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Pharmacognosy, Chemical Constituent and Pharmacological Uses of *Calotropis gigantea*: A Review

	
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ABSTRACT

Calotropis gigantea was traditionally used medicinal plant in AYUSH. *Calotropis* is a plant belonging to the family Apocynaceae and also known as gaint milkweed commonly named Madar (Hindi) & Rui (Marathi). *Calotropis gigantea* is a perennial herb. *Calotropis* was considered as a genetic resource and can be used as food, fertilizer, fuel, vermifuge. *Calotropis* found in all parts of India & some parts of Srilanka, Pakistan, China, Indonesia, Malaysia, Africa. The extract of *Calotropis gigantea* shows various active constituents like Giganteol, isogigantiol, B-amyrin, A-B-calotropeal, Alkaloids, Terpenoids, Steroids, Flavonoids, Tannins, Saponin, Carbohydrate, Glycoside, Resins, Peroxide & Polyuronoids etc possessing activities as Antimicrobial activity, Antioxidant activity, Anthelmintic activity, Antipyretic activity, Antidiarrhoeal activity, Anti Flatulence activity, Wound healing activity, Insecticidal, Expectorant, Sedative, Leprosy, Ulcer inducing agent, Astringent, Tonic, Antidote, Stomach ache, Cholera & Toothache.

INTRODUCTION

An herb is a plant or plant part used for its odour, flavour, or therapeutic properties. Herbal medicines are one type of the dietary supplement. They are sold as the tablets, capsules, powders, teas, extracts, and fresh or dried plants. People use herbal medicines to try to maintain or improve their health problems. Many people believe that products labelled "natural" are always safe and good for their health. This is not necessarily true. Herbal medicines do not go through the testing that allopathy drugs do. Some herbs, such as comfrey and ephedra, can cause serious harm to the health. Some herbs can interact with prescription or the drugs sold over-the-counter.

Herbal Medicine is an open access journal and the main aim of this journal to provide a platform for students, scientists and researchers in Herbal medicine and Ayurveda fields all over the world to present their new ideas, information and discuss new strategies, and promote developments in all areas of Herbal Medicine.

PLANT PROFILE

Synonyms:

Sanskrit synonyms: Arka, Alaka Mandara, Vasuka, Pushpaka, Ushmarashmi, Ravi, Bhanu, Shvetamandara, Haridashwa, Kheere, etc.

Biological Source: It consists of dried flowers, leaves and roots of *Calotropis gigantea* belonging to the family Asclepiadaceae.

Table No. 1: Regional Names of *Calotropis gigantea*

English	Mudar, Madar, Giant milkweed, Muda-ycum etc.
Hindi	Ark, Aanka, Aka, Arka, Aaka, Ak, Madara etc.
Marathi	Ruee, Mudi, Lal madar etc.
Bengali	Aankada, Swetakonda etc.
Behari	Moortakanda
Gujarati	Aakado, Akro, Nihanoakdo etc.
Kashmir	Aka.
Tamil	Arukkan, Erukama etc
Telugu	Jilledachetta, Mandaram etc.
Urdu	Ak
Dravid	Yorikke.

Geographic distribution:

It is a native of India, China and Malaysia and distributed in the following countries: Algeria, Afghanistan, Arab Jamahiriya, Burkina Faso, Chad, Cote d'Ivoire, Cameroon, Democratic Republic of Congo, Ethiopia, Eritrea, Egypt, Ghana, Gambia, Guinea-Bissau, Iran, India, Israel, Iraq, Kenya, Kuwait, Lebanon, Libyan, Morocco, Myanmar, Mozambique, Mauritania, Mali, Niger, Nigeria, Nepal, Oman, Pakistan, Senegal, Sudan, Syrian Arab Republic, Saudi Arabia, Somalia, Sierra Leone, Thailand, Tanzania, United Arab Emirates, Uganda, Vietnam, Yemen, Republic of Zimbabwe^[1].

Scientific Classification:

Kingdom	Plantae
Order	Gentianales
Family	Asclepiadaceae
Subfamily	Asclepiadoideae
Tribe	Asclepiadaceae
Subtribe	Asclepiadinae
Genus	Calotropis
Species	Gigantea

Morphological Property



Figure No. 1: *Calotropis gigantea* plant




Microscopical Study:

Microscopical characteristics of the leaf:

Transverse sections through the midrib showed an upper and lower, single-layered epidermis that was externally covered with a thick, striated cuticle, a few epidermal cells on both lower and upper surfaces, parenchymatous cells that were thin-walled and isodiametric to circular. Intracellular spaces were present in ground tissue and the stele was crescent-shaped and composed of bicollateral and open vascular bundles. The xylem consisted mostly of vessels and tracheids, and a strip of cambium was present between the xylem and phloem tissues. Laticifers were also present along with the phloem and parenchymatous zone.

The lamina which was dorsiventral with the mesophyll was seen to be differentiated into a palisade and spongy tissue. The upper and lower epidermis was covered externally with a thick, striated cuticle. Below the upper epidermis were three rows of elongated, closely arranged, palisade parenchyma. Spongy parenchyma tissues were almost radially elongated with intracellular spaces. Central cells were irregular in shape; laticifers and vascular bundles were also present scattered in this region.

Table No. 2: Systemic position of the *Calotropis gigantea*

Characteristic	Leaf	Root	Flower
	 <p>Fig. No. 2. <i>Calotropis gigantea</i> leaves</p>	 <p>Fig. No. 3. <i>Calotropis gigantea</i> Roots</p>	 <p>Fig. No. 4. <i>Calotropis gigantea</i> Flowers</p>
Colour	Green	Whitish grey	White or lavender
Shape	Sessile and sub-sessile, opposite, ovate, cordate at the base	Cubical	Five pointed petals and a small "crown" rising from the center which holds the stamens
Size	6-15 cm by 4.5-8 cm	Depending on size of plant	3.8 to 5.1 cm
Odor	Unpleasant	No Fragrance	No Fragrance
Chemical constituent	Sapogenins, holarrhetine; cyanidin-3-rhamnoglucoside; taraxasterol isovalerate. mudarine and three glycosides calotropin uscharin, calotoxin along with phenol.[2]	Calotropnaphthalene [naphthalenederivative], calotropisesquiterpenol, calotropisesterterpenol [terpene derivatives], calotropbenzofuranone [aromatic product] and sucrose.[3]	Ester of α -and β -calotropeols.[4]
Uses	Anti-diarrhoeal activity, anti-Candida activity [5] and antibacterial activity, antioxidant activity	Anti-pyretic activity, cytotoxic activity, antimicrobial activity, insecticidal activity, wound healing activity, CNS activity and pregnancy interceptive properties	Analgesic activity, antimicrobial and cytotoxic activity

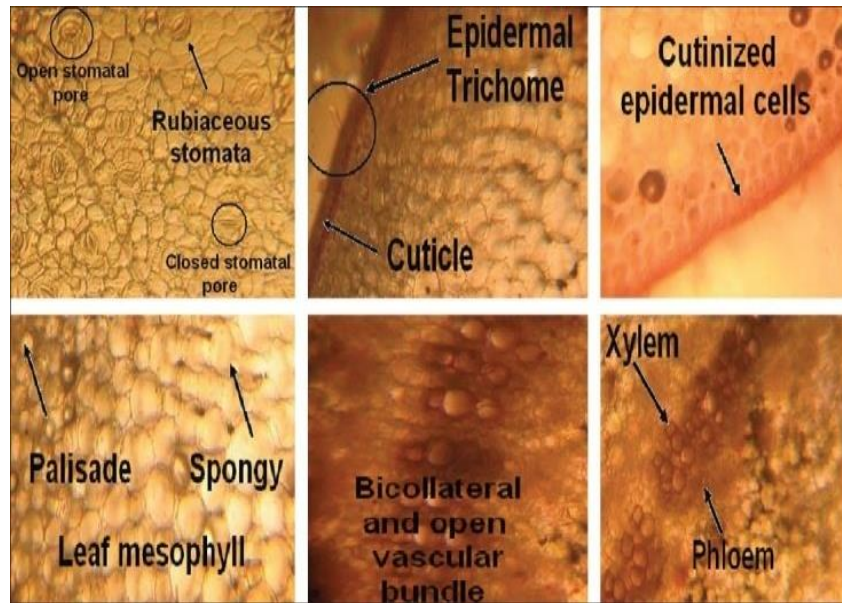


Figure No. 5: Microscopy of *Calotropis gigantea* leaf

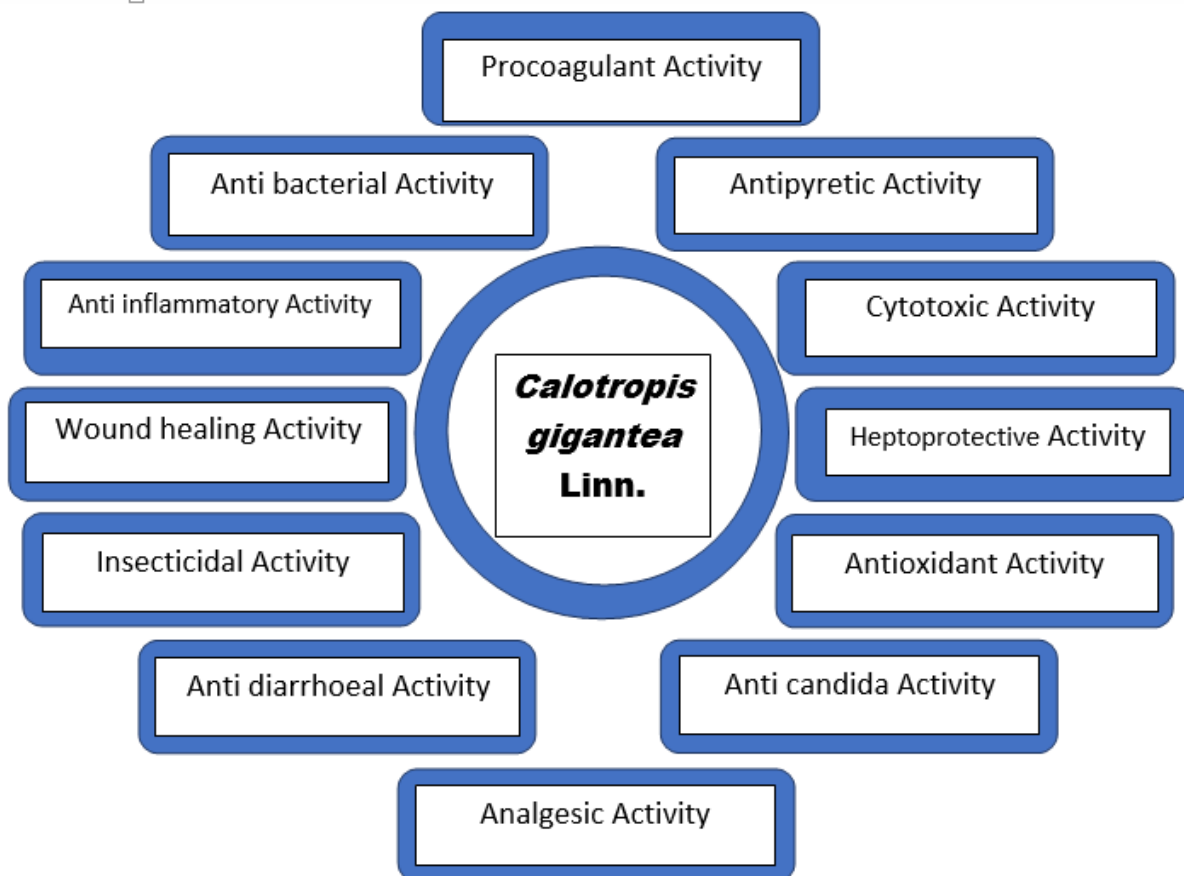


Figure No. 6: Medicinal properties of *C. gigantea* Linn.

Uses:

Calotropis gigantea is used as Asthma [19,20], Abortifacient [21,22], Analgesic and Antinociceptive activity [23], Antifertility and emmenagogue, Anti-inflammatory activity [24,25], Anthelmintic activity [26], Anti cancer activity [27,28], Anti dote for Scorpion stings and insect bites [29], Antitumor activity [30], Anti-diarrheal and anti dysentery activities [30], Antimicrobial activity [31], Antiviral activity [32], Anxiety and pain [33], CNS Activity [34], Cold [35], Dyspepsia [36], Cytostatic activity [38], Expectorant [37], Epilepsy [39], Elephantiasis of the legs and scrotum [40], Expectorant [41], Fibrinolytic activities [42], Free radical Scavenging activity [43], (Goat) Motility of mature *Haemonchus contortus* of goat origin [44], kesarayer disease [45], Leprosy [46], Liver injuries as well as on oxidative stress, Hepatoprotective [47], Mental disorders [48], Migrine [49], Nasal ulcer, laxative, rheumatoid arthritis, bronchial asthma, diabetes mellitus, nervous disorders [50], Piles [51], Pregnancy interceptive activity [52], Purgative [53], Removing anemia [54], Rheumatism [55], Secondary syphilis, gonorrhoea, ascites, helminthiasis, and jaundice [56], Skin diseases [57], Spleen disorder [58], Swelling and inflammation in sprain [59], TB and leprosy [60], Uterus stimulant [61], Vermicidal activity [62], Worms. [63]

Chemical Constituents:

The extracts of *Calotropis gigantea* shows various active constituents like Giganteol^[18], isogigantiol^[18], B-amyirin^[16], A-B-calotropeal^[17], Alkaloids^[14], Terpenoids^[13], Steroids^[14], Flavonoids^[12], Tannins, Saponin [14], Carbohydrate, Glycoside^[15], Resins^[14], Peroxide & Polyuronoids etc.

Table No. 3: Chemical Constituent of *Calotropis gigantea*

Parts of Plant	Chemical constituents
Leaves	Sapogenins, holarrhettine; cyanidin-3-rhamnoglucoside; taraxasterol isovalerate. mudarine and three glycosides calotropin uscharin, calotoxin along with phenol.
Latex	Water and water soluble substance (86-95.5%) and caoutchouc (0.6-1.9%). The coagulam consist of caoutchouc (5.1-18.6), resin (73.6-87.8) and insoluble matter (4.5-13.8%).[6] α - and β -calotropeols (also in latex); latex-protease, calotropains FI & FII, flower β -amyirin, stigmasterol. ^[7] Calotoxin, uscharin, and calactin. Two new Triterpene ester-3'-methyl butanoates of α -amyirin and Ψ taraxasterol-isolated from latex.
Stem Bark	Giganteol, α and β calotropeol, β -amyirin.
Seed	Oil extracted from seeds contains palmitic, oleic, linoleic and linolenic

	acid. The unsaponifiable fraction contains phytosterol, stigmasterol, melissyl alcohol and laurane.
Root Bark	Root bark contains β -amyrin, two isomeric crystalline alcohols, giganteol and isogiganteol.
Root	Calotropnaphthalene [naphthalene derivative], calotropisesquiterpenol, calotropisesterterpenol [terpene derivatives], calotropbenzofuranone [aromatic product] and sucrose.
Flower	Ester of α -and β -calotropeols.

PHARMACOLOGICAL ACTIVITIES

Antimicrobial activity:

The aqueous extract of leaves of the *Calotropis gigantea* was reported to possess antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Bacillus cereus*, *Micrococcus luteus* and the *Klebsiella pneumoniae* [64]. Antifungal activity of an *Calotropis gigantea* was reported against the plant pathogenic fungi like *Fusarium mangiferae*, that causes serious threat in the mango cultivation.^[65]

Alam *et al.* (2008) reported that the antibacterial activity of the methanol extract from the root, bark of *C. gigantea* and its petroleum ether, chloroform and ethyl acetate fractions. Both of the methanol extract and its chloroform fraction showed activity against *Sarcina lutea*, *B. megaterium* and *P. aeruginosa*. Petroleum ether fraction showed activity against the *B. subtilis* and *Shigella sonnei*, whereas ethyl acetate fraction showed activity against the *P. aeruginosa* and *E. coli*.⁶⁶

Analgesic activity

The alcoholic extract of the flowers of *C. gigantea* was reported for an analgesic activity in chemical and the thermal models in mice and rats. The analgesic activity was performed by an acetic acid induced writhing test and the hot plate method. Oral dose of ethanolic extract of *C. gigantea* flower gives a significant lowering in the number of writing and delay in paw licking time.^[67]

The CNS activity (analgesic activity) of an alcoholic extract of peeled roots of the *C. gigantea* was tested in albino rats. Analgesic activity was observed in the Eddy's hot plate method and acetic acid induced writhing. Oral dose of the extract (250 and 500 mg/kg body weight) significantly delayed the paw licking time and the numbers of writing were greatly decreased.^[69]

Wound healing activity

Root bark extract of *C. gigantea* was investigated for a wound healing activity in Wistar albino rats. The rats were topically treated with the extract formulated in ointment for excision wound healing models and the 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. [68]

The crude latex of *C. gigantea* was evaluated for its wound healing activity in the 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 the controls. [70]

Cytotoxic activity:

The cardenolide glycosides collected from the root *C. gigantea* were reported to hold cytotoxic activity against several human and mouse cell lines. Calotropin, frugoside and 4'-O- β -Dglucopyransylfrugoside was found as the active principles. [64] 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 leukaemia K562 and human gastric cancer SGC-7901 cell lines. [71] Crude ester 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 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. [72]

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 weight (intraperitoneal dose). The extract also showed significant inhibition in weight and volume of intestinal content. [73]

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.[74]

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.[75]

Anti-inflammatory activity:

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.[76]

Antioxidant activity:

Leaves of *C. gigantea* were reported to carry antioxidant activity. The study reports the DPPH radical scavenging activity, reducing power activity and gas scavenging activity of the hydroalcoholic extract of *C. gigantea* leaves. Extract exhibited the utmost DPPH radical scavenging activity (85.17%) at 400µg/ml concentration. At 100µg/ml concentration extract showed 54.55% gas scavenging activity. Reducing power of the extract was found to increase with increasing the concentration of extract.[77]

Pregnancy interceptive property:

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.[78]

Procoagulant activity:

The latex of *C. gigantea* is reported to carry procoagulant activity. The latex extract hydrolysed casein, human fibrinogen and crude fibrin clot during a dose dependent manner. Extract hydrolyses the subunits of fibrinogen, subunit A hydrolysed 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 liable for procoagulant activity of *C. gigantea*. [79]

Hepatoprotective activity:

Ethanol extract of stems of *C. gigantea* was reported for hepatoprotective activity in male Wistar rats against carbon tet 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.[80]

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