

An overview on giant milkweed (*Calotropis procera* (Ait.) Ait. f.)

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Abstract: *C. procera* in India holds a pride of place largely because of its pharmacological uses and economic values. Arka (*C. procera*) an important drug of Ayurveda is known from the earliest time. Traditionally *Calotropis* is used alone or with other medicines to treat common disease such as fevers, rheumatism, indigestion, cough, cold, eczema, asthma, elephantiasis, nausea, vomiting, and diarrhea. The plant is poisonous can lead to blindness if its juice is put in to the eyes. The silky hairs are using to stuff pillows. The wood is used in impoverished desert areas for a cooking fuel. The stem is useful for making ropes, carpets, fishing nets and sewing thread. The wood is used in making charcoal. *C. procera* is an ideal plant for monitoring sulphur dioxide emissions in the air. *C. procera* is a potential plant for bioenergy and biofuel production in semi arid regions of the country.

Keywords: *C. Procera*, Ayurveda, Medicines, Charcoal, Sulpher Dioxide

1. Introduction

1.1. The Plant

The Indian subcontinent is rich in medicinal plants and is one of the richest countries in terms of genetic diversity of medicinal plants. It exhibits a wide range in topography and climate. Plants have been a rich source of medicines because they produce wide array of bioactive molecules, most of which probably evolved as a chemical defense against predation or infection [1]. *Calotropis* is one such genus of flowering plants which contains many phytochemicals with potential pharmacological activity. *Calotropis* belongs to Asclepiadaceae or Milkweed or Aak family which includes 280 genera and 2,000 species of world-wide distribution but most abundant in the sub-tropics and tropics, and rare in cold countries. They are commonly known as milkweeds because of the latex they produce. *Calotropis* species are considered common weeds in some parts of the world. *C. procera* in India holds a pride of place largely because of its other uses and economic values. Arka (*C. procera*) an important drug of Ayurveda is known in India from the earliest time. It is mentioned by the earliest Hindu writers and the ancient name of the plant which occurs in Vedic literature was Arka alluding to the form of leaves which was used in sacrificial rites. Traditionally *Calotropis* is used alone or with other

medicines [2] to treat common disease such as fevers, rheumatism, indigestion, cough, cold, eczema, asthma, elephantiasis, nausea, vomiting, and diarrhea [3]. The plant is poisonous can lead to blindness if its juice is put in to the eyes. The milky exudates from the plant are a corrosive. It is said to have mercury like effects on the human body and is sometimes referred as vegetable mercury. Calotropin a compound in the latex is more toxic than strychnine which is responsible for the cytotoxicity of *Apocynum cannabinum* [4].

1.2. Common Name

Giant milkweed is also known as sodom apple, calotrope, French cotton, small crown flower (English), algodón de seda, bomba (Spanish), cotton-france, arbre de soie, and bois canon (French) [5-8].

1.3. Taxonomy

Kingdom	<i>Plantae</i> – Plants
Subkingdom	<i>Tracheobionta</i> – Vascular plants
Superdivision	<i>Spermatophyta</i> – Seed plants
Division	<i>Magnoliophyta</i> – Flowering plants
Class	<i>Magnoliopsida</i> – Dicotyledons
Subclass	<i>Asteridae</i>
Order	<i>Gentianales</i>
Family	<i>Asclepiadaceae</i> – Milkweed family

Genus	<i>Calotropis</i> R. Br. – calotropis
Species	<i>Calotropis procera</i> (Aiton) W.T. Aiton – Roostertree

1.4. Habit

This plant is a soft-wooded, evergreen, perennial shrub.

1.5. Natural Habitat

Calotropis grows wild up to 900 meters throughout the country [9] on a variety of soils in different climates, sometimes where nothing else grows.

1.6. Geographical Distribution

The species is now naturalized in Australia, many Pacific islands, Mexico, Central and South America, and the Caribbean islands. It is distributed in tropical and sub-tropical regions of India.

1.7. Biophysical Limits

The species grows in dry habitat (150 to 1000 mm precipitation) and sometimes in excessively drained soils in areas with as much as 2000 mm of annual precipitation. Giant milkweed may be found in areas up to 1,000 m in elevation in India [8].

1.8. Ecology

C. procera is drought-resistant, salt-tolerant to a relatively high degree, and through its wind and animal dispersed seeds, it quickly becomes established as a weed along degraded roadsides, lagoon edges and in overgrazed native pastures.

1.9. Biology

Highly cross-pollinated through insects such as monarch butterflies. Progeny genetically both divergent and different from its parents (chromosome number $2n = 22$). Both animals and wind disperse seeds.

2. Ethnopharmacology

2.1. Plant Parts

All the parts, viz, root, stem, leaf and flowers of *C. procera* are in common use in indigenous system of medicine [10]. Compounds derived from the plant have been found to have emeto-cathartic and digitalic properties. The principal active medicinal are asclepin and mudarin [11]. Other compounds have been found to have bactericidal and vermifugal properties. *C. procera* used medicinally, to treat boils, infected wounds and other skin problems in people and to treat parasitic skin infestation in animals. The whole plant when dried and consumed is a good tonic, antihelmintic and as an expectorant [12].

2.2. Root

Giant milkweed tissues, especially the root bark, are used

to treat a variety of illness including leprosy, fever, menorrhagia, malaria, and snake bite [8]. Traditionally, the dried root is powdered and effectively used to cure bronchitis, asthma, leprosy, eczema and elephantiasis, hepatic and splenic enlargement [13]. An infusion of bark powder is used in the treatment and cure of leprosy and elephantiasis [14]. It is inadvisable to use bark that has been kept for more than a year [15]. Roots are used to treat eczema, leprosy, elephantiasis, asthma, cough and rheumatism [16]. Roots used as purgative and taken in dysentery [17]. Extract of root is taken orally by the tribal ladies in dysmenorrhea [18]. The leaves are useful in the treatment of paralysis, arthralgia, swellings, and intermittent fevers [19]. The root of the plant is used as a carminative in the treatment of dyspepsia. The root bark and leaves of *C. procera* are used by various tribes of central India as a curative agent for jaundice [20].

2.3. Shoot

The twigs are applied for the preparation of diuretics, stomach tonic and anti-diarrhoeics and for asthma. Also used in abortion, as an anthelmintic, for colic, cough, whooping cough, dysentery, headache, lice treatment, jaundice, sore gums and mouth, toothache, sterility, swellings and ulcer [21]. The juice was also found to induce abortion in women and tanners use the milky juice to remove hair from the hides [22].

2.4. Leaves

Traditionally, the leaves of the plant are warmed and tied around any body organ in pain. It is practically useful in backache and joint pains, warm leaves also relieve from stomach ache if tied around. Inhalation of burnt leaf cures headache. Leaf latex if applied on fresh cut, stops bleeding immediately. Recent investigation has found that the alkaloids calotropin, calotaxein and uskerin are stimulant to heart [23]. It is also used by traditional medicine practitioner in Gwari communities for the treatment of ring worms [24].

2.5. Latex

The milky sap is used as a rubefacient and is also strongly purgative and caustic. The latex is used for treating ringworm, guinea worm blisters, scorpion stings, venereal sores and ophthalmic disorders; also used as a laxative [25]. Its use in India in the treatment of skin diseases has caused severe bullous dermatitis leading sometimes to hypertrophic scars. The local effect of the latex on the conjunctiva is congestion, epiphora and local anesthesia [26]. It also yield ash for making gun powder, the latex is processed and use in treating vertigo, baldness, hair fall, tooth aches, intermittent fevers, rheumatoid/joints swellings and paralysis. The pungent latex extracted from the leaf and flowers of *C. procera* is processed and used in the commercial preparation of eye tonic [13].

2.6. Flowers

The flowers are bitter, digestive, astringent, stomachic,

anthelmintic, and tonic [27].

2.7. Pharmacological Screening

All the parts, viz, root, stem, leaf and flowers of *C. procera* are in common use in indigenous system of medicine [28]. *Calotropis* is also a reputed Homoeopathic drug [29]. The plant shows anticancer, antifungal [30] and insecticidal activities. The roots are reported to have antifertility [31] and anti-ulcer effects [25]. The latex of the plant is reported to possess analgesic and wound healing activity [10], as well as anti-inflammatory [15], antimicrobial activity [32] and also exhibited local anesthetic activity [33]. The protein fraction derived from the whole latex of *C. procera* possesses antinociceptive activity, which is independent of the opioid system [26]. Leaf extract shows antimicrobial activity [34]. The flowers of the plant exhibit hepatoprotective activity [35], anti-inflammatory, antipyretic, analgesic, and antimicrobial effects and larvicidal activity [36]. The milky juice is regarded as drastic purgative and caustic flowers were considered to improve digestion, catarrh and increases appetite [37]. Extracts, chopped leaves, and latex have shown great promise as nematocides, *in vitro* and *in vivo* [38].

3. Economical Importance

The plant is occasionally grown as an ornamental in dry or coastal areas because it is handsome, of a convenient size, and is easy to propagate and manage. It is recommended as a host plant for butterflies [39]. In the past, the silky hairs were used to stuff pillows [40]. Giant milkweed was tested as a host for sandalwood, *Santalum album* L., a partial root parasite. It resulted in greater growth of sandalwood than all other species tested [41]. Sheep, goats, and camels will eat the leaves of giant milkweed during droughts, but consumption is low. If the leaves are chopped and mixed with other feed, consumption greatly increases with no ill effects [42]. Although it is lightweight, the wood is used in impoverished desert areas for a cooking fuel [43]. The plant yields a durable fiber commercially known as bowstrings. The stem is useful for making ropes, carpets, fishing nets and sewing thread. Fiber from the inner bark was once used in the manufacture of cloth for the nobility. The wood is used in making charcoal. Floss, obtained from the fruit, was used for stuffing purposes. The plant is a good source of green manure. The plant can help improve soil water conditions and also acts as a soil binder. It is a suitable indicator of exhausted soil. *C. procera* is an ideal plant for monitoring sulphur dioxide emissions in the air. Susceptibility to pests is relatively high. Aphids, grasshoppers and other insect pests eat or suck the leaves despite the toxic latex within. The caterpillar of the plain tiger butterfly, *Danaus chrysippus*, feeds on *C. procera*. The milkweed food plant contains cardiac toxins and these are transferred to the tissue of the adult butterfly. These toxins afford excellent protection against attack from vertebrate predators, such as birds and lizards.

4. Significance and Conclusion

India has over 180 million of wasteland out of which 90 million ha is uncultivable. The degraded and denuded lands arise due to soil erosions as well as secondary Stalinizations. However *C. procera* is a potential plant for bioenergy and biofuel production in semi arid regions of the country because it is able to grow on such lands. The plant has a growth potential of 2 dry tones to 40 dry tons per ha depending on the agro climatic conditions of its growth. The plant has high level of regeneration potential and could be harvested up to 4 times a year. The plant yields valuable hydrocarbons which could be converted into diesel substitutes. The bio-diesel derived from *C. procera* is free from NO_x gases, SO₂ and Suspended Particulate Matter (SPM) and has high cetane value. Due to its enormous potential for growth under adverse climatic conditions *C. procera* is suggested as potential plant for bio-diesel production under semi-arid and arid conditions. Biocrude obtained from this plant is reported to be a rich source of triterpenoid type of hydrocarbons. Hexane extract of different parts of *C. procera* viz. whole plant, stem, leaves and pods have been evaluated. Recently ethanol derived from renewable biomass has emerged as a major contender expected to replace liquid petroleum fuel. The potential of these flowers as a source of ethanol can further be studied.

C. procera has many curative principles and other economic values with the following features: perennial shrub, distributed up to 1000m elevation in the tropical and cultivation practices. A thorough review of the published literature on both species shows that phytochemical composition of these plant species exhibited the presence of various active principles justifies the use of these species for various ailments by traditional practitioners. This is probably due to the fact that each of the components identified has one therapeutic usage or another. For instance, plants rich in saponins have immune boosting and anti-inflammatory properties. Similarly tannins have been reported to have antibacterial potential due to their basic character that allows them to react with proteins to form stable water soluble compounds thereby killing the Bacteria by directly damaging its cell membrane. The antibacterial activities of alkaloids and flavonoids have been reported by a number of authors. However, higher doses cause vomiting diarrhea, bradycardia and convulsions. This medicinal plant produces toxic effects on the animal system, if they are not used carefully or in regulated amount.

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