

Exploring the Traditional and Modern Uses of *Calotropis gigantea*: A Review

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Abstract

Calotropis gigantea, often known as *C. gigantea* or Sweta Arka, is indigenous to Bangladesh, India, and Thailand in South and Southeast Asia. It has therapeutic purposes. This plant features clusters of white or lavender waxy blossoms, an oval-shaped, light green leaf, and a milky stem. The beneficial properties of *C. gigantea*, which is commonly used in traditional medicine, especially in India, have been validated by recent scientific findings. Among their many functions, plants like *C. gigantea* have historically contributed significantly to the development of human culture and civilization by acting as sources of food, fuel, and medicine. *C. gigantea* is known as toxic in the Siddha, Unani, and Ayurvedic systems, highlighting its dual nature as a potent and hazardous herb despite its numerous health benefits and fascination with medicine.

Keywords: *Calotropis gigantea*, Siddha, Unani, Ayurved, Toxicity

INTRODUCTION

Plants, animals, and natural resources have deeply influenced human culture and civilization, particularly since prehistoric times. In India, for example, *Calotropis gigantea*, known as “Sweta Arka” in Ayurveda, and *Calotropis procera*, or “Raktha Arka,” have played significant roles. These plants, often sharing similar botanical traits and pharmacological effects, are utilized in various ways including fuel, food, fiber, and medicine [1].

C. gigantea, also known as gigantea milkweed, is a wildflower native to countries in South and Southeast Asia, including India, Bangladesh, and Thailand. It features clusters of white or lavender waxy flowers, a milky stem, and light green, oval leaves. In India, it is commonly used in traditional medicine and has recently been recognized for its various therapeutic properties [2–3].

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Received Date: December 19, 2024

Accepted Date: January 22, 2025

Published Date: February 11, 2025

Citation: Patil Shraddha S., Sameer R. Shaikh, Divakar R. Patil, Akash S. Jain, Azam Z. Shaikh, Sunil P. Pawar. Exploring the Traditional and Modern Uses of *Calotropis gigantea*: A Review. Journal of AYUSH: Ayurveda, Yoga, Unani, Siddha and Homeopathy. 2025; 14(1): 33–41p.

India, often called the “World’s Botanical Garden,” boasts 17,000–18,000 flowering plant species, with 6,000–7,000 used in traditional medicine. Medicinal plants are crucial for health maintenance in India and are increasingly recognized worldwide, with their use growing annually by 7%–15%. *Calotropis gigantea* (L.) Dry is one such plant. This study focuses on the pharmacology, chemical composition, and ethnopharmacological uses of *C. gigantea* [4].

Arka (*Calotropis procera/gigantea*) is listed as a toxic substance under Schedule E (1) of the Drugs

and Cosmetic Rules 1945 in Ayurvedic, Siddha, and Unani systems. Despite its toxicity, Arka has been used in both traditional and modern medicine for its therapeutic properties [5]. Known as “Nakshatra” in Hindu mythology, it symbolizes the Sun and holds spiritual significance [6, 7].

Scientific Classification

1. *Kingdom*: Plantae.
2. *Subkingdom*: Tracheobionta.
3. *Class*: Dicotyledonous.
4. *Sub Class*: Asteridae.
5. *Order*: Gentianales.
6. *Family*: Apocynaceae.
7. *Subfamily*: Asclepiadaceae.

Biological Source

Calotropis gigantea, commonly called crown flower or Giant milkweed [8].

Plant Name in Different Languages

1. *Common names*: Swallow Wort, Crown Flower, and Giant Milkweed.
2. *Hindi*: Bara Akand, Akanda, Sveta Arka, Madar, Safed aak, Aak, and Alarkh.
3. *Gujarati*: Aakando
4. *English*: Giant Indian milkweed, crown flower, Bowstring hemp, madar, and crown plant [9].

Morphology and Plant Profile

- *Habit*: Shrub or small tree up to a maximum height of 2.5–6 meters.
- *Roots*: Simple, branching, woody at base, with a corky bark covering that is locked; branches are slightly succulent and have a dense white tomentose texture; they are also early glabrescens. Cut or bruised portions of the plant release a white latex substance.
- *Flowers*: Actinomorphic, pentamerous, hypogynous, pedicellate, pedicel, bracteate, complete, bisexual 1–3 centimeters in length.
- *Features of Flowers*: The dense, multi-flowered, umbellate, pedicled cymes that emerge from the nodes and look axillary or terminal are known as inflorescences.
- *Calyx*: 5 sepals, 5 lobed, glabrescent, quincuncial aestivation, briefly joined at the base.
- *Corolla*: Five lobed, gamopetalous, twisted aestivation petals.
- *Androecium*: Five gynandrous stamens, a ditheous and cohesive anther.
- *Gynoecium Peltate*: stigma with five lateral stigmatic surfaces, bicarpellary, apocarpous, styles joined at the apex. To form a gynostegium, others adhere to the stigma.
- *Fruit*: A straightforward, meaty, inflated, subglobose to obliquely ovoid follicle with diameter at of least 10 cm.
- *Seed*: Many tiny, flat, obovate seeds measuring 6 by 5 mm and compressed with a silky white pappus that is at least 3 cm long [10, 11].

The Chemical Constitution

Calotropis procera contains various bioactive compounds across different parts of the plant. Its leaves and stem have calotropin and calotropagenin, while the flowers contain multi-flavonoids and calotropenyl acetate. The latex is rich in cardenolides and permethrin, and the root bark includes benzoylelinesolone. Triterpenoids, such as calotropursenyl acetate and calofriedelenyl, along with norditerpenyl esters and esters leonine triterpenes, are also present. Additionally, the plant has bioflavonoids, cardiac glycosides, tannins, and saponins [12].

PHARMACOLOGY ACTION

Antinociceptive and Analgesic Effects

This study evaluated the analgesic effects of *C. procera* dry latex (DL) using different nociception models. DL at 415 mg/kg was more effective than aspirin (100 mg/kg) in reducing acetic acid-

induced writhing. In the tail-flick test, DL (830 mg/kg) showed minimal analgesia like aspirin [13, 14]. Additionally, proteins from *C. procera* latex exhibited a dose-dependent antinociceptive effect at 25 and 50 mg/kg in acetic acid, formalin, and hot plate tests, without involving the opioid system [15].

Anticonvulsant

The study examined the anticonvulsant properties of *C. procera* root aqueous and chloroform extracts in rats using maximal electroshock seizures (MES), pentylenetetrazol (PTZ), lithium pilocarpine, and electrical kindling seizures. The results of the PTZ and MES tests indicated a highly significant effect of the chloroform extract. Lithium-pilocarpine and electrical kindling induced convulsions were also suppressed by both extracts [16].

Anti-Inflammatory

The latex of *C. procera* shows strong anti-inflammatory effects, particularly against inflammatory mediators like formalin and carrageenan. Its aqueous and metabolic extracts surpass phenylbutazone in efficacy against carrageenan and are comparable to chlorpheniramine and phenylbutazone in managing histamine and prostaglandin E2. The extracts inhibit around 80% of inflammation caused by bradykinin, compound 48/80, and serotonin, and are more effective than phenylbutazone in reducing cellular infiltration and subcutaneous edema. Overall, *C. procera*'s crude latex exhibits significant anti-inflammatory properties [17, 18].

Anti-Malarial

The mosquito-repelling properties of *Calotropis gigantea* flower extract against blood-starved female *Culex quinquefasciatus* mosquitoes. Their study found that the alcoholic extract was more effective than petroleum ether and chloroform extracts, showing a dose-dependent repellent activity [19].

Antiasthmatic Activity

In ova albumin (OVA)-induced asthma, the antiasthmatic activity of *Calotropis gigantea*. The effects of 100, 200, and 400 mg/kg of *Calotropis gigantea* on different body cells, catalysts, and histopathological alterations were observed. Thus, plant concentrate may be useful in the management of asthma [19].

Antipyretic in Action

Calotropis gigantea root extract shows the anticipated antipyretic effect against both yeast-induced fever, suggesting that *Calotropis gigantea* may be developed into a more potent and affordable antipyretic drug [20].

Antioxidant Activity

With the use of 2, 2-diphenyl-1-picrylhydrazyl and fluorescence recovery following photobleaching experiment, Bairagi et al. (2018) [19] investigated the in vitro antioxidant activity of *Calotropis gigantea* root extract. Because the extract has a high concentration of several phytochemicals, it has a high level of antioxidant activity when compared to ordinary ascorbic acid in both methods.

Antidiarrheal Activity

The anti-diarrheal efficacy of a hydro alcoholic (50:50) extract of the aerial portion of *Calotropis gigantea* Linn against a mouse model of diarrhea produced by castor oil was investigated by Ajboye et al. (2010) [20]. The analysis suggests that the extract has anti-diarrheal properties.

Antibacterial Activity

The leaves and flowers of *Calotropis gigantea* Linn. Have strong antibacterial activity against *Staphylococcus aureus* when extracted in aqueous, metabolic, and metabolic forms [21].

Anticancer Activity

It has been said that *Calotropis gigantea* is an anticancer plant. The plant contains cytotoxic cardiac glycosides. Cardiac glycosides (calactin) usually cause growth suppression in neoplastic cells by altering the DNA of leukemia cells in breast cancer. Calotroposides A and cardenolides both have anticancer qualities. One of the active ingredients found in *Calotropis gigantea* flowers, anhydrosophoradiol-3-acetate, has been demonstrated to lessen cancer-related issues in vivo [22].

Cytotoxic Activity

A study revealed that MDA MB-231 cell lines were susceptible to the cytotoxic effects of zinc oxide nanoparticles made from aerial (leaf) sections of *Calotropis gigantea* Linn. Thus, plant extract has cytotoxic effects as well [23].

Insecticidal Activity

The metabolic extract of *Calotropis gigantea* Linn's root bark, as well as its petroleum ether and chloroform soluble sections were found to be effective against different stages of *Tribalium castaneum* larvae and adults. *Tribalium castaneum* was moderately repelled by the methanol extracts as well as by its chloroform and petroleum ether soluble parts [24].

Pregnancy Interceptive Activity of *Calotropis gigantea* Linn. Roots in Rats

A metabolic extract of *C. gigantea* Linn. Roots showed 100% pregnancy interceptive action in rats when given as a single oral dosage of 100 mg/kg on Day 1 postcoitum. The extract also showed 100% efficacy at a dosage of 12.5 mg/kg when given in the Days 1–5 and 1–7 postcoitum regimens. When given during the pericumeary post implantation period (i.e., Days 5–7 postcoitum at 250 mg/kg), most implantations show indications of desorption [25].

Procoagulant

It has been found that *C. gigantea* latex has Procoagulant properties. In a dose-dependent way, the latex extract hydrolyzed casein, human fibrinogen, and crude fibrin clot. The fibrinogen subunits are digested by the extract, with subunit Aa hydrolyzed first and then Bb and g subunits. In contrast to try sin and papa in, the crude extract hydrolyzes crude fibrin clot significantly. The Procoagulant action of *Candida gigantea* is attributed to proteins found in its latex, which exhibit significant proteolytic activity [26].

Hepatoprotective effects

Male Wistar rats treated with an ethanol extract of *C. gigantea* stems were shown to be protected against liver damage caused by carbon tetrachloride. The extract effectively protected the liver and caused a considerable drop in ALT, AST, and lipid peroxide levels. The rats are shielded against oxidative damage by the extract as well [27].

Schizonticidal Activity

P. falciparum crude fractions of flower, bud, and root were tested against two strains: MRC 20, which is chloroquine-sensitive, and MRC 76, which is chloroquine-resistant. In vitro, the CQ-sensitive strain and the CQ-resistant strain were used to compare the efficacy of its fractions.

Myocardial Infarction

In albino rats, the protective effect of *C. procera* latex against isoproterenol (20 mg/100g)-induced myocardial infarction was assessed. Pretreatment with an oral dose of 300 mg/kg of metabolic latex extract three times a day for 30 days dramatically lowers the levels of elevated marker enzymes in blood and cardiac homogenates, including serum glutamic-pyruvic transaminase, serum glutel oxaloacetic transaminase, and alkaline phosphatase [28].

Wound Healing Activity of *Calotropis gigantea*

Based on its traditional use, *C. gigantea* was selected for a study investigating its ability to heal wounds in Guinea pigs. A sterile 1.0% plant latex solution of 20 liters was applied topically to the

animals. Latex considerably sped the healing process by greatly accelerating synthesis of collagen, DNA, and proteins as well as epithelization. Tsala et al. investigated rats with pyloric ligation and found that Guinea pigs with histamine-induced duodenal ulcers showed significant protection. The capacity of *C. gigantea* root bark extract to hasten wound healing in Wistar albino rats was investigated. Rats were given extracts topically for excision wound healing models and orally at dosages of 100, 200, and 400 mg/kg for incision wound handling models [29].

Toxicity

The latex from *C. gigantea*, known for its ocular toxicity causing conditions like keratitis and toxic iridocyclitis, is used by tribal people to make poison arrows. Its anti-inflammatory properties have been tested using rat models. Additionally, the latex's effects on cell development have been studied in McAfee and HeLa cell line cultural [30].

Religion is Significant to Aak Plants

The Madar, or Aak tree, is revered in Hinduism, particularly by Lord Shiva. Believed to be the residence of Ganesh Ji, this plant, which comes in white and black varieties, is used mainly for tantric practices. Its roots are thought to house Ganapati. For maximum benefit, it should be worshiped and cared for properly, especially after being brought home during an auspicious time, accompanied by the Ganapati Mantra. Hinduism views certain plants as divine, offering not just food and oxygen, but also spiritual benefits. One must repeat the Ganapati Mantra when offering worship. The devotee receives the blessings from Lord Ganesh in this way. Some plants are considered miraculous and to contain the very essence of God in Hinduism. According to Hinduism, in addition to giving humans food and oxygen, the surrounding greenery also possesses several other benefits [31].

Medical Uses

Calotropis procera, known for its medicinal properties, produces latex, bark, and leaves with various uses. The latex contains calotropin, a cardio-toxic enzyme with antiviral properties effective against the tobacco mosaic virus. Historically, Calotropis has been used to treat elephantiasis, leprosy, and jaundice. The plant's bark, if aged properly, is used in asthma tonics, as a digestive, and as an emetic. Its flowers and buds have antimalarial effects, while seed extracts show antibacterial activity. Additionally, the plant's latex exhibits antifungal properties [32].

Uses of Whole Plant

1. *Snake Poison Antidote:* The *Calotropis gigantea* plant's leaves were once chewed, and the latex was used to bandage snake bite wounds.
2. *Toothache Relief:* We apply latex to the gums to relieve toothache pain.
3. *Gastritis Relief:* The leaves of the madar plant are prepared and used as a treatment for gastritis.
4. *Indigestion and Chronic Diarrhea Cure:* The medications found in the Arka. The plant can be used to treat persistent diarrhea. It promotes improved digestion and soothes the stomach.
5. *Use as an Abortifacient:* The milky discharge of the Arka plant contains an abortifacient. Thus, women who want to abort their infant will employ latex preparation.
6. *Spasmogenic Property:* The preparations made from the plant may result in spasms. It is therefore used to treat a wide range of illnesses.
7. *Treat Sexually Transmitted Disease:* The white blooms of the Madar plant are used to treat syphilis and other diseases.
8. *Good Antifungal Property:* You can cure conditions like candidacies by using plant extracts from the Arka. It might be harmful to take too much medication, so proceed with caution. There is poisonous aak latex available. *Calotropis gigantea*, often known as the madar plants can momentarily blind you, therefore handle them with caution.

Other Facts

1. The robust "Bowstring of India" fiber, derived from the Crown Flower, finds application in the production of ropes and carpets, among other materials.

2. You can utilize leaves for soil binding in sandy soil, leaf mulching, and green maturing in rice fields.
3. Wood is the source of charcoal, which is utilized as fuel.
4. Fine fiber can be produced from the bark of the stems.
5. Plants can sporadically be cultivated as hedges.
6. It's commonly used to manufacture fabrics, fishing nets, and bowstrings.
7. Candle Wicks can be made with seed floss.
8. Twigs are used to make chewing gum to clean teeth.

The Futures of Chief

1. There is some toxicity in latex (sap).
2. It's used to make poison arrows.
3. It is conceivable because of the plant's inclusus and *Culex tritaeniorhynchus*.
4. The latex causes kerato-conjunctivitis, and the plant is also known to produce allergic contact Dermatitis.
5. If consumed, plant parts are poisonous.
6. Use abstinence while breastfeeding and pregnancy.
7. The intake of the various components of this herb should be carefully controlled because an Overdose might cause patients to have severe vomiting and diarrhea.
8. Children should not be administered it.

Extraction and Process

The dried powder of "*Calotropis gigantea*" was extracted twice with 70% ethanol (1:10 and 1:8 ratios) for 72 hours each. The filtrate was evaporated to create a viscous extract, which was then mixed with deionized water to obtain a liquid methanolic extract. This extract was separated into dichloromethane, ethyl acetate, and butanol fractions, with the residue identified as a water fraction [33].

Disease and Pests

Poekilocerus pictus is a leafhopper pest of *Calotropis gigantea*, which uses cardenolides for chemical defense. Both the oleander aphid (*Aphis nari*) and caterpillars of the tiger (*Danaus chrysippus*) and monarch (*Danaus plexippus*) butterflies feed on *Calotropis* species. In India, *Calotropis gigantea* roots harbor *Meloidogyne incognita* and *Meloidogyne javanica* nematodes, though these are eliminated by the leaf extract. Additionally, *Aphis nari* vectors a mosaic disease affecting *Calotropis gigantea* [34].

Various uses of *Calotropis gigantea* in Ayurvedic medicine practice

Use of flowers for cough and asthma- Bark-derived smoke is used in inhalation therapy. Flowers are collected, shade-dried, and then pulverized. To chew, mix a pinch or two of this with a small amount of rock salt powder; you can also mix this combination with some warm water. Using leaves to reduce swelling: Three to four mature arka leaves have their ventral side, or fine region, heated. It is applied to swollen or inflamed areas and lightly coated with sesame oil. Frequent fomentation lowers the edema efficiently over a period of 5–6 days. Leaf application for joint pain: Mature leaves are mashed into a fine paste without adding any water. If needed, add more salt. This paste is used on inflammatory joints. In 2–3 days, medication truly helps to reduce the discomfort and swelling. Using leaves for eczema and muscle pain-A paste is made by combining 200 ml of sesame oil, 200 ml of water, and 50 g of leaves. The paste is then cooked until the water has evaporated. It is retained and screened. This can be used to treat both aching joints and muscular issues [35, 36].

Traditional Uses of *C. gigantea*

- According to Ayurveda: *C. gigantea* is used in traditional medicine for various ailments. Its leaves treat swollen areas, paralysis, and sporadic fevers. The flowers are utilized for fever,

inflammation, helminth infections, anorexia, catarrh, and asthma. The root bark addresses ascites, helminth infections, cutaneous infections, and intestinal worms, while root powder helps with dyspepsia, bronchitis, asthma, and stimulates gastrointestinal secretion.

- *In Siddha*: Intestinal worms, ulcers, vatha illnesses, periodic fever, and venomous snake bites are all treated using the leaves of *C. gigantea*. The crushed roots of this plant are applied to the bitten region by massaging it vigorously. This plant's latex is used to treat rheumatic ailments, such as gonococcal arthritis, swelling rat bites, and dental issues. One remedy for bronchial asthma is flowers [37].

Some Formulation of Aak Plant

According to a publication by Abidetal, a porous carbon structure with low carbonaceous adsorbent was left behind after *Calotropis gigantea* (Giant Estabragh) was carbonized in a barely vented atmosphere. This eliminated the need to compare K_2CO_3 and $KHCO_3$ for volatile preparation. The green manufacturing of zinc oxide nanoparticles utilizing zinc nitrate and the bio components of extract from *Calotropis gigantea* leaves was documented by Vidya C, et al. ZnO nanocrystallites, with average diameters in the 30–35 nm range, have been synthesized in a fast, Easy and greenway. Zinc nanoparticles were characterized by X-ray diffraction and scanning electron microscopy (SEM) [38].

Mother Tincture

Mother tincture of *Calotropis gigantea* (homeopathic medicine of SBL). A homeopathic remedy called *Calotropis gigantea* SBL Mother Tincture Q is used to treat several illnesses, including lung and skin diseases. Additionally, inflammation and joint discomfort can be treated with it. It works well for treating syphilis as well [39].

CONCLUSIONS

A traditional medicinal plant, *Calotropis gigantea*, has several phytochemical properties, including anti-inflammatory, CNS activity, Analgesic, anti-malarial, anthelmintic activity, antioxidant, anticancer, antimicrobial, immunomodulatory activity, antipyretic activity, insecticidal activity, hepatoprotective, cytotoxic activity, pregnancy interceptive, Procoagulant, myocardial infarction, schizontocidal activity, and wound healing properties. Because this plant is hydrocarbon-rich, more research on energy conversion is necessary. A multitude of factors, such as soil composition, climate, and others influence the quantity and quality of the active ingredient, which are essential for treating a range of illnesses. Using these methods to standardize the phytochemicals allows Essential components to establish the plant's applications more successfully. An outline of *Calotropis gigantea*'s pharmacognostic description, phytoconstituents, biological activity, and ethno pharmacological importance is given in the current study.

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