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Mini Review

Phytochemical and pharmacological properties of *Jatropha dioica*

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Abstract

Jatropha dioica sesse ex cerv is a specie native to Mexico and Texas, commonly known as "sangre de drago", its name is due to its colorless juice turning dark at exposure to the wind. This mini-review aims to collect information about the phytochemical and pharmacological properties of *Jatropha dioica*. The phytochemicals identified are diterpenes, (citlalitrione, jatrophone and riolozatrione), β-sitosterol, oxalic acid and ellagic acid. The stems, whole plant, or the root of *J. dioica* in traditional medicine are used to avoid hair loss, as an antibacterial, and antiviral, to strengthen teeth, and to heal some injuries among others uses. Among the biological activities attributed to *Jatropha dioica* are found in antiviral activity, antifungal, antimicrobial, chemopreventive, anti-hyperglycemic and cytotoxic. However, the little information about the chemical composition of this species and the scarce scientific studies validating its pharmacological properties make *J. dioica* an interesting species to study.

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Introduction

The use of medicinal plants dates since the beginning of humankind, every culture worldwide, had used medicinal plants for ages as their basic personal medicine; this custom has been transmitted from generation to generation throughout history [1]. It is estimated that about 80% of the world population depends on traditional herbal remedies and at least 35000 plant species have a potential medicinal use [2].

In Mexico, there is a large number of plants considered medicinal (approximately 4500 species), one of them belongs to the family of *Euphoborbiacea*, *Jatropha's* kind, to be more specific, more than 175 species are known of the same kind, which is used in the traditional medicine of countries like India, Portugal, Mexico and throughout the African continent [3].

The *dioica* species, originally from Mexico and Texas, is a small bush that lives in dry and semiarid climates. In traditional medicine *Jatropha dioica* (*J. dioica*) is used because of its numerous pharmacological and biological activities, it is a natural resource for the treatment of different illnesses. Because of this, the report centralizes mainly on the Phytochemical and Pharmacological properties of *J. dioica* [4,5].

Botanical description and distribution

Jatropha dioica sessé ex cerv: *J. dioica* (*Jatropha spathulata,* synonyms) belongs to the Magnoliophyta, order Euphorbiales. The common name in México depends on the city or place of origin, some common names are sangre de drago, sangre, de draco, or sangregado, its Indian name is B'othue [4,6,7].

J. dioica is a small bush of 0.5 m - 5 m, with large, smooth, flexible, porous and dark stems. They have an astringent juice that changes its color to dark at wind contact, like a blood color. Its leaves are fasciculate to spatula-like and sometimes oval of 1 cm - 7 cm, they have small white and pink flowers and small fruits with black seeds of 8 mm - 10 mm (Figure 1) [8,9].

Habitat

J. dioica is native to México and Texas in the United States, found in dry and semiarid climates, in the tropical forest caducifolio, xerófilo and grassland [4] at altitudes of approximately 100 to 2800 m [5] In Mexico it is found the northwest and in the central part of the country, in states

Figure 1: Image of *Jatropha dioica.*

like Hidalgo [10] Zacatecas, Durango, the desert of Chihuahua [11,12], San Luis Potosi [13], Tamaulipas and Puebla [14].

Ethnomedicinal uses

In traditional medicine, the stems boiled in water, smashed roots or the whole plant of *J. dioica*, is used to avoid hair loss, for this, people prepare a special shampoo with roots of *J. dioica*. Also, this plant is used for the treatment of varicose veins and injuries. The residue of the water in which the plant was boiled, is used to heal infections in different wounds and skin injuries like pimples (SAGARPA). The fruit of *J. dioca* is used for the treatment of irritated eyes, for this, it is necessary 2 or 3 drops of this fruit into the eyes. Also there reported that *J. dioica* is a good alternative for the treatment of decayed teeth, for only chewing the stems or roots and the teeth get stronger and more solid [8].

This plant has a tuberous root, succulent and creeping. Roots of about 5 meters in length have been found around the plant. This unique characteristic about the plant is what makes it an important herbal due to its curative properties found on the root (SAGARPA).

Phytochemistry

J. dioica is a little-studied species, has been identified four pure compounds of methanolic root extract of *J. dioica*, the β-sitosterol, tropolone B, citlalitrione, and riolozatrione (Figure 2) [15]. The β-sitosterol is a sterol that is found naturally in plants, it has been reported which presented chemoprotective and estrogenic activity [16], also, one prominent anti-proliferative and pro-apoptotic effects [17]. Jatrophone is a macrocyclic diterpene, this possesses multiple biological activities such as inhibition of insulin release, relaxation effect of induced muscle contraction, relaxant action in rat portal vein, inhibition of lymphocytes activation, anti-protozoal activity, antitumor activity, molluscicide activity and, gastroprotective effects [18,19]. Citlalitrione is an epoxytrione diterpene, it has been reported to have an antitumor effect *in vitro* [14]. Riolozatrione is a terpene with antibiotic activity against *Staphylococcus aureus* [14].

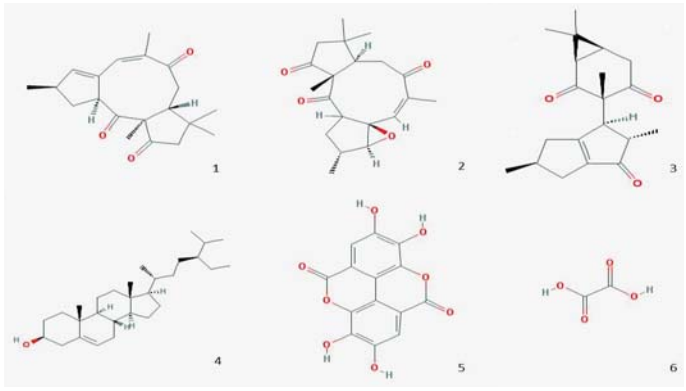

Figure 2: The structures of some phytochemical compounds isolated from Jatropha dioica. 1: jatrophatrione; 2: citlalitrione; 3: riolozatrione; 4: beta-sitosterol; 5: ellagic acid and 6: oxalic acid.

Aguilera-Carbo, et al. reported that the branches of *J. dioica* contain 0.81 ± 0.43 of ellagic acid per mg /g of a plant [20]. The ellagic acid is a natural phenol antioxidant, exhibits activity as anti-atherosclerosis and inhibits the proliferation of malignant cancer cells of the colon, prostate, cervical, tongue, esophagus and, skin [8,21]. There are also reports of its antimicrobial activity [22], antiviral [23], and gastroprotective [24]. Ellagic acid leads to decreased phosphorylation of RB proteins mainly through modulation of the TGF-β/Smad3 pathway and thereby inhibits the proliferation of MCF-7 breast cancer cells [21].

Biological activities

Antiviral activity: There is evidence to suggest that certain plant extracts and naturally occurring compounds inhibit *in vitro* replication of some viruses, so it gives them a possible antiviral activity. The anti-HSV activity *in vitro* of *J. dioica* was evaluated using the plaque reduction assay with HSV-1 and HSV-2 (from clinical isolates) infected Vero cells. The hydro-methanolic extract of *J. dioica* showed IC_{50} of 280 µg/mL for HSV-1 and 370 µg/mL for HSV-2. The n-hexane extract of *J. dioica* extract showed IC50 of 300 and 270 µg /mL for HSV-1 and HSV-2, respectively [25].

Antifungal activity: The antifungal activity of *root extracts of J. dioica* was evaluated on *Candida albicans, Candida parapsilosis, Aspergillus fumigatus, Histoplasma capsulatum, Coccidioides immitis, Cryptococcus neoformans, Sporothrix chenckii.*

Alanís-Garza, et al. evaluated the antifungal activity of root extracts hydro-alcoholic of *J. dioica* about *Candida albicans, Aspergillus fumigatus, Histoplasma capsulatum* and *Coccidioides immitis.* They concluded that *J. dioica* was active only against *Candida albicans* (Alanis, et al. 2007).

Silva-Belmares, et al., evaluated the antifungal activity of methanol, hexane and, acetone extracts of *J. dioica* root about *Candida albicans, Candida parapsilosis, Cryptococcus neoformans* and, *Sporothrix chenckii.* The methanol extract was active against *Candida albicans* and *Sporothrix schenckii.* The

acetone extract was active against only *Sporohtrix schenckii* and the hexane extract was active against the four fungi (Silva, et al. 2014).

Antimicrobial activity: The antimicrobial activity of the plants is attributed to secondary metabolites such as polyphenols, flavonoids, and, terpenes which are part of the natural defense mechanism of the plant (Wong, et al. 2010). The antimicrobial activity of *J. dioica* was evaluated on gram-positive and negative bacteria. Silva-Bermares, et al. evaluated the antimicrobial activity of methanol, hexane, and, acetone root extracts of *J. dioica* in *Bacillus cereus, Staphylococcus aureus, Escherichia coli, Salmonella Typhimurium, Salmonella typhi, Enterobacter aerogenes,* and *Enterobacter cloacae.* The methanol extract was active against *Staphylococcus aureus* and, *Escherichia coli.* The acetone extract was against *Staphylococcus aureus, Escherichia coli and, Enterobacter aerogenes* and the hexane extract was active against *Bacillus cereus, Staphylococcus aureus, Escherichia coli* and *Salmonella Typhimurium.* They attributed the antimicrobial activity of *J. dioica* to its metabolite β-sitosterol (Silva, et al. 2014; Wong, et al. 2010).

Chemopreventive activity: Recently the chemopreventive effect of root decoction *J. dioica* at the dose of 14.88, 42.84, and 85.68 mg/kg in cells of liver, kidney, and bone marrow of mice by the comet assay was evaluated; the genotoxic agents used were cyclophosphamide (50 mg/kg), daunorubicin (10 mg/kg) and methyl methanesulfonate (40 mg/kg). The results showed that all three doses of the decoction of the root of *J. dioica* had a chemopreventive effect against cyclophosphamide-induced damage in liver cells, and bone marrow at 3 and 9 hours after administration. The decoction of *J. dioica* also showed one chemopreventive effect on hepatic, renal, and bone marrow cells, to inhibit the damage caused by daunorubicin, also showed a slight inhibitory effect of the alkylation induced by methyl methanesulfonate in the cells of liver, kidney, and bone marrow to 3 and 9 hours after treatment (Martínez, 2013).

Anti-hyperglycemic effect: Alarcon-Aguilara et al. evaluated the anti-hyperglycemic effects of 28 medicinal plants used as antidiabetics. They reported that the decoctions of *J. dioica* (40 g of the dried plant was slowly boiled in 300 ml of water and heated for 10 min.) reduced the hyperglycemic peak by 13.7% (Alarcon, et al. 1998).

Likewise, ethyl acetate and hydroalcoholic extracts from Jatropha dioica significantly reduced the glucose uptake in the ex vivo everted intestinal sac test [26].

Cytotoxic and genotoxic activity: The cytotoxic activity of the aqueous and 70% ethanol (EtOH) extracts of *J. dioica* of the leaves and roots was evaluated. The extracts were obtained from the suspension of 18 g of the aerial (leaves) and root parts of *J. dioica* in 200 ml of 70% EtOH and water for 24 h. The cytotoxicity was evaluated by the survival of 3T3/NIH mouse fibroblasts measured photometrically in a 3-(4, 5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay after a 24 h exposure. The aqueous and ethanol extracts of *J. dioica* presented low cytotoxicity (Oliveira, et al. 2013). Too, was evaluated the cytotoxic activity of hexanoic extract of the roots of *J. dioica* was evaluated on Chang, OK, and LLCPK-1 normal cell lines, reporting an IC_{50} > 100 µg/mL (Silva, et al. 2014).

Araujo-Espino, et al. determinaron el efecto genotóxico y citotóxico *in vivo* del extracto acuoso de *J. dioica* empleando el ensayo de micronúcleos de sangre periférica de ratón a dosis de 30, 60, 100 y 300 mg/kg, reportando que el extracto acuoso de *J. dioica* no produce efecto genotóxico ni citotóxico a las dosis evaluadas [27].

Similarly, no genotoxic effect was reported after oral administration of doses of 60, 100 and 300 mg/kg of the aqueous extract of the root of *J. dioica* in pregnant rat or their newborns, after transplacental exposure [28-30].

Conclusion

Jatropha dioica has been used in traditional medicine for its pharmacological and biological activities in various diseases. It has been reported the presence of different phytochemicals of *J. dioica* with important biological activities, however, the literature review reveals little scientific information on the pharmacological uses of *J. dioica,* and most studies only evaluate the effect of the root of *J. dioica*, therefore it is important to continue the investigation of phytochemical and pharmacological properties of *J. dioica.*

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