e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2025; 15(2); 01-09

Review Article

Review on Traditional Uses, Photochemistry and Medicinal Properties of Jatropha gossypiifolia L.

Y. S. Sarangdevot[1], Bhumika Dadheech[2]

[1]Department of Pharmacy, Professor and Head Department of Pharmacology, B. N. University, Udaipur 313001 Rajasthan

[2]Department of Pharmacy, Research scholar, B. N. University, Udaipur 313001 Rajasthan

Received: 18-10-2024 / Revised: 21-11-2024 / Accepted: 26-12-2024

Corresponding author: Dr. Bhumika Dadheech

Conflict of interest: Nil

Abstract:

Jatropha gossypiifolia L. (Euphorbiaceae), widely known as "bellyache bush," is a medicinal plant largely used throughout Africa and America. Several human and veterinary uses in traditional medicine are described for different parts and preparations based on this plant. However, critical reviews discussing emphatically its medicinal value are missing. This review aims to provide an up-to-date overview of the traditional uses, as well as the phytochemistry, pharmacology, and toxicity data of J. gossypiifolia species, in view of discussing its medicinal value and potential application in complementary and alternative medicine. Pharmacological studies have demonstrated significant action of different extracts and/or isolated compounds as antidiabetic, antimicrobial, anti-inflammatory, antidiarrheal, antihypertensive, and anticancer agents, among others, supporting some of its popular uses. No clinical trial has been detected to date. Further studies are necessary to assay important folk uses, as well as to find new bioactive molecules with pharmacological relevance based on the popular claims. Toxicological studies associated with phytochemical analysis are important to understand the eventual toxic effects that could reduce its medicinal value. The present review provides insights for future research aiming for both ethnopharmacological validation of its popular use and its exploration as a new source of herbal drugs and/or bioactive natural products.

Keywords: Jatropha gossypiifolia L.; Phytochemistry; Pharmacology; Toxicology.

Introduction

The Euphorbiaceae family, which is considered one of the largest families of Angiosperms, covers about 7,800 species distributed in approximately 300 genera and 5 subfamilies worldwide. These species occur preferentially in tropical and subtropical environments [1, 2].

Among the main genera belonging to this family, there is Jatropha L., which belongs to the subfamily Crotonoideae, Jatropheae tribe and is represented by about 200 species. This genus is widely distributed in tropical and subtropical regions of Africa and the Americas [1].

The name "Jatropha" is derived from the Greek words "jatros," which means "doctor" and "trophe," meaning "food," which is associated with its medicinal uses [3]. The Jatropha genus is divided into two subgenera, Jatropha and curcas, from which the subgenus Jatropha has the widest distribution, with species found in Africa, India, South America, West Indies, Central America, and the Caribbean [4]. Jatropha species are used in traditional medicine to cure various ailments in Africa, Asia, and Latin America or as ornamental plants and energy crops [3]. Several known species from genus Jatropha have been reported for their medicinal uses, chemical constituents, and biological activities such as Jatropha curcas, Jatropha elliptica, Jatropha gossypiifolia, and Jatropha mollissima, among others [3]. From these species, Jatropha gossypiifolia L. (Figure 1) is discussed here. It is a vegetal species widely known as "bellyache bush" and is a multipurpose medicinal plant largely used in folk medicine for the treatment of various diseases [3, 5, 6]. It is widely distributed in countries of tropical, subtropical, and dry tropical weather and tropical semiarid regions of Africa and the Americas [7]. In Brazil, it predominates in the Amazon, Caatinga, and Atlantic Forest and is distributed throughout the country in the North, Northeast, Midwest, South, and Southeast regions [8].

Figure 1: Jatropha gossypiifolia L. (a) aerial parts of plant (b) flowers detail

Several human and veterinary uses in traditional medicine are described for different parts (leaves, stems, roots, seeds, and latex) and preparations (infusion, decoction, and maceration, among others) based on this plant, by different routes (oral or topical). The most frequent reports concern its antihypertensive, anti-inflammatory, antiophidian, analgesic, antipyretic, antimicrobial, healing, antianemic, antidiabetic, and antihemorrhagic activities, among many other examples [3, 5, 7, 9]. Other uses are also related to this plant, such as biodiesel production, pesticide, insecticide, vermifuge, ornamentation, and even its use in religious rituals [3, 6, 10–13].

An important feature of J. gossypiifolia species is that, due to its important potential medicinal applications, in Brazil, it is included in the National List of Medicinal Plants of Interest to the Brazilian Public Health System (Relação Nacional de Plantas Medicinais de Interesse ao Sistema Único de Saúde Brasileiro—RENISUS), which is a report published by the Brazilian Health Ministry in February 2009 that includes 71 species of medicinal plants that have the potential to generate pharmaceutical products of interest to public health of Brazil [14].

Regarding its phytochemical constitution, alkaloids, coumarins, flavonoids, lignoids, phenols, saponins, steroids, tannins, and terpenoids were already detected in different extracts from different parts of this plant [15].

Among the main activities already studied for this species (including various types of extracts from different parts of the plant), the antihypertensive, antimicrobial, anti-inflammatory, antioxidant, and antineoplasic activities mainly stand out, supporting some of its popular uses [3, 16]. Some toxicity studies have shown that despite the known toxicity of Jatropha species, J. gossypiifolia presented low toxicity in some in vitro and in vivo experiments. However, some studies have indicated that ethanolic extract from the leaves, in acute oral use, is safe for rats, but with chronic use, it could be toxic [17–19]. So, in view of the potential applications of this plant, this review aims to provide an up-to-date overview of the traditional uses, phytochemistry, pharmacology, and toxicity data of different parts from J. gossypiifolia, which could be significant in providing insights for present and future research aimed at both ethnopharmacological validation of its popular use, as well as its exploration as a new source of herbal drugs and/or bioactive natural products. The medicinal value and pharmacological and/or biotechnological potential of this species are also discussed in this paper.

Chemical Constituents:

Various chemical constituents have been detected in extracts from different parts of J. gossypiifolia, the literature havingreported, in general, the presence of fatty acids, sugars, alkaloids, amino acids, coumarins, steroids, flavonoids, lignans, proteins, saponins, tannins, and terpenoids, Accordingly reviewed by Zhang et al. [15], the main compounds isolated from Jatropha genus are the terpenoids. In fact, many of them were isolated from different parts of J. gossypiifolia. Another very important class from J.gossypiifolia is the lignoids, since a good number of them was already isolated and identified. However, it is important to note that most of the phytochemical studies found in literature are not about isolation of compounds, but only about the phytochemical screening of the major classes through chemical qualitative reactions or more sensitive and specific methods such as thin layer chromatography (TLC).

Relative to other Jatropha species, few studies have isolated chemical compounds from J. gossypiifolia. In addition, up till now it is not clear which are the major bioactive compounds in the plant, since only a few studies were conducted by bioassay guided isolation. Additionally, to the best of our knowledge, there are nophytochemical studies regarding the use of water as solvent for the extraction of J. gossypiifolia constituents. This is important to note since popular use occurs more frequently with infusions or decoctions, and little is

known about the constitution of this type of extract. In this context, it is important to conduct studies to evaluate the phytochemical constitution of these extracts. More commonly, the studies use solvents or mixtures of solvents with nonpolar characteristics, which could contribute to further characterization of nonpolar compounds, such as terpenoids and lignoids. Polar compounds such as flavonoids, tannins, and sugars are poorly described in the species so far, probably due to this fact.

Traditional Uses:

Various medicinal properties for the species J. gossypiifolia are reported by traditional medicine. Some properties related to J. gossypiifolia are also common to other species of the Jatropha genus [3, 9], where human and veterinary uses are described. Different parts of this plant, such as leaves, stems, roots, seeds, and latex, are used in different forms of preparation (infusion, decoction, and maceration, among others), by different routes and forms(oral, topical, baths, etc.). The most frequent reports refer toits anti-inflammatory, antidiarrheal, antiophidian, analgesic, antipyretic, antimicrobial, healing, antianemic, antidiabetic, and antihemorrhagic activities, among many other examples [3, 5, 7, 9].Some properties are attributed to specific parts of the plant, while others are assigned to different parts. Interest-ingly, in some cases certain uses may appear contradictory, such as antidiarrheal and laxative or its use as anticoagulantand antihemorrhagic. One hypothesis is that this difference may be related with the dose used, since, for example, the laxative effect is an effect commonly related with toxic events with this plant.

Pharmacological Properties:

Regardless of excellent assortment of famous utilizations and the information from Jatropha species, J. gossypiifolia is hardly examined in regards to organic exercises. Studies demonstrating the natural capability of fluid concentrate are uncommon up until now. Among the principle exercises that is considered antihypertensive, anticancer, antimicrobial, mitigating, and pain relieving exercises stick out.

Antidiabetic Activity:

The extracts from J. gossypiifolia plants showed significant α glucosidase activity. α-glycosidase comprises a family of enzymes hydrolase, which is located in the brush-border surface membrane of small intestinal cells and it is the key enzyme by which the final step of digestion is catalyzed, so glycosidase inhibitors can stop the liberation of D-glucose from complex dietary carbohydrates and can delay glucose absorption which in turn reduce plasma glucose level and decrease hyperglycaemia [10, 11-13].

Antihypertensive Action:

Properties and In view of well-known utilization J. gossypiifolia roots and ethereal tensive and vasorelaxant impacts of ethanolic concentrate flying pieces of plant remained tried by Abreu et al. Examination uncovered that concentrate, in a portion subordinate way, created a decrease of systolic pulse in cognizant normotensive creatures [14 18]. Such hypotensive impact can be credited to its vasorelaxant activity, because it created focus subordinate relaxant impact in rodent secluded endothelium denied mesenteric conduit pre-contracted with norepinephrine or calcium [19-21]. Besides, hindered, in focus needy and uncompetitive way, the contractile reaction initiated norepinephrine in a similar planning.

Anti-inflammatory Properties and Action:

Numerous significant mainstream employments of J. gossypiifolia are identified with provocative procedure. One of the researchers has demonstrated that methanolic concentrate of leaves of aforementioned species has critical foundational intense and ceaseless calming action. The concentrate, at 445 and 1050 mg/kg oral dosages, had the option to restrain the intense carrageenan-prompted paw edema in rodents and at 55 and 105 mg/kg oral portions hindered the ceaseless cotton pellet-actuated granuloma development within rodents [22–24]. Moreover, the J. gossypiifolia leaf glue demonstrated critical decrease in TPA-prompted nearby incendiary modifications in rodent ear edema prototype. In another examination, the mitigating and pain relieving In animals, specifically mice, the effects of benzene and oil ether blends of otherworldly pieces of J. gossypiifolia were demonstrated. Only the bioethanol separate produced significant pain relief in Eddys gas hob and dorsal fin experiments and relaxing motion in carrageenan induced paw edema when given at 240 and 230 mg/kg/day for 12 hours via primary outcome. Calming action of bark from J. gossypiifolia was additionally exhibited in carrageenan-prompted paw edema in rodents. Anti-inflammatory properties of the extract of the plant rostachys japonicus A. Berger (O. japonicus) was also studies wherein the plant is extracted in 95% ethanol followed by fractionating the extract by subjecting them to series of organic solvents which specifically include, n-hexane (hexane), dichloromethane (DCM), ethylacetate (EtOAc), n-butanol (BuOH), and water (H(2)O) and then anti-inflammatory properties of the extract was determined on the lipopolysaccharides stimulated RAW 264.7 cells.

Further western blotting was also performed to analyze the potency of transcription factors and inflammatory mediators [25] Simlary, anti-inflammatory effects of Phellinus Linteus was also

determined in lipopolysaccharides stimulated RAW 264.7 cells [26]. In an ongoing report, utilizing the in vitro human red platelet layer adjustment technique, One of the researchers has recommended that ethyl alcohol and water extricates from J. gossypiifolia leaves possess mitigating movement. As per the creators, since human red platelet films are like the lysosomal layer segments, the counteraction of hypotonicity-instigated layer lysis of these cells could be taken as a measure in evaluating the mitigating property of mixes. The pain relieving movement of the methanol extricate from the leaves of J. gossypiifolia was assessed in acidic corrosive initiated squirming test in mice, where exceptionally noteworthy restraint was seen of 68.58 and 66.15% at 200 and 405 mg/kg oral portions, individually. Comparable outcomes were seen in the methanolic remove from organic product.

Healing Properties and Action:

The mending activity of ethanol rough concentrate of J. gossypiifolia was assessed in the suture recovery of rodents dorsal abdomen volume, using able to understand the information approximation and a broad size and negligible portion of the preoperative time The concentration was controlled by an intralesional insertion of 410 milligrams in the pulmonary pit, which resulted in a much more remarkable grasp on normally evident evaluation, as well as more conspicuous strain evaluation and vascular pseudo. In any case, a more noteworthy incendiary procedure was likewise watched, and other histological levels were like benchmark group, showing that, all in all, concentrate introduced deprived injury properties in the pre-owned model. of recuperating Another examination assessed the mending activity the hydro-ethanolic unrefined concentrate from leaves of J. gossypiifolia in recuperating procedure of sutures accomplished on bladder of rodents, and comparative outcomes remained introduced, albeit some enhancement were seen in certain limitations. By and large, creators reasoned that no ideal recuperating impact was seen with the organization of solitary intraperitoneal portion of J. gossypiifolia L. In another investigation dissecting the in morphological parts of recuperating procedure happening in open skin injuries rodents underneath topical organization of crude concentrate from J. gossypiifolia (insights concerning remove readiness and plant part not indicated), the writers additionally watched a nonappearance of recuperating activity, albeit some histological improvement was demonstrated. Nonetheless, considering the impact of J. gossypiifolia on mending procedure of colonic anastomosis in rodents [27]. One of the researchers has demonstrated that organization of 1 mL/kg single portion of the aq. alcoholic concentrate from flying portions leaves valuable impact over recuperating procedure. Notwithstanding, as per these creators, on the seventh day of the analysis, there was a diminishing in the activity of the concentrate, recommending that the concentrate, right now, less dynamic in later phases of recuperating process. A conceivable theory, not raised by the creators, could be the way that the concentrate was directed in a solitary portion, which might not have been adequate to keep up the impact for the duration of the hour of the investigation. Furthermore, Vale et al. indicated ethanolic extricate through airborne pieces of J. gossypiifolia, at solitary intraperitoneal portion of 220 mg/kg, supported recuperating procedure of gastrorrhaphies and diminished incendiary response in vivo.

Hemostatic Properties and Action:

Utilization of J. gossypiifolia, particularly latex, expanded as hemostatic operator for forestalling draining scatters. Consequences of entire blood coagulating time utilizing Lee and White strategy, draining time utilizing Ivys technique were altogether decreased when stem latex was presented, proposing pro-coagulant movement. With respect to conceivable component of activity, in light of analyses that show the encouraging activity of the latex upon cow-like egg whites, the creators recommend that the latex accelerates thickening elements along these lines fetching the coagulation levels into nearby contacts, and afterward initiation of coagulation course prompts age of thrombin and development of coagulation happens very quickly when contrasted with the control try, that took minutes to finish thickening. It is imperative to accentuate, as far as we could possibly know, its the main examination achieved on human models.

Anti-cholinesterase Properties and Action:

Acetylcholinesterase inhibitors are commonly used to control Alzheimers disease, owing to the cholinergic hypothesis. J. gossypiifolia had an important antitumoral effect, with an IC50 of 0.08 mg/ml in a methanol extract of leaves [28,29]. Another study found that solubilized plant rubber had the capacity to suppress moment section provisionally butyrylcholinesterase complex sensitive tissue in Dhal marulius, an aquatic plane species.

Antioxidant Properties and Action:

Cancer prevention agent action of concentrates from J. gossypiifolia was assessed by the one of the researchers. Right now high substance of phenols, and flavonoids in leaves incited the creators to assess cancer prevention agent movement of the leaves. DPPH free radical, and nitric oxide searching techniques utilized for examining the

cancer prevention agent movement in vitro of methanol, ethyl acetic acid derivation, watery concentrates, showing positive outcomes. The creators ascribed the free radical rummaging movement to the nearness of flavonoids. Then again, an examination indicated that various concentrates (petroleum ether, chloroform, ethyl acetic acid derivation, and n butanol) through entire plant of J. gossypiifolia had just incomplete cancer prevention agent movement in DPPH searching, complete cell reinforcement limit, and lipid peroxidation tests. Amongst them, the ethyl acetic acid derivation remove was the most dynamic, which corresponds decidedly with its higher substance of phenolic mixes in correlation with different concentrates.

Contraceptive Properties and Action:

In light of its well-known uses, J. gossypiifolia was evaluated for its anti-fertility movement, as an option in contrast to oral prophylactic operators [30]. J. gossypiifolia leaf separate changed the significant hormones associated with estrous cycle guideline, demonstrating its antifertility impact on mice. Assessing different levels (estrogenic and early abortifacient exercises) counter fruitlessness impact of concentrate was again shown.

Tocolytic Properties and Action:

In view of the ethno-pharmacological utilization of plants as tocolytic cure, consequences for calcium-induced uterine smooth muscles compression of ethanolic concentrate and parts were assessed. Rough concentrate and, to an advanced degree, the chloroformic division diminished the calcium-induced contractile reaction of uterine smooth muscle, advancing rightward relocation of calcium total bends, just to lessen the utmost withdrawals [31].

Antineoplastic Properties and Action:

Utmost notable pharmacological exercises of J. gossypiifolia includes anti-neoplasic activity that often times connected with substance of lignose and terpenoids.

The primary reports was delivered by one of the researchers, when creators ethanolic extricate from roots, just to confined diterpene jatrophone, displayed huge restrictory movement in-vitro against cells got from human cancer cells from naso-pharynx and lymphocytic leukemia and in vivo against quaternary standard creature voids frameworks, for example, sarcoma 180 and Walker 259 intramuscular carcinosarcoma [32]. Afterward, triple naive antitumor subordinates of jatrophone secluded via oil ether removes through underlying foundations of J. gossypiifolia. As of late, two different diterpenes with intense anti neoplasic action were disengaged from J. gossypiifolia.

Local Anesthetic Action:

The local anesthetic action of J. gossypiifolia was evaluated by plexus anaesthesia in frogs [33]. The authors observed that the aqueous and methanol extract (plant part not specified) presented significant anesthetic action when compared to control group.

Neuropharmacological Action:

The Neuropharmacological action of the methanol extract of the leaves of J. gossypiifolia was evaluated by Apu et al. [34]. The authors observed that in hole cross test the extract at 200 and 400 mg/kg, by oral route, showed significant sedative effect in mice. In hole board test, the extract showed highly significant anxiolytic activity at a dose of 200 mg/kg, whereas the same activity was observed at 400 mg/kg dose in elevated plus-maze test [35].Similar results were observed in the methanolic extract from fruits.

Immunomodulatory Action:

The immunomodulatory action of synthetic lignan compounds was evaluated by the assay of proliferation of mouse spleen cell in vitro and compared with petrol ether extract of whole plant of J. gossypiifolia, since it is a natural source of this kind of compound [36]. The authors showed that both synthetic and naturally occurring 1-phenylnaphthalene lignans could positively modulate the immunity of the host, since they significantly increased the proliferation of mouse spleen cell in vitro [37]

Hepatoprotective Action:

Despite some studies having shown the hepatotoxic potential of J. gossypiifolia, a study was performed to analyze the possible hepatoprotective action of extracts of this plant in carbon tetrachloride induced liver damage in rats [38]. In fact, the petrol ether, methanol,and water extracts from the aerial parts of J. gossypiifolia presented significant hepatoprotective action in this model Substantially restoring towards normalization the serum levels of serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, serum alkaline phosphatase, total bilirubin, superoxide dismutase, and catalase [39]. The authors also discuss the close relationship between the hepatoprotective action observed and the possible antioxidant mechanism present in the extracts.

Antisickling Activity:

The red blood cell membrane stabilization mechanism has also been implicated in the management of sickle cell anaemia [SCA]. This might explain the folkloric use of J. gossypiifolia fresh juice in the management of SCA. The

haemostatic action of the fresh juice might also explain its folkloric use in the management of SCA [40].

Other Activities:

J. gossypiifolia is said to be a noxious weed and has been declared as a class 2 pest plant in some parts of Australia. Its emergence as a highly suitable feedstock plant for biodiesel production showing a promising economic exploitation of these raw materials as biodiesel in diesel engines and as a source of pesticide biomolecules e.g. ricinine from the ethyl acetate extract from senescent leaves. Some essential oils such as linalool, [E]-β-ionone, β caryophyllene, hexahydrofarnesyl acetone and phytol have been reported to have larvicidal [41] and insecticidal activity [42]. Reports have shown that the diluted fresh latex J. gossypiifolia can be used as precipitating agent for biochemical determination of proteins in plasma, urine, and cerebrospinal fluid, with values comparable to those obtained from the conventional protein precipitants sodium tungstate and trichloroacetic acid and thus quite useful in biochemical analysis. However, caution must be taken to ensure that the extract is purified to remove interfering substances for it to be perfectly suitable for biochemical analysis. Leaf extract of J. gossypiifolia reduced the fecundity and egg viability against stored product insect pests Tribolium castaneum. The potential molluscicidal activity of J. gossypiifolia has also been evaluated as an alternative mode of prevention of schistosomiasis.

Toxicology:

The toxic nature of J. gossypiifolia is mostly to its latex and seeds [43, 44]. The latex is released from the aerial parts of the plant by mechanical injury and it causes irritation to the skin and mucous membranes. The seeds are rich in toxalbumins that are responsible for agglutination and haemolysis of erythrocytes as well as damage to other cell types and contain a lipoid resin complex that can cause dermatitis [45]. The adverse effects have been observed to be gastrointestinal disorders [abdominal pain, nausea, vomiting, and diarrhoea]. Other problems that could arise could be cardiovascular, neurological, and renal complications [46]. Cases of poisoning in humans usually occur by ingestion of the fruit and seeds because of its similarity to edible chestnuts [47]. Sukumaran et al. showed that the methanol and n-butanol extracts from unripened seeds of J. gossypiifolia was toxic against eggs and adults of two species of fresh water snails, Lymnaea luteola and Indoplanorbis exustus. The results indicated that n-butanol extract was the most effective and that the eggs were more susceptible than adults [48]. Some reports have demonstrated the toxic properties, while others show the absence of toxicity. However, it is important to observe the models used, doses administrated, and types of extract employed [solvent and plant part], among other aspects, to make the proper conclusions about the toxicity [49]. Awachie and Ugwu, [50] reported low toxicity of ethanol and methanol extracts in the in vitro cytotoxicity assay using brine shrimp larvae test. The irritant activity was visualized in mouse ear after 24 h of the application of the fractions and isolated compounds [51]. The crude ethanol extract from J. gossypiifolia leaves was reported to have relatively low oral acute toxicity in Wistar rats [52]. Rats treated with single doses of 1.2–5.0 g/kg by oral route were observed for 14 days, and the most important signs of toxicity were ptosis, reduction of body weight, and hind limb paralysis. Other significant alterations occurred only in males treated with 5.0 g/kg dose: Increase in creatinine, aspartate aminotransferase, sodium and potassium seric levels, reduction of urea and albumin, leucopenia and small alteration in color, and consistency of viscera. The median lethal dose [LD50] was higher than 4.0 g/kg for males and higher than 5.0 g/kg for females [53]. In the histopathological evaluation some alteration was observed in liver and lung only at 5.0 g/kg, suggesting the relatively low toxicity of the extract [54]. However, in the chronic toxicological study [thirteen weeks of treatment], this extract showed significant oral chronic toxicity in rats [55]. The most significant toxic signs indicated a reduction of the activity in the central nervous system and digestive disturbances. The histopathological analysis revealed hepatotoxicity and pulmonary damages. The lethality was 46.6% and 13.3% among males and females under the higher tested dose [405 mg/kg], respectively [56]. Based on this, Mariz et al. [57] discussed that the development of herbal medicine based on this species needs to prioritize the chemical refinement of the crude extracts to obtain less toxic fractions, which should be tested for their safety and therapeutic efficacy [58]. The toxicity of the stem latex of J. gossypiifolia was studied in Wistar rats by applying different doses of crude latex on incised skin daily for 18 days, based on the popular use of the latex as haemostatic agent in skin lesions [59]. It was observed that the application of the latex did not produce any significant difference in results of biochemical and haematological parameters obtained from the control and experimental animals, leading to the conclusion that the stem latex has no harmful effects [60].

Conclusion:

Based on this review J. gossypiifolia presents an important potential for drug development based on popular uses and biological studies. However, further studies are necessary to verify important

folkloric uses of the various parts of the plant. Further research into bioactivity guided fractionation of extracts and isolation of compounds responsible for various pharmacological activities such analgesic, anticholinesterase, antidiabetic, antihypertensive, antisickling and neuropharmacological activities. This is imperative for further formulation studies and drug development.

References

1. Sabandar CW, Ahmat N, Jaafar FM, Sahidin I. Medicinal property, phytochemistry and pharmacology of several Jatropha species [Euphorbiaceae]: A review. Phytochemistry. 2013; 85:7-29.
2. Leal CKA, Agra MDF. Estudo farmacobotânico comparativo das folhas de Jatropha molissima [Pohl] Baill. Acta Farmaceutica Bonaerense. 2005; 24:5-13.
3. Juliana Félix-Silva, Raquel Brandt Giordani, Arnóbio Antonio da Silva-Jr, Silvana Maria Zucolotto, Matheus de Freitas Fernandes-Pedrosa. Jatropha gossypiifolia L. [Euphorbiaceae]: A review of traditional uses, phytochemistry, pharmacology, and toxicology of this medicinal plant. Evidence-Based Complementary and Alternative Medicine. 2014; 32.
4. Morton JF. Atlas of medicinal plants of Middle America: Bahamas to Yucatan. Charles C. Thomas, Springfield, USA. 1981; 1420.
5. Olowokudejo JD. Comparative epidermal morphology of West African species of Jatropha L. [Euphorbiaceae]. Botanical Journal of the Linnean Society. 1993; 111:139-154.
6. Oudhia P. Jatropha as medicinal herb in Chhattisgarh, India: Natural occurrence, traditional medicinal knowledge and cultivation. Research Note; 2001.
7. Aworinde DO, Nwoye DU, Jayeola AA, Olagoke AO, Ogundele AA. Taxonomic significance of foliar epidermis in some members of Euphorbiaceae family in Nigeria. Research Journal of Botany. 2009; 4:17-28.
8. Khyade MS, Vaikos NP. Pharmacognostical and phytochemical evaluation of leaf of Jatropha gossypifolia L. International Journal of Research in Ayurveda & Pharmacy. 2011; 2:177-180.
9. Parvathi VS, Jyothi BS, Lakshmi T, Babu PS, Karthikeyan R. Morpho-anatomical and physicochemical studies of Jatropha gossypiifolia [L.]. Der Pharmacia Lettre. 2012; 4:256-262.
10. Ogundare OA. Antimicrobial effect of Tithonia diversifolia and Jatropha gossypifolia leaf extracts. Trends in Applied Sciences Research. 2007;2:145
11. Sharaibi OJ, Ogundipe OT, Afolayan AJ, Aworinde DO. Ethnobotanical survey and phytochemical analysis of medicinal plants used for the treatment of hyperprolactinemia in Lagos State, Nigeria. Journal of Medicinal Plant Research. 2014; 8(43):1284-1288.
12. Di Stasi LC, Hiruma-Lima CA. Plantas medicinais na Amazônia e na Mata Atlântica. Edition 2 UNESP: São Paulo, Brazil; 2002.
13. Auvin-Guette C, Baraguey C, Blond A, Pousset JL, Bodo B. Cyclogossine B, a cyclic octapeptide from Jatropha gossypifolia. Journal of Natural Products. 1997; 60:1155-1157.
14. Wadankar GD, Malode SN, Sarambekar SL. Traditionally used medicinal plants for wound healing in the Washim District, Maharashtra [India]. International Journal of Pharm Tech Research. 2011; 3:2080 2084.
15. Kumar B, Vijayakumar M, Govindarajan R, Pushpangadan P. Ethnopharmacological approaches to wound healing- exploring medicinal plants of India. Journal of Ethnopharmacology. 2007; 114:103–113.
16. Koudouvo K, Karou DS, Kokou K. An ethnobotanical study of antimalarial plants in Togo Maritime Region. Journal of Ethnopharmacology. 2011; 134:183-190.
17. Coelho-Ferreira M. Medicinal knowledge and plant utilization in an Amazonian coastal Community of Marudá, Pará State [Brazil]. Journal of Ethnopharmacology. 2009; 126(1):159-175.
18. Ajose FOA: Some Nigerian plants of dermatologic importance. International Journal of Dermatology. 2007; 46:48-55.
19. Oliveira FCS, Barros RFM, Moita Neto JM. Plantas medicinais utilizadas em comunidades rurais de Oeiras, semi´arido piauiense. Revista Brasileira de Plantas Medicinais. 2010; 12:282-301.
20. Santos JDFL, Pagani E, Ramos J, Rodrigues E. Observations on the therapeutic practices of riverine communities of the Unini River, AM, Brazil. Journal of Ethnopharmacology. 2012; 142: 503–515.
21. Cartaxo SL, de Almeida Souza MM, de Albuquerque UP. Medicinal plants with bioprospecting potential used in semi-arid Northeastern Brazil. Journal of Ethnopharmacology. 342. 2010;131(2):326
22. Jansen O, Angenot L, Tits M, et al. Evaluation of 13 selected medicinal plants from Burkina Faso for their antiplasmodial properties. Journal of Ethnopharmacology. 2010; 130:143-150.
23. Yetein MH, Houessou LG, Lougb´egnon TO, Teka, Tente B. Ethnobotanical study of medicinal plants used for the treatment of malaria in plateau of Allada, Benin [West

Africa]. Journal of Ethnopharmacology. 2013; 146:154-163.
24. Diallo A, Traore MS, Keita SM, et al. Management of diabetes in Guinean traditional medicine: An ethnobotanical investigation in the coastal lowlands. Journal of Ethnopharmacology. 2012; 144(2):353–361.
25. Olabanji SO, Adebajo AC, Omobuwajo OR, et al. PIXE analysis of some Nigerian anti-diabetic medicinal plants [II]. Nuclear Instruments and Methods in Physics Research B. Beam Interactions with Materials and Atoms. 2014; 318:187-190.
26. Coe FG, Anderson GJ. Screening of medicinal plants used by the Gar´ıfuna of Eastern Nicaragua compounds. For Journal bioactive of Ethnopharmacology. 1996; 53(1):29–50.
27. Oduola T, Avwioro OG, Ayanniyi TB. Suitability of the leaf extract of Jatropha gossypifolia as an anticoagulant for biochemical and haematological analyses. African Journal of Biotechnology. 2005; 4 (7):679-681.
28. Chariandy CM, Seaforth CE, Phelps RH, Pollard GV, Khambay BPS. Screening of medicinal plants from Trinidad and Tobago for antimicrobial and insecticidal properties. Journal of Ethnopharmacology. 1999; 64(3):265–270.
29. Kumar VP, Chauhan NS, Padh H, Rajani M. Search for antibacterial and antifungal agents from selected Indian medicinal plants. Journal of Ethnopharmacology. 2006; 107:182–188.
30. Dabur R, Gupta A, Mandal TK, et al. Antimicrobial activity of some medicinal plants. African Journal of Traditional, Complementary and Alternative Medicines. 2007; 4:313– 318.
31. Ong HC, Nordiana M. Malay ethno-medico botany in Machang, Kelantan, Malaysia. Fitoterapia. 1999; 70(5):502-513.
32. Cano JH, Volpato G. Herbal mixtures in the traditional medicine of Eastern Cuba. Journal of Ethnopharmacology. 2004; 90: 293-316.
33. Sanz-Biset J, Campos-de-la-Cruz J, Epiquién-Rivera M, Cañigueral S. A first survey on the medicinal plants of the Chazuta valley [Peruvian Amazon]. Journal of Ethnopharmacology. 2009; 122(2):333–362.
34. Panda BB, Gaur K, Kori ML, Tyagi LK, Nema RK, Sharma CS. Anti-Inflammatory and analgesic activity of Jatropha gossypifolia in experimental animal models. Global Journal of Pharmacology. 2009; 3(1):1-5.
35. Ningthoujam SS, Talukdar AD, Potsangbam KS, Choudhury MD. Traditional uses of herbal vapour therapy in Manipur, North East India: An ethnobotanical survey. Journal of Ethnopharmacology. 2013; 147:136–147.
36. De Albuquerque UP, Monteiro JM, Ramos MA, de Amorim ELC. Medicinal and magic plants from a public market in Northeastern Brazil. Journal of Ethnopharmacology. 2007; 110(1):76–91.
37. Lans C, Harper TK, Georges K, Bridgewater E. Medicinal and ethnoveterinary remedies of hunters in Trinidad. BMC Complementary and Alternative Medicine. 2001; 1. Article 10.
38. Asase A, Oteng-Yeboah AA, Odamtten GT, Simmonds MSJ. Ethnobotanical study of some Ghanaian antimalarial plants. Journal of Ethnopharmacology. 2005; 99(2):273-279.
39. Adeosun GO, Oduola TF, Fagbomedo A. Suitability of stem latex of Jatropha gossypifolia as a protein precipitant for biochemical analysis. Indian Journal of Clinical Biochemistry. 2014; 29(2):210-212.
40. Oduola T, Adeosun GO, Oduola TA, Avwioro GO, Oyeniyi MA. Mechanism of action of Jatropha gossypifolia stem latex as a haemostatic agent. European Journal of General Medicine. 2005; 2:140-143.
41. Rasingam L, Jeeva S, Kannan D. Dental care of Andaman and Nicobar folks: Medicinal plants use as tooth stick. Asian Pacific Journal of Tropical Biomedicine. 2012; 1013-1016.
42. Hosamani KM, Katagi KS. Characterization and structure elucidation of 12-hydroxyoctadec-cis-9-enoic acid in Jatropha gossypifolia and Hevea brasiliensis seed oils: A rich source of hydroxy fatty acid. Chemistry and Physics of Lipids. 2008; 1521:9–12.
43. Ashidi JS, Houghton PJ, Hylands PJ, Efferth T. Ethnobotanical survey and cytotoxicity testing of plants of South Western Nigeria used to treat cancer, with isolation of cytotoxic constituents from Cajanus cajan Millsp. Leaves. Journal of Ethnopharmacology. 2010; 128:501–512.
44. Falodun A, Kragl U, Touem SMT, Villinger A, Fahrenwaldt T, Langer P. A novel anticancer diterpenoid from Jatropha gossypiifolia. Natural Product Communications. 2012; 7:151–152.
45. Quintans Junior LJ, Almeida JRGS, Lima JT, et al. Plants with anticonvulsivant properties—a review. Revista Brasileira de Farmacognosia. 2008; 18:798–819.
46. Rios MNS, Pastore Junior F. Plantas da Amazˆonia: 450 Esp´ecies de Uso Geral, Universidade de Bras´ılia—Biblioteca Central, Bras´ılia; 2011.
47. Jain A, Katewa SS, Chaudhary BL, Galav P. Folk herbal medicines used in birth control and sexual diseases by tribals of Southern Rajasthan, India. Journal of Ethnopharmacology. 2004; 90:171-177.
48. Jain S, Choudhary GP, Jain DK. Antioxidant and hepatoprotective potential of ethanolic

leaves extract of J. gossypifolia. International Journal of Plant Science and Ecology. 2005; 1(5): 190-195.
49. De Albuquerque UP, Monteiro JM, Ramos MA, De Amorim ELC. Medicinal and magic plants from a public market in Northeastern Brazil. Journal of Ethnopharmacology. 2007; 110(1):76-91.
50. Falodun A, Sheng-Xiang Q, Parkinson G, Gibbons S. Isolation and characterization of a new anticancer diterpenoid from Jatropha gossypifolia. Pharmaceutical Chemistry Journal. 2012; 45(10):636–639.
51. Garcia D, Domingues MV, Rodrigues E. Ethnopharmacological survey among migrants living in the Southeast Atlantic Forest of Diadema, S˜ao Paulo, Brazil. Journal of Ethnobiology and Ethnomedicine. 2010; 6:29.
52. Agra MDF, Silva KN, Bas´ılio IJLD, De Freitas PF, Barbosa-Filho JM. Survey of medicinal plants used in the region Northeast of Brazil. Brazilian Journal of Pharmacognosy. 2008; 18(3):472-508.
53. Kosalge SB, Fursule RA. Investigation of ethnomedicinal claims of some plants used by tribals of Satpuda Hills in India. Journal of Ethnopharmacology. 2009; 121:456– 461.
54. Ayyanar M, Ignacimuthu S. Ethnobotanical survey of medicinal plants commonly used by Kani Tribals in Tirunelveli Hills of Western Ghats, India. Journal of Ethnopharmacology. 2011; 134:851–864.
55. Ritter RA, Monteiro MVB, Monteiro FOB, et al. Ethnoveterinary knowledge and practices at Colares Island, Par´a State, Eastern Amazon, Brazil. Journal of Ethnopharmacology. 2012; 144:346–352.
56. Adolf W, Opferkuch HJ, Hecker E. Irritant phorbol derivatives from four Jatropha species. Phytochemistry. 1984; 23(1):129 132.
57. Bhagat R, Ambavade SD, Misar AV, Kulkarni DK. Anti-inflammatory activity of Jatropha gossypifolia L. leaves in albino mice and wistar rat. Journal of Scientific and Industrial Researchs. 2011; 70(4): 289–292.
58. Abreu IC, Marinho ASS, Paes AMA, et al. Hypotensive and vasorelaxant effects of ethanolic extract from Jatropha gossypiifolia L. in rats. Fitoterapia. 2003; 74:650–657.
59. Taylor MD, Smith ABG, Furst GT, et al. New antileukemic jatrophone derivatives from Jatropha gossypiifolia structural and stereochemical assignment through nuclear magnetic resonance spectroscopy. Journal of the American Chemical Society. 1983; 105:3177-3183.
60. Maia JMA, Czeczko NG, Filho JMR, et al. Estudo da cicatrizac¸˜ao de suturas na bexiga urin´aria de ratos com e sem utilizac¸˜ao de extrato bruto de Jatropha gossypiifolia L. intraperitoneal. Acta Cir´urgica Brasileira. 2006; 21:23-30.