Phytochemicals of *Jatropha gossypiifolia* (Linn.): A Review

Reetu Dubey¹, Sanjukta Rajhans², Archana U. Mankad³
Department of Botany, Bioinformatics and Climate Change Impacts Management
School of Science, Gujarat University
Ahmedabad, Gujarat, India.

Abstract:- *Jatropha gossypiifolia* (Linn.) is one of the poisonous ornamentals, as well as a medicinal plant. The shrub is native to Gujarat State (India), Central and South America. This review study includes the complete Botanical description, Phytochemical constituents and Pharmacological activity and ethnomedical properties of *Jatropha gossypiifolia* (Linn.) plant parts. *Jatropha gossypiifolia* (Linn.) is a member of the family Euphorbiaceae, which is the largest family belonging to the Angiosperms. This plant has been used since ages for its well-known medicinal properties. It has been well established that the phytochemicals are responsible for the pharmacological properties. This review has included extensive information regarding the various aspects of the plant.

Keywords:- *Jatropha gossypiifolia* (Linn.), Pharmacological properties, Phytochemistry, Traditional uses.

I. INTRODUCTION

*Jatropha gossypiifolia* (Linn.) is small shrub, common ornamental garden plant and medicinal plant belonging to family Euphorbiaceae. The family contains 172 identified species. Euphorbiaceae is the largest family among the Angiosperms (J. Felix-Silva et al., 2014). It is placed in the order, “Geranales”. Euphorbiaceae family is rich in secondary metabolites such as alkaloids, cyanogenic glycosides, diterpenes, glucosinolates, tannins and triterpenes. *Jatropha* is a Greek word in which “jatros” means doctor and “trope” means food (Kumar A and Sharma S, 2008; Sabandar C.W. et al., 2013). This present review of *Jatropha gossypiifolia* (Linn.) is focused on its morphology, distribution, phytochemistry, medicinal properties, ethnomedical uses and its future prospectives.

- Vernacular names of *Jatropha gossypiifolia* (L.)
  - India: Athalai, Lal-berenda, Ratan-jyoti
  - French: Medicinier sauvage
  - Spanish: Purga de huane
  - Marma: Karachi
  - Garo: Kander
  - Africa: Babatidjin
  - Nigeria: Pignut, Fignut, Lapalapa, Botuje pupa, Botuje red, Binidasugu.

**Distribution:** *Jatropha gossypiifolia* (Linn.) is native to the Gujarat State (India), Central and South America. (Sabandar C.W. et al., 2013). It is mostly found in the tropical regions of the world. The plant is widely distributed in the subtropical and semiarid regions of African and the American regions of the world.
Mariz et al., 2010). In India generally, the plant is seen in the wild.

**Flowering season of Jatropha gossypiifolia (L.): April-August (Shahidul et al. 2019)**

II. **PHYTOCHEMISTRY OF THE PLANT**

The whole plant of *Jatropha gossypiifolia* (Linn.) is rich in many bio-active compounds. The plant parts contain different phytochemical constituents. These chemical constituents have been extracted by using various solvent systems. (C. Lans 2007; R. Seth and R. Sarin., 2010). Phytochemicals like alkaloids, flavonoids, diterpenoids, tannins, steroids, saponins, phenolic compounds have been found to be present in this species. (Nwokocha et al., 2011; Rufino et al., 2010; Gupta et al., 2011). The species is also rich in anthocyanins, carotenoids, carbohydrates, proteins, phytosterols and amino acids. (Rufino et al., 2010).

The leaves of the plant are rich in tannins, phenols and flavonoids. The bark has the highest amount of the alkaloid named as Jatrophone. (Oduola et al., 2005). Jatroden (a lignin) isolated from stem part of *Jatropha gossypiifolia* (Linn.). (Oduola et al., 2005). The primary phytochemical screening showed that the stem of *Jatropha gossypiifolia* (Linn.) plant are rich in lignin and also possess Jatrophan, Gadain, Prasanthaline, Arynaphthalene, Gossypian, Jatrodien, Gossypiline, Gossypidien, Isogadaain. (Sabandar C.W. et al., 2013). The stems are also contended with tannins, steroid, phenolic substances (tetradecyl-(E)-ferulate, ferulic acid and fraxetin), ascorbic acid, alkaloids (4’-O-Demethyl retrochinesin) flavonoids. (N. Nwokocha et al., 2011), lignoids and terpenoids (Vitexin, Isovitexin, Apigenin). (Sabandar C.W. et al., 2013; Singh et al., 2014; Zhang X.P. et al., 2009; Das B. et al., 2018). In *Jatropha gossypiifolia* (Linn.) root the content of the phenolic compounds is very high. This is one of the main compounds responsible for the anti-inflammatory and anti-oxidant properties. (Maisuthisakul et al., 2007). Sesquiterpenes such as 1,4-Epoxy-p-methan-2-ol and 4-Patchoulen-15-oic acid are found mostly in the rhizomes. The roots contain 9β-13α-Hydroxyisabellion and jatrophenone as the chief compounds. (Pertino et al., 2007).

The whole plant is rich in phenolic acids such as galic, vanillic, syringic, 2,5-dihydroxy benzoic, p-coumaric, caffeic, and rosmarinic. (Povichit et al., 2010; Nwokocha et al., 2011). In addition, Seeds of this species show the presence of polyunsaturated diterpenes diester. (Haas et al., 2002; Jing et al., 2005). K. M. Hosamani and K. S. Katagi, 2008 have isolated various types of fatty acids from the seeds in the petroleum ether extract. Zhang X.P. et al., 2009 discovered a new compound Cyclogossine A in the Latex part of *Jatropha gossypiifolia* (Linn.). The essential oils from the stem and leaves contain bioactive compounds such as limonene, menthol, linalool and carophyllene which are used as flavouring agents in food products in European Commission. (H. Morten et al., 2012).

<table>
<thead>
<tr>
<th>Classification</th>
<th>No.</th>
<th>Chemical component</th>
<th>Part of plant</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>1.</td>
<td>Cyclogossine A</td>
<td>Latex</td>
<td>Zhang X.P. et al., 2009</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td>Cyclogossine B</td>
<td>Latex</td>
<td>Fatokun et al., 2016</td>
</tr>
<tr>
<td>Alkaloid</td>
<td>3.</td>
<td>Racemicine</td>
<td>Leaves</td>
<td>Bullangpoti V. et al., 2016</td>
</tr>
<tr>
<td></td>
<td>4.</td>
<td>Piderine</td>
<td>Whole plant</td>
<td>Fatokun et al., 2016</td>
</tr>
<tr>
<td></td>
<td>5.</td>
<td>4’-O-Demethyl retrochinesin</td>
<td>Stem</td>
<td>R. Das et al., 2004</td>
</tr>
<tr>
<td></td>
<td>6.</td>
<td>Cleomiscosin A</td>
<td>Whole plant</td>
<td>B.Das et al., 2003</td>
</tr>
<tr>
<td></td>
<td>7.</td>
<td>2α-Hydroxyjatrophone</td>
<td>Roots</td>
<td>F.X. Silva et al., 2014</td>
</tr>
<tr>
<td></td>
<td>8.</td>
<td>2β-Hydroxy-5,6-isojatrophone</td>
<td>Roots</td>
<td>F.X. Silva et al., 2014</td>
</tr>
<tr>
<td></td>
<td>9.</td>
<td>2β-Hydroxyjatrophone</td>
<td>Whole plant</td>
<td>F.X. Silva et al., 2014</td>
</tr>
<tr>
<td></td>
<td>10.</td>
<td>Piderine</td>
<td>Seeds</td>
<td>Fatokun et al., 2016</td>
</tr>
<tr>
<td></td>
<td>11.</td>
<td>9-acetoxynerolidol</td>
<td>Whole plant</td>
<td>Falodun A et al., 2012</td>
</tr>
<tr>
<td>Phenols</td>
<td>12.</td>
<td>Gallic Acid</td>
<td>Whole plant</td>
<td>Povichit et al., 2010</td>
</tr>
<tr>
<td></td>
<td>13.</td>
<td>Vanilic Syringic</td>
<td>Whole plant</td>
<td>Povichit et al., 2010</td>
</tr>
<tr>
<td></td>
<td>14.</td>
<td>2,5-dihydroxy benzoic</td>
<td>Whole plant</td>
<td>Povichit et al., 2010</td>
</tr>
<tr>
<td></td>
<td>15.</td>
<td>Caffeic</td>
<td>Whole plant</td>
<td>Povichit et al., 2010</td>
</tr>
<tr>
<td></td>
<td>16.</td>
<td>Rosmarinic acid</td>
<td>Whole plant</td>
<td>Povichit et al., 2010</td>
</tr>
<tr>
<td>Flavonoid</td>
<td>17.</td>
<td>Ferulic acid</td>
<td>Stem</td>
<td>C.W. Sabandar et al., 2013</td>
</tr>
<tr>
<td></td>
<td>18.</td>
<td>Fraxetin</td>
<td>stem</td>
<td>C.W. Sabandar et al., 2013</td>
</tr>
<tr>
<td>Coumarin-lignoid</td>
<td>19.</td>
<td>p-coumaric</td>
<td>Aerial parts</td>
<td>Fatokun et al., 2016</td>
</tr>
<tr>
<td></td>
<td>20.</td>
<td>Gossypiline</td>
<td>Aerial parts</td>
<td>Shahwar D. et al., 2010</td>
</tr>
<tr>
<td></td>
<td>21.</td>
<td>Gossypifan</td>
<td>Stem</td>
<td>Povichit et al., 2010</td>
</tr>
<tr>
<td></td>
<td>22.</td>
<td>Vitexin</td>
<td>Leaves</td>
<td>C.W. Sabandar et al., 2013</td>
</tr>
<tr>
<td></td>
<td>23.</td>
<td>Apigenin</td>
<td>Leaves</td>
<td>C.W. Sabandar et al., 2013</td>
</tr>
<tr>
<td></td>
<td>24.</td>
<td>Isovitexin</td>
<td>Leaves</td>
<td>C.W. Sabandar et al., 2013</td>
</tr>
<tr>
<td>Coumarin-lignoid</td>
<td>Diterpene</td>
<td>Cardiac-glycosides</td>
<td>Esters</td>
<td>Fatty acids</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------</td>
<td>-------------------</td>
<td>--------</td>
<td>------------</td>
</tr>
<tr>
<td>25. Prasanthaline</td>
<td>33. Propacin</td>
<td>42. Apogenin</td>
<td>46. 12-Deoxy-16-hydroxyphorbol</td>
<td>47. Oleic acids</td>
</tr>
<tr>
<td>27. Cleomiscosin A</td>
<td>35. Jatrophane B</td>
<td>44. Orientin/Isoorientin</td>
<td></td>
<td>49. Palmitoleic acid</td>
</tr>
<tr>
<td>30. Jatrophan</td>
<td>38. Falodone</td>
<td></td>
<td></td>
<td>52. Vernolic acid</td>
</tr>
<tr>
<td>32. Arylnaphthalenes</td>
<td>40. 9b-13a-Hydroxyisabellione</td>
<td></td>
<td></td>
<td>54. Linoleic acid</td>
</tr>
<tr>
<td></td>
<td>41. Citralitrion</td>
<td></td>
<td></td>
<td>55. Capillic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>56. Arachidic acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1
III. PHARMACOLOGICAL ACTIVITIES

Jatropha gossypiifolia (Linn.) plant plays a key role in the treatment of various infectious as well as non-infectious ailments. Various relevant scientific studies have confirmed its pharmacological potential. So far numerous researchers have reported, Jatropha gossypiifolia (Linn.) as a plant with wide range of pharmacological potential. Antimicrobial, antidiabetic, hepatoprotective, antioxidant, anti-inflammatory (Yerramsetty N. et al., 2013), cytotoxic, antihypertensive, antithrombotic, antipyretic (Murugalakshmi, M. et al., 2014), anti-coagulating (Murugalakshmi M. et al., 2012), anti-cholinesterase (Pratap B. et al., 2013), analgesic (Panda et al., 2009), anti-chitososomicidal (Sherifat A. et al., 2015), anti-malarial (Koudouvo K. et al., 2011), antifertility (Sachin J. et al., 2012), anticancer (Apurba et al., 2013), anti-diarrhoenal (Apurba et al., 2013), pesticidal activity (Tripathi Y.C. et al., 2015) are some of the pharmacological properties this plant possesses.

- **Anti-bacterial Activity of the plant:**
  Several studies have revealed the antibiotic potential of the plant using different extracts. (Seth and Sarin, 2010; Purohit and Purohit, 2011). Aqueous and Benzene extract of the leaves demonstrated antimicrobial activities against Bacillus subtilis and Escherichia coli. As a result, the aqueous extract showed minimum effect (zone of inhibition 2.04 ± 0.02mm) and the benzene extract displayed the maximum antimicrobial potential (zone of inhibition 13.05 ± 0.02mm) in opposition of the organism (Seth and Sarin 2010). Okho et al., 2016 investigated the antibacterial potential of the essential oil extracted from the stem and the leaves, against E. coli, E. faecium, and S. aureus. The extract derived from the stem exhibited the maximum potential (MIC=0.025-0.05mg/ mL) and the extract derived from the leaf showed minimum efficacy (MIC = 0.05–0.1mg/mL) against the test microorganisms.

Jatropha gossypiifolia (Linn.) methanolic extract has shown potential against various pathogens such as A. fumigatus, A. flavus, S. pyogenes and S. typhi. (Singh, 2018). The different concentrations of the ethanolic and the aqueous leaf extracts have shown inhibitory effects against E. coli, S. aureus, N. gonorrhoea and C. albicans bacteria. (Ajayi, O.A. et al., 2018). Jatropha gossypiifolia (Linn.) ether, alcohol, chloroform leaf extracts showed antimicrobial activity against Escherichia spp., Pseudomonas spp., Staphylococcus spp., and Bacillus spp. The best result was obtained in the alcoholic extract. (D. A. Dhale and A. R. Birari., 2010). The leaf extract of dichloromethane/methanol (DC/MethOH) possesses antibacterial activity & antiprotozoal activity against Staphylococcus aureus, and Plasmodium falciparum. (Jansen et al., 2010).

- **Anti-diabetic Activity of the plant:**
  Diabetes mellitus is a chronic disease caused by the deficiency of insulin. Saleem et al., 2016 demonstrated that the extracts from Jatropha gossypiifolia (Linn.) plants showed significant α-glucosidase activity. The α-glucosidase comprises of a family of enzyme hydrolase, which is located in the brush-border surface membrane of small intestinal cells. Neha R. et al., 2013 has revealed that the stem possesses antidiabetic activity and hypolipidemic activity in a fraction comprising of 95% ethanolic extract with chloroform. The fraction restored the blood glucose profile, serum lipid level, renal and hepatic functions to nearly normal level.

- **Anti-inflammatory Activity of the plant:**
  The methanolic extracts of the aerial parts of the plant were effective in reducing pain and inflammation in carrageenan-induced paw oedema in rats. (Panda B. B. et al., 2009). The ethanolic extracts of the leaves are similarly effective in reducing pain and inflammation (Bhagat et al., 2011). The leaf extract of the plant was treated with aqueous (4.2%) and ethanol (5.8%) and was dried. At 200μg/mL concentration both the extracts showed essential immobilization of membrane of Human red blood cell (HRBC) (Nagaharika et al., 2013). Some researchers have explained that some secondary metabolites such as alkaloids and steroids present in the extracts have the ability to reduce the release of histamine, kinins and serotonin, which are the main reasons for inflammation. (Bhagat et al., 2011; Nagaharika et al., 2013).

Ahmed S. A. et al., 2015 also described the anti-inflammatory and anti-arthritis activity of the plant due to the rich flavonoid content of the latex of Jatropha gossypiifolia (Linn.). The latex showed the anti-inflammatory potential in carrageenan induced acute model (edema) and anti-arthritis potential in CFA induced (sub-chronic model) in rats. Xavier-Santos et al., 2018 revealed that the leaf extract of the plant was rich in C-glycosyl flavonoids and was the main curing agent of the cutaneous inflammatory disease.

- **Anti-oxidant Activity of the plant:**
  The leaf extracts possess antioxidant properties (Kharat et al., 2011; J. Sachin et al., 2015; F. Silva et al., 2014). The presence of the phytochemicals such as tannins, phenols and flavonoids are responsible for the antioxidant activity. (Okoh et al., 2016; Shahwar et al., 2010). The leaf and the stem bark have shown the activity with the IC50 value of 31.32 ± 1.72μg/mL and 10.79 ± 1.56μg/mL. (Rofida, 2015). Okoh et al., 2016 studied the antioxidant activity from the essential oils of the stems and leaves. The drugs produced from the oils create a probability for curing Alzheimer’s disease and arteriosclerosis (Qinghua Wu et al., 2019).

- **Anti-cancer Activity of the plant:**
  Investigation of the cytotoxic potential of the plat has provided positive results. (G.M. Cragg and D. J. Newman., 2005). The methanolic and the ethanolic extracts of the stem has shown positive result against HeLa cell lines (Nazeema and Girija 2013). A diterpenoid Falodon has been isolated from the roots of the plant. This diterpenoid exhibited potent proliferation inhibition activity against the A-549 human cancer cell line (Falodun et al., 2012). Jatrophone a phytochemical isolated from the stem bark
was effective against human cancer cell line Hep G2. (ASEP et al., 2017). Like the various parts of the plant the latex has also exhibited anticancer properties. (F. O. A. Ajose, 2007). Phytochemicals like Jatrophone, Jatrophenone, and Spruceanol are the main constituents for the effective results against various cancer cell lines. (Devappa et al., 2011).

- Anti-neoplastic Activity of the plant:
  A phytochemical named Jatrophone present in the plant *Jatropha gossypifolia* (Linn.) exhibited an effective result against the hepatocellular cancer cell line Hep G2 1886. (Asep et al., 2017). The leaves and branches of this plant contain a phytochemical named atrogossones which have been reported to be effective against RKO colon carcinoma cell line. (Zhang et al., 2018).

- Anti-purgative Activity of the plant:
  In castor oil induced diarrhea, the methanolic extract of the leaves, at the oral doses of 200 and 400 mg/kg showed significant antidiarrheal activity in mice. The results were highly satisfactory with the decreasing of the mean number of stool and total weight of the faecal output when compared with the control group. (Apu A.S. et al., 2013; Apurba S.A. et al., 2012).

- Anti-cholinesterase Activity of the plant:
  Dichloromethanolic extracts of leaves and roots and methanolic extracts of roots exhibited inhibition of acetylcholinesterase activity at the rate of 57.71–65.43% (Saleem et al., 2016). The leaf extracts of the plant demonstrated the inhibition of acetylcholinesterase at the rate of IC50 =0.05mg/mL. (Feitosa et al., 2011). Content of the alkaloids is considered responsible for the maximum level of acetylcholinesterase inhibition. (Saleem et al., 2016).

- Anti-plasmodial Activity of the plant:
  The ethanolic leaf extract of the plant has shown effective results against *P. berghei*. This proves the presence of anti-plasmodial property in the plant specifically in the leaves. (Onyegbule F. A. et al., 2019).

- Neuropharmacological, Sedative and Anxiolytic Properties of the plant:
  Using the hole cross test model researcher Apu et al., 2013 explored the neuropharmacological potential of *Jatropha gossypifolia* (Linn.) in the methanolic extracts of the fruits and leaves in oral doses of 200 and 400mg/kg in mice. The result was positive for both the extracts. The maze test model represented the sedative and anxiolytic properties of the plant with the dose of 200mg/kg. (Falodun A et al., 2012).

- Lipoxigenase Inhibitory Properties of the plant:
  Saleem et al., 2016 have explored the lipoxigenase inhibitory potential from the various extracts of the plant. The Hexane extract demonstrated the minimum inhibition rate (36.1%) and the dichloromethane extract showed the maximum inhibition rate (92%).

**Ethnomedical uses:** This species of *Jatropha* is used as an effective ethnomedical plant. (M.R. Khan et al., 2006).
- In Africa, Latin America and Asia, the plant extracts are used in curing various ailments. (Ayelaagbe, 2007; Sabandar C.W. et al., 2013).
- The young and fresh stems are used as toothbrush and for cleansing the tongue. (Sherifat A. et al., 2015).
- The plant is used for managing diabetes, curing cancer and skin diseases. (S. O. Okoh et al., 2016).
- In certain regions of India, the plant is used for treating diarrhoea, dysentery, itching and eczema. (R. Seth and R. Sarin., 2010).
- In Nigeria, the crushed leaves of the plant are used for treating haemorrhoids, bleeding nose, malaria, eczema, stomach-ache and typhoid. (Opeyemi O. F. et al., 2017).
- The leaf decoction is used for cleaning wounds, the stem sap is applied on skin for providing relief from itching cuts, scratching and bleeding. (B. B. Panda et al., 2009).
- The bark decoction is used for emmenagogue. The roots are used as an antivenom for snakebite. The leaves are used for providing relief from stomach ache and are effective as blood purifiers. (B. B. Panda et al., 2009).
- The various parts are used for curing tooth related problems, ringworm and for reducing inflammation. (Vijayakumar et al., 2016).
- In China the plant is used for reducing pain and fever. It is also used in dysentery. (Geronikaki A et al., 2003).
- Extracts of the stem bark, leaf and root help in the inhibitory effects of α-glucosidase and α-chymotrypsin. The plant is a potential natural heater for ulcers and diabetes. (Saleem and Gill, 2016).
- In Latin America and Caribbean region, the leaves are used in curing rashes, sprains and sores. The latex of the plant is effective against microbes. (Uddin et al., 2006).
- In Togo region the leafy stems are used for treating anaemia (Koudouvo et al., 2011).
- In Ghana the leaf decoction is effective in treating malaria with the combination of *Ocimum canum* and *Combretum glutelensis* plant parts.

**IV. CONCLUSION**

From the review of the available works it was concluded that *Jatropha gossypifolia* (Linn.) is a valuable plant. The plant is used by the traditional healers and is considered as one of the most important ethnomedicinal plant. Almost every part possesses some or the other pharmacological activity. The review has extensively included the list of the phytochemicals present in the specific parts of the plant. Although some of the phytochemicals have been isolated till date, many more are still left to be explored. The review will be helpful for the future explorations of the plant.
REFERENCES


[5]. Ashrafuzzaman, Zannatul Naim, Mustahsan Billah, Masud Rana SM. (2019); Biomedical and medicinal properties of Jatropha gossypiifolia plants: a short review; MOJ Bioequivalence & Bioavailability; 6(1); 7–8


[15]. H. Morten, T. L. Mygind and M. Rikke, (2012); Essential oils in food preservation: mode of action synergies and interactions with food matrix components; Front Microbiology; 3(12).


[17]. J. Felix-Silva, R. B. Giordani, A. A. Silva Jr, S. M. Zucolotto, and M.F. Fernandes-Pedrosa., (2014); Jatropha gossypiifolia L. (Euphorbiaceae); A Review of Traditional Uses, Phytochemistry, Pharmacology, and Toxicology of This Medicinal Plant; Evidence-Based Complementary and Alternative Medicine; 1-33


[55]. Sherifat A. Aboaba, Muritala A. Adebayo, Isiaka A. Ogunwande, Tajudeen O. Olayiwola (2015); Volatile constituents of *Jatropha gossypifolia* L. grown in Nigeria; *American Journal of Essential Oils and Natural Products*; 2(4): 08-1


[58]. Sukohar Asep, Herawati Hening, Sari Gema P, Setiawan Gigh, Morfi Chicy Widiy ssnd Sahidin (2017); Anticancer Activity of Jatrophone an Isolated Compound from *Jatropha gossypifolia* Plant Against Hepatocellular Cancer Cell HEP G2 1886; *Biomedical & Pharmacology Journal; Chemosphere* 10(2), 667-673


