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IMPORTANCE OF PHARMACOGNOSTIC STUDY OF MEDICINAL PLANTS *CALOTROPIS GIGANTEA* (LINN.): A REVIEW

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ABSTRACT: *Calotropis gigantea* Linn. white (Asclepiadaceae), it is a weed plant commonly known as giant milkweed. It has one of the important traditional medicines to treat various ailments. The basic aim of this study to *Calotropis gigantea* is one such plant. In this review, the systematic position, introduction about the plant, morphological study, phytochemistry and the economical values of the *Calotropis gigantea* are discussed. *Calotropis gigantea* is a glabrous or hoary, laticiferous shrubs or small trees, it also known as "the swallow-wort or milkweed." *Calotropis* is used as a traditional medicinal plant. *C. gigantea* contains chemical constituents are cardenolides, flavonoids, terpenes, pregnanes, and nonprotein amino acid. The latex, leaves, flowers, bark, the root is also used as caustic, acrid, expectorant, depilatory, antihelmintic, useful in leprosy scabies ringworm of the scalp, piles, eruptions on the body, asthma, enlargement of spleen and liver, dropsy applied to painful joint swellings. This review gives a brief idea about its phytochemistry and pharmacological activity.

INTRODUCTION: *Calotropis gigantea* Linn. is a traditional medicinal plant it belongs to the family of Asclepiadaceous [1, 2] are widely distributed in Asia and Africa [3, 4, 5]. Asian countries that include India, Indonesia, Malaysia, Thailand, Srilanka, and China. It is commonly known as milkweed and laticiferous shrub [6]. The plant grows up to 2-4.3 m long. It has oral, light green leaves and milky stem. The leaves are very much succulent [7]. Plants contain many biologically active molecules with different medicinal properties [8, 9]. It is popularly known because it produces a large quantity of latex and known as milkweed or swallowwort. Latexes are the source of various biologically active compounds, including glycosides, tannins, and many proteins, among others [10, 11].

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Humankind first utilized materials found in the environment an empirical basis to cure various ailments. Natural products from plants and animals traditionally have provided the pharmaceutical industry with one of its relevant sources of lead compounds in search of new drugs and medicines. The search for new pharmacologically active agents from natural resources such as plants, animals, and microbes led to the discovery of many clinically useful drugs [12, 13].

Morphology: [14, 15]

Root: Simple, branched, woody at the base and covered with a fissured; corky bark; branches somewhat succulent and densely white tomentose; early glabrescent. All parts of the plant exude white latex when cut or broken.

Leaves: Opposite-decussate, simple, subsessile, exstipulate; blade-oblong obovate to broadly obovate, 5-30X 2.5-15.5 cm, apex abruptly and shortly acuminate to apiculate, base cordate, margins entire, succulent, white tomentose when young, later glabrescent and glacouse.

Flowers: Bracteate, complete, bisexual, action-morphic, pentamerous, hypogynous, pedicellate, pedicel 1-3 cm long

Calyx: Sepal 5, Polysepalous, 5 lobed, shortly united at the base, glabrescent, quincuncial aestivation

Androecium: Stamens five, gynandrous, anther dithecous, coherent.

Floral Characteristics:

Inflorescence: A dense, multi-flowered, umbellate, peduncled cymes, arising from the nodes and appearing axillary or terminal

Gynoecium: Bicarpellary, apocarpous, styles are united at their apex, peltate stigma with five lateral stigmatic surfaces. Anthers are adnate to the stigma of forming a gynostegium.

FIG. 1: WHOLE PLANT OF *CALOTROPIS GIGANTEA* LINN.

Fruit: A simple, fleshy, inflated, subglobose to obliquely ovoid follicle up to 10 cm or more in diameter.

Seeds: Many, small, flat, obovate, 6 × 5 mm, compressed with silky white pappus, 3 cm or more long.

Chemical Constituents: The chemical constituents of *C. gigantea* have been extensively investigated, leading to the isolation of many cardenolides [16, 17, 18, 19], flavonoids [20], terpenes [21, 22, 23, 24], pregnanes [25, 26] and a nonprotein amino acid [27].

Uses: The flower was described in ancients Ayurveda as sweet-bitter, anthelmintic, analgesic, astringent, cures inflammations, tumors, Kapha, rat-bite. The flowers are considered as a digestive, stomachic, tonic, useful in asthma, catarrh, and loss of appetite [28]. Aerial parts of *Calotropis gigantea* reported for antidiarrheal activity [29]. Latex of *Calotropis gigantea* evaluated for procoagulating activity associated with fibrinolytic activity [30]. Alcoholic extract of the dried, peeled roots of *Calotropis gigantea* posses CNS activity and contraceptive activity [31, 32]. Aerial parts of total aqueous extract and water-soluble fraction of *Calotropis gigantea* were evaluated for immunomodulatory, anti-inflammatory, anticancer and antimitotic activity [31, 32, 33]. Alcoholic extract of stems possesses hepatoprotective activity [34, 35].

TABLE 1: PHYTOCHEMICAL ACTIVITY OF PLANT *CALOTROPIS GIGANTEA*

S. no.	Activity	Plant Part	Year	Remark
1	Repellant activity	Whole Plant	2005	Maximum repellent effect followed by leaf, flower, stem, and root extracts [36]
2	Protective effect	Flowers	2008	The protective effect of the extract may be due to its ability to inhibit lipid peroxidation and prevent the depletion of vitamins C [37]
3	Gastric cancer, chronic myelogenous leukemia	Roots	2008	Chronic myelogenous leukemia K562 and human gastric cancer SGC-7901 cell lines [38]
4	Wound Healing Activity	Latex	2009	Latex treated animal's exhibit 83.42 % reduction in wound area when compared to controls which were 76.22 %. The extract treated wounds are found to epithelize faster as compared to controls [39]
5	Vasodilatation Effect	Latex	2009	Thus the present study reveals that the latex produces vasodilatation effect at fixed dose concentration [40]
6	Diabetes mellitus, bronchial asthma, rheumatoid arthritis, and nervous disorders	Leaf and Flower	2009	It was observed that the effect of chloroform extracts of *Calotropis gigantea* on alkaline phosphatase, cholesterol, superoxide dismutase, serum glutamic pyruvic transaminase, serum glutamic oxaloacetic transaminase, levels are comparable to that of those produced by the positive control [41]
7	Anti-inflammatory	Whole plants	2009	This study also proved the greater anti-inflammatory action due to the combined effect of *C. gigantea* and *T. procumbens* with Ibuprofen than Ibuprofen alone[42]
8	Anthelmintic	Latex	2009	The potency of the compound in anthelmintic activity was found to be inversely proportional to the time taken for paralysis or death of the worms.
9	Antitumor activity	Flower	2009	The *Calotropis gigantea* flower has a potent inhibitory effect against EAC cells in a dose-dependent manner [43]
10	Antagonistic activity Antibacterial	Leaves	2010	The extract showed a significant effect on the tested organisms. The extract showed maximum zone of inhibition against *Escherichia coli, Bacillus cereus, Pseudomonas aeruginosa, Micrococcus luteus* [44]
11	Antihistaminic	Flowers	2010	The results obtained suggest that the ethanol extract of *Calotropis gigantea* flowers possess antihistaminic, mast cell stabilizing effect and hence confirms its potential role in the treatment of anaphylaxis and allergic disorders [45]
12	Cytotoxicity	Whole plant	2010	*C. gigantea* and investigate preferential cytotoxicity of the insect extract, if any, on human cancer cell lines. Comparative chemical characterization by HPTLC, UV and IR studies revealed the presence of cardenolides in both the extracts and biotransformation of some of the ingested cardenolides in the insect extract [46]
13	Antimicrobial activity	Leaves	2011	Thus it may be suggested that leaf extracts of *Calotropis gigantea* L. may be used to treat oral bacterial diseases [47]
14	Diabetes; Antidiabetic	Leaves and Flowers	2011	It is concluded that chloroform extracts of *Calotropis gigantea* leaves and flowers have significant anti-diabetic activity [48]
15	Antibacterial activity	Leaves	2011	The leaves extract of *Calotropis gigantea* were screened for its antibacterial and phytochemical activities [49]
16	Antiasthmatic, Bronchoconstriction	Roots	2011	These studies showed significant protection at lower doses while further increase in dose level showed reduced activity [50]
17	Anti-anaphylactic and mast cell stabilizing the effect	Roots	2011	Roots containing α-and β-amyrin are reported to possess anti-lipoxygenase activity. Hence, our

				objective was to evaluate the effect of the methanolic extract of *Calotropis gigantea* (CG) root on egg albumin induced passive paw anaphylaxis and compound 48/80 induced mast cell degranulation in rats [51]
18	Antitumor activity	Root Bark	2011	The methanol extract (ME) of *C. gigantea* root bark and its chloroform soluble fraction (CF) possesses significant antitumor activity [52]
19	Wound healing and antimicrobial properties	Latex	2011	It exhibits a wide array of pharmacological activities including wound healing and antimicrobial properties. Lupeol, a pentacyclic triterpenoid was extracted for the first time from the latex of *Calotropis gigantea* and characterized by spectral studies. The presence of lupeol in the latex in appreciable amounts may account for its various biological activities [53]
20	Asthma	Root	2011	These results suggest that CG may prove to be a potential therapeutic drug for treating asthma owing to its anti-inflammatory, anti-lipoxygenase and antioxidant activities [54]
21	cytotoxic activity	Root	2011	The ethanolic root extract of *C. gigantea* exhibits potent cytotoxic property comparable to that of standard drug. Therefore, this might be utilized for the development of novel anticancer drug leads [55]
22	Antimicrobial Activity	Whole plant	2012	This plant showed significantly showed significant antibacterial and antifungal effect against most of the pathogenic organic organisms: *Bacillus subtilis* [MTCC (121)], *Staphylococcus aureus* [MTCC (96)], *Pseudomonas aeruginosa* [MTCC (429)], *Escherichia coli* [MTCC (443)], and two fungi *Candida albicans* [MTCC (183)], *Tinea capitis* [MTCC (7739)] [56]
23	Cervical cancer	The aerial part of the plant	2012	The docking analysis showed that all the sterol compounds showed the docking energy in the range of -12 to 16 Kcal/mol. The desmosterol exhibits higher docking energy, showing the maximum potential against the HPV16 E6 cervical oncoprotein [57]
24	Mosquito repellent activity	Leaves	2012	These results suggest that the leaves of *C. gigantea* have the potential to be used as a natural source for the development of new, safe, potential and eco-friendly insecticide for the control of *C. gelidus* and *C. tritaeniorhynchus* mosquitoes [58]
25	Antioxidant	Root	2012	The plant extract possess high antioxidant activity when compared with standard ascorbic acid due to the presence of high content of various phytochemicals [59]
26	antileishmanial activity	Whole plant	2012	These results indicated that non-polar fractions of *C. gigantea* have favorable leishmanicidal activity and they should be further tested against amastigotes of *L. major* [60]
27	Antibacterial, antiasthmatic, free radical scavenging, wound healing, vasodilation, pro-coagulant, antifertility, anti-inflammatory, anti-cancer, cytotoxic, analgesic, antipyretic, anti-convulsant and antidiarrheal activities	Whole plant	2012	The plant was also mentioned in Ayurveda and Unani for the treatment of asthma and many other diseases [61]
28	Larvicide; dengue	Leaf	2012	The present report is the first preliminary study to show the larvicidal effect of *C. gigantean* [62]
29	Procoagulant activity caustic, acrid, expectorant, depilatory,	Whole plant	2012	This review gives a brief idea about its phytochemistry

	antihelmintic, useful in leprosy scabies ring worm of the scalp, piles, eruptions on the body, asthma, enlargement of spleen and liver, dropsy applied to painful joint swellings			and pharmacological activity [63]
30	Antibacterial	Whole plant	2013	Synergism between plant extract and synthetic antibiotics can develop standardization of herbal medicine for treatment and prevention of infectious diseases [64]
31	Repellent activity	Whole plant	2013	Studied Chemical repellents have been used in the past for controlling the vectors and to control the man-vector contact [65]
32	Repellent activity	Flower	2013	It may be concluded from the result that ethanol extract of *Calotropis gigantea* flower was effective in mosquito vector control and has excellent potential in controlling the mosquito [66]
33	Antimicrobial activity	Flowers	2013	The essential oil also showed antifungal activity at a concentration of 1000 ppm against *Rhizoctonia solani* sasakaii (maize host) (% Inhibition = 75) when compared with standard antifungal agent [67]
34	Protease inhibitors	White and violet varieties plant	2013	The plant has also exhibited PLA2 inhibition activity in blood agar containing egg yolk. Protein interaction network profile has shown interactions with circulatory, neural and immune system components that can modulate and simulate the mechanism in the system approach [68]
35	Antimicrobial Activities	Leaf	2014	The plants extract for their antimicrobial activity gave significant control of two pathogenic fungi at various concentration *i.e.* 25, 50, 75 and 100 percent respectively [69]
36	Antioxidant, Antimicrobial	Flower	2014	This study forms a basis of biological characterization and the importance of the compounds identified and creates many bioactive ingredients to treat many diseases [70]
37	Larvicidal activity	Leaf	2014	These results suggest that the synthesized Ag NPs have the potential to be used as an ideal eco-friendly approach for the control of the *A. aegypti* and *A. stephensi*. This method is considered as a new approach to control vectors. Therefore, this study provides the first report on the mosquito larvicidal activity of synthesized Ag NPs against vectors [71]
38	Analgesic activity, antimicrobial and cytotoxic activity, anti-diarrhoeal activity, anti-Candida activity, antibacterial activity, and antioxidant activity	Whole plant	2014	Given this, the present study was investigated to review the phytochemistry, pharmacological activity, medicinal properties and biological properties of *Calotropis gigantea* [72]
39	Antianxiety; antidepressant; analgesic	Whole plant	2014	that the present studies scientifically validated traditional claims of *C. gigantea* for neuropharmacological activities [73]
40	Antibacterial	Whole plant	2014	In the present investigation, the phytochemical and antibacterial activity of *Calotropis gigantea* and *Datura metel*. The solvent used chloroform, acetone and ethanol antibacterial activity maximum in *Calotropis gigantea* against *Staphylococcus aureus Escherichia coli, Salmonella* sp., *Klebsiella* sp., compared to *Datura metel* [74]
41	Anti-HIV activity	Flowers	2014	Estari Mamidala studied The AIDS (Acquired Immunodeficiency Syndrome) in humans

				caused by the HIV-1 (Human immunodeficiency virus type 1) remains among the leading causes of death worldwide. To establish the study was undertaken to investigate the HIV-RT inhibitory activity of *Calotropis gigantea* flowers extracts [75]
42	Antimicrobial activity	Leaves	2015	The results obtained from this study inferred that the leaf extract of *Eucalyptus camaldulensis* was effectively inhibited the growth of test organism, while *Calotropis gigantae* did not show the activity which is in combination with *E. camaldulensis* shows the more activity against all pathogens [76]
43	Anti-proliferative activity	Leaves	2015	The taxol extracted from the fungal culture showed strong anti-proliferative activity against MCF 7 cell lines *in-vitro*. The findings evidenced that the endophytic fungus *Phoma* sp. isolated from *Calotropis gigantea* can act as a potential candidate for taxol production laying a foundation for further research heading towards the scale-up studies related to taxol production [77]
44	Immunosuppressive activity	Whole plant	2015	The data suggest that saponins extracted from these medicinal plants, *i.e. Calotropis gigantea*, *C. roteng*, and *A. integrifolia* showed immunosuppressive activity [78]
45	Anti-helminthic, anti-pyretic, and anti-malarial activities	Root	2015	The study showed that methanolic root extract induces apoptosis in HepG2 cells by altering Bax/BCl-2 expression. Further studies are required to obtain knowledge about the complete mechanism of its apoptosis-inducing activity [79]
46	Toothache and earache, sprain, anxiety, pain, epilepsy and in mental disorder	Whole plant	2015	The study conducted to find out the number of insects damaging the plant *Calotropis gigantea*. In their natural habitat and estimate the population density of nine insects with the biology of two major insects. The field activities of insects and their habitat were recorded and emphasized the role played by climatic factors on their population under the field condition of Guwahati [80]
47	Anticancer phytopharmaca agent	Leaves	2016	*C. gigantea* leaves extract at a dose of 100 and 150 mg/Kg BW were able to inhibit the growth of fibrosarcoma in experimental animals induced DMBA. This extract also improved the apoptotic index of the cell, respectively for 20.9 %; 21.5 % and 24.6 %, and increased the caspase-3 expression significantly. Based on those data, *C. gigantea* leaves ethanol extract was potential to develop as anticancer phytopharmaca agent [81]
48	Antimicrobial, analgesic, antitumor, antioxidant, anti-diarrhoeal, anti-malarial activity	Whole plant	2016	Species have been known to possess antimicrobial, analgesic, antitumor, antioxidant, anti-diarrhoeal, anti-malarial activity, *etc.* They are also using as a source of methane, through anaerobic fermentation for bio-fuel production [82]

CONCLUSION: The plant *Calotropis gigantea* is a traditional medicinal plant having many of phytochemical values with the antimicrobial, analgesic, antitumor, antioxidant, anti-diarrhoeal, anti-malarial activity, anti-asthmatic, free radical scavenging, wound healing, vasodilation, pro-coagulant, anti-fertility, anti-inflammatory, anti-cancer, cytotoxic, analgesic, antipyretic, anti-convulsant and anti-diarrheal activities. As a hydrocarbon-rich plant, this plant needs more investigation on the aspect of energy conversion.

The quality and quantity of the active principle which is important for many ailments are subjected to many factors such as climate, soil, *etc*. In this way standardization of the phytochemicals by these

factors are very important to establish the uses of the plant more effectively.

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