form	Mujamdar and Visar (2004)
Bleeding gums and toothache	Decoction as a mouthwash	Aiyelaagbe et al., 2007

that have been isolated from *J. curcas* leaves include the flavonoid apigenin and its glycosides vitexin and isovitexin, the sterols stigmasterol, β-D-sitosterol and its β-D-glucoside (Chhabra et al., 1990).

Furthermore, *J. curcas* leaves were reported to contain steroid sapogenins, alkaloids, the triterpenae alcohol, 1-triacontanol and a dimer of a tripene alcohol (Neuwinger, 1994; Staubmann et al., 1999) had isolated a complex of 5-hydroxypyrrolidin-2-one and pyrimidine-2, 4-dione from the leaves of *J. curcas* by extraction with ethyl acetate. In the island of Tonga, in Oceania, the leaves of *J. curcas* have been used in folk medicine to treat vaginal bleeding (Singh et al., 1984).

Members of rural communities of Churu district in the Thar Desert, India, used the juice from leaves to cure diseases such as dysentery and colic (Parveen et al., 2007). The leaves were also applied to the breast to promote lactation (Parveen et al., 2007). In Southeast Asia and in some regions of Africa, the leaves are used as purgative, while in the Philippines and Cambodia the leaves are applied to wounds (Staubmann et al., 1999). In Cape Verde and Cameroon, a decoction is used internally and externally against fever. In Cameroon, the leaves are also in use as the remedy against rheumatism and in Nigeria against jaundice (Staubmann et al., 1999). Thomas (1989) investigations turned out that the leaves are also active in lymphocytic leukaemia. An ethanolic extracted of the defatted leaves and twigs of *J. curcas* have shown confirmed activity both *in vivo* and *in vitro* against P-388 lymphocytic leukemia (Hufford and Oguntimein, 1978). Fagbenro-Beyioku (1998) investigated and reported the anti-parasitic activity of the sap and crushed leaves of *J. curcas*. In Mali, the leaves are used as treatment for malaria (Henning, 1997). The leaves are utilized extensively in West Africa ethnomedical practice in different forms to cure various ailments like fever, mouth infections, jaundice, guinea worm sores and joint rheumatism (Irvine, 1961; Oliver-Bever, 1986).

Stem bark, branches and twigs

Phytochemical screening of *J. curcas* stem bark extracts revealed the presence of secondary metabolites such as saponins, steroids, tannins, glycosides, alkaloids, flavonoids and also yields dark blue dye (Igbinosa et al., 2009). These compounds are recognized to be biologically active, hence, aid the antimicrobial activities of *J. curcas*. These secondary metabolites exert anti-microbial activity through different mechanisms (Igbinosa et al., 2009). Shimada (2006) investigated that tannins have been found to form irreversible complexes with proline rich protein resulting in the inhibition of cell protein synthesis. Parekh and Chanda (2007) reported that tannins reacted with proteins to provide the typical tanning effect which is important for the treatment of inflamed or ulcerated tissues. Herbs that have tannins as their main components are astringent in nature and are used for treating intestinal disorders such as diarrhea and dysentery (Dharmananda, 2003). From these observations, *J. curcas* is used in herbal cure remedies. The biological activities of tannins had been observed to have anticancer activity and can be used in cancer prevention, thus suggesting that *J. curcas* has the potential as a source of important bio-active molecules for the treatment and prevention of cancer (Li et al., 2003). The presence of tannins in *J. curcas* stem bark supports the traditional medicinal use of this plant in the treatment of different ailments.

Alkaloid is another secondary metabolite com pound

observed in the stem bark extract of *J.* curcas. One of the most common biological properties of alkaloids is their toxicity against cells of foreign organisms. These activities have been widely studied for their potential use in the elimination and reduction of human cancer cell lines (Nobori et al., 1994). Alkaloids, which are one of the largest groups of phytochemicals in plants, have amazing effects on humans, and this has led to the development of powerful painkiller medications (Kam and Liew 2002). The inhibitory effect of saponins on inflamed cells was revealed by Just et al. (1998). Saponin was found in *J. curcas* stem bark extracts, thus has supported the usefulness of this plant in managing inflammation.

Steroidal compounds present in *J. curcas* stem bark extracts are in large interest due to their relationship with various anabolic hormones, including sex hormones (Okwu, 2001). Quinlan et al. (2000) worked on steroidal extracts from some medicinal plants, which exhibited antibacterial activities on some bacterial isolates. Neumann et al. (2004) also confirmed the antiviral property of steroids.

Flavonoid is another secondary metabolic compound of *J. curcas* stem bark extracts. It exhibited a wide range of biological activities like antimicrobial, anti-inflammatory, anti-angionic, analgesic, anti-allergic, cytostatic and antioxidant properties (Hodek et al., 2002). Hence, the presence of these compounds in *J. curcas* supports the antimicrobial activities observed. Members of rural communities of Churu district in the Thar Desert, India used the twigs of this plant as tooth brushes to strengthen the gum and to cure gum boils (Parveen et al., 2007). The extraction of *J. curcas* branches using water as solvent inhibited strongly the HIV-induced cytopathic effects with cytotoxicity (Matsuse et al., 1999).

It is concluded that *J. curcas* stem bark could be a potential source of active antimicrobial agents; and a detailed assessment of its *in vivo* potencies and toxicological profile is ongoing, and it makes the plant a candidate for bio-prospecting for antibiotic and antifungal drugs (Igbinosa et al., 2009).

Latex

Folklore uses of *J. curcas* latex are to cure toothache, as a mouth rinse to treat bleeding gums, as a haemostatic, wound dressing and many others (Fazwishni and Kristiani, 2007). The latex contains tannin, saponin, wax and resin (Perry and Metzger, 1980; Watt and Breyer-Brandwijk, 1932). A proteolytic enzyme, curcain, can be obtained from the latex by alcohol and acetone precipitation (Nath and Dutta, 1991) and has been reported to have wound healing activity in mice (Nath and Dutta, 1997; Villegas et al., 1997). A novel cyclic octapeptide known as curcacycline A was isolated from the latex, which inhibits the classical pathway of human complement and proliferation of human T-cells (Van den Berg et al., 1995). A new cyclic nonapeptide named curcacycline B, observed by Catherine et al. (1997), can enhance the rotamase activity of cyclophilin B. In Mexico, the latex is used for fungal infections in mouth, wasp and bee stings and digestive troubles in children (Schmook and Seralta-Peraza, 1997; Watt and Breyer-Brandwijk, 1932). In tropical Africa and Southeast Asia, the latex is said to effectively treat scabies, eczema and ringworm. Furthermore, it is used as a mouth rinse to treat bleeding gums and to sooth a baby’s inflamed tongue. In The Philippines and Indonesia, a little latex on absorbent cotton is used to cure a toothache (Watt and Breyer-Brandwijk, 1932; Perry and Metzger, 1980; Burkill, 1935; Heyne, 1987; Suwondo, 1993). One of the reported traditional use of *J. curcas* latex is as haemostatic or styptic: for example, when the latex is applied directly to cuts and bleeding wounds, the bleeding soon stops (Dalziel, 1955; Watt and Breyer-Brandwijk, 1932; Neuwinger, 1996). These observations indicate the presence of pro-coagulant activity in this plant. Osaniyi and Onajobi (2003) were interested in investigating coagulant activity of the latex as this has great medical potentials. Investigation of the coagulant activity of the latex of *J. curcas* showed that whole latex significantly reduced the clotting time of human blood. They also discovered that diluted latex, however, exhibits anticoagulant activity. This indicates that *J. curcas* latex possesses both pro-coagulant and anticoagulant activities (Osaniyi and Onajobi, 2003). Fazwishni and Kristiani (2007) conducted mutagenicity test to evaluate the mutagenicity of the latex by Ames method and the result showed that *J. curcas* latex produces no mutagenicity activity. The latex can be used as anti-inflammation by massaging the latex to the traumatic area (De Feo, 1989).

J. curcas latex also exhibited good antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis, Escherichia coli, Pseudomonas aeruginosa, Streptococcus pyogenes, Candida albicans* and *Trichophyton* sp. (Oyi et al., 2002). The antimicrobial activities of the latex could be due to the presence of secondary metabolite such as tannins, flavonoids and saponins which have been confirmed to be present in the latex (Levens et al., 1979). Tannins coagulate the cell wall proteins resulting in bactericidal activity in high concentrations. Saponins are surface-active agents where they alter the permeability of the cell wall, thus facilitating the entry of toxic materials or leakages of vital constituents from the cell. Flavonoids are phenolic compound in nature; they act as cytoplasmic poisons where they inhibit the activity of enzymes (Iwu, 1993; Pathak et al., 1991).

Fruits and seeds

The seeds of *J. curcas* have good potentials as a fuel substitution. However, the seeds in general, are toxic to human and animals. Curcin is a toxic protein isolated from the seeds, and also contains a high concentration of phorbol esters (Adolf et al., 1984; Makkar et al., 1997). Two new esterases (JEA and JEB) and a lipase (JL) were isolated from the seeds (Staubmann et al., 1999). Esterases have been isolated from mammalian tissue as well as from microorganisms and plants. Because of the simple availability, microbial esterases are of interest for application in industrial processes. They are widely used for the resolution of racemic mixtures of compounds, in order to produce pure enantiomers (Staubmann et al., 1999). Lipases constitute a significant portion of enzymes that have been investigated for use in organic synthesis (Hills et al., 1990). Lipases have potential use in lipid modification to produce synthetic lipids for various industrial applications (Macrae, 1983; Svensson et al., 1992).

In Egypt, the seed is used for the treatment of arthritis, gout and jaundice (Khafagy et al., 1977). The seed of this plant has also been used traditionally for the treatment of many ailments including burns, convulsions, fever and inflammation (Osoniyi and Onajobi, 2003). The seed oil can be applied to treat eczema and skin diseases and to sooth rheumatic pain (Heller, 1996). The oil is also used externally for the treatment of sciatica, dropsy and paralysis (Mujamdar et al., 2000). The 36% linoleic acid (C18:2) content in *J. curcas* kernel oil is the possible interest for skin care (Kumar and Sharma, 2008). The oil has a strong purgative action and also is widely used for skin diseases and to sooth pain such as pain caused by rheumatism. Also, as reported, the seed oil can be a remedy against syphilis. In South Sudan, the seeds as well as the fruits are used as a contraceptive or as abortifacient (List and Horhammer, 1979).

Roots

J. curcas roots are used for treating eczema, scabies, ringworm and gonorrhea where these diseases are caused by fungi and bacterial infections (Aiyelaagbe et al., 2007). Phytochemical analysis of the extracts revealed the presence of many secondary metabolites including steroids, alkaloids and saponins. Chen et al. (1988) had isolated diterpenoids jatropholone A and B and a new diterpenoid named jatropholol from the roots of *J. curcas*. Previous work (Dekker et al., 1986; Aiyelaagbe et al., 2000; Aiyelaagbe, 2001) has shown that many Jatropha species possess antimicrobial activities. Aiyelaagbe et al. (2007) investigated an *in vitro* antimicrobial activity against different microorganisms responsible for various infections especially sexually transmitted diseases. The results displayed potent antimicrobial activity against the target organisms giving minimum inhibitory concentration (MIC) as low as 0.75 µg/ml. It confirmed the potency of this plant in treating infections including sexually transmitted infection. The roots contain yellow oil with strong anti-helmintic properties (Sirisomboon et al., 2007). The roots are also reported to be used as an antidote for snake bites. During an ethnobotanical survey of Raignad and Ratnagiri districts of Konkan area, a part of the West coast of India, was recorded to use *J. curcas* roots to control dysentery and diarrhea. In order to control these symptoms, a dose of two tablespoons of root suspension with butter milk is recommended, once or twice a day depending on the severity of the symptoms (Mujamdar et al., 2000). It is reported that the root is triturated with a little asafetida and given with butter milk in treating dyspepsia and diarrhea (Desai, 1975; Dymock et al., 1976; Nadkarni, 1976). Based on ethnobotanical practice, the root extract of this plant was investigated by Mujamdar et al. (2000) and Mujamdar et al. (2000) for pharmacognistic studies and evaluation of anti diarrheal activity in albino mice. The proposed mechanism of action was through a combination of inhibition of elevated prostaglandin biosynthesis and reduction in propulsive movements of small intestine (Mujamdar et al., 2000).

The roots of this plant are applied locally in paste form after crushing, for the treatment of inflammation by Bhil tribes from Rajasthan area in India on empirical basis (Joshi, 1995). Considering this information, Mujamdar and Visar (2004) evaluated for local and systematic anti-inflammatory activity using various animal models in the present investigation. Anti-inflammatory activity of topical application of *J. curcas* root powder in paste form in TPA-induced ear inflammation was confirmed in albino mice and the successive solvent extraction of these roots was carried out by ether and methanol. Resultant anti-inflammatory activity might be due to the effects on several mediators and arachidonic acid metabolism involving cyclo-oxygenase pathway resulting in prostaglandin formation, anti-proliferative activity leading to reduction in granular tissue formation and leukocyte migration from the vessels (Mujamdar and Visar, 2004). The roots can also be used in decoction as a mouthwash for bleeding gums and toothache.

Conclusions

The use of traditional medicine and medicinal plants as a normative basis for the maintenance of good health has been widely observed (UNESCO, 1996). *J. curcas* is a versatile plant with several actual and potential uses especially in medicinal uses. A lot of medicinal uses of *J. curcas* plant parts had been investigated and studied by the researches. This plant typically contains mixtures of different chemical compounds that may act individually, additively or in synergy to improve health. Numerous biologically active substances have been isolated and characterized from all parts of the Jatropha plant. Their mechanisms of action have been studied in associate to a great number of applications of *J. curcas* in traditional medicines. However, the full potential of *J. curcas* plant is far from being realized both technically and economically for several reasons. The role of *J. curcas* in medicinal uses should be taken into consideration as it shows promising potentials in the pharmaceutical field. Commercializing on the medicinal product derived from *J. curcas* may turn out to be more profitable than using Jatropha as fuel substitution. All non-energy uses of *J. curcas* should be tabulated to provide a wide range of options. The investigations of economics of making such products and the markets for the products should be vigorously developed. Currently, the growers of this plant are unable to achieve the optimum output in terms of economic benefits from the plant, especially for its various uses because of poor documentation and little experience in marketing its products. As a result, the growers including those in the subsistence sector do not have concrete information on the potential of this plant to exploit commercially. Promotion is needed to increase awareness to the public on this plant various potentials in medicinal uses. Some of the current strategies used to promote usefulness of *J. curcas* may be sub-optimal and could act as a deterrent instead of stimulating. Hence, it is crucial to examine the problems encountered in order to promote this plant widely. In order to re-stimulating the interest in *J. curcas*, the emphasis should be adjusted and moved away from its use as fuel substitution. The focus should be shifted to examine all the medicinal uses of this plant and to expand and develop the most profitable uses of its products.

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REFERENCES

Adolf W, Opferkuch HJ, Hecker E (1984). Irritant phorbol derivatives from four Jatropha species. Phytochemistry, 23: 129-132.
Aiyelaagbe OO (2001) Antimicrobial activity of Jatropha *multifida* roots. Fisioterpia, 72: 544-546.
Aiyelaagbe OO, Adeyeni BA, Fatunsin OF, Arimah BD (2007). *In vitro* antimicrobial activity and phytochemical analysis of Jatropha curcas roots. Int. J. Pharmacol., 3(1): 106-110.
Aiyelaagbe OO, Adsogan EK, Ekundayo O, Adeyeni BA (2000). The antimicrobial activity of roots of Jatropha *podagrica* Hook. Phytother. Res., 14: 60-62.
Burkill IH (1935). A Dictionary of the Economic Products of Malay Peninsula. The Crown Agents for Colonies, London, Pp. 1267-1271.
Catherine A, Carine B, Alain B, Francoise L, Jean-Louis P, Bernard B (1997). Curcacycline B, a cyclic nonapeptide from Jatropha curcas enhancing rotamase activity of cyclophilin. Tetrahedron Lett., 38(16): 2845-2848.
Chen M, Hou L, Zhang G (1988). The diterpenoids from Jatropha curcas. Zhiwu Xueboa, 30: 308-311.
Chhabra SC, Mahunnah RLA, Mshiu EN (1990). Plants used in traditional medicine in Eastern Tanzania. III Angiosperms (Euophorbiaceae to Menispermaceae). J. Ethnopharmacol., 28: 255.
Dalziel JM (1955). The Useful Plants of West-Tropical Africa. Crown Agents for Oversea Governments and Administration, London, P. 147.
De Feo V (1989). Use of plant action antiinflammatoria Upper Ucayall, eastern Peru. Fitoterapia, 62: 481-494.
Dekker TG, Fourie TG, Mathee E, Snyckers FO (1986). Studies of South African medicinal plants part 4, Jaherin, a new daphene diterpene with antimicrobial properties from Jatropha zeyheri. South Afr. J. Chem., 40: 74-76.
Desai VG (1975). Aushadhi Sangraha. (Marathi). Shri Gajanan Book Depot, Dadar, Mumbai, P. 188
Dharmananda S (2003). Gallnuts and the uses of Tannins in Chinese Medicine. In: Proceedings of Institute for Tradit. Med, Portland, Oregon.
Duke JA (1988). CRC Handbook of Medicinal Herbs. CRC Press, Boca Raton, Florida, pp. 253–254.
Dymock C, Warden CJH, Hooper D (1976). Pharmacographica Indica – A history of the Principal drugs of Vegetable origin Bishen Singh Mahindra Pal Singh. Dehra-Dun, P. 274.
Fagbenro-Beyioku AF, Oyibo WA, Anuforom BC (1998). Disinfectant/antiparasitic activities of *Jatropha curcas*. East Afr. Med. J., 75: 508-511.
Fazwishni S, Kristiani I (2007). Mutagenicity activity of Jatropha curcas L. (Euphorbiaceae) latex. Period. Kedoktoran Sci., 39(1): 23-26.
Gübitz GM, Mittelbach M, Trabi M (1999) Exploitation of the tropical oil seed plant Jatropha curcas L. Bio Tech., 67: 73–82.
Heller J (1996). Physic Nut. Jatropha curcas L. Promoting the Conservation and use of Underutilized and Neglected Crops. International Plant Genetic Resources Institute, Rome
Henning K (1997). Fuel production improves food production: The Jatropha project in Mali. In: Biofuels and Industrial products from Jatropha curcas. Gubitz G.M., Mittelbach M., Trabi M., (Eds.). DBV Graz, pp. 92-97.
Heyne K (1987). Tumbuhan Berguna Indonesia. Vol II 1st Ed Translated by Litbang Kehutanan, Jakarta, pp. 1180-1182.
Hills MJ, Kiewitt I, Mukherjee KD (1990). Enzymatic fractionation of fatty acids enrichment of gamma linolenic acid and docosahexaenoic acid by selective esterification catalyzed by lipases. J. Am. Oil Chem. Soc., 67: 561–564.
Hodek P, Trefil P, Stiborova M (2002). Flavonoids - Potent and versatile biologically active compounds interacting with cytochrome P450. Chemico-Biol. Int., 139(1): 1-21.
Hufford CD, Oguntimein BO (1978) Non-polar constituents of Jatropha curcas. Lloydia, 41: 161-165
Igbinosa OO, Igbinosa EO, Aiyegoro OA (2009). Antimicrobial activity and phytochemical screening of stem bark extracts from Jatropha curcas (Linn). Afr. J. Pharm. Pharmacol., 3(2): 58-62.
Irvine FR (1961). Woody Plants of Ghana (With Special Reference to Their Uses). 2^{nd} Edition, OUP, London, pp. 233-237.
Iwu M (1993). Handbook of African medicinal plants. CRC Press, Boca Raton, Florida.
Joshi P (1995). Ethnobotany of the Primitive Tribes in Rajasthan. Printwell, Jaipur, India, p. 89.
Just MJ, Recio MC, Giner RM, Cueller MJ, Manez S, Bilia AR, Rios JL (1998). Anti-inflammatory activity of unusual lupine saponins from Bupleurum fruticescens. Planta Med., 64: 404-407.
Kam PCA, Liew S (2002). Traditional Chinese herbal medicine and anaesthesia. Anaesthesia, 57(11): 1083-1089.
Khafagy SM, Mohamed YA, Abdel SNA, Mahmoud ZF (1977). Phytochemical study of Jatropha curcas. Planta Med., 31: 274-277.
Khanna S, Gupta SR, Grover JK (1986). Effect of long term feeding of tulsi on reproductive performance of adult albino rats. Ind. J. Exp. Biol., 24: 302-304.
Kumar A, Sharma S (2008). An evaluation of multipurpose oil seed crop for industrial uses (Jatropha curcas L.): A review. Bios Eng., 97: 201-207.
Levens M, Vandan-Berghe DA, Marten J, Vihen T, Lomiveas EC (1979). Screening of higher plants for biological activity. Planta Med., 36: 311-312.
Li H, Wang Z, Liu Y (2003). Review in the studies on tannins activity of cancer prevention and anticancer. Zhong Yao Cai, 26(6): 444-448.
List PH, Horhammer L (1979). Hager's Handbuch der Pharmazeutischen Praxis, Springer, Berlin
Macrae AR (1983). Lipase catalyzed interesterification of oils and fats. J. Am. Oil Chem. Soc., 60: 291–294.

Makkar HPS, Becker K, Sporer F, Wink M (1997). Studies on nutritive potential and toxic constituents of different provenances of Jatropha curcas. J. Agric. Food Chem., 45: 3152-3157.
Mart´ınez-Herrera J, Siddhuraju P, Francis G, D´ avila-Ort´ız G, Becker K (2006). Chemical composition, toxic/antimetabolic constituents, and effects of different treatments on their levels, in four provenancesof Jatropha curcas L. from Mexico. Food Chem., 96: 80–89.
Matsuse IT, Lim YA, Hattori M, Correa M, Gupta MP (1999). A search for anti-viral properties in Panamian medicinal plants. The effects on HIV and its essential enzymes. J. Ethnopharcol., 64: 15-22.
Mujamdar AM, Upadyhe AS, Misar AV (2000). Studies on antidiarrhoeal activity of Jatropha curcas root extract in albino mice. J. Ethnopharmacol., 70: 183-187.
Mujamdar AM, Visar AV (2004). Anti-inflammatory activity of Jatropha
curcas roots in mice and rats. J. Ethnopharmacol., 90: 11-15.
Nadkarni AK (1976). Dr. K.M Nadkarni's Indian Materia Medica Vol. 1 (originally K.M. Nadkarni (Ed.)). Popular Prakashan, Bombay, P. 705.
Nath LK, Dutta SK (1991). Extraction and purification of curcain, a protease from the latex of Jatropha curcas Linn. Ind. J. Pharmacol., 43: 111-114.
Nath LK, Dutta SK (1997). Acute toxicity studies and wound healing response of curcain, a proteolytic enzyme extract from the latex of Jatropha curcas L. In: Gubitz, G.M., Mittelbach, M., Trabi, M., (Eds.), Biofuel and Industrial Products from *Jatropha curcas*. DBV Graz, pp. 82-86.
Neumann UP, Berg T, Baha M, Puhl G, Guckelbeger O, Langreh JM, Neuhaus P (2004). Long-term outcome of liver transplant for hepatitis C: A 10 year follow-up. Transplantation, 77(2): 226-231.
Neuwinger HD (1994). African Arzneip ¯ ances and huntingpoisons. WV Gesmb H, Germany, p. 450.
Neuwinger HD (1996). African Ethnobotany: Poisons and Drugs. Chapman & Hall, New York, pp. 500–509
Nobori T, Miurak K, Wu DJ, Takabayashik LA, Carson DA (1994). Deletion of the cyclin-dependent kinase-4 inhibitor gene in multiple human cancers. Nature, 368(6473): 753-756.
Okwu DE (2001). Evaluation of the chemical composition of indigenous Spices and flavouring agents. Glob. J. Appl. Sci., 7(3): 455-459.
Oliver-Bever B (1986). Medicinal Plants in Tropical West Africa, Cambridge University Press, London
Osoniyi O, Onajobi F (2003). Coagulant and anticoagulant activities in Jatropha curcas. J. Ethnopharmacol., 89: 101-105. (Osaniyi Clarify).
Oyi AR, Onaolapo JA, Adigun JO (2002). Phytochemical and antimicrobial Screening of the latex of Jatropha curcas Linn (Euphorbiaceae). J. Phytomed. Therap., (1&2): 63-74.
Parekh J, Chanda S (2007). *In vitro* antibacterial activity of crude methanol extract of Woodfordia fruticosa Kurz flower (Lythacease). Braz. J. Micro, 38: 2.
Parveen BU, Shikha R, Ashawani K (2007). Traditional uses of medicinal plants among the rural communities of Churu district in the Thar Desert, India. J. Ethnopharmacol., 113: 387-399.
Pathak D, Pathak K, Singla AK (1991). Inhibition of Xanthine-oxidase activity by some flavonoids. Fisiotherapia, 62: 371-385.
Perry LM, Metzger J (1980). Medicinal Plants of East and Southeast Asia. MIT Press, Cambridge, pp. 246-247.
Perry LM, Metzger J (1980). Medicinal plants of East and Southeast Asia. MIT Press, Cambridge, pp. 246-247.
Quinlan MB, Quinlan RJ, Nolan JM (2000). Ethnophysiology and herbal treatments of intestinal worms in Dominica, West Indies. J. Ethanopharmacol., 8: 75-83,
Rice EL (1995). Biological control of weeds and plant diseases. Adv. Applied Allelopathy, Univ. Oklahoma Press.
Schmook B, Seralta-Peraza L (1997). *J. curcas:* distribution and uses in the Yucatan Peninsula of Mexico. In: Biofuels and industrial products from Jatropha curcas. (Gübitz G M; Mittelbach M; Trabi M, eds), DBV Graz, pp. 53–57.
Shimada T (2006). Salivary proteins as a defense against dietary tannins. J. Chem. Ecol., 32(6): 1149-1163.
Singh YN, Ikahihifo T, Panuve M, Slatter C (1984). Folk medicine in Tongga. A study on the use of herbal medicines for obstetric and gynecological conditions and disorders. J. Ethnopharmacol., 12: 305-329.
Sirisomboon P, Kitchaiya P, Pholpho T, Mahuttanyavanitch W (2007). Physical and mechanical properties of Jatropha curcas L. fruits, nuts and kernels. Biol. Eng., 97: 201-207.
Staubmann R, Manfred S, Alois H, Theodor K (1999). A complex of 5-hydroxypyrrolidin-2-one and pyrimidine-2,4-dione isolated from Jatropha curcas. Phytochemistry, 50: 337-338.
Staubmann R, Neube I, Gubitz GM, Steiner W, Read JS (1999). Esterase and lipase activity in Jatropha curcas L. seeds. J. Biotechnol., 75: 117-126.
Suwondo S (1993). Improving the use of the Indonesia traditional herbal medicine for the prevention of caries and gingivitis on the basis of antibacterial activity test against streptococcus mutans and clinical trial on gingivitis. Dissertation. Univ. Padjadjaran, Bandung.
Svensson I, Adlercreutz P, Mattiasson B (1992). Lipase catalyzed transesterification of phosphatidylcholine at controlled water activity.
J. Am. Oil Chem. Soc., 69: 986–991.
Thomas OO (1989). Re-examination of the antimicrobial activities of *Xylopia aethiopica, Carica papaya, Ocimum gratissimum* and *Jatropha curcas*. Fitoterapia, 60: 147-155.
UNESCO (1996). Culture and Health, Orientation Texts – World Decade for Cultural Development 1988 – 1997, Document CLT/DEC/PRO – 1996, Paris, France, p. 129.
Van den Berg AJJ, Horsten SFA, Ketteness-van den BJJ, Kroes BH, Beukelman CJ, Leeflang BR, Labadie RP (1995). Curcacycline A, a novel cyclic octapeptide isolated from the latex of *Jatropha curcas* L. F.E.B.S. Lett., 358: 215-218.
Villegas LF, Fernandez ID, Maldonado H, Torres R, Zavaleta A, Vaisberg AJ, Hammond GB (1997). Evaluation of the wound-healing activity of selected traditional medicinal plants from Peru. J. Ethnopharmacol ., 55: 193-200.
Watt JM, Breyer-Brandwijk MG (1932). The Medicinal and Poisonous Plants of Southern and Eastern Africa. E&S. Livingstone, Edinburg, p. 302. 1962; pp. 420-422.