

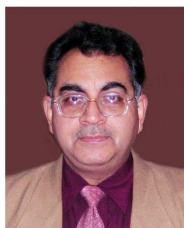


REVIEW ARTICLE

PHARMACOGNOSY

PHARMACOGNOSTICAL ASPECTS OF *CALOTROPIS PROCERA* (Ait.) R. Br.**ANIL KUMAR SHARMA<sup>1\*</sup>, RAJEEV KHARB<sup>1</sup> AND RAJANDEEP KAUR<sup>1</sup>,**

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**ABSTRACT**

Medicinal plants have remained the major sources of drugs; in fact many of the currently available drugs were derived either directly or indirectly from them. The approach to new drugs through natural products has proved to be the single most successful strategy for the discovery of new drugs. In the past decade, research has been focused on scientific evaluation of traditional drugs of plant origin for the treatment of various diseases. *Calotropis procera* is small, erect and compact shrub, which is used in several traditional medicines to cure various diseases. This shrub has been known to possess analgesic, antitumor, antihelmintic, antioxidant, hepatoprotective, antidiarrhoeal, anticonvulsant, antimicrobial, oestrogenic, antinociceptive, and antimalarial activity. This review is a sincere attempt to summarize the information concerning pharmacognostical features of *Calotropis procera* shrubs.



## KEY WORDS

Calotropis procera, macroscopy, microscopy, antimicrobial activity

## INTRODUCTION

Arka (*Calotropis procera*) an important drug of Ayurveda is known in this country from the earliest time. It is mentioned by the earliest Hindu writers and the ancient name of the plant which occurs in the vedic literature was Arka alluding to the form of leaves, which was used in the sacrificial rites. There are two common species of Calotropis, viz. *Calotropis gigantea* (Linn.) R.Br. and *Calotropis procera* (Ait.) R.Br described by the Sanskrit writers <sup>1</sup>. Both the species are used as substitutes for one another and are said to have similar effects. In Dhanvantari Nigantu three varieties of Arka are mentioned viz. Rajarkah, Suklarkah and Sveta mandarah. It has been widely used in the Sudanese, Unani, Arabic and Indian traditional medicinal system for the treatment of various diseases namely leprosy, ulcers, piles and diseases of the spleen, liver and abdomen <sup>2</sup>.

The latex is used as an abortifacient, spasmogenic and carminative properties, antidysentric, antisyphilitic, antirheumatic, antifungal, mullusccide, diaphoretic and for the treatment of leprosy, bronchial asthma and skin affliction. Different parts of the plant have been reported to possess a number of biological activities such as proteolytic, antimicrobial, larvicidal, nematocidal, anticancer, anti-inflammatory <sup>3</sup>. Its flowers possess digestive and tonic properties. On the contrary, the powdered root bark has been reported to give relief in diarrhoea and dysentery. The root of the plant is used as a carminative in the treatment of dyspepsia. The root bark and leaves of *Calotropis procera* are used by various tribes of central India as a curative agent for jaundice <sup>4</sup>.

Table no.1  
List of synonyms <sup>5, 6</sup>

Sr. No.	Language	Common names
1.	Sanskrit	Arka, Alaka, Ravi
2.	Hindi	Aaka, Aanka, Ak
3.	English	Calotropis, Roostertree, Mudar plant
4.	Arabic	Oshar
5.	French	Calotrope, Pomme de Sodome
6.	German	Wahre Mudarpflanzer, Gomeiner
7.	Italian	Calotropo
8.	Spanish	Algodon extranjero, Cazuela
9.	Turkish	Ipekag



**Table no.2**  
**Scientific classification**<sup>7, 8</sup>

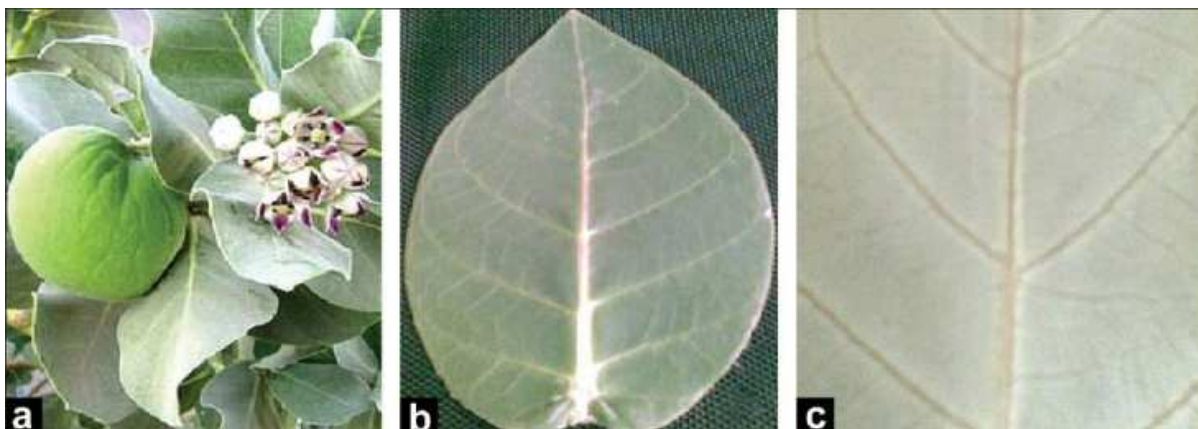
Kingdom	<i>Plantae</i> – Plants
Subkingdom	<i>Tracheobionta</i> – Vascular plants
Superdivision	<i>Spermatophyta</i> – Seed plants
Division	<i>Magnoliophyta</i> – Flowering plants
Class	<i>Magnoliopsida</i> – Dicotyledons
Subclass	<i>Asteridae</i>
Order	<i>Gentianales</i>
Family	<i>Asclepiadaceae</i> – Milkweed family
Genus	<i>Calotropis</i> R. Br. – calotropis
Species	<i>Calotropis procera</i> (Aiton) W.T. Aiton – roostertree

### **Geographic distribution**

*C. Procera* is drought-resistant, salt-tolerant to a relatively high degree, and it disperses seeds through wind and animals. It quickly becomes established as a weed along degraded roadsides, lagoon edges and in overgrazed native pastures. It has a preference for and is often dominant in areas of

abandoned cultivation especially sandy soils in areas of low rainfall; assumed to be an indicator of over-cultivation. *C. Procera* is native to India, Pakistan, Nepal, Afghanistan, Algeria, Iran, Iraq, Israel, Kenya, Kuwait, Niger, Nigeria, Oman, Saudi Arabia, United Arab Emirates, Vietnam, Yemen and Zimbabwe<sup>9</sup>.

### **Botanical description**



Morphology of *Calotropis procera* leaf [a - A twig with oppositely arranged subsessile leaves; b - Broadly ovate or elliptical, cottony, pubescent when young and glabrous on maturity; c - Portion of the lamina showing venation pattern]

*Calotropis procera* occurs as a single or many stemmed soft-wooded shrub, and occasionally a tree reaching to 6m. All parts of

the plant exude white milky latex when cut. Botanical description of *Calotropis procera* includes following parts:

#### **Bark & Branches**

The bark is thick, rough and corky and a yellow-brown colour; twigs are green and fleshy and may have a covering of tomentum (white fur like hairs).

**Leaves**

Leaves are opposite-decussate, simple, ovate to obovate with 4-6 pairs of subopposite nerves prominent on the abaxial surface, an acute apex, sessile (almost decurrent) base, a pale green colour, and quite large which is about 30x25 cm<sup>10</sup>.

**Inflorescences**

Inflorescences arise from the base of the leaves in pedunculate (c.7cm) cymes of 3-20.

**Flowers**

Flowers consist of 5 small triangular dirty white sepals, 5 thick ovate petals (c1cm x 1cm) which are white at the base and purple at the tips and 5 purple tipped stamens, which surround a white 5 lobed stigma<sup>11</sup>.

**Fruits**

Fruits consist of green, spongy ovoid fruits (follicles), up to 15cm long by 10cm wide. They split open to release plumed, papery light brown seeds with a pappus of white filaments up to 6cm long on one side. The main flowering period would be from March to October<sup>12</sup>.

**Macroscopical characteristics**

Macroscopical characteristics of various parts of *Calotropis procera* are as follows:

**Root**

The root occurs in the entire condition. The bark is separated from the wood 0.5-2.0 cm. in diameter bearing rootlets with diameter varying from 0.2 to 0.5 cm. externally whitish grey in colour, wrinkled in the fresh condition, plenty of whitish latex exudes from cuts or wounds in the bark. Fracture is incomplete.

**Leaf**

Simple, opposite, sub-sessile, slightly thick, fleshy, coriaceous, 10-15 cm. long and 4.5 to 6.5 cm. broad, broadly cuneate, obovate or obovate oblong, slightly cordate and auricled at base with tuft of short simple hairs on the upper side near place of the attachment to the petiole. The tender leaves are covered with ashy gray pubescence. Mature leaves are nearly smooth or even glabrous and pale green<sup>13</sup>.

**Flowers**

Regular, bisexual, lilac or pale rose, purple or light greenish yellow and have a faint odour. They are arranged in simple or rarely compound cymose corymbs at the ends of laterally placed or interpetiolar peduncles arising from alternate sides of the nodes. Each cluster is surrounded by an involucre of several small oblong pointed scaly caducous bracts. Flower buds ovoid.

**Calyx**

Five lobes broadly ovate with small fleshy teeth like glands within the base.

**Corolla**

Regular, gamopetalous, pale rose purple or lilac, subcordate to broadly sub-campanulate with a short tube and five broad ovate, lanceolate, valvate, spreading lobes.

**Stamens**

Five, inserted at the base of the corolla. Filaments united to form a large staminal column provided with five conspicuous radiating coronal appendages that are completely adnate to, but slightly shorter than the column. The appendages are fleshy, pale purplish or yellowish white and laterally compressed with a circinnately recurved hollow corolla spur at base and two short obtuse obliquely divergent cuticles towards the top just below the apex. Anthers short, broad, somewhat horny with broadly triangular membranous anther tips that are inflexed over the sides of the stigmatic hood.

**Root bark**

The tap roots are found to be having prominent tops with rounded head and rest of the portion spirally curved. These hard roots are greyish white in colour and exhibit sap exudations at the places where bark has been cut. The bark of the older roots is cracked at places. The bark is yellowish grey outside and yellowish white inside. The upper cork portion is spongy and rough while the inner portion of bark is smooth and mucilaginous. The dried bark is bitter to taste<sup>14</sup>.



### **Microscopical characteristics**

Microscopical characteristics of various parts of *Calotropis procera* are as follows:

#### **(A) Stem**

**(I) Epidermis:** This is an outermost layer of uniseriate cells with thick cuticle. Uni- and multicellular hairs clothe epidermis almost completely. Cells are barrel to rectangular and are compactly arranged.

**(II) Cortex:** These form a few layers below the epidermis which are collenchymatous (thickened corners). A few chloroplasts may also occur in these cells. Rest of the cortex is parenchymatous. Intercellular spaces are numerous.

**(III) Endodermis:** This layer of uniseriate cells forms a wavy ring around the vascular tissue (separates cortex from underlying tissues.) The cells are barrel- rectangular shaped and are compactly arranged. Characteristic casparian thickening is lacking. It, however, contains starch grains (termed as starch sheath).

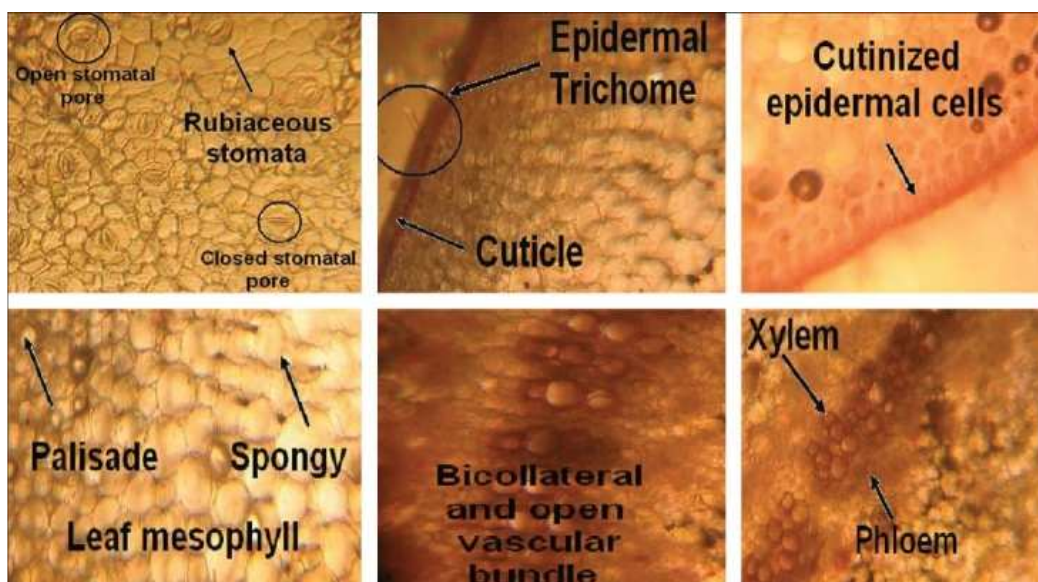
**(IV) Pericycle:** It is in the form of small patches of sclerenchymatous fibres. A few parenchymatous cells of the original pericycle are present between these groups.

**(V) Vascular tissue system:** Secondary growth is prominent. It shows groups of primary phloem, secondary phloem, cambium, secondary xylem, primary xylem and intraxylary phloem. Primary phloem is completely obliterated. Patches of secondary phloem occur above and close to the cambium. Cambium is unistratose. (but its derivatives on either side which are alike, give an appearance of a broad zone of cambium). Secondary xylem forms a broad and extensive region. It comprises vessels and tracheids. The annual rings are feeble. Primary xylem occurs near the pith and is endarch. A few groups of phloem are situated just below the primary xylem in the region of pith and are the groups of intraxylary or internal phloem<sup>15</sup>.

**(VI) Pith:** Centre is occupied by thin walled parenchyma and also many latex vessels.

**(VII) Points of ecological interest:** A well differentiated cortex, presence of conjoint, bicollateral, opens and endarch vascular bundles indicate that the material is a dicotyledonous stem. Intraxylary phloem which is primary phloem of the bicollateral vascular bundle is characteristic.

#### **(B) 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.

The lamina which was dorsiventral with the mesophyll, was seen to be differentiated into a palisade and spongy tissue. The upper and lower epidermis were 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.<sup>16, 36</sup>

### **Chemical constituents**

Phytochemical studies on *Calotropis procera* have afforded several types of compounds such as Cardenolide, triterpinoids, alkaloids, resins, anthocyanins and proteolytic enzymes in latex, flavonoids, tannins, sterol, saponins, cardiac glycosides. Flowers contain terpenes, multiflorenol, and cyclisadol<sup>17</sup>.

### **Leaves**

The leaves contain mainly the amyirin, amyirin acetate,  $\beta$ -sitosterol, urosolic acid, cardenolides, calotropin, calotropagenin.

### **Latex**

The latex contains caoutchouc, calotropin, calotoxin 0.15%, calactin 0.15%, uscharin 0.45%, trypsin, voruscharin, uzarigenin, syriogenin and proceroside<sup>18</sup>.

### **Flower**

The flower contains the flavonoids, quercetin-3-rutinoside, sterol, calactin, calotoxin, calotropagenin, calotropin, polysaccharides with D-arabinose, glucose, glucosamine and L-rhamnose. Flowers also contain enzymes 3-proteinase and calotropain (protease). Other chemical constituents of *C. procera* flowers are lupeol, uscharin, proceroside, proceragenin (cardenolide), syriogenin, taraxast-20(30)-en-3-(4-methyl-3-pentenoate), 3-thiazoline cardenolide, gigantol, giganteol, isogiganteol, uscharidin, uzarigenin, voruscharin, a-calotropeol, 3-epimoretenol, a-lactuceryl acetate and a-lactuceryl isovalerate<sup>19</sup>.

### **Bark**

Root bark of *Calotropis procera* contains triterpenes, A new norditerpenyl ester, named Calotropterpenyl ester, and two unknown pentacyclic triterpinoids, namely calotropursenyl acetate and calotropfriedelenyl acetate, akundarol isovalerate, mundarol isovalerate and quercetin-3-rutinoside<sup>20, 21</sup>.

### **Propagation and management**

#### **Propagation methods**

The tree seeds freely, and natural regeneration is common. Vegetative propagation through half stumps assumes a special importance as compared with the entire stumps because they help in faster multiplication of the parent genotype with plus characters, as each plant gives rise to 2 half stumps. Stumps also help in propagating only one plant. Vegetative propagation through stem and root cuttings is very useful in large-scale multiplication of the superior genotypes<sup>22</sup>.

#### **Tree Management**

*C. procera* has been cultivated in South America and on the Caribbean Islands for the production of fibres at a spacing of 1-1.5 m. When cultivated, annual yields of up to 500 kg/ha are expected. A single harvest per season is preferable to a double (or triple)



harvest; a single harvest would result in a net saving of energy input both on the farm and in the processing plant. Well suited for intensive energy farming in arid or semi-arid regions where frost is not a limiting factor<sup>23</sup>.

### **Ethnopharmacology**

All the parts, viz, root, stem, leaf and flowers of *Calotropis* are in common use in indigenous system of medicine<sup>24</sup>. Compounds derived from the plant have been found to have emeto-cathartic and digitalic properties. The principal active medicinals are asclepin and mudarin<sup>25</sup>. Other compounds have been found to have bactericidal and vermifugal properties. The latex contains a proteolytic enzyme called calotropaine<sup>26</sup>. An infusion of bark powder is used in the treatment and cure of leprosy and elephantiasis. It is inadvisable to use bark that has been kept for more than a year<sup>27</sup>. The root bark is an emetic, the flower a digestive, and a tonic is used for asthma and catarrh. Bark and wood stimulate lactation in cattle<sup>28</sup>. Roots (extremely poisonous) are applied for snakebite. 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<sup>29,30</sup>. 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 anaesthesia<sup>31-33</sup>. 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<sup>34,35</sup>.

### **CONCLUSION**

Empirical knowledge about medicinal plants plays a vital role in primary health care and has great potential for the discovery of new herbal drugs. The pharmacognostical studies including macroscopic and microscopic evaluation of various parts of *Calotropis procera* would be of considerable use in the identification of this drug. These findings may be useful to supplement existing information with regard to the identification and standardization of *Calotropis procera* to distinguish it from substitutes and adulterants. In conclusion, the present manuscript may be useful to supplement information with regard to its identification and in carrying out further research of its use in the treatment of various diseases.

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