Review Article

Phytochemistry and Ethnopharmacology of *Jatropha gossypiifolia* L. (Euphorbiaceae): Bioactivities and Future Direction

ABSTRACT

Background: The Plant of *Jatropha gossypiifolia* is known for their many biological activities including anticoagulant, antihypertensive, anti-inflammatory, antibacterial, antiviral, antifungal and other.
Aim: To carry out recent informations regarding phytochemistry, ethnopharmacology, bioactivities, toxicology, antiviral and medicinal activities *of the plant*.
Study Design: Multidisciplinary advanced bibliographic surveys and dissemination of the resulted knowledge.
Results: After literature review, we could notice that *Jatropha gossypiifolia* has antibacterial, and antiviral properties on different types of viruses. Leaves, roots, latex, seeds, fr,uits and other parts have been reported to have different compounds which have interesting bioactivities and medicinal properties.
Conclusion: This work can orient or guide scientifics research for the development of anti-inflammatory, anti-cancer, anti-Hepatitis B virus, and anti-Covid-19 herbal drugs also nutritional values from *Jatropha gossypiifolia* for the benefit the of human beings

Keywords: Jatropha gossypiifolia, Pharmacology, Ethnopharmacology, antiviral

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1. INTRODUCTION

Jatropha gossypiifolia is a useful plant in traditional medicine. The genus *Jatropha* has been reported in a number of reviews covering many topics, such as, phytochemistry, pharmacology and medicinal properties [1,2], diterpenes [3], toxicity [4], nutritional, biochemical and pharmaceutical potential of proteins [5] and chemical constituents [6]. Some reviews have been reported regarding the medicinal benefits of *J. gossypiifolia* [7,8], there is still a critical necessity to have a comprehensive review that covers the therapeutic (antiviral) and toxicological properties. This work intends to bring together available informations *J. gossypiifolia* regarding medicinal, toxicological and other interesting aspects. It is hoped this can provide a basis for explaining ethnopharmacological usage, especially the antiviral activity of *J. gossypiifolia*.

2. METHODOLOGY

The literature review was conducted on *J. gossypiifolia* during searches on different databases such as PubMed, PubMed Central, Scielo, DOAJ, Google scholar, and Science Direct. The scientific names of *J. gossypiifolia*, compounds, biological activities and toxicology of the plants of interest were used as keywords. This literature review started from Mars 2022 up to the middle of May 2022.

The chemical structures of the natural compounds from *J. gossypiifolia* were drawn using ChemBioDraw Ultra 12.0 software.

3. RESULTS AND DISCUSSION

3.1. TAXONOMY AND BOTANICAL DESCRIPTION OF GENUS *Jatropha*.

The genus *Jatropha* is belonging to *Euphorbiaceae* fanily. Native to tropical America, *Jatropha* species are now widespread throughout the tropical and subtropical regions of Asia and Africa, where they are traditionally used to treat several ailments. The name "Jatropha" has its roots in the Greek language and its meaning is associated with the medicinal purpose. From the Greek, "jatros" means "doctor" and "trophe" means "food". Several species of this genus have been studied for their pharmacological and chemical properties, including *Jatropha curcas, J. isabellei, J. gossypiifolia, J. integerrima* and *J. macrorhiza* [9].
Even though *Jatropha* genus is is known for its necessary usages, some species have been subjet to chemical evaluation. The genus is known to be an important source of secondary metabolites, such as terpenes, which are fairly well known in this genus [10].
The Euphorbiaceae family, known as the biggest angiosperms group, has more or less 8,900 species subdivided 350 genus and 6 subfamilies worldwide. These species are found specifically in climatic conditions. Among the main genera belonging to this family is *Jatropha*, which belongs to the subfamily Crotonoideae, the clan Jatropheae, and is represented by about 250 species. Euphorbiaceae is spread equatorial and sub- equatorial Asian and African countries. Jatropha has by far the most distributed mainly in the above cited regions especially India, Sri Lanka, also in Africa (tropical), Northern America and the Southern Pacific. Researches have demonstrated the presence of metabolites, polyphenols ,antioxidants also lignoids derived from various components of the plant. Antidiabetic [11,12], antibacterial, anticancer aiding, and bashing activities are among principal and interesting activities frequently pointed out for its importance. These activities justify why the plant is commonly used [13,14]. Polyphenols are used as specific secondary metabolites to provide protection against ultraviolet radiation. Antioxidant characterists of polyphenols are known for playing crucial role in immune system reinforcement and serve in combatting some diseases[15].

3.2. DESCRIPTION, ORIGIN AND DISTRIBUTION OF *Jatropha gossypifolia*[16]

This plant also known as False castor, Cotton-leaf medicinal, Wild medicinal or Red medicinal, belongs to Euphorbiaceae family which has purple and yellow colored inflorescences.
The species appears as an erect plant that can grow up to 1.5 meters high. Its succulent stems contain white latex.
The leaves, only present at the end of the stems, have a three-lobed blade. They present glandular hairs on their margin as well as on their long petiole. The young leaves, sticky and of a deep purple, become light green with time.

The flowers are grouped in clusters at the end of the stems. They measure one centimeter in diameter and have 5 obovate purple petals.
The fruits are oblong capsules with 3 compartments that can be seen from the outside. Once reached maturity, the fruit explodes by projecting its seeds to more than 3 meters. They can thus grow not far (autochory), or be carried by the animals (zoochory). The species is very resistant because the seeds can remain viable in the ground for 10 years, and their germination can be encouraged by the fires.

Figure 1: Leaf, fruit and flowers of *Jatropha gossypiifolia* L.

Originated from tropical America; *Jatropha gossypifolia* was introduced as an ornamental and medicinal plant to other parts of the world and often grow spontanously. From ITIS Report (Integrated Taxonomic Information System) we can notice a variety known as *Jatropha gossypiifolia* var. *Elegans(Pohl) Müll. Arg.(* ITIS - Report: Jatropha gossypiifolia var. elegans)

Seed oil are used against leprosy and rabies while its juice is known everywhere for healing wounds, for its hemostatic virtues, treating epidermic problems. On the other side, it is used to treat infected wounds, eczema, ulcers, cuts, abrasions, dermatosis, scabies, ringworm, and sexual transmitted infections. Styptic effects has been noted on its juice and also the usage as pain relief liquid after be stinging by bees or wasps. Powder obtained after drying, the root bark is applied as a poultice, and internally it is used to expel worms and treat oedema.
In Senegal, a decoction of the leaves is used to treat colic, stomach ache, and fever, including malaria. In Ghana, the leaves are used as a purgative, and the juice of the leaves is applied to the tongues of babies to treat thrush, and to the tongues of adults for inflammation. The pith of old stems is put in the nostrils to make people sneeze and thus cure headaches. In the Caribbean, the juice of the plant is a traditional remedy generally used to cure cancer. Taken as an infusion, the stem is used to cure high blood pressure in western indies.
In West Africa, people often plant it in hedges in the periphery of villages, both for the spectacular dark red leaves when young and to keep houses safe from fire. The other reason is that, near the houses, the plant keeps them away from snakes. In some places, the mark the boundaries of fields is done using *J.gossyfolia* and sometimes cultivated as a plant in a pot. The oil from the seeds is used in oil lamps and as fuel.

Figure2: Distribution of *Jatropha Gossipifolia L* in Africa

Jatropha gossypiifolia is spread throughout tropical Africa and South Africa, except in the arid regions of southern Africa.

3.3. ETHNOBOTANICAL

Many of the restorative properties of *J. gossypiifolia* species are taken into account in conventional medicine. Some biological activities found in the plant are common to different types of *Jatropha* species, used by humans and animals. Various parts of the plant are used, such as, leaves, stems, roots are used in various types of preparation, by various courses and structures (oral, topical, etc.). Frequent informations mention calming, antidiarrheal, antidiabetic, antiophidic, painkiller, antianalgesic, antimicrobial, recuperative, anti anemic, and antihemorrhagic activities [17,18]. Some properties are attributed to explicit parts of the plant, while others are attributed to various parts. The leaves and/or aerial parts areused as an anti-inflammatory, antipyretic, healing and anti-infective in several skin diseases is a common practice in a couple of regions in the world. Through baths or dressings, *J. gossypiifolia* is pointed out in traditional medicine.

3.4. MICROSCOPY STUDY

A pharmacognosy study by microscopy method, often used to establish the correct identity of raw materials was proceeded to determine the macro and microscopic characters of the leaf and stem. Physicochemical analysis of parameters such as drying loss, total ash, water-soluble ash, acid insoluble ash, sulfated ash, and extraction values in different solvents (petroleum ether, toluene, ethyl acetate, methanol and water) was carried out. A qualitative phytochemical analysis and a fluorescence analysis were also performed. From the results found that the leaves have a cordate base, a sarmentate glandular margin, a subacute apex and both surfaces are very rough with stiff surface hairs. There are anomoctic stomata, epidermis, parenchymal tissue, secretory glands, calcium oxalate crystals in clusters, simple starch grains, glandular trichomes and simple covering trichomes, dispersed as such

throughout the epidermal cells or attached to them. The majority of glandular trichomes had a uniseriate stalk with 4 or 5 cells in the petiole region [19].

3.5. PHYTOCHEMISTRY

From the phytochemical analysis of the powder, different phytoconstituents such as alkaloids, flavonoids, saponins, triterpenes, phlobatanins, and tannins are majorly present.
The phytochemical analysis revealed the presence of alkaloids, flavonoids, proteins, tannins, steroids and/or terpenoids and sugars.
The aqueous extract of leaves was prepared by decoction and phytochemical analysis showed the presence of sugars, alkaloids, flavonoids, tannins, terpenoids and/or steroids and proteins [20].
Methanolic leaf extract contains cardiac steroids, glycosides, triterpenes, flavonoids, and tannins [20].

Some compound isolated in *J.gossypifolia* [20-21]

Compounds	Plant part	Classification
Schaftoside	leaves	Cardiac glycosides
Isoschaftoside	leaves	Cardiac glycosides
Ricinine	leaves	Alkaloids
2,24,25-Trihydroxylanosta-1,7dien-3-one	leaves	Triterpenes
2,24,25-Trihydroxylanost-7-en-3on	leaves	Triterpenes
Apigenin	leaves	Cardiac glycosides
Isovitexin	leaves	Cardiac glycosides
Orientin	leaves	Cardiac glycosides
isoorientin	leaves	Cardiac glycosides
Cleomiscosin A	Stems	Coumarin-lignoids
Gossypidien	Stems	Coumarin-lignoids
Isogadain	Stems	Coumarin-lignoids
Jatrodien	Stems	Coumarin-lignoids
Prasanthaline	Stems	Coumarin-lignoids
Ferulic acid	Stem	Flavonoid
Fraxetin	Stem	Flavonoid
4'-O-Demethyl retrochinensin	Stem	Alkaloid
2α-Hydroxyjatrophone	Roots	Alkaloids
2β-Hydroxy-5,6-isojatrophone	Roots	Alkaloids
2β-Hydroxyjatrophone	Roots	Alkaloids
Citlalitrione	Roots	Diterpenes
Falodone	Roots	Diterpenes

Jatropholone A	Roots	Diterpenes
Jatropholone B	Roots	Diterpenes
Jatrophone	Roots	Diterpenes
12-Deoxy-16-hydroxylphorbol	Roots	Diterpenes
Arachidic acid	Seeds	Fatty acids
Caprilic acid	Seeds	Fatty acids
Lauric acid	Seeds	Fatty acids
Lignoceric acid	Seeds	Fatty acids
Linoleic acid	Seeds	Fatty acids
Myristic acid	Seeds	Fatty acids
Oleic acid	Seeds	Fatty acids
Palmitic acid	Seeds	Fatty acids
Palmitoleic acid	Seeds	Fatty acids
Ricinoleic acid	Seeds	Fatty acids
Stearic acid	Seeds	Fatty acids
Vernolic acid	Seeds	Fatty acids
Arylnapthalenes	Seeds	Coumarin-lignoids
12-Deoxy-16-hydroxyphorbol	Seeds	Diterpenes
Gossypifan	Aerial parts	Lignans
Gossypiline	Aerial parts	Lignans
Propacin	Whole plant	Coumarin-lignoids
Venkatasin	Whole plant	Coumarin-lignoids
Citlalitrione	Whole plant	Coumarin-lignoids
Cyclogossine A	Latex	Proteins
Cyclogossine B	Latex	Proteins
Gallic Acid	Whole plant	Phenols
Vanilic Syringic	Whole plant	Phenols
2,5-dihydroxy benzoic	Whole plant	Phenols
Caffeic	Whole plant	Phenols
Rosmarinic acid	Whole plant	Phenols
3-O-acetylaleuritolate acid	Rhizome	Triterpenes
Triterpenes	Rhizome	Monoterpene
4-Patchoulen-15-oic acid	Rhizome	Sesquiterpene

Table 1: Some Chemical compounds within *J.gossypifolia*

From table 1, we can see major classifications of compounds: Cardiac glycosides, Alkaloids, triterpenes, Coumarin-lignoids, Flavonoids, Diterpenes, Lignans, Fatty acids, Proteins, Phenols, Monoterpene and Sesquiterpene.

Another research [22] the GC-MS analysis of leaves pointed some other compounds. The following table is enlighten with their potential pharmaceutical activities.

Compound	Nature of compound	Activity
Vitamin d3	Vitamin compound	Anti cancer, Increases insulin secretion ,Skin care, Reduce blood pressure,
3-Hexadecyloxycarbonyl-5-(2-hydroxyethyl)-4-methylimidazolium ion	Amino compound	Antimicrobial
9-Octadecenoic acid (Z)-,phenylmethyl ester	Unsaturated fatty acid ester	Anti-inflammatory, Cancer preventive
6,9,12-Octadecatrienoic acid,phenylmethyl ester, (Z,Z,Z)-	Linolenic acid ester	Anti-inflammatory, Cancer preventive, Hepatoprotective
Oleic Acid	Unsaturated fatty acid	Cancer preventive/ Anti-inflammatory
1,2-Benzenedicarboxylic acid,butyl octyl ester	Plasticizer compound	Antimicrobial, Antifouling
Phytol	Diterpene	Anticancer Anti-inflammatory, Antimicrobial, Diuretic
d-Mannitol, 1-decylsulfonyl-	Sugar alcohol with sulfur	Anti microbial/ Anti-cancer
9,12,15-Octadecatrienoic acid,2-(acetyloxy)-1-[(acetyloxy)methyl]ethyl ester,(Z,Z,Z)-	Linolenic acid ester compound	Anti-inflammatory, Hepatoprotective, Cancer preventive
(-)-Globulol	Sesquiterpene alcohol	Anti-tumor, Analgesic, Antibacterial, Anti-inflammatory, Sedative Fungicide.
d-Mannitol, 1-decylsulfonyl-	Sugar alcohol with	Anti-cancer, Anti microbial
1-Monolinoleoylglycerol trimethylsilyl ether	Steroid	Antiarthritic, Anticancer, Hepatoprotective, Antimicrobial, Antiasthma, Diuretic
Vitamin A aldehyde	Vitamin compound	Antioxidant, Anticancer, Antimicrobial, Cardioprotective, , Helps in night vision
Lanosterol	Sterol compound	Antiarthritic, Hepatoprotective, Antimicrobial, Antiasthma, Anticancer, Diuretic
ç-Sitosterol	Steroid	Antiarthritic, Anticancer, Antimicrobial Antiasthma, Diuretic, Hepatoprotective

Table 2: Some compounds isolated on leaves and their pharmaceutical activities

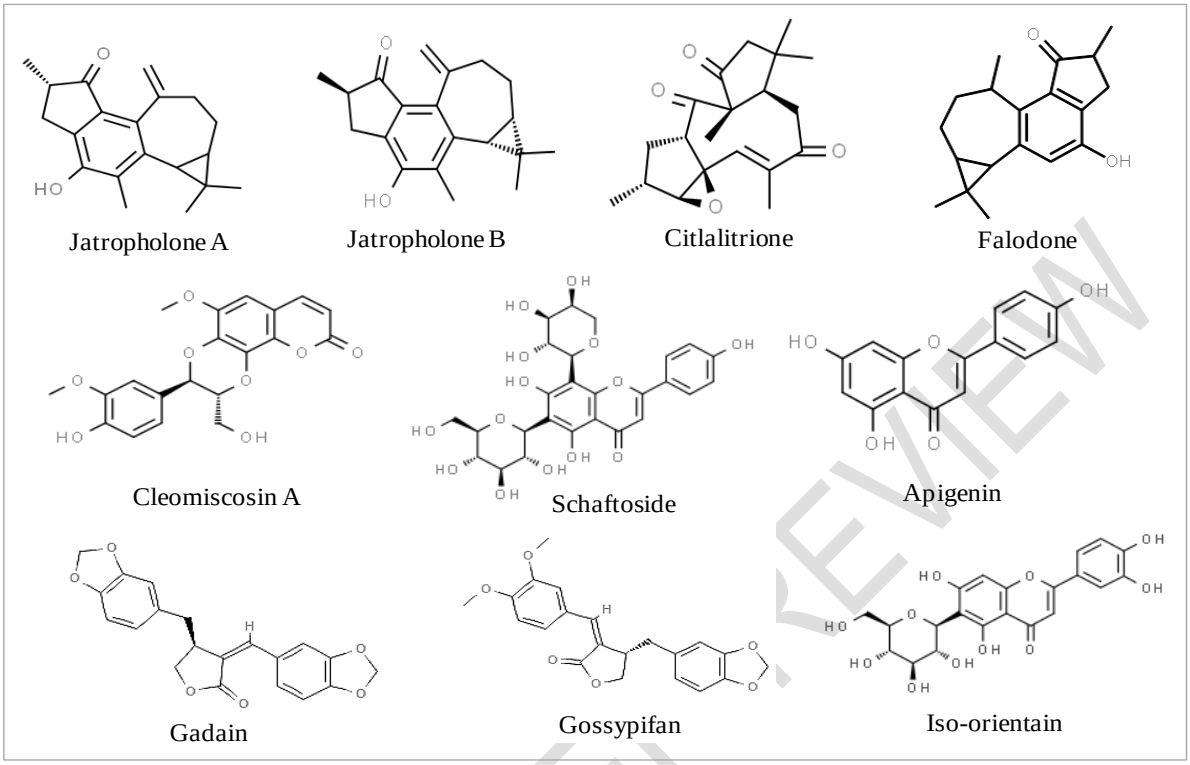

Figure 3: Chemical structures of some main compounds isolated in *J. gossypiifolia*

Pharmacological studies of the Jatropha genus have shown correlations between secondary metabolites and several bioactivities. We can cite antileishmanial [23], antimicrobial [24], antihelminthic [25], cytotoxic [26], antiespasmodic [27], antitumor, antioxidant, anagelian [28] and gastroprotective activities [29].

Jatropha species, including *J. gossypiifolia* is hardly studied regarding biological properties. Researches showing the natural capacity of fluid extracts are scarce up to date. Among the main properties considered, there are activities such as antihypertensive, anticancer, antimicrobial, anti-inflammatory, etc.

3.6 ANTICANCER ACTIVITY

Two modified lathyrane diterpenoids were isolated in 2020 from *Jatropha gossypiifolia*: Jatrofolianes A and B. Their structures were determined by spectroscopic analysis, quantum chemical calculations and single-crystal X-ray diffraction. Jatropholiane B has shown interesting anti-cancer activities [30].

3.7 INSECTICIDAL ACTIVITY

Paul-André et al. [31] reported in the literature that in South America, the cassava mealy bug *Phenacoccus herreni* is a pest of cassava, *Manihot esculenta* Crantz. The proteins,

which represent direct gene products, are prime candidates in genetic engineering manipulations for host plant resistance. *J. gossypiifolia* L , containing insect-toxic proteins, has exhibited insecticidal properties to *P. herreni*. Mature leaves containing proteins of approximatively 101.02 kDa were identified to be the origin of toxic compounds.
Extracts of the stem, leaves and fruit of *J. gossypiifolia tested* on *Biomphalaria glabrata have* shown, after analyzing the survival, feeding capacity, and oviposition capacity. The results obtained from the extracts showed that by macerating the parts of the plant in ethanol at 92%, which were then evaporated until obtaining a dry residue and make the phytochemical study. This study was about to analyze the molluscicidal activity of *B. glabrata using W.H.O recommended procedures* (1965). In each experiment, a measurement of the quantity of food ingested and the depositing of eggs was perfomed. *J. gossypiifolia* leaf extract was found to be a potent molluscicidal agent, causing 100% mortality of *B. glabrata* even at the lowest concentration tested, 25 ppm. With regard to the fruit extract, a variation in mortality was observed, depending on the concentration used (100, 75, 50, and 25 ppm) i.e. dose-dependent. After contact with fruit extract, Snails had a significant reduction in feeding and embryo number compared to the control. At the concentrations tested, there was no exhibition of molluscidal activity nor influence the feeding and oviposition abilities of *B. glabrata* from the steam extract. The leaf and fruit extracts of *J. gossypiifolia* studied showed molluscicidal effect and might contain useful compounds that could combat schistosomiasis [32].

3.8 ANTICOAGULANT, ANTIOXIDANT ACTIVITIES, AND TOXICITY

The leaf teas are used to cure thrombosis agent and the limbes are used most of the time as a "thick blood" agent. The combination of these 2 properties could be important for many cardiovascular illnesses. Proteins, sugars and some compounds were discovered using thin layer chromatography (TLC) and spectrophotometric quantification. The anticoagulant activity was evaluated by prothrombin time (PT) and activated partial thromboplastin time (aPTT) tests. The ability to act in the fibrinolytic system (fibrinolytic and fibrinogenolytic activities) was also evaluated. In the fibrinolytic system, no effect was observed. Using the, It was observed while using aPTT assay, that the residual aqueous fraction (RA) has mostly been active, being twice as active as CE. RA showed a very significant antioxidant activity in all models tested, comparable or even superior to that of CE. On safety side, not significant cytotoxicity has been noted on CE and RA tests. For safety, CE and RA did not produce significant cytotoxicity in the two tests used. CE and RA have an important anticoagulant and antioxidant effect and no in vitro cytotoxic effect, thereby indicating the potency of the plant, in specific of the RA portion, as a new bioactive molecule source for therapeutic purposes, with a specific focus on the treatment of cardiovascular diseases [33].
The cancer-preventive activity of *J. gossypiifolia* concentrates was also evaluated. The high level of flavonoids and phenols in the leaves incited the researchers to evaluate the anti-cancer potential of the leaves. Free radical and DPPH nitric oxide research techniques were used to examine the potency of the in vitro cancer prevention agent of methanol, ethylacetic acid, aqueous extracts, showing positive results. The authors attributed the antioxidant property against free radicals to flavonoids. [33].

3.9 ANTIHYPERTENSIVE EFFECT

The roots of *J. gossypiifolia* are known for their uses. The vasorelaxant and hypotensive impacts of the ethanolic concentrate fragments have been assessed. The analysis revealed that the concentrated material, in a summarlly subordinated way, produced a reduction in the systolic pulse rate in conscious tense subjects. Such hypotensive effect is likely due to decrease in the tone of the muscular wall of the arteries, as it has caused a focus-dependent relaxant effect in rodents whose endothelium was loaded with norepinephrine or calcium [34]. In addition, it impaired the norepinephrine-triggered contractile response in a similar plane in a one-off, non-competitive manner.

3.10 HYPOTENSIVE EFFECT

Research was conducted to examine the hypotensive activities of ethanolic extract. Oral ethanolic extract administration (125 or 250 mgkgy/day) induced a dose-related significant reduction in the systolic blood flow pressure. The concentration-response curves y1 to norepinephrine (NE) or Ca2+ ion were shifted non-parallel by 2q to the right, and maximal contractile responses were depressed in a concentration-dependent manner by EE (0.1 or 0.5 mgyml) in the endothelium-deprived mesenteric artery. Accumulated supplements of EE (0.1-30 mgyml) induced a concentration-dependent relaxant response in the endothelium-deprived mesenteric artery precontracted with NE or Ca2+. In conclusion, results have shown that EE from *J. gossypiifolia* L. can cause, when used orally, hypotension in conscious normotensive rats and vasorelaxation activity in rat mesenteric rings precontracted with NE or Ca2+[34].

3.11 ANTI-INFLAMMATORY PROPERTIES

Provocative procedure is used to identify important current uses of *J. gossypiifolia*. A research has shown that the concentrated of methanolic of the leaves is used as an intense and consistently soothing melting action. The concentrate, at oral doses of 445 and 1050 mg/kg, has the potential to limit intense paw edema in rodents induced by carrageenan and, at oral doses of 55 and 105 mg/kg, prevents the incessant development of cotton ball-induced granulomas in rodents [35]. Moreover, *J. gossypiifolia* leaf glue showed a significant decrease in TPA-triggered proximal inflammatory changes in the rodent ear oedema prototype. In another review, pain alleviation and relief effects in animals, particularly mice, were demonstrated by benzene and petroleum ether mixtures of extracts. Only the separate bioethanol produced significant pain relief in the Eddys gas plate and dorsal fin experiments and a relaxing movement in carrageenan-induced paw oedema when administered at 240 and 230 mg/kg/day for 12 hours, depending on the primary outcome. RAW 264.7 cells stimulated with lipopolysaccharide were used to determine the anti-inflammatory properties of the extract. Western blotting was also done in order to exaninate the ability of transcription factors and inflammatory mediators [36]. Moreover the anti-inflammatory actions of Phellinus linteus were determined on RAW 264.7 cells stimulated

by lipopolysaccharide [37]. In the literature, it has been documented that when using the in vitro human red platelet layer tuning technique, research has shown that ethyl alcohol and aqueous extracts from the leaves of *J. gossypiifolia* possess an attenuating movement. According to the authors, since human red platelet films resemble segments of the lysosomal layer, the backlash of lysis induced by the hypotonicity of these cells could be considered as a measure to assess the attenuating activity of the mixtures. The analgesic property of methanolic extract of *J. gossypiifolia* leaves was evaluated in the acid corrosion-initiated wriggling test in mice, where an exceptionally remarkable restraint was found of 68.58 and 66.15% at 200 and 405 mg/kg oral portions, individually.
The study conducted on the topical anti-inflammatory activity of the aqueous extract of *J. gossypiifolia* leaves was conducted with the aim of developing a safe and effective plant gel with anti-inflammatory potential. After various procedures, researchers demonstrated that the aqueous extract showed interesting anti-inflammatory activities in rodents. [38].

3.12 PROPERTIES AND HEALING ACTION

Various studies have reported healing activity from the crude ethanol concentrate of *J. gossypiifolia***.** This was evaluated in the recovery by suturing of the dorsal abdominal volume of rodents. The concentrate was controlled by intralesional insertion of 410 milligrams into the pulmonary fossa, which induced a more visible crisis on the normally obvious assessment, as well as on the assessment of the more visible and pseudovascular deformity. In very situation, there was also a more visible incendiary procedure, and the other histological stages were close to those of the reference group, showing that, overall, the concentrate introduced wound healing properties into the opportunity model. A further analysis was made of the reparative activity of the unrefined hydroethanol concentrate of J. gossypiifolia leaves in the suture revision procedure performed on the rodent bladder, and the comparative results remained introduced, although an improvement was observed within certain limits. From all point of view, the feeling was like no ideal recovery impact was observed within the organism of a solely intraperitoneal portion the plant. In another research dissecting the morphological parts of the salvage pathway occurring in open skin wounds in rodents under topical organism of the crude concentrate. Authors also observed a lack of salvage activity, although some histological improvements were demonstrated [39].
However, the influence of *J. gossypiifolia* on the colonic anastomosis healing protocol was observed in rodents. Research has demonstrated that the administration of a single 1 mL/kg portion of aqueous alcohol concentrate from flying portions has a considerable effect on the healing procedure.

3.13 HEMOSTATIC PROPERTY

The use of *J. gossypiifolia* latex is extended to haemostatic component in order to prevent dispersion of the drainage. The consequences of the duration of the coagulation of the blood using ‘’Lee and White's approach’’, the drainage time using Ivys technique were completely minimized while the stem latex was added, resulting in a pro-coagulant. With regard to the postulated element of activity, following the analyses showing the encouraging activity of

latex on egg whites,it has stated that latex accelerates the coagulation elements by bringing the coagulation levels closer together, then the start of the coagulation course induces the age of thrombin and the development of coagulation occurs fastly compared to the control test, which lasted a while to complete the coagulation. The essential is note that, every time we think about it, this is the main analysis carried out in human models. [39].

3.14 ANTICHOLINESTERASE PROPERTY

Acetylcholinesterase inhibitors are largely utilized in combatting against neurodegeneratives disordes, due to cholinergic effects. *J. gossypiifolia* had a significant antitumor effect, with an IC_{50} of 0.08 mg/mL in a methanolic extract of leaves [40]. Researches revealed that diluted rubber has the capacity to destroy tissue tentatively sensitive to butyrylcholinesterase complex in Dhal marulius, a species of water plane tree.

3.15 CONTRACEPTIVE ACTIVITY

Anti-fertility activity of *J. gossypiifolia* has been assessed, as an alternative to oral prophylactic compounds [41]. The leaf extract has altered significant hormones associated with the main pathway of the oestrous cycle, demonstrating its anti-fertility impact on mice. By evaluating at various scales such as properties, the anti-fertility impact of the portion has also been shown.

3.16 TOCOLYTIC ACTIVITY

Given the ethnopharmacological use of plants as to suppress uterine contractions and allow a pregnancy to be carried to term, research was carried out. An assessment based on ethanolic extract to examinate the effects on calcium-induced uterine smooth muscle contraction of ethanolic. The portion and, to an advanced degree, the chlorocarbonic acid division decreased the contraction response of uterine smooth muscle induced by Calcuim, advancing the right turn shift of the total Calcium curves, just to decrease the larger withdrawals [42].
In Brazil, research has been done on ethanolic extract and portions of the plant were assessed for their effects on calcium-induced smooth muscle contraction of the uterus. Overall, these findings imply that the ethanolic extract and fractions of *J. gossypiifolia* reduce the calcium-induced contractile response of uterine smooth muscle, which supports its traditional application to suppress uterine contractions and allow a pregnancy to be carried to term (tocolytic). [43].

3.17 ANTINEOPLASTIC ACTIVITY

The most remarkable pharmacological properties of *J. gossypiifolia* include antineoplastic activity that is often related to the substance as of lignose and terpenoids. Researchers have reported in the literature that when the ethanolic fraction of the roots containing the diterpene jatrophone, showed great restrictive activity *in vitro* against cells obtained from

human nasopharyngeal cancer cells and lymphocytic leukemia and *in vivo* compared to standard, e.g., sarcoma 180 and intramuscular carcinosarcoma Walker 259 [35]. Subsequently, triple naive antitumor activities of jatrophone were isolated via petroleum ether extract removals from *J. gossypiifolia*. Later, two diterpenes with intense antineoplastic activity have been released from *J. gossypiifolia* [43].

3.18 ANTI-PROTOZOAL, ANTIMICROBIAL AND ANALGESIC ACTIVITIES

Jatrophone, a diterpenoid present in *J. gossypiifolia* has been subject of an interesting research regarding anti-protozoal activity. After various phytochemical process and comparison with the literature to isolate Jatrophone. The assessment for anti-protozoal effect against *Plasmodium falciparum* [D6 (sensitive to chloroquine) and W2 (resistant to chloroquine)], *Leishmania donovani* and *Trypanosoma brucei* strains. Antimicrobial activity was assessed against selected fungal and bacterial type cultures, Analgesic using the acid-induced torsion model, cytotoxicity using VERO. In fine, Jatrophone has demonstrated interesting antimicrobial, analgesic and antiprotozoal activities[44].

3.19 ANTIVENOM ACTIVITY

Due to its high morbidity and mortality, snakebite is a serious public health problem. Most of people all over the world use the antivenom serum as remedy but this one as some challenges unlike neutralisation of local effects, not secured regarding immunologic organism response, etc.. Considering these challenges, an alternative to antivenom serum would be helpful for all mankind. Due to the fact *J. gossypiifolia*, is used in traditional medicine to cure snakebite, a study was conducted to assess its antiophidic capacities. Aqueous extract from leaves was utilized for this experience. In vitro and in vivo, the venom of the snake *Bothrops jararaca* on which aqueous extract was added an inhibition of enzymatic and biological activities was observed. No blood coagulation was observed on the oral extract. On the rate of 56% for previous attempt and 100% for the last, they could observe local haemorragic and oedematogenic effects were inhibited in animals treated with the treated extract orally and intraperitoneally. For almost 100%, an inhibition of the myotoxic action of *B. jararaca* was reached. From the enzymatic tests carried out, it can be suggested that the antiophidic activity could be due to an inhibitory action on SVMPs and/or (SVSPs), including fibrinogenolytic enzymes, coagulation factor activators and thrombin-like enzymes (SVTLEs), also on catalytically inactive phospholipases A2 (Lys49 PLA2). It was observed, in a non-insignificant consideration, an anti-inflammatory activity that could induce topical action [20].

3.20 ANTICONVULSANT EFFECT

In some ethnomedical practice observed in northern Nigeria, leaves of *J. gossypiifolia* are usually utilized the treatment of epilepsy and infantile convulsions. Researchers had examined the anticonvulsant properties via scientific protocols. In the anticonvulsant studies, the extract at all doses tested (75, 150, and 300 mg/kg) did not delay the recovery

time of convulsed roosters in the MEST model or the mean onset of convulsions in the PTZ and 4-AP models in mice compared to controls. On the side, the 150 mg/kg extract significantly ($p \leq 0.05$) has delayed the average onset of stroke in mice in the STN model compared with control treatments. Thus, researchers noted an anticonvulsive effect of *Jatropha gossypifolia* and confirmed the traditional use for the treatment of epilepsy and infantile convulsions [45].

3.21 CERCARICIDAL EFFECT

Using ethanolic extracts of *J. gossypiifolia* and *Piper arboreum*, researchers noted interesting antiparasitic actvities on *Schistosoma mansoni* especially cercariae and adult worms. Bioassays were performed at a concentration of 0-10,000 µg/mL for 0-72 hours. Adult worms were stained with carmine to assess external and internal damage. *P. arboreum* showed the best cercaricidal effect, with a 100% reduction in viability in only 60 min. On other side, *J. gossypiifolia* extract demonstrated good ability to combat adult worms, with a 100% reduction in viability of male and female after respectively 12 and 24 h. The 2 plants equally inhibited oviposition of *S. mansoni* (93% reduction) and in damaged the internal and external structures of adult worms. Thus, they concluded that ethanolic extracts of leaves of the 2 plants have demonstrated to have relevant biological activities to combat cercariae and adult *S. mansoni* worms[46].

3.22 ANTIULCER EFFECT

A reseach has been done the methanolic extract of *J. gossypiifolia* to evaluate its gastro-protective activity on Wistar rats. The anti-ulcer activity of MEJG (100 and 200 mg/kg, b.w.) was evaluated using aspirin (200 mg/kg, p.o.) plus pylorus ligation ulcer model and the parameters studied were ulcer index (UI), gastric juice volume, pH, total acidity and total acid production. The study provided scientific support for the anti-ulcer activities of the extracts of this plant and also highlighted its antioxidant potential. Traditional use of the plant in the cure of gastric ulcers was, therefore, confirmed [47].

3.23 ANTIDIURETIC AND ANTI-HYPERGLYCEMIC ACTIVITIES

The antidiuretic and antihyperglycaemic activities of *J. gossypiifolia* from leaf extract were evaluated on streptozotocin-induced diabetic rats. 30, 50 and 100 mg/kg of *J. gossypiifolia* leaf extracts were subjected to diuretic and hyperglycaemic properties using the established protocol of diuresis and diabetes test. The purpose of this method was about to control on blood and urine from rats the evolution of diuretic index after incremental addition. The result of this research confirmed that the adding of extract has influenced the rate by decreasing the diuretic and hyperglycaemic in blood and urine. [48].

3.24 ANTIVIRAL ACTIVITIES

The antiviral activities of *J. gossypiifolia* have been reported in several studies (49-50). Different parts of the plant have been exhibiting antiviral activities. Seeds and fruits are reported to have anti Influenza (H1N1) properties. It has also been reported an effective action against Herpes simplex virus Type-2 (HSV-2) and Para 3 virus activities. The Para 3 virus is known as a Human Parainfluenza Virus (HPV) that most of the time associated with bronchiolitis, bronchitis, and pneumonia.

3.25 TOXICITY, CYTOTOXIC, GENOTOXIC AND MUTAGENIC EFFECTS

Toxins are most of the time due to the latex. Latex extract using electrical wound, a painful and corrosive substance that contains toxalbunis. This one induces phagocytosis , hemolytic anemia , and erythropoiesis, including cell damages, somatic symptoms, psoriasis, including digestive problems. Heart, cognitive or kidney affections might also be due to initial treatment. In a laboratory examination of toxicity in cattle, it was found that even a high injection of 40 g/kg of fresh leaf tissue was lethal. Adolf et al. conducted a study related to the detection of the acute toxicity of Jatropha in a sequential manner. The methanol extract showed low efficacy in an in vivo pharmacokinetic assay using Artemia salina larvae. The liquid and diethyl ether fractions of methanol extracts from the aerial parts of *J. gossypiifolia* did not induce exposure in the same species in a previous analysis. The property of collagen from the stem of *J. gossypiifolia* was studied in Wistar rats using incremental doses of synthetic silicone to the incised skin daily for two weeks considering the use latex as a chemotherapeutic agent for neural symptoms. According to the authors, rubber application did not generate major differences in metabolic and hematological outcomes [48].

Ethanolic and aqueous leaf extracts of *J. gossypiifolia* were evaluated using the Allium cepa test system. In addition, the phytochemical profile of the extracts was also obtained. A. cepa bulbs were subjected to different concentrations of the two extracts (0.001, 0.01, 0.1, 1, and 10 mg/mL). Distilled water was used for the negative control and methyl methanesulfonate (4 x 10-4 M) and trifluralin (0.84 ppm) for the positive controls. The values of Mitotic index at all concentrations of ethanolic extract and at 0.1, 1, and 10 mg/mL of aqueous extract showed a significant decrease. It was observed that micronuclei of the extracts also indicates mutagenic action. Thus, it was suggested that extracts of this species should be used with great caution for medicinal purposes [51].

Ethanolic extract of *J. gossypiifolia* root and Prednisolone administrated orally had actions on kidney histology and renal function of albino rats. Grouped in 4 differet batches, they were administrated extract in order to assess toxicity. After incremental doses, animals were killed on days 7, 10, and 14, and their kidneys were collected and processed for histological studies. Their blood was also collected for measurement of serum urea. Photomicrographs of histological sections from rats in groups II, III, and IV revealed changes from the control group, and serum urea levels were significantly higher in these groups. The histologic changes observed were consistent with glomerulonephritis and included increased urinary space (Bowman), narrowing and distortion of the glomerular tuft, and scarring of the glomeruli. The changes appeared to be both dose and time-dependent, and the

administration of Prednisolone as an adjuvant had no ameliorative effect. The conclusion was that the increase of retention of urea in the blood and toxicity to the kidney were caused ethanolic extract of *J. gossypiifolia* root [52].

4. CONCLUSION

The literature review showed that *J. gossypiifolia* Linn. presents sufficient particularities to be used for a wide medical opportunities. When considering the large spectrum of biological activities and medicinal properties, we can realize the role that it can play a role against viruses, bacteria or different cancers. As a candidate plant for disease control, it is therefore imperative to assess the biochemimical property of this plant and to initiate a research program for the development of new bioactive compounds.
Molecular docking against SARS COV-2, viral hepatitis B, and Influenza are ongoing. These studies will allow us to identify active compounds against these diseases and suggest what orientation should be taken to value this plant according to its pharmaceutical properties.

COMPETING INTERESTS:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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