Biological Morphology and Ethano-Pharmocological Importance of Calotropis Species - A Review

Navdeep Ranjan*, Sushil Kumar Singh and Chandrawati Kumari

Department of Biotechnology, A.N. College, Patna, (Magadh University), Bihar, India
*Corresponding author

A B S T R A C T

Calotropis a medicinal plant of family Asclepiadaceae has been utilized in Ayurveda, Unani, Siddha and many other traditional systems to cure diseases. There are two common species of Calotropis viz. Calotropis gigantean (Linn.) R.Br. and Calotropis procera (Ait.) R.Br. Calotropis gigantea called Swetarka and Calotropis procera called Raktarka. Secondary metabolites of Calotropis have well known pharmaceutical and therapeutic applications. Chemical constituents of plants such as alkoloids, steroid, terpenoids, resin, glycosides, carbohydrates, etc are reported in Ayurvedic literature. This present review enumerates the morphology and ethno pharmacology utilization of C. procera and C. gigantea for the treatment of various human ailments. This plant has been known to possesses antibacterial activity, anti-inflammatory activity, schizontocidal activity, anti larvicidal activity, antioxidant activity, skin disease, jaundice, leucoderma, eczema, ulcer, piles, dysentery, dropsy, ring worm, removing thorn from body, elephantiasis and leprosy and other miscellaneous activities.

Keywords
Calotropis, Ethano-pharmacology, Morphology.

Introduction

As stated by Acharya Charak (6th century to 2nd century) that there is nothing in this world which cannot be used as medicine after proper purification, formulation and given in appropriate doses. A poison after proper purification if given in appropriate doses, can act as a medicine. Calotropis also called as Arka, is an example of plant having both therapeutic and toxicological properties. According to Ayurveda, action of a drug depends upon seven factors viz. dravya, rasa, guna, veerya, vipaka, prabhay and karma while active ingredient present in body is solely responsible for its effect and side effect according to modern science, this is the basic difference in the pharmacological principle of both the sciences. Modern science uses the single active principle in the form of medicine while Ayurveda advocate use of effective part of the plant as a whole.

Medicinal plants are used from the ancient time to cure the diseases and it is the sources of different drugs formulation in all systems of medicine. The allopathic, Ayurvedic and Unani medicines were obtained by plant resources, the presently available drugs, either directly in the extract form or in the modified synthetic form. Naturally, plants have the ability to synthesize natural products which are beneficial for us known as phytococonstituents that are used to perform biological functions. Calotropis species is used in several traditional medicine and
folklore systems to cure various ailments as reported in the Hindu literature. It is widely used in the Indian traditional medicinal system as well as in Arabic, Unani and Sudanese systems. It is also reported widely in various folklore preparations and ethnomedicines, the plant possesses many secondary metabolites. The secondary metabolites are biologically active and structurally unique compounds which may be useful for generation of new medicines. Secondary metabolites of *Calotropis* have well known pharmaceutical and therapeutic applications. Chemical constituents of plants such as Alkoloids, Steroid, Terpenoids, Resin, Glycosides, Carbohydrates, Aluminum, Iron, Magnesium, and Sodium are reported in Ayurvedic literature. These chemicals are reported to be Analgesic, Resilient, Anti-inflammatory, Schizontocidal Activity (P. Sharma *et al.*, 1999), Emetic, Expectorant, Stomachic, Digestive, Laxative and Depurative. Further, these phytocomponents are also reported potentially active for the treatment of several diseases such as Skin disease, Jaundice (Jan *et al.*, 2009), leucoderma, eczema, ulcer, piles, dysentry (Khan *et al.*, 2009), dropsy, ring worm (Kuta, 2008) and removing thorn from body (Rai *et al.*, 2000). *Calotrois* root bark is very largely used as a treatment for elephantiasis and leprosy. The latex is as potent as standard anti-inflammatory drug phenylbutazone (PBZ) in inhibiting inflammatory response induced by various inflammagens in acute and chronic models of inflammation.

Preferred Scientific Name:  
*Calotropis procera*  
*Calotropis gigentia*

Preferred Common Name:  
Akwan, Arka, Madar in India

**Systematic classification**

**Table.1** Systematic classification of *Calotropis procera* given by three taxonomists

| Classification | Bentham and Hooker | Engler and Prantl | Hutchinson |
|----------------|--------------------|-------------------|------------|
| Kingdom        | Plantae            | Plantae           | Plantae    |
| Class          | Dicotyledones      | Dicotyledones     | Dicotyledones |
| Division       | Gamopetalae        | Sympetalae        | Lignosae   |
| Order          | Gentianales        | Asclepiadaceae    | Asclepiadaceae |
| Family         | Asclepiadaceae     | Asclepiadaceae    | Asclepiadaceae |
| Genus          | Calotropis         | Calotropis        | Calotropis |
| Species        | Procera            | Procera           | procura    |

**Table.2** Systematic classification of *Calotropis gigentia* given by three taxonomists

| Classification | Bentham and Hooker | Engler and Prantl | Hutchinson |
|----------------|--------------------|-------------------|------------|
| Kingdom        | Plantae            | Plantae           | Plantae    |
| Class          | Dicotyledones      | Dicotyledones     | Dicotyledones |
| Division       | Gamopetalae        | Sympetalae        | Lignosae   |
| Order          | Gentianales        | Asclepiadaceae    | Asclepiadaceae |
| Family         | Asclepiadaceae     | Asclepiadaceae    | Asclepiadaceae |
| Genus          | Calotropis         | Calotropis        | Calotropis |
| Species        | Gigentia           | Gigentia          | gigentia   |
### Table 3 International name

| Country   | English Name                                                                 |
|-----------|-----------------------------------------------------------------------------|
| England   | Calotrope, calotropis, dead Sea fruit, desert wick, giant milkweed, swallow-wort, mudar fibre, rubber bush, rubber tree, sodom apple. |
| Arabic    | Dead sea plant, debaj, usher, oshar, kisher                                 |
| Malaysia  | Remiga, rembega, kemengu                                                    |
| German    | Wahre mudarpflanzer, gomeiner                                                |
| Philippines | Kapal-kapal (Tagalog)                                                        |
| Spanish   | Bomba, algodón extraniero, cazuela                                           |
| Indonesia | Bidhuri (Sundanese, Madurese), sidaguri (Javanese), rubik (Aceh)            |
| Chinese   | Bai hua nio jiao gua                                                        |
| Somali    | Boah, bo’ah                                                                |
| French    | Faux arbre de soie, mercure vegetal                                         |
| Turkish   | Ipekag                                                                      |
| Thailand  | Po thuean, paan thuean (northern), rak (central).                            |
| Laos      | Kok may, dok kap, dok hak                                                   |
| Persian   | Kharak                                                                      |
| Vietnam   | B[oot]ng b[oot]ng, l[as] hen, nam t[it]b[at]                                 |
| Nigeria   | Tumfafia                                                                    |
| Pakistan  | Ak                                                                          |

### Table 4 National name

| Country   | Name                                      |
|-----------|-------------------------------------------|
| Sanskrit  | Arka, Ganarupa, Mandara, Vasuka, Svetapushpa, Sadapushpa, Alarka, Pratapass |
| Hindi     | Aak, Madar                                |
| Bengali   | Aakna                                     |
| Urdu      | Madar, aak                                |
| Punjabi   | AK                                        |
| Marathi   | Rui, mandara                              |
| Kannada   | Ekka                                      |
| Tamil     | Eruku                                     |
| Telugu    | Jilledi Puvvu                             |
| Malayalam | Neela Eukku                               |

### Table 5 National distribution

| Country  | Distribution | Origin | Invasive | Natural |
|----------|--------------|--------|----------|---------|
| India    | Present      | Native | Invasive | Natural |

### Table 6 International distribution

| Country      | Distribution | Origin   | Invasive | Natural |
|--------------|--------------|----------|----------|---------|
| Afghanistan  | Present      | Native   | Invasive | Natural |
| China        | Present      | Introduced | Invasive | Natural |
| USA          | Present      | Introduced | Invasive | Natural |
| Bangladesh   | Present      | Native   | Invasive | Natural |
| Mexico       | Present      | Introduced | Invasive | Natural |
| Brazil       | Present      | Introduced | Invasive | Natural |
| Pakistan     | Present      | Native   | Invasive | Natural |
### Table 7: Pharmacological Importance of *Calotropis* Species

| Sl. No. | Pharmacological Importance                                      | Plant Parts Used                                      |
|---------|-----------------------------------------------------------------|-------------------------------------------------------|
| 1.      | Antibacterial activity                                          | Leaf, Flower, Root or Whole plant                     |
| 2.      | Antiviral activity                                               | Leaf, or Whole plant                                  |
| 3.      | Antifertility and emmenagogue                                    | Leaf, Flower, Root, Latex OR Whole plant              |
| 4.      | Anti-inflammatory activity                                       | Leaf, Latex                                           |
| 5.      | Anti-tumor activity                                              | Leaf, Flower, Root, Latex OR Whole plant              |
| 6.      | Anti-diarrheal and anti dysentery activities                     | Leaf, Flower, Root,                                  |
| 7.      | Anti-cancer activity                                            | Leaf, Flower, Root,                                  |
| 8.      | Asthma                                                          | Flower                                               |
| 9.      | Anxiety and pain                                                 | Leaf, Flower, Root,                                  |
| 10.     | Abortifacient                                                   | Leaf, Flower, Latex                                   |
| 11.     | Analgesic and Antinociceptive activity                          | Leaf, Root,                                           |
| 12.     | Cytotoxic activity                                               | Leaf, Flower, Root,                                  |
| 13.     | CNS activity                                                     | Leaf                                                  |
| 14.     | Cold                                                            | Leaf                                                  |
| 15.     | Cytostatic activity                                              | Flower, Root,                                         |
| 16.     | Dyspepsia                                                       | Leaf, Flower, Root, Latex OR Whole plant              |
| 17.     | Diabetes mellitus                                               | Leaf, Flower, Root,                                  |
| 18.     | Eczema                                                          | Latex                                                |
| 19.     | Expectorant                                                     | Leaf, Flower,                                        |
| 20.     | Elephantiasis of the legs and scrotum                           | Leaf, Flower, Root,                                  |
| 21.     | Fever                                                           | Leaf, Flower, Root, Latex OR Whole plant              |
| 22.     | Free radical Scavenging activity                                | Leaf, Flower, Root, Latex OR Whole plant              |
| 23.     | Fibrinolytic activities                                         | Leaf, Flower, Root, Latex OR Whole plant              |
| 24.     | Healing the ulcers and blotches                                 | Leaf, Flower, Latex OR                                |
| 25.     | Indigestion                                                     | Leaf                                                  |
| 26.     | Jaundice                                                        | Leaf                                                  |
| 27.     | Leprosy                                                         | Latex                                                |
| 28.     | Liver injuries as well as on oxidative stress                   | Leaf, Flower, Root,                                  |
| 29.     | Mental disorders                                                | Flower                                               |
| 30.     | Piles                                                           | Latex                                                |
| 31.     | Pregnancy interceptive activity                                 | Leaf, Flower, Root, Latex OR Whole plant              |
| 32.     | Removing anemia                                                 | Leaf, Flower, Root, Latex OR Whole plant              |
| 33.     | Rheumatism                                                      | Leaf                                                 |
| 34.     | Ringworm of the scalp                                           | Leaf, Flower, Root, Latex                            |
| 35.     | Secondary syphilis                                              | Leaf, Flower, Latex                                  |
| 36.     | Skin diseases                                                   | Leaf, Flower, Root, Latex                            |
| 37.     | TB                                                              | Leaf, Flower, Root,                                  |
| 38.     | Uterus stimulant                                                | Leaf, Flower,                                        |
| 39.     | Vermicidal activity                                             | Leaf, Flower, Root, Latex                            |
| 40.     | Worms                                                           | Leaf, Flower, Root,                                  |
| 41.     | Wound healing                                                   | Leaf, Flower, Root,                                  |
**Distribution**

*Calotropis* is native to tropical Africa and Asia and introduced to the Southern United States and Brazil (Crothers et al., 1998). It is naturalized in Australia, many Pacific islands, Mexico, Central and South America and the Caribbean islands.

The Fresh leaves are used in treatment of Rheumatoid, Arthritis and Healing of wounds (Patil et al., 2009). The pungent latex extracted from the leaf and flowers of *C. procera* is processed and used in the commercial preparation of eye tonic (Vohra, 2004; Henrich et al., 2004; Gurib-Fakim, 2005; Bruneton, 1999).

**Morphology**

*Calotropis species* is a shrub with thick twisted branches, the young ones bluntly quadrangular, bark ash colored, covered with a minute white woolly down (Ahirwar et al., 2007). The species can be differentiated by the floral characteristics. *Calotropis gigantea* bears corolla lobes which are spreading, uniformly coloured, pure lavender to white, coronal scales narrow truncate shorter than the staminal column with pubescent back, apex entire. Whereas the corolla lobes of *Calotropis procera* are erect while pink or purple spotted on the corolla lobes, corona scales equal or longer than the staminal column, glaburous on back apex bifid, auricles wanting (Raman Sehgal et al., 2005).

**Habit**

An upright shrub or small tree usually growing 1-4 m tall.

**Habitat**

It is drought-resistant, salt-tolerant species, grows in poor soils, found along roadsides, railway tracts watercourses, river side and coastal dunes, and is often prevalent in disturbed areas. Found mostly in semi-arid and arid inland areas, as well as in the drier parts of tropical and sub-tropical regions.

**Somatic chromosomes:** 2n=22

**Karyotypic formulae**

*Calotropis procera* Br. = mi6+sm6+sto+to=2n=22

*Calotropis gigantea*  
Br.=mi6+sm6+sto+to=2n=22

**Chromosomal Formulae**

*Calotropis procera* Br = A6+B4+C6+D4+E2+F0=2n=22

*Calotropis gigantea* Br = A2+B io+C6+D0+E4+F0=2n=22

**Root:** Taproot, approximately 3000-4000 mm deep.

**Stems**

Approximately 2000-4000 mm tall, erect, branched, glabrous, woody below and herbaceous above, tomentose, solid, cylindrical. Branched from the base at times and branched higher up, Waxy, Copious milky sap exuded when injured.

**Leaves**

Oval, broad and flat in opposite pairs, thick and hairless apart from a basal tuft, leaves are arranged at higher angles. Waxy Grey-green to blue green with indented bases. None-petiole. Blade – Thick, egg shaped. Approx 50- 150 mm long x 40-100 mm wide, tip pointed. Notched at the base where it clasps the stem. Stiff tuft of hairs at the base of the midrib.
**Inflorescence**

Cymose, umbellate cyme, dense, multiflowered, umbellate, peduncled, cymes, arising from the nodes and appearing axillary or terminal.

**Flower head**

In groups (umbels) of up to 15 flowers in the upper leaf axils, outer flowers develop first and inner ones don't develop fully.

**Flowers**

Approx 25 mm wide, scented and white with a deep purple blotch at the base of each petal, Waxy texture, Bracts - Deep purple bracts between the petals and stamens, (5) lobed, 20-30 mm wide, Scented. No milky sap. Petals - Deep purple bracts between the petals and stamens, tubular, five (5) lobed. 20-30 mm wide. Stamens – five (5) united with the stigma to form gynostegium, each stamen is represented by two pollinia with their retinaculae. Anther is bilocular and with a hyaline outgrowth of the connective that covers the stigmatic disc at the periphery; appendaged. It appendages are apical. Unisexual flowers absent.

**Pollination**

Each anther sac contains a pollinium. There are five pollinaria, each consisting of paired pollinia from adjacent anthers joined by translator arms to a corpusculum located just above the slit or opening of the stigmatic chamber.

The stigmatic chambers are beaklike, due to raised anther flaps (wings). Anther flaps are hard, straight and enclose the stigmatic chamber tightly. Each pollinium is a flat wing-like body, narrow at its base close to the translator and wide at the apex. It has no external appendages and no pellucid margin.

**Calyx**

Sepal five (5), Polysepalous, five (5) lobed, shortly united at the base, glabrescent, quincuncial aestivation.

**Corolla**

Petals five (5), gamopetalous, five (5) lobed, twisted aestivation. Petals, gamopetalous, pink or whitish with purple spots, lobes spreading, inferior, twisted aestivation.

**Androecium**

Stamens five (5), gynandrous, anther dithecous, coherent, Five (5) stamens, filaments connate in a fleshy staminal tube around the ovary, the apex of the staminal tube united with the much-dilated stigmatic head to which the anthers are also coherent, forming the pentagonal gynostegium; anthers short, broad tipped with inflexed membranous flaps, bi-celled, the pollen grains of each cell aglutinated into sac like pollinium; the pollinia of each anther are united together by means of short stalks or caudicles to a distinct dark coloured dot-like structure, the corpusculum, which lies at the angle of the gynostegium, thus forming a translator apparatus.

**Gynoecium**

Bicarpellary, apocarpus, styles are united at their apex, peltate stigma with five (5) lateral stigmatic surfaces. Anthers adnate to the stigma forming a gynostegium. 2 carpels (bicarpellary), syncarpous; the pistil free below and fused above; two distinct ovaries end in two styles forming a pentangular stigmatic head to the sides of which the anthers are coherent; ovary superior, unilocular, many ovules, marginal placentation. Placenta axile. Ovules 30–50 per locule (‘many’).
Fruit

Long and balloon like. Follicle (bladdery pod). Grey-green. 70-125 mm long and almost as wide. Rounded at the base. Tip pointed. Numerous (400-600) seeds are released when the ripe pod bursts. A simple, fleshy, inflated, subglobose to obliquely ovoid follicle up to 10 cm or more in diameter.

Seeds

Brown, Flattened, Tuft of long, white, silky hairs at top. Many, small, flat, obovate, 6x5 mm, compressed with silky white pappus, 3 cm or more long. Mainly, broadly ovate, flat tomentose with tuft of silky hairs.

Physiology

Salt tolerant, root stocks tolerate fire and drought.

Reproduction

Plants hermaphrodite, plants homostylos. Reproduces usually by seed and sometimes by suckers.

Flowering times

July to October mainly but can flower at any time of year. Fruit mainly ripens from November to February.

Life cycle

Seed germinates from October to December with tropical rain and it makes rapid growth in the wet season. Flowers occur in August to October when the plant is probably two years old. Flowers stay open for 10-12 days. Fruit is set from September to November and has many seeds. They ripen from November to February then burst to release seeds. New growth and suckering is stimulated by the break of each season in October to December.

Seed biology and germination

Prefers to germinate in light conditions and seed germination is inhibited in shaded conditions. Seed normally germinates in favorable conditions. Good germination takes place when temperature alters at 40/20 degrees Celcius and 36/21 degrees Celcius.

Vegetative propagules

Crows and roots form suckers. Broken stems may take root and regenerate.

Propagation and management

The seeds freely float in the air and natural regeneration is very common. Vegetative propagation through stem and root cutting is very useful in large scale multiplication of the superior genotypes. Calotropis has been cultivated in South America and on the Caribbean Islands for the production of fibres at a spacing of 1-1.5m. When cultivated annually yields of up to 500kg/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 form and in the processing plant.

It is well suited for intensive energy farming in arid or semi-arid regions where frost is not a limiting factor.

Population dynamics and dispersal

In 5 years one WA infestation grew from 20ha to over 5000ha. Seeds are spread by wind and water or mud attaching to passing animals and vehicles. Localised spread is from suckering of the roots and crowns and seedling recruitment.

Earthmoving equipment is a major means of spreading rootstocks and seeds.
Dehiscence

The atrichomatous wall of ovary in *Calotropis procera* becomes highly pubescent in the young fruit, but scabrous in the mature fruit. The single layered epicarp develops from the outer epidermis of the ovary wall. The mesocarp which develops form the mesodermis is distinguished into outer, middle and inner zones. The central mesocarp breaks up in the course of fruit development and disintegrates to form large air chambers. The 2-3 layered lignified endocarp develops from the inner epidermis as well as from the inner mesodermis layers of the ground tissue and shows a ‘parquetry pattern’ of cell arrangement in surface view.

Ethano- pharmacological importance of *Calotropis*

*Calotropis procera* is commonly used in India both orally and topically for various joints and gastrointestinal complaints. It has highly economic importances in pharmacology as well as other industry. Some of the medicinal importance of the plant has been mentioned in table 7.

In conclusion, both the species of *Calotropis* having many curative principles and other economic values, it grows in all types of soils and environmental conditions, requiring no cultivation practices. The plants are a rich source of phytoconstituents. A large number of synthetic compounds are available but due to their environmental pollution and adverse effect on the human body there use is restricted. To find the safe, effective, and environmental friendly agent from a plant source, *Calotropis* is a plant that may present as effective one. The literature on *Calotropis* suggests a huge biological potential of this plant. The present study may be useful to provide morphological information with regard to its identification and in accordance to carry out further research on its use in the treatment of various diseases and secondary metabolites will be useful for development of novel drugs to treat many human diseases in the modern era of globalization and intellectual property right regime after proper isolation, purification and formulation.

References

Ahirwar, D., Ahirwar Bharti, Kharya, M.D. 2007. Influence of Calotropis procera roots on biochemistry of reproductive organs of ovariectomized rats. *Indian J. Pharm. Sci.*, Vol 69, pp. 459-461.

Bruneton, J. 1999. Pharmacognosy, Phytochemistry and Medicinal Plants. Intercept Ltd. England, U.K.

Gurib-Fakim, A. 2006. Medicinal plants: Traditions of yesterday and drugs of tomorrow. *Mol. Aspects of Med.*, 27: 1–93.

Heinrich, M., Barnes, J., Gibbons, S., and Williamson, E.M. 2004. *Fundamentals of Pharmacog. Phytother.*, Churchill
Livingstone, Elsevier Science Ltd., UK.

Jan, G., Khan, M.A. and Gul, F. 2009. Ethnomedicinal plants used against jaundice in Dir Kohistan Valleys (NWFP), Pakistan, *Ethnobot. Leaflets*, 13: 1029-41.

Khan, F.M. 2009. Ethnoveterinary medicinal usage of flora of greater Cholistan Desert Pakistan.

Kuta, F.A. 2008. Antifungal effects of calotropis procera stem back on Epidermophyton, Flocosum and Trichophyton, gypseum. *African J. Biotechnol.*, 7(13): 2116-2118.

Patil, S.B., Naikwade, N.S., Kondawar, M.S., Magdum, C.S. and Awale, V.B. 2009. Traditional uses of plants for wound healing in the Sangli District, Maharashtra, *Int. J. Pharm. Tech. Res.*, 1(3): 876-878.

Sharma, P., J.D. Sharma. 1999. Evaluation of in vitro schizontocidal activity of plant parts of calotropis procera- an ethanobotanical approach, *J. Ethnopharmacol.*, 68: 83–95.

Rai, M.K., Pandey, A.K. and Acharaya, D. 2000. Ethnomedicinal plants used by Gond tribe of Bahanalehi District Chhinwara, M.P. *J. Nontimber Forest*, 7(3/4): 237-241.

Raman Sehgal and Vijay, L., Kumar. 2005. Calotropis procera Latex-Induced Inflammatory Hyperalgesia—Effect of Antiinflammatory Drugs. *Mediators Inflamm.*, Vol 4, pp. 216–220.

Vohra, R. 2004. Calotropis the medicinal weed. Online medicinal book store, India.

How to cite this article:

Navdeep Ranjan, Sushil Kumar Singh and Chandrawati Kumari. 2017. Biological Morphology and Ethano – Pharmocological Importance of Calotropis Species- A Review. *Int.J.Curr.Microbiol.App.Sci.* 6(4): 1640-1648. doi: [https://doi.org/10.20546/ijcmas.2017.604.200](https://doi.org/10.20546/ijcmas.2017.604.200)