A Review on Pharmacological and Phytochemical Profile of *Calotropis Gigantea* Linn

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Summary

Calotropis gigantea is a weed plant commonly known as giant milk weed. The plant is belonging to Apocynaceae family which includes latex bearing plants. *C. gigantea* is known for various medicinal properties in traditional medicinal system and use to cure a variety of diseases. In last few decades, C. *gigantea* is extensively studied for its medicinal properties by advanced scientific techniques and a variety of bioactive compounds have been isolated from the different parts of the plant and were analysed pharmacologically. The plant is reported for analgesic activity, antimicrobial activity, antioxidant activity, anti-pyretic activity, insecticidal activity, cytotoxicity activity, hepatoprotective activity, pregnancy interceptive properties, purgative properties, procoagulant activity and wound healing activity. The medicinal properties of this plant represent it as a valuable source of medicinal compound. This study is a collective information concerning the ethnobotany, pharmacology, phytochemistry and biological activities of the C. *gigantea*.

Keywords: *Calotropis gigantea*, antimicrobial activity, cytotoxicity, ethnobotany, phytochemistry

Introduction

C. gigantea is a common wasteland weed and commonly known as giant milk weed. This plant is a native of Bangladesh, Burma, China, India, Indonesia, Malaysia, Pakistan, Philippines, Thailand and Sri Lanka. The plant has oval, light green leaves, milky stem and clusters of waxy flowers that are either white or lavender in colour. *C. gigantea* is frequently available in India and used for several medication purposes in traditional medicinal system. [1] Most recently *C. gigantea* is scientifically reported for several medicinal properties (Figure 1) viz. the flowers are reported to possess analgesic activity [2], antimicrobial and cytotoxic activity [3]. Leaves and areal parts of the plant are reported for anti-diarrhoeal activity [4], anti-Candida activity [5] and antibacterial activity [6], antioxidant activity. [7] Roots are reported to contain anti-pyretic activity [8], cytotoxic activity [9],

antimicrobial activity [10], insecticidal activity [11], wound healing activity [12], CNS activity [13] and pregnancy interceptive properties. [14] Latex of the plant is reported to contain purgative properties, procoagulant activity [15], wound healing activity [16] and antimicrobial activity. [17] Stem was reported to possess hepatoprotective effects. [18] The present review is focused an overall outline of the medicinal properties and biomolecules of *C. gigantea* and its future prospects for the further scientific investigation for the development of effective therapeutic compounds.

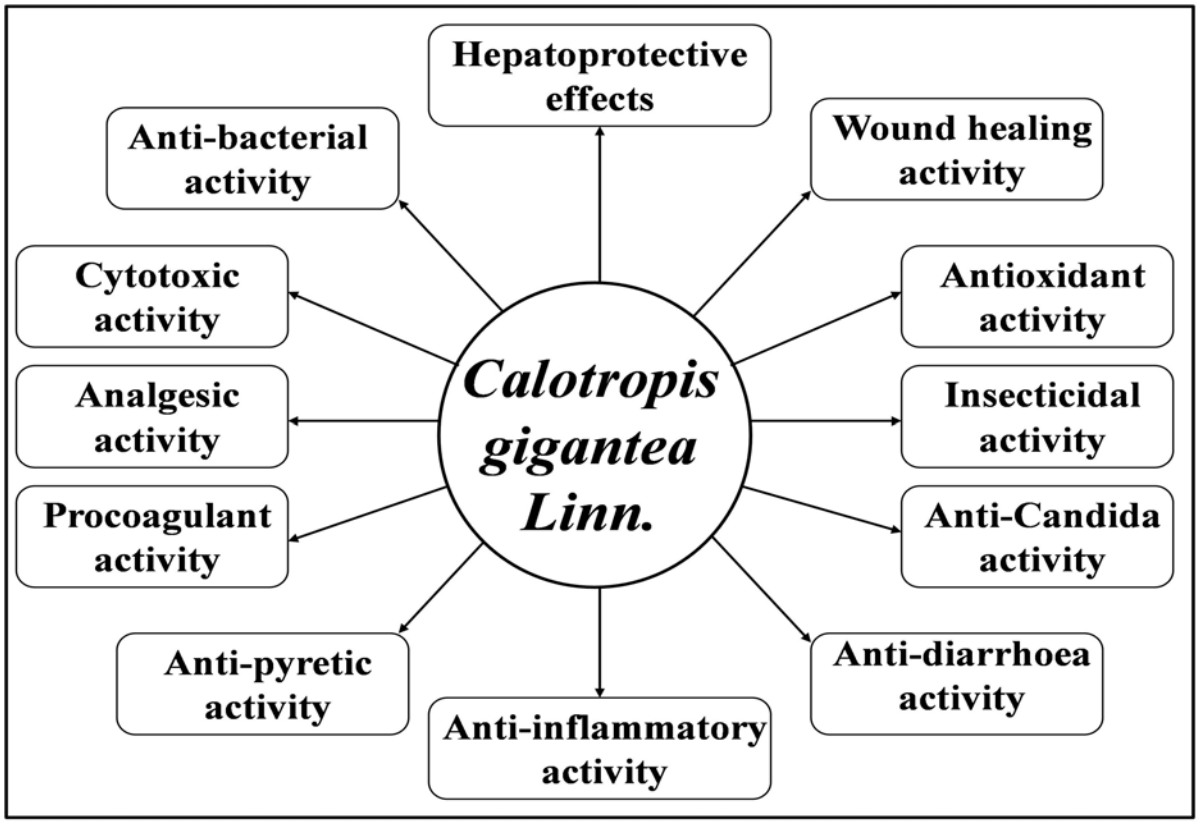

Figure 1: Medicinal properties of *C. gigantea* Linn.

Taxonomy

The plant belongs to Kingdom: Plantae, Order: Gentianales, Family: Apocynaceae, Subfamily: Asclepiadoideae, Genus: *Calotropis,* Species: *C. gigantea*

Traditional use of *C. gigantea*

In ayurveda

The leaves of *C. gigantea* are used in the treatment of paralysis, swellings and intermittent fevers. Flowers are used to cure asthma, catarrh, anorexia, helmintic infections, inflammations and fever. Root bark of the plant is used in cutaneous infections, intestinal worms, helmintic infections, cough and ascites. Powdered root are used to cure asthma, bronchitis and dyspepsia and it promotes gastric secretions.

In Siddha

The leaves of *C. gigantea* are used for the treatment of poisonous snake bites, periodic fever, vatha diseases, intestinal worms and ulcers. Root of this plant are crushed well and applied well by rubbing firmly over the bitten area. Latex of this plant is used to cure dental problems, rat bite, swellings, gonococcal arthritis and other rheumatic complaints. Flowers are used to cure bronchial asthma.

Phytochemistry

C. gigantea is reported to possess alkaloids, cyanogenic, glycosides, phenolics, tannins [19], cardenolides [20, 21], flavonoids [22], terpenes [23, 24], sterols [25], Proteinases [26] and nonprotein amino acid [27] as major phytochemical groups. A series of bioactive molecules have been reported from thee different parts of *C. gigantea*, some of them are reported in Table 1.

Table 1: Some bioactive molecules reported from different parts of *C. gigantea* Linn

Chemical constituent	Plant part	Chemical nature	Reference
19-Nor- and 18,20-Epoxy-cardenolides	Leaves	Cardenolides	20
15beta-hydroxycardenolides	Leaves	Cardenolides	21
16alpha-hydroxycalactinic acid methyl ester	Leaves	Cardenolides	21
Isorhamnetin-3-*O*-rutinoside	Arial parts	Flavonol	22
Isorhamnetin-3-*O*-Glucopyranoside	Arial parts	Flavonol	22
Taraxasteryl acetate	Arial parts	Flavonol	22
Calotropain-F1 and	Latex	Proteinases	26
Calotropain-FII	Latex	Proteinases	26
3′-methylbutanoates of α-amyrin	Latex	triterpene esters	28
ψ-taraxasterol	Latex	triterpene esters	28
Calotropins DI	Latex	Proteinases	29
Calotropins DII	Latex	Proteinases	29
Di-(2-ethylhexyl) Phthalate	Flowers	Triterpenoids	3
Anhydrosophoradiol-3-acetate	Flowers	Triterpenoids	3
Calotropone	Roots	Cardiac glycoside	9
Calotropises juiterpenol	Roots	Terpene	23
Calotropisesterterpenol	Roots	Terpene	23
Calotropbenzofuranone	Roots	Aromatic product	23
Coroglaucigenin	Roots	Cardenolides	30
Frugoside	Roots	Cardenolides	30
Stigmasterol	Root bark	Sterols	25
β-sitosterol	Root bark	Sterols	25
Giganticine	Root bark	Nonprotein amino acid	27

Medicinal properties of *C. gigantea*

Antimicrobial activity

Aqueous, methanol, ethanol and petroleum ether extracts of the leaves of *C. gigantea* were reported to possess anti-Candida activity against clinical isolate of *Candida albicans, C. parapsilosis, C. tropicalis* and *C. krusei*. [5]

The aqueous extract of leaves of *C. gigantea* was reported to possess antibacterial activity against *Staphylococcus aureus*, *Escherichia coli, Bacillus cereus, Pseudomonas aeruginosa, Micrococcus luteus* and *Klebsella pneumonia*. [6] The aqueous extract of the latex of *C. gigantea* was reported to exhibit significantly inhibitory effect on *S. aureus, B. cereus, E. coli* and *C. krusei*. [17] Antifungal activity of *C. gigantea* was reported against plant pathogenic fungi like *Fusarium mangiferae,* that causes serious threat in mango cultivation. [31]

Alam et al. (2008) reported the antibacterial activity of methanol extract from the root bark of *C. gigantea* and its petroleum ether, chloroform and ethyl acetate fractions. Both of methanol extract and its chloroform fraction showed activity against *Sarcina lutea, B. megaterium* and *P. aeruginosa*. Petroleum ether fraction showed activity against *B. subtilis* and *Shigella sonnei, w*hereas ethyl acetate fraction showed activity against *P. aeruginosa* and *E. coli.*[10]

Analgesic activity

The alcoholic extract of the flowers of *C. gigantea* was reported for analgesic activity in chemical and thermal models in mice. The analgesic activity was performed by acetic acid induced writhing test and hot plate method. Oral dose of ethanolic extract of *C. gigantea* flower produced a significant decrease in the number of writhings and delay in paw licking time. [2]

The CNS activity (analgesic activity) of alcoholic extract of peeled roots of *C. gigantea* was tested in albino rats. Analgesic activity was observed in Eddy's hot plate method and acetic acid induced writhings. Oral dose of the extract (250 and 500 mg/kg body weight) significantly delayed the paw licking time and the numbers of writhings were greatly reduced. [13]

Wound healing activity

Root bark extract of C. *gigantea* was investigated for wound healing activity in Wistar albino rats. The rats were topically treated with extract formulated in ointment for excision wound healing models and extract was given orally (100, 200 and 400 mg/kg dose) for incision wound healing models. The results indicate that extract treatment accelerated wound healing in rats. [12]

The crude latex of *C. gigantea* was evaluated for its wound healing activity in albino rats using excision and incision wound models. At a dose of 200 mg/kg/day *C. gigantea* latex showed the significant wound healing activity as treated animals exhibit 83.42 % reduction in wound area when compared to controls which was 76.22 %. The extract treated wounds are found to epithelize faster as compared to controls.[16]

Cytotoxic activity

The cardenolide glycosides collected from the root *C. gigantea* were reported to carry cytotoxic activity against several human and mouse cell lines. Calotropin, frugoside and 4'–*O*-β-D-glucopyransylfrugoside was found as the active principles. [32]

Two compounds (compound 1 and 2) isolated from ethanol extract of the roots of *C. gigantea* were reported to display inhibitory effects towards chronic myelogenous leukemia K562 and human gastric cancer SGC-7901 cell lines. [9]

Crude ethyl acetate extract from the flower of *C. gigantea* was reported to inhibit the Ehrlich's ascites carcinoma in mice. Intraperitoneal injection (50, 100 and 200 mg/kg body weight) of the extract significantly decreases the viable tumour cells and body weight gain induced by the tumour burden and prolonged survival time. The extract also restores the haematological and biochemical parameters (glucose, cholesterol, triglyceride, blood urea, ALP, SGPT and SGOT) that was altered during tumour progression, at 200 mg/kg body weight dose extract exhibits the best activity. [33]

Anti-diarrhoeal activity

The hydroalcoholic (50:50) extract of aerial part of *C. gigantea* was studied for anti-diarrhoeal activity against castor oil-induced-diarrhoea model in rats. The extract exhibited significant reductions in fecal output and frequency of droppings at the doses of 200 and 400 mg/kg body weight (intraperitoneal dose). The extract also showed significant inhibition in weight and volume of intestinal content. [4]

Anti-pyretic activity

Chitme et al. (2005) reported the anti-pyretic activity of the water:ethanol (50:50) extract of *C. gigantea* roots. Anti-pyretic activity was studied by using yeast and TAB (Typhoid) vaccine-induced pyrexia in Albino Swiss rats and rabbits. At the dose of 200 and 400 mg/kg body weight (intraperitoneal injection) extract significantly reduced the fever and body temperature was normalized. [8]

Insecticidal activity

Methanol extract of *C. gigantea* root bark and its chloroform and petroleum ether fractions were evaluated for residual film toxicity, fumigant toxicity and repellent effect against several inster of larvae and adult of *Tribolium castaneum*. Methanol extract showed high insecticidal activity against *T. castaneum* followed by petroleum ether fraction and chloroform fraction. None of the sample showed fumigant toxicity. [11]

Anti-inflammatory

Ethanol extract of *C. gigantea* was reported for the anti-inflammatory activity against carrageenan induced paw edema in Wistar albino rats. The oral administration of 400mg/kg of *C. gigantea* showed significant anti-inflammatory activity, the activity was found more than that of 100mg/kg of Ibuprofen. [34]

Antioxidant activity

Leaves of *C. gigantea* were reported to carry antioxidant activity. The study reports the DPPH radical scavenging activity, reducing power activity and nitric oxide scavenging activity of the hydroalcohlic extract of *C. gigantea* leaves. Extract exhibited the maximum DPPH radical scavenging activity (85.17%) at 400µg/ml concentration. At 100µg/ml concentration extract showed 54.55% nitric oxide scavenging activity. Reducing power of the extract was found to increase with increasing the concentration of extract. [7]

Pregnancy interceptive properties

Different organic solvents of *C. gigantea* roots were reported to exhibit pregnancy interceptive activity in rats. The extract exhibited 100% pregnancy interceptive activity at a dose of 100 mg/kg. The extract also exhibited 100% efficacy at the dose of 12.5 mg/kg when administered in the Days 1-5 and 1-7 postcoitum schedules. [14]

Procoagulant activity

The latex of *C. gigantea* is reported to carry procoagulant activity. The latex extract hydrolysed casein, human fibrinogen and crude fibrin clot in a dose dependent manner. Extract hydrolyses the subunits of fibrinogen, subunit Aa hydrolyzed first followed by Bb and g subunit. The crude extract hydrolysis crude fibrin clot strongly compared to trypsin and papain. Proteins present in the latex of *C. gigantea* are strongly proteolytic and responsible for procoagulant activity of *C. gigantea.* [15]

Hepatoprotective effects

Ethanol extract of stems of *C. gigantea* was reported for hepatoprotective activity in male Wistar rats against carbon tetrachloride induced liver damage. The extract resulted in significantly decreased of AST, ALT and lipid peroxide levels and showed effective protection of liver. The extract also protects the rats from oxidative damage. [18]

Conclusion

In recent years, ethnomedicinal studies received much attention as this brings to light the numerous little known and unknown medicinal virtues especially of plant origin. Pharmacological screenings of *C. gigantea* revealed its medicinal potential and represents as a valuable medicinal plant with several medicinal properties. As the pharmacologists are looking forward to develop new drugs from natural sources, development of modern drugs from *C. gigantea* can be emphasized for the control of various diseases. A systemic research and development work should be undertaken for the conservation of *C. gigantea* and development of products for their better economic and therapeutic utilization.

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