# The Jatropha Plant (*Jatropha curcas* Linn.) And Its Applications

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## Abstract
This paper examined the multiple uses and benefits of the Jatropha plant and oil expressed from the seeds. The plant is useful in saving the environment from pollution. It supports employment generation and entrepreneurship development. Furthermore, Jatropha has potentials in use as energy crop, forestry crop, and for soil conservation and industrial applications. These and other applications are attractive factors that can be used as justification and need for the cultivation of the plant in unused, barren and marginal lands. The paper emphasized the need for intensive research to improve the variability of this multipurpose natural gift to mankind to enhance its multifunctional benefits to countries that cultivate it and to the generality of mankind.

**Keywords:** *Jatropha curcas*, medicinal, industrial, environmental values, other applications.

## Introduction
*Jatropha curcas* commonly called physic nut is a bush or small tree (up to 5m high). The genus:*Jatropha* is derived from the Greek word jatros (doctor), trophe (food), which implies medicinal uses. The plant is planted as a hedge (living fence) by farmers all over the world because it is not browsed by animals (Sukarin *et al..*, 1987; Achen *et al..*, 2007).

*Jatropha curcas* is a perennial shrub whose seeds are used for producing biodiesel (Fairless, 2007; Achten *et al..*, 2008). It is traditionally used as hedging plant in parts of India to protect agriculture and livestock. The seeds are also used as insecticides. Once deshelled, the glycerin within the almond of the seed can be used to make soap while the pressed cakes that remain after the oil has been extracted are often used as organic fertilizer because of the high concentration of nitrogen (Achten *et al..*, 2007). It is a multipurpose crop used in the reclamation of marginal soils, good growth under saline conditions, drought tolerant and high water use efficiency, an important energy crop, low labour in plants, does not compete with food crops and it is a wonder bio-fuel crop (Keyejo *et al..*, 2010).

*Jatropha curcas* is a perennial plant in infertile and marginal soils. It is a drought resistant large shrub or small tree that produces oil containing seeds widely used for varying purposes (Ferson *et al..*, 2004). This review is an attempt to highlight the various ways *Jatropha curcas* can be put into different applications.

*Jatropha curcas* commonly called Physic nut or biodiesel fuel plant and locally called: *Lapalapa* (Yoruba); *Oluluidu* (Igbo); *Cridazugu* (Hausa), and *Itiakpa* (Urhobo).

## Medicinal uses of *Jatropha curcas*
The medicinal, external and internal uses of *Jatropha curcas* are as presented in Table 1.

**Table 1: (i) External Medicinal Uses of *Jatropha curcas***

| | Parts Used | Ailment Treated |
|---|---|---|
| 1 | Leaves | (1) Anti-parasitic, applied to scabies; ruberfacient for paralysis, rheumatism, and also to hard tumor<br>(2) Sap from the leaves is used on bee or wasp sting<br>(3) Leaves when pounded can be applied on the eye of a horse to scare flies from it especially in India.<br>(4) Latexfrom the stem and leaf petiole is applied on the affected part against dermatophytic diseases (Ilondu and Okeowale, 2002)<br>(5) A decoction of the leaves is used against cough and as an antiseptic after birth (Nayak and Patel, 2010).<br>(6) The leaves contain apigenin, vitexin and ansovitexin which when combined with other factors enable them to be used against muscular pains (Nayak and Patel, 2010). |
| 2 | The oil | Soothes rashes, eczema and other parasitic skin diseases<br>- When mixed with benzylbenozoate becomes effective against scabies and dermatitis, hence flourishes in skin care industries and soothes rheumatic pain.<br>- Causes premature abortion, and has purgative action. |
| 3 | The soap | Cures dermatomucosal diseases. Sap from the bark is used to dress bleeding wound and ulcer, stops bleeding. Sap from the leaves is used for the treatment of pile. The latex is applied to boils and sores, and thrust, fish barb wounds, snake bitter, cords, heart burns, dropsy, dysentery, dyspepsia, fever, tetanus, ulcer, uteruses, yaws. |

Source: Agbogidi and Ekeke (2011); Agbogidi*et al.*, (2013a)

Table 1.(ii)**Internal Medicinal Uses of *Jatropha curcas***

| | Part Used | Ailment Treated |
|---|---|---|
| 1a. | Stem/tender twig | Treatment of urinary infections, tooth ache, gum inflammation, gum bleeding, pyorrhea |
| b. | Stem bark | Infectious diseases including sexually transmitted diseases |
| 2 | The roots | Used as antidote for snake bites, in decoction as mouth wash for bleeding gums and tooth aches, ringworm, scabies, eczema.<br>The root powder is used in the treatment of inflammation, scabies, syphilis, blood cleansing, headache, flu, evil eye, cleansing house, congestion and tumor HIV |
| 3 | The bark | Tea from the bark is given to people with leprosy, rheumatism, jaundice and gonorrhea |
| 4 | The seeds | As asperiant, laxative, the ashes are used as salt substitutes, treatment of tongue sere. A seed swallowed once in a year aids family planning. |

Source: Agbogidi and Ekeke (2011); Agbogidi*et al.*. (2013a)

**Use as biopesticides / insecticides**

As noted by Habour *et al.* (2011), *Jatropha curcas* can be used as a biopesticide. Several authors have tested the use of oil emulsion against insects that attack stored maize grain. The environmental side effects of pesticides are of global concern hence pathologists are now

seeking ways and materials that are environmentally friendly (Agbogidi and Ekeke, 2011). *J. curcas* has been showed to contain some toxins and anti-nutritive compounds which have been identified as curcin, alkaloids, tannins, flavonoids, saponins, vitexine, and cyanide as trypsin inhibitor. These phytochemicals, especially saponinsare general biocide and also responsible for the toxicity of the plant. The phytochemical, saponin is responsible for the anti-schistosomal properties of the plant on both the adults and juveniles of *Schistosoma mansoni* (Balick*et al..*, 2000).Table 2 shows the phytochemical constituents of *J. curcas.*

**Table 2: Phytochemical constituents of Jatropha plant parts**

| Plant parts | Chemical Composition |
|---|---|
| Aerial part | Organic acids (o and p-coumaric acid, p-OH-benzoic acid, protocatechuic acid, resorsilic acid), saponins and tannins |
| Stem bark | β-amyrin, β-sitosterol and taraxerol |
| Leaves | Cyclic triterpenes stigmasterol, Stigmast-5-en-3β, 7β-diol, Stigmast-5-en3β, 7α-diol, cholest-5-en3β, cholest-5-en3fl, campesterol, β-D-glucoside of β-sitosterol, Flavonoids apigenin, vitexin, isovitexin leaves also contain the dimmer of the triterpene alcohol ($C_{63}H_{117}O_9$) and two flavonoidalglucosides |
| Latex | Curcacyline A, a cyclic octapeptidecurcain (protease) |
| Seeds | Curcin, a lectin, PhorbolestersEsterases (JEA) and Lipase (JEB) |
| Kernel and press cake | Saponins and a trypsine inhibitor |
| Roots | β-Sitosterol and its β-D-glucoside, marmesin, propacin, the curculathyranes A and B and the curcusones A-D, diterpenoidsjatrophol and jatropholone A and B, the coumarintomentin, the coumarin-lignanjatrophine as well as taraxerol |

Source: Balick *et al.*. (2000); Agbogidi *et al.*. (2013a).

Different parts of the plant including the leaves, fruits, latex, and bark contain glycosides, tannins, phytosterols and flavonoids that enable the plant to perform a wide range of medicinal uses.

**Industrial uses of Jatropha**

**Biofuel production:** The seeds when crushed produce Jatropha oil which can be processed to produce high-quality biofuel or biodiesel that can be used in standard diesel car or further processed into jet fuel while the residue (press cake) can be used as biomass feedstock to produce electricity generating machines (Ferson *et al.*, 2004). Agbogidi and Ekeke (2011) maintained that aviation fuels may be widely substituted with biofuels such as Jatropha oil than fuels from other sources for transportation. This is directly connected to the fact that *J. curcas* oil has a very high saponification value, and as such, is being used extensively for soap production in many countries. The fuel from Jatropha oil burns without emitting smoke. Besides, the use of *J. curcas* when compared with other vegetables like soybeans, castor oil, moringa, mahua, karenji, jojoba, rubber seeds, fongunia, rapeseeds, neem seeds and algae is cheaper. It holds a lot of promise in clean alternative energy used for biofuel. The oil is also free of fatty acids hence it has promising solutions to transportation. The high cost of fossil fuels will be reduced if technologies develop *Jatropha curcas* for biofuel production. The oil

extracts showed good physical and chemical properties that have useful applications as biodiesel seed stock and other industrial applications (Ferson *et al.*., 2004).

The agronomic quality and yields of Jatropha are also a plus to its consideration in biofuel development. It grows in marginal and other waste soils not conducive to other conventional crop plants. The plant yields more than four times as much fuel per hectare as soya bean and more than ten times that of maize (corn). The major limitation is the lack of its wide domestication and improvement by plant breeders to enhance its sustained yields and technological applications including use to minimize environmental degradation, obtain cleaner and greener environment, and as ready sources of renewable energy (Correcton *et al.*., 2004; Shivani *et al.*, 2012).

The fatty acid (%) composition of *Jatropha curcas* species is presented in Table 3. The oil from *Jatropha curcas* is minor unsaturated in classification and it is higher than other vegetable oil such as palm kernel oil, sunflower etc.

Table 3. Fatty acid (%) compositions of *Jatropha curcas* and other plants

| **Free Fatty acid** | **Plant species** | | | | |
|---|---|---|---|---|---|
| | ***J. curcas*** | **Palm kernel oil** | **Sunflower oil** | **Soya bean oil** | **Palm oil** |
| Oleic 18.1 | 44.7 | 15.4 | 21.1 | 23.4 | 39.2 |
| Linoleic 18.2 | 32.8 | 2.4 | 66.2 | 53.2 | 10.1 |
| Palmitic 16.0 | 14.2 | 8.4 | - | 11.0 | 44.0 |
| Stearic 18.0 | 7.0 | 2.4 | 4.4 | 4.0 | 4.5 |

Source: Jumat and Waleed (2012).

The chemical and physical properties of *Jatropha* oil also make it to stand out in its industrial and other applications. The chemical and physical properties of *Jatropha* oil are as given in Table 4.

**Table 4: Chemical and physical properties of the *Jatropha* plant**

| **Parameter** | **Value** |
|---|---|
| %FFA as oleic acid | 2.23±0.02 |
| Iodine value | 103.62±0.07 |
| Saponification value | 193.55±0.61 |
| Peroxide value | 1.93±0.012 |
| Percentage oil content (kernel) | 63.16±0.35 |
| Density at $20^0$C (g/ml) | 0.90317 |
| Viscosity at room temperature (cp) | 42.88 |
| Physical state at room temperature | Liquid |

Source: Jaspen *et al.* (2006); Jumat and Waleed (2012).

The thermodynamic properties of the Jatropha in 4 also indicate that the by-products of its oil extraction including biodiesels like glycerin and oil cake, can generate favourable economic return, which make cultivation of Jatropha and production of its oil an economically feasible venture, and which can launch Nigeria as one of the World's producer and user of biodiesel. The ten (10) top countries of the world in terms of biodiesel usage is shown in Table 5.

Table 5.Top 10 Countries in terms of biodiesel production and usage

| Rank | Country | Potential biodiesel (ml) | Production ($/l) |
|---|---|---|---|
| 1 | Malaysia | 14,540 | 0.53 |
| 2 | Indonesia | 7,575 | 0.49 |
| 3 | Argentina | 5,255 | 0.62 |
| 4 | USA | 3,212 | 0.70 |
| 5 | Brazil | 2,567 | 0.62 |
| 6 | Netherlands | 2,496 | 0.75 |
| 7 | Germany | 2,024 | 0.79 |
| 8 | Philippines | 1,234 | 0.53 |
| 9 | Belgium | 1,213 | 0.78 |
| 10 | Spain | 1,073 | 0.71 |

Source: Shivani*et al.*. (2012).

**Industrial Potentials of *J. curcas* as biofuel source**

The seed of *J. curcas* contains much oil (63.16%, Table 4), and hence, its seed cake contains much energy as it emerges from the press. These pellets can be connected to charcoal (Correcton *et al*, 2004). *Jatropha curcas* is attractive to investors because of the biological characteristics of the seeds. The plant starts yielding from 9-12months after planting (A.P.) and the best yields are obtained from 2 to 3 yearsafter planting. The oil is low in acidity and has good stability when compared to soyabean oil. Additionally, the use of non-edible oils (e.g. *Jatropha* oil) is very significant beside their cheap nature compared to that of the costlier edible oils (e.g., soya bean oil).Thus, biofuels have great advantages in the area of economic growth, smaller trade deficit, establishment of new industries, utilization of new technologies, and creation of job opportunities (Agbogidi *et al..*, 2016)..

**Environmental benefits of *Jatropha curcas***

It has been established that *J. curcas* is an environmental friendly plant because of its zero toxicity to the environment and its usefulness in the soil enrichment and reformation processes (Agbogidi and Ekeke, 2011). Some of the environmental values of *J. curcas* include the following:

Phytoremediation of contaminated soils including heavy metals (Kumar *et al..*, 2008; Agbogidi and Eruotor, 2012), green technology using *J. curcas* is effective, and long term remediation to detoxify the soil of metals by accumulation of the toxic metals in the plant tissues. *J. curcas* can extract volatile contaminants such as mercury and selenium from polluted soils and to ascend them into the air as foliage a process called phytovolatilisation. *J. curcas* also helps to improve soil enrichment (Agbogidi and Ekeke, 2011).

The plant can re-anchor the soil with its substantial root system (Jepsin *et al.*, 2006). *J. curcas* has also been shown to stimulate the degradation of toxic organic materials hence the efficiency of *J. curcas* plant parts is in the following order: stems< leaves < roots (Agbogidi *et al..*, 2013b).

The Jatropha plants have also been reported as having the capability of remediating hydrocarbon contaminated soils (Agbogidi *et al..*, 2013b). The following are implicated as contributing to its bioremediation property: enhancing aeration by releasing oxygen directly to the root zone as well as increasing the porosity of the peripheral soil layer; restricting the physical and chemical properties of the contaminated soil as well as intercepting and retarding

the movements of contaminants, effecting co-metabolic and plant enzymatic transformation of hazardous/toxic materials. Agbogidi and Ekeke (2011) maintained that industrial non-food crops including *J. curcas* have been widely used for energy plantations and wasteland reclamation due to their ability to tolerate extreme environmental conditions such as drought, non-fertile and heavily polluted soils. According to Kumar *et al.* (2008), *J. curcas* is capable of out-competing weeds and its toxicity (allelopathic nature) deters livestock thereby monopolizing and creating territorialistic outfit. The oil cake improves soil enrichment. The plant can also retain marginal lands. The cake is rich in nitrogen, potassium and phosphate. Its rapid growth rate, promising live fence and its role in carbon sequestration is notable thereby ameliorating environmental degradation including soil erosion, sand drift and desertification (Agbogidi and Ekeke, 2011).

The plant also shades soils and other plants against evaporation. It also protects some soil microbes. In the tropics, the plant is widely used as a hedge in fields and settlement. It protects plants against wind erosion and keeps animals out. The *Jatropha curcas* species is particularly chosen for this purpose mainly because it can easily be propagated by cutting, densely planted and the species is not easily browsed by cattle. The roots also form a protection against water erosion and can protect against soil erosion by run-off if planted with lemon grass and other food crops (Agbogidi *et al..,* 2016).

**Conclusion**

The study is an attempt to review the various applications of *Jatropha curcas* to mankind. Indeed the species is nature's gift to man which is yet to be fully harnessed especially in Nigeria. The plant has a lot of industrial, health and environmental benefits yet to be tapped and developed. A clarion call is hereby made to government and her parastatals as well as philanthropists and technocrats to pour in resources for a better study of this multipurpose species whose applications is multi-faceted as this will enhance its diversification into an agro-industrial production chain and maximization of its usage as a plant of economic importance.

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