



**Review Article**

**PHARMACOLOGICAL AND BIOLOGICAL OVERVIEW ON *CALOTROPIS GIGANTEAN*: A COMPREHENSIVE REVIEW**

**\*Baby Joseph, Jency George, Jeevitha M.V, Sissy Charles**

Interdisciplinary Research Centre, Department of Biotechnology, Malankara Catholic College, Mariagiri, Kaliakkavilai, Tamil Nadu, India.

Corresponding Author : Baby Joseph, Email: [petercmiscientist@yahoo.co.in](mailto:petercmiscientist@yahoo.co.in)

**Abstract:** *Calotropis gigantea* (Asclepiadaceae) is a glabrous or hoary, laticiferous shrubs or small trees, commonly known as “the swallow-wort or milkweed”. *Calotropis* is used as a traditional medicinal plant. *C. gigantea* contain chemical constituents are cardenolides, flavonoids, terpenes, pregnanes and a nonprotein amino acid. The latex, leaves, flowers, bark, root is also used as caustic, acrid, expectorant, depilatory, 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. This review gives a brief idea about its phytochemistry and pharmacological activity.

**Keywords:** Procoagulant activity, Calotropin, Phytochemistry, *Calotropis gigantean*.

**INTRODUCTION**

Herbal medicines, also referred to as botanical medicine or phytomedicine, include herbs, herbal materials, herbal preparations and finished herbal products that contain parts of plants or other plant materials as active ingredients. The World Health Organization has estimated that 80% of people in some Asian and African countries rely on herbal medicines for some part of their primary health care. Finding healing powers in plants is an ancient idea, especially in India. Currently 25 to 50% of all pharmaceuticals dispensed around the world are of plant origin and only few among them have been used as antimicrobials.

The *Calotropis gigantean*, invites attention of the researchers worldwide for its pharmacological activities such as anti diabetic, antitoxin, antihepatotoxin, antioxidant and wound healing activity. Latex contains the cardiac glycosides, calotropin, uscharin, calotoxin, calactin and uscharidin; gigantinin<sup>1</sup>. All parts of the tree are considered to possess medicinal properties and used in the treatment of syphilis, boils, inflammation, epilepsy, hysteria, fever, muscular spasm, warts, leprosy, gout, snakebites, and cancer. The purpose of this article is to review phytochemical and pharmacological properties of this medicinal plant.

**SCIENTIFIC CLASSIFICATION:**

Kingdom	:	Plantae
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Order	:	Gentianales
Family	:	Apocynaceae
Genus	:	<i>Calotropis</i>
Species	:	<i>C. gigantean</i>

**COMMON NAMES:**

English: Bowstring hemp, calotrope, crown flower, crown plant, gaint milk weed,  
Hindi: Safed aak  
Kannada: Ekka  
Manipuri: Angkot  
Tamil: Erukku  
Telugu: Jilledi puvvu  
Sanskrit: Svetarka

**ORIGIN AND DISTRIBUTION:**

*Calotropis gigantea* is native to continental Asia and South-East Asia and has been introduced in the Pacific Islands, Australia, Central and northern South America and Africa as an ornamental near villages and temples and as a weed. In Africa it is recorded from Gabon, DR Congo, Sudan, Kenya, Tanzania, Angola and Mozambique, as well as from Seychelles and Mauritius. However, its distribution is incompletely known, and it probably occurs in other countries as well<sup>2</sup>.

**BOTANICAL DESCRIPTION:**

Large shrub or small tree up to 4-10m tall, much-branched at base, stems erect, up to 20 cm in diameter; bark pale grey, longitudinally cracked; young shoots woolly hairy; latex in all parts. Leaves opposite, decussate, simple and entire, sessile; stipules absent; blade broadly ovate to oblong-obovate, 9.5–20 cm × 6–12.5 cm, base cordate with semi-amplexicaul lobes, apex almost acute, short-hairy beneath. Inflorescence an axillary, umbellate to almost corymbose cyme up to 12.5 cm in diameter, peduncle 6–12 cm long, stout, secondary branches up to 2 cm long. Flowers bisexual, regular, 5-merous, white, cream, lilac or purple; pedicel 2.5–4 cm long, densely woolly hairy; calyx lobes broadly ovate, 4–6 mm × 2–3 mm; corolla 2.5–4 cm in

diameter, lobes broadly triangular, 10–15 mm × 5–8 mm; corona with 5 narrow, fleshy scales, laterally compressed, 6–11 mm long, adnate to and shorter than the staminal column, forming an upturned horn with 2 rounded auricles on either side, cream or lilac to purple, with a dense longitudinal dorsal row of short white hairs; ovary superior, 2-celled, gynostegium up to 1 cm long, stigma head star-

shaped. Fruit contain a pair of follicles, each follicle ovoid and boat-shaped, inflated, 6.5–10 cm × 3–5 cm, many-seeded. Seeds are attached with abundant white coma and seeds are ovoid, 5–6 mm long, with 2–3 cm long coma at one end<sup>3</sup>. Botanical description of *Calotropis gigantean* shown in **Table: 1**.

**Table: 1 Botanical description of *Calotropis gigantean***

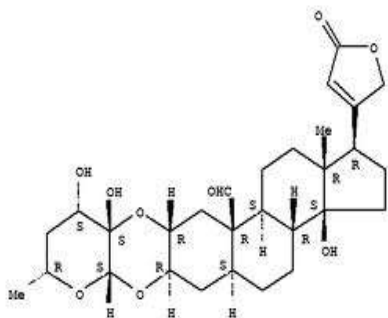
Characters	<i>Calotropis gigantean</i>
Plant	Evergreen shrub or small tree
Bark	Whitish, thick and corky, pale grey
Wood	Whitish and soft
Leaves	Opposite, decussate, simple and entire, sessile, stipules absent, leathery and pale green
Flowers	Bisexual, regular, 5-merous, white, cream, lilac or purple
Fruit	Kidney-shaped fruit, green and becomes brown when mature
Seeds	Ovoid
Harvesting	The leaves, flowers and roots of <i>Calotropis gigantea</i> are harvested throughout the year.

#### DISEASES AND PESTS:

The leaf hopper *Poecilocus pictus* is a pest of *Calotropis gigantea* plants. The oleander aphid (*Aphis nerii*) and the caterpillars of the tiger butterfly (*Danaus chrysippus*) and of the monarch butterfly (*Danaus plexippus*) feed on *Calotropis* spp., using the cardenolides as a chemical defence mechanism. The nematodes *Meloidogyne incognita* and *Meloidogyne javanica* are found on the roots of *Calotropis gigantea* in India, although the leaf extract kills them. A sap-transmissible mosaic disease of *Calotropis gigantea* is transmitted by *Aphis nerii*<sup>4</sup>.

#### PRINCIPAL CONSTITUENTS OF CALOTROPIS GIGANTEAN:

The latex of *Calotropis gigantea* contains cardiac glycosides, calotropin, uscharin, calotoxin and gigantol. The resinol portion consists mainly of two new alcohols,  $\alpha$  and  $\beta$ -calotropeols in almost equal quantities and minor amounts of  $\beta$ -amyrin. Also mixture of tetracyclic triterpene, fatty acids, flavanoids, alkaloids, proteolytic enzyme calotropain, traces of sterols<sup>5</sup>. Structure of calotropin shown in **Figure: 1**.



**Figure: 1 Calotropin**

#### PHARMACOLOGICAL ACTIVITY:

*Calotropis gigantea* are used for the treatment of various disorders including life-threatening diseases. Researchers have done different *in vivo* and *in vitro* pharmacological screenings to authenticate the traditional uses. These studies have revealed the potential of the plant to be developed as a curative agent from natural resources.

#### HEPATOPROTECTIVE ACTIVITY

Ethanol extract (50 %) of stems of *Calotropis gigantea* R. Br. (Asclepiadaceae) at doses of 250 and 500 mg kg<sup>-1</sup> were studied for hepatoprotective activity in male Wistar rats with liver damage induced using carbon tetrachloride, 2 mL kg<sup>-1</sup> twice a week. The protective effect of *C. gigantea* extract was compared with the standard drug silymarin. Various biochemical parameters such as aspartate amino transferase (AST), alanine amino transferase (ALT), glutathione (GSH), lipid peroxide (LPO), superoxidodismutase (SOD), glutathione peroxidase (GPx) and catalase (CAT) were evaluated<sup>5</sup>.

#### 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 ethanol extract of *C. gigantea* flower produced a significant decrease in the number of writhings and delay in paw licking time<sup>6</sup>.

#### WOUND HEALING ACTIVITY

The effects of *Calotropis gigantea* root bark on wound healing activity in rats by excision, incision and dead space wound healing models in rats was investigated. The percentage of wound closure; epithelization time, hydroxyproline content and scar area on complete epithelization were measured. Topical application of *Calotropis gigantea* in excision wound model increased the

percentage of wound contraction. Scar area and epithelization time were decreased. In incision wound and dead space wound breaking strength of wounds and hydroxyproline was increased<sup>7</sup>.

#### 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*<sup>8</sup>.

#### ANTI INFLAMMATORY AND ANTIPYRETIC ACTIVITY

Chloroform, n-butanol, ethanol and distilled water extracts of leaves of *Calotropis gigantea* (Linn.) was screened for anti-inflammatory and antipyretic activities. Anti-inflammatory was compared with standard drug Paracetamol for Carrageenan induced rat paw oedema method. The antipyretic activity compared with standard drug Paracetamol in Yeast induced pyrexia method in albino rats. In all method chloroform, n-butanol, ethanol and distilled water extracts showed better results statistical significance<sup>9</sup>.

#### ANTICONVULSANT AND CENTRAL NERVOUS SYSTEM ACTIVITY

Alcoholic extract of peeled roots of *Calotropis gigantea* R.Br. (Asclepiadaceae) was tested orally in albino rats at the dose level of 250 and 500 mg/kg bodyweight for CNS activity. Prominent analgesic activity was observed in Eddy's hot plate method and acetic acid induced writhings. The paw licking time was delayed and the numbers of writhings were greatly reduced. Significant anticonvulsant activity was seen as there was a delay in the onset of pentylenetetrazole induced convulsions as well as decrease in its severity. The extract treated rats spent more time in the open arm of EPM showing its antianxiety activity. There was a decrease in the locomotor activity. The fall off time (motor coordination) was also decreased. A potentiation in the pentobarbitone-induced sleep due to the sedative effect of the extract was observed. No mortality was seen upto the dose of 1 g/kg. These results show the analgesic, anticonvulsant, anxiolytic and sedative effect of the extract<sup>10</sup>.

#### ANTI-DIARRHOEAL ACTIVITY

The anti-diarrheal effect of hydroalcoholic (50:50) extract of aerial part of *Calotropis gigantea* was studied against castor oil-induced-diarrhea model in rats. The gastrointestinal transit rate was expressed as the percentage of the longest distance traversed by the charcoal divided by the total length of the small intestine. The weight and volume of intestinal content induced by castor oil were studied by enteropooling method. Like atropine (3 mg/kg, i.p.) there were significant reductions in fecal output and frequency of droppings when the plant extracts of 200 and 400 mg/kg doses were administered intraperitoneally compared with castor oil

treated rats. All doses of the plant extracts also significantly retarded the castor-oil induced enteropooling and intestinal transit. The dose 100 (P<0.01), 200 and 400 mg/kg significantly inhibited (P<0.001) weight and volume of intestinal content. The remarkable anti-diarrheal effect of *C. gigantea* extract against castor oil-induced diarrhea model attests to its utility in a wide range of diarrhoeal states<sup>11</sup>.

#### ANTIOXIDANT ACTIVITY

The effect of chloroform extracts of *Calotropis gigantea* leaf and flower on free radical scavenging activity, and lipid profile in streptozotocin-induced diabetic rats was investigated. The lipid peroxidation, superoxide dismutase, and catalase were measured in liver homogenate and serum glutamic pyruvic transaminase, serum glutamic oxaloacetic transaminase, alkaline phosphatase, lipid profile were measured in blood serum<sup>12</sup>.

#### ANTIVENOM ACTIVITY

The antivenom activity of *Calotropis gigantea* plant extract against *Vipera russelli* snake venom was evaluated. The lyophilized snake venom of *Vipera Russelli* was dissolved in saline and required concentrations were prepared. Lyophilized polyvalent snake venom antiserum was used as reference serum. The methanolic extract of *Calotropis gigantea* was evaluated for its efficacy to neutralize various actions of the venom like lethality, necrotizing activity, edema forming activity and haemorrhagic activity. Present study confirms the anti snake venom activity of alcoholic extract of *C. gigantea*<sup>13</sup>.

#### BIOCIDAL ACTIVITY:

##### ANTIBACTERIAL ACTIVITY

The fresh dried leaves of the plant *Calotropis gigantea* were successively extracted with chloroform, ethyl alcohol, ethyl acetate and dichloromethane using Soxhlet extractor. Aqueous extract was prepared by cold maceration method. Well plate method was employed to determine the antibacterial activity against certain Gram positive bacteria like *B.subtilis* NCIM 2063, *Micrococcus luteus* NCIM 2704, *Staphylococcus aureus* NCIM 2079 and Gram negative bacteria namely, *K.pneumoniae* NCIM 2719, *P. vulgaris* NCIM 2027 and *E.coli* NCIM 2118. Ethyl acetate and dichloromethane extracts showed better and broader spectrum of activity when compared to other extracts. Ciprofloxacin (10 µg/well) was used as the standard antibacterial agent<sup>14</sup>.

##### ANTIFUNGAL ACTIVITY

Evaluate the antifungal effect of partially purified *C. gigantea* latex extract on some human pathogenic fungi. Ethanolic extract of the latex were tested *in vitro* against fungi strains. The inhibitory effect was assessed by disc diffusion method. The latex extract possesses potent fungicidal activity which may be due to the presence of biologically active ingredients with antimicrobial activity in the ethanolic extract of *C. gigantea* latex<sup>15</sup>.

##### INSECTICIDAL ACTIVITY

The residual film toxicity, fumigant toxicity and repellent effect of methanol extract of root bark of *Calotropis gigantea* (Linn) and its chloroform and petroleum ether (40-60°C) soluble fractions were evaluated against several insect

of larvae and adult of *Tribolium castaneum*. In residual film toxicity, methanol extract and its chloroform and petroleum ether fractions showed insecticidal activity against *T. castaneum* and data were analyzed by probit analysis<sup>16</sup>.

#### TOXICOLOGICAL STUDIES:

##### ACUTE TOXICITY STUDIES

Acute toxicity study was conducted to determine the median lethal dose (LD50) of the methanolic extract of plant *Calotropis gigantea*. The toxicity studies were carried out according to OECD guidelines- 425. Rats of either sex (three females and three males, weight: 200-220 g, age: 1.5-2 months) received methanolic extract of the plant *Calotropis gigantea*, suspended in 0.6% Na CMC starting dose at 2000mg/kg of body weight orally. The animals were observed for toxic symptoms continuously for the first 4 hrs after dosing. Finally, the number of survivors was noted after 24 hrs<sup>17</sup>.

##### TRADITIONAL USES:

*Calotropis* is used as a traditional medicinal plant with unique properties. Traditionally *Calotropis* is used alone or with other medicinals to treat common disease such as fevers, rheumatism, indigestion, cough, cold, eczema, asthma, elephantiasis, nausea, vomiting, and diarrhea. According to Ayurveda, dried whole plant is a good tonic, expectorant, depurative, and anthelmintic. The dried root bark is a substitute for ipecacuanha. The root bark is febrifuge, anthelmintic, depurative, expectorant, and laxative. The powdered root used in asthma, bronchitis, and dyspepsia. The leaves are useful in the treatment of paralysis, arthralgia, swellings, and intermittent fevers. The flowers are bitter, digestive, astringent, stomachic, anthelmintic, and tonic. *Calotropis* is also a reputed Homoeopathic drug.

*Calotropis* yields a durable fiber (commercially known as Bowstring of India) useful for ropes, carpets, fishing nets, and sewing thread. Floss, obtained from seeds, is used for stuffing purposes. Fermented mixture of *Calotropis* and salt is used to remove the hair from goat skins for production of "nari leather" and of sheep skins to make leather which is much used for inexpensive book-binding. Fungicidal and insecticidal properties of *Calotropis* have been reported. Allelopathic effects of *Calotropis* on different agricultural crops have not been well studied. Extracts of different plant parts viz. root, stem, leaf, and stem and leaf of *Calotropis* affect germination and seedling vigor of many agricultural crops have been reported. However, extracts of *Calotropis* failed to produce any detrimental effects on weeds such as *Chenopodium album*, *Melilotus alba*, *Melilotus indica*, *Sphaeranthus indicus*, and *Phalaris minor*.

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<sup>17</sup>.

#### CONCLUSION

This review has focused on the Pharmacological activity, Biocidal Activity and Toxicological Studies. Pharmacological activity includes antioxidant activity, Anti-diarrhoeal activity, Anticonvulsant and Central nervous system activity, Procoagulant activity. Biocidal Activity includes Insecticidal activity and Pesticidal activity, Antibacterial activity, Antifungal activity. Toxicological Studies includes Acute Toxicity of the plant *Calotropis gigantea*.

*Calotropis gigantea* is a plant with much potential and is useful in many diseases. Though *Calotropis gigantea* has various medicinal applications, but it is the need of hour to explore its medicinal values at molecular level with help of various biotechnological tools and techniques. Further studies should be conducted to elucidate the molecular mechanism of interaction of various plant based drugs with human in different diseases.

#### Conflict of interest statement

We declare that we have no conflict of interest.

#### REFERENCE

1. Narendra Nalwaya, Gaurav Pokharna, Lokesh Deb, Naveen Kumar Jain. Wound Healing Activity of Latex Of *Calotropis gigantea*, *International Journal of Pharmacy and Pharmaceutical Sciences*, **2009**; 1(1): 176-181.
2. Aiton WT, Jiofack Tafokou RB. *Calotropis gigantea* (L.) Record from Protabase. Schmelzer, G.H. & Gurib-Fakim, A. (Editors). PROTA (Plant Resources of Tropical Africa / Ressources végétales de l'Afrique tropicale), Wageningen, Netherlands, **2010**.
3. Prateek Shilpkar, Mayur Shah, Chaudhary DR. An alternate use of *Calotropis gigantea*: Biomethanation, *Current science*, **2007**; 92(4): 435-437.
4. Bhagat RC. Aphids (Insecta) damaging medicinal and aromatic plants of Jammu and Kashmir State (India): An updated checklist and biodiversity, *Indian J. Applied & Pure Bio*, **2012**; 27(1):1-10.
5. Gaurav Iodhi, Hemant kumar sing, Kamlesh K pant, Zeashan Hussain. Hepatoprotective effects of *calotropis gigantea*, *Acta pharmaceutica*, **2009**; 59: 89-96.
6. Pathak AK, Argal A. Analgesic activity of *Calotropis gigantea* flower. *Fitoterapia*, **2007**; 78(1): 40-42.
7. Deshmukh PT, Fernandes J, Atul A, Toppo E. Wound healing activity of *Calotropis gigantea* root bark in rats. *J Ethnopharmacol*, **2009**; 125 (1): 178-81.
8. Rajesh R, Raghavendra Gowda CD, Nataraju A, Dhananjaya BL, Kemparaju K, Vishwanath BS. Procoagulant activity of *Calotropis gigantea* latex associated with fibrin(ogen)olytic activity. *Toxicol*, **2005**; 46(1): 84-92.
9. Mahatma OP, Singhvi I, Shirsat Mrunal K, Dwivedi J, Vaya R. Antiinflammatory and antipyretic activities leaves of *Calotropis gigantea* (Linn), *Journal of Global Pharma Technology*, **2010**; 2(4): 75-78.
10. Argal A, Pathak AK. CNS activity of *Calotropis gigantea* roots. *J Ethnopharmacol*, **2006**; 106(1): 142-5.
11. Chitme HR, Chandra M, Kaushik S. Studies on anti-diarrhoeal activity of *Calotropis gigantea* R.Br. in

- experimental animals, *J Pharm Pharm Sci*, **2004**; 7(1): 70-5.
12. Rathod NR, Raghuveer I, Chitme HR, Chandra R. Free radical scavenging activity of *Calotropis gigantea* on streptozotocin-induced diabetic rats, *Indian J Pharm Sci*, **2009**; 71: 615-21.
13. Nimmy Chacko, Mohammed Ibrahim, Prerana Shetty, Shastry CS. Evaluation of Antivenom Activity of *Calotropis Gigantea* Plant Extract Against *Vipera Russellii* Snake Venom, *JPSR*, **2012**; 3(7): 2272-2279.
14. Bharathi P, Alex Thomas, Ansa Thomas, Krishnan S, Ravi TK. Anti bacterial activity of leaf extracts of *Calotropis gigantea* linn Against certain gram negative and gram positive bacteria, *Int. J. Chem. Sci*, **2011**; 9(2): 919-923.
15. Subramanian S.P, Saratha V. Evaluation of antifungal activity of *calotropis gigantea* latex extract: an *in vitro* study, *IJPSR*, **2010**; 1(9): 88-96.
16. Ashraful Alam M, Rowshanul Habib M, Farjana Nikkon M, Khalequzzaman M, Rezaul K. Insecticidal Activity of Root Bark of *Calotropis gigantea* L Against *Tribolium castaneum* (Herbst), *World Journal of Zoology*, **2009**; 4(2): 90-95.
17. Gaurav Kumar, Loganathan Karthik, Kokati Venkat Bhaskara Rao. A Review on Pharmacological and Phytochemical Profile of *Calotropis Gigantea* Linn, *Pharmacology online*, **2011**; 1: 1-8.