



Milkweed Plantcalotropis, A Review

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ABSTRACT

A medicinal plant is one that can be used for traditional and therapeutic uses and is also a precursor for the synthesis of life saving drugs. *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* are some such plants. *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* belongs to the Asclepiadaceae family. The geographical distribution of *Calotropis gigantea*, *Calotropis procera*, and *Calotropis acia* have been seen in several places throughout Asia. This review elaborates on the phytochemical composition and bioactive compounds and their therapeutic uses present in these plants. The vegetative and floral characteristics of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* have been differentiated for better understanding of these unique plants. The medicinal and pharmacological applications of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* have been illustrated.

Keyword: *Calotropis acia*, *Calotropis gigantea*, *Calotropis procera*, International plant Index.

INTRODUCTION

The Indian systems of medicine has been a part of the culture and tradition of India down the centuries. [1] A medicinal plant is any plant which, in or most of it contains substance that can be used for therapeutic purpose or which is a precursor for the synthesis of useful drugs. The plant that posses therapeutic properties or exert beneficial pharmacological effects on the animal body are designated as “Medicinal plant” [2, 3]. *Calotropis* is one among the most sorts after medicinal plant. *Calotropis* belongs to the Asclepiadaceae family. According to International Plant Name Index (IPNI), three species of *Calotropis* plants have been accepted for their therapeutic properties they are: *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* [4].

Calotropis gigantea:-

Calotropis gigantea is a shrub. It is drought resistant, salt-tolerant weed found roadsides, lagoon edges. It is used to treat rheumatism, indigestion, cold fever, ring worm of scalp, swelling, pain, tumour, piles. Different parts of the plant such as leaves, root, bark, flower and latex shows wound healing, anti -microbial, anti-candida, anti-nematicide, anti-oxidant, and analgesic activity. [5]

Calotropis procera:-

Calotropis procera is also a shrub. It is drought resistant and salt-tolerant to a relatively high degree. All the parts of *Calotropis procera* are in common use in indigenous system of medicine. Different parts of the plant such as latex, leaves, root, bark and wood are used to treat ring worm, guinea worm blisters, scorpion stings, ophthalmic disorder, laxative, jaundice, toothache, sterility and whooping cough. They possess a number of biological activities such as proteolytic, antimicrobial, larvicidal, nematocidal, anti-cancer and anti-inflammatory. [6]

Calotropis acia:-

Calotropis acia is an under shrubs or herb. It is a strong medicinal plant. It is used to induce vomiting, purgation and used in the treatment of rheumatism, vitilgo, joint pains, mumps and ear-aches.



Fig.1: *Calotropis gigantea*



Fig.2: *Calotropis procera*



Fig.3: A plant of *Calotropis acia*

Systematic position of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia*[6,8]:-

Classification	<i>Calotropis gigantea</i>	<i>Calotropis procera</i>	<i>Calotropis acia</i>
Kingdom	Plantae-Plants	Plantae-Plants	Plantae-Plants
Sub kingdom	Tracheobionta-Vascular plants	Tracheobionta-Vascular plants	Tracheobionta-Vascular plants
Super division	Spermatophyta-Seed plants	Spermatophyta-Seed plants	Spermatophyta-seed plants
Division	Mangliophyta-Flowering plants	Mangliophyta-Flowering plants	Mangliophyta-Flowering plants
Class	Mangliopsida-Dicotyledons	Mangliopsida-Dicotyledons	Mangliopsida-Dicotyledons
Sub class	Asteridae	Asteridae	Asteridae
Order	Gentianales	Gentianales	Gentianales
Family	Apocynacea	Apocynacea	Apocynacea
Sub Family	Asclepiadoideae	Asclepiadoideae	Asclepiadoideae
Tribus	Asclepiadeae	Asclepiadeae	Asclepiadeae
Sub Tribus	Asclepidinae	Asclepidinae	Asclepidinae
Genus	Calotropis R.Br-Calotropis	Calotropis R.Br-Calotropis	Calotropis
Species	<i>Calotropis gigantea</i>	<i>Calotropis procera</i> (Aiton).W. T. Aiton-rooster tree	<i>acia</i>

Systematic position:-

The Systematic position of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* has been tabulated. [Table-1]

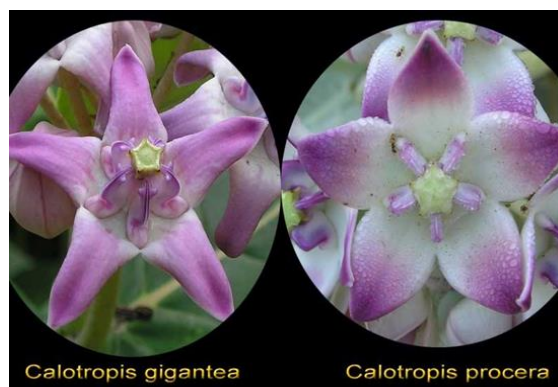


Fig.4: Flowers of *Calotropis procera* and *Calotropis gigantea*

Table-2:- Vernacular name [6, 2, 10, 11, 12, 13, 15, 16, 17]

Languages	Calotropis gigantea	Calotropis procera	Calotropis acia
English	Crown flower, Asclepiadaceae gigantea, Giant Calotrope, Swallow-wort, Giant Milk weed, Kapal-kapal, bowstring hemp	Mudra, Rooster tree, Asclepiadaceae procera, Articula tree, Dead Sea apple, Sodom apple, Rubber brush ,French cotton, Swallow-wort, Dead sea fruit	Madar, Giant Milk-weed, Rooster tree ,Mudar plant
Tamil	Erukku, Malaiyerukku, Arrkam, Yerdkku	Ekka, Yerkum, Vellai erukkan, velai Erukku	Erukku
Hindi	Aaka, Safed Aak,	Aaka, Aanka Ak	Madaar, Aak
Sanskrit	Alanka, Arki, Sadapushpa, Hrasvagnih, Arka, Aditya	Ark, Alanka, Ravi, Adityapushpika, Alarka, Ksirapara, Mandra	Alarka, Rajaarka, Shvetarka, Vauka, Mandaar, Bhasvanmuula, Dinesh, Prabhakar
Malayalam	Erikkalachedi, Dinesam, Vellerikk, Vellaerriku, Chuvanneerikk	Remiga, Rembega, Kemengu, Erriku	Erukku
Telugu	Jilledi Puvvu, Uhcinta, Nallajilledu, Uccinta	Erra jilledu, Jilledu, Mandaaramu	Uccinta
Kannada	Ekka, Ekkemale,	Bili aekka, Bili aekkada gida	Ekka
Marathi	Arki, Rui, Ruiti, Lal Arka	Mandara, Rui	Rui
Gujarati	Akondo	Aankando	-
Manipuri	Angkot	Numseubatong(Ao-Changki)	-
Nepali	Aank, Madaar	Setho Aank, Bahramasse Aank, Aank	-
Assamese	Akonda, Akon	Akon	-
Turkish	Ipekag	Ipekag	-
Spanish	Lechoso	Algodon extranjero, Cazuela, bomba	-
French	Faux arbre de soie, Mercure vegetal	Calotrope, Pomme de Sodome	-
Malaysia	Remiga, Rebinga, Kemengu	Rebinga, Kemengu	-
Thai	Po thuean, Paan Thuean, Rak	Paan Thuen	-
Vietnamese	B[oot]ng b[oot]ng, l[as]hen, Namt[ot]b[at], Bang bien.	Saharo-sindish, cây lá hen	-
Arabic	Ushar	Ushar, Oshar, tourha, sano, Fafetone, Dead sea Ushar	Oshar
Japanese	Rubik	Rubik	-
Laos	Kok may, Dok kap, Dok hak	Rèmbenga, kēmengu.	-
Italian	Calotropo	Calotropo	-
German	Kronenblume, Madar-Strauch, Mudarpflanze, Akonfaserstrauch	Wahre Mudarpflanzer, Gomenier	-
Chinese	Niu jiao gua	bai hua niu jiao gua	-
Portuguese	Saco-de-velho	Algodao-de-seda;saco-de-velho	-
Spanish	Mata de seda, Alogon de seda	Alogon de seda, Algodon extranjero, mata de seda	-

The Vernacular name of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* has been tabulated.
[Table-2]

Table-3: Vegetative Character of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* [6, 11, 21, 23, 10]

Vegetative Characters	<i>Calotropis gigantea</i>	<i>Calotropis procera</i>	<i>Calotropis acia</i>
Habit and Habitat	It is a shrub or a small tree about 4m tall. Crown flower grow in any habitat, but it thrives in hot, sunny and dry environment, including the areas near the coast that are exposed to salt.	It is a shrub which is about 3 to 6 feet tall. The tender parts of the plant and the under surface of the leaves are covered with white waxy secretion, called latex.	It is an herb or under shrub. The tender parts of the plant are covered with floccose tomentose.
Stem	They are erect, branched and herbaceous	They are crooked and covered with a fissured corky bark. They are erect, branched, glabrous, woody below and herbaceous.	They are erect, short, branched and corky.
Root	They are simple, branched and woody at the base and covered with a fissured, corky bark. Branches are succulent. They are covered with tomentose (covered with densely matted hairs) when the plants are tender and in later stage they become glabrescent and glaucous.	They have a tap root which is 3-4m deep, and a secondary root system with woody lateral roots that may rapidly regenerate adventitious shoots when the plant is injured.	-
Bark and Branches	The bark is cracked and corky. They grow wild on a variety of soil in different climates.	The bark is thick, rough and corky and yellow-brown colour; twigs are green and fleshy and may have a covering of tomentum (white fur like hairs). Branches are succulent and dense while tomentose, glabrescent.	-
Leaves	They are obovate or oblong, sessile or with petiole. 0.2-0.7mm long; lamina elliptic to oblong. 10cm long, 3 to 8cm wide, cordate to articulate, acute to round. Colleters 19 or 20 pointed at the tip and heart shaped at the base.	Simple, cauline, sessile, opposite, decussate, exstipulate, 2-5 inches long, thick, glaucous-green, elliptical or obovate oblong with cordate or often amplexicaul base, acute or shortly acuminate, unicosate reticulate venation.	They are oblong, abruptly short, acute lateral nerves about 6-7cm on both the sides. The size of leaves varies and ranges between 12-22 cm in length and 5-13cm inches breadth. Cuticle is thick and entire.
Flowers	They have a faint odour, downy on outside, arranged in axillary or sub terminal. They have simple or compound inflorescence.	Flowers consist of five small triangular dirty white sepals, five thick ovate petals (1x1 cm) which are white at the base and purple at the tips and they possess a white five lobed stigma.	Colour of the flower is purplish. It is about 1 inch in diameter.

The Vegetative character of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* has been tabulated. (Table-3)



Fig.5: *Calotropis gigantea* shrub [23]



Fig.6 *Calotropis procera* shrub[26]



Fig.7: *Calotropis gigantea* leaves [25]



Fig.8 *Calotropis procera*leaves[29]

Table-4:-Floral characters of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia*[30,14,34,25]

Floral characters	<i>Calotropis gigantea</i>	<i>Calotropis procera</i>	<i>Calotropis acia</i>
Flowers	They are composed of bracteate, complete, actinomorphic bisexual, hypogynous, pedicellate and pedicel upto 1-3 cm	They are pentamerous and hermaphroditic (both androecium and gynoecium are present in the same flower).	They are composed of bracteate, pentamerous and have pedicel. Flowering occurs during cold weather from December-March
Inflorescence	They appear in clusters (umbellate cymes)	They are composed of erect, axillary, umbellate cymes and polychasial cyme, one per axil. Peduncle and pedicel are present.	Inflorescence are axillary and terminal umbellate
Calyx	They consist of five sepals, polypetalous, five lobed, shortly united at the base, glabrescent, quincidal aestivation.	They consist of five sepals, polysepalous, quincidal. They are five-lobed with many glands at the base.	Calyx are polysepalous, five in number and lanceolate
Corolla	They have five petals gamopetalous, five lobed, twisted aestivation	They consist of five petals, gamopetalous, twisted and coloured.	Corolla lobes are erect, acuminate with bluish purple near the apex and whitish at the base.
Androecium	They have five stamens, gynadrous, and anther ditheous and coherent.	They have five Stamens, united with the stigma to form gynostegium (a specialized cap	There are five numbers of stamens which forms stamina column with stigmatic disc to

		like mass of tissue covering a gynoeceium); each stamen is represented by two pollinia with their retinaculae. The pollinia of the adjacent anthers are joined by their reticulanae to form corpusculum in a groove to form a unit known as translator.	form gynostegium.
Gynoeceium	They have bicarpellary apocarpous ovary (having carpels free from each other) and styles are united at their apex. Pellate stigma with five lateral stigmatic surfaces. Anthers adenate to the stigma forming a gynostegium.	They have two carpels, distinct, ovaries free but upper portion of style and stigma are fused, superior, placentation marginal, ovules many per locule, pentagonal stigmatic head.	They are bicarpellary, apocarpous, ovary, superior style, free stigma fused to form stigmatic disc
Fruit	It is simple, fleshy, inflated, and sub globose to obliquely ovoid follicles up to ten cm or more in diameter. Follicles are recurved up to two or one follicles, second more often suppressed, 3-4 inches long.	Fruit consists of an aggregate of two dry follicles. They consist of ovoids. Follicles were 3-4 inches, recurved.	Pollination is antomophillus. Fruiting occurs during cold season from December to March.
Seed	Seeds are broadly ovate, up to 5-7×3-4mm.	They are flat obovate up to 6×5mm with silky white pappus which is up to 3cm or longer.	-

The floral characters of *Calotropis gigantea*, *Calotropis procera* and *Calotropis acia* have been tabulated.



Fig.9: *Calotropis gigantea* flower [27]

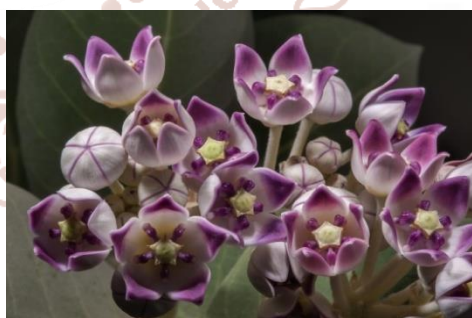


Fig.10: *Calotropis procera* flower [26]



Fig.11: Milk weed-*Calotropis gigantea* fruit [30]



Fig.12: *Calotropis procera* fruit [29]

Fig.13: *Calotropis gigantea* seeds [33]Fig.14: *Calotropis proceraseeds* [32]Fig.15: *Calotropis acia*–Inflorescence [14]

Geographic distribution:

1. *Calotropis gigantea*:-

Calotropis gigantea is common plants which are found in a warm climate in dry, sandy and alkaline soil. In India, it is found throughout the plains and lower hills, usually near water growing up to an altitude of 900 m including Andaman.[5]. It is grown in Africa, South east Africa, Eastern Asia.[36]. It is native in India to Sri Lanka, Iran to China, Malaysia, Indonesia, Africa-Asia.[5]

2. *Calotropis procera*:-

Calotropis procera is dominant in areas of abandoned cultivation especially sandy soils in the areas of low rainfall: assumed to be an indicator of over-cultivation. This plant is widely distributed in tropical and sub-tropical Africa and Asia.[37].It is native to India, Pakistan, Iran, Pakistan, Nepal, Afghanistan, Algeria, Israel, Kenya, Kuwait, Niger, Nigeria, Oman, Saudi Arabia, United Arab Emirates, Yemen, and Zimbabwe. [6].

3. *Calotropis acia*:-

Calotropis acia are found in India, Nepal, East, North East India, Tropical Himalayas, Assam, Kamrup, Goalpara and Darjeeling. [38]

Table-5:Phyto chemical studies of *Calotropis* species

S. No.	Experiment	<i>Calotropis gigantea</i> [40,43,5,41]					<i>Calotropis procera</i> [39,6,73]						
		Aqueous extract	Methanolic Extract		Ethanolic Extract		Benzene Extract	Petroleum ether Extract			Methanolic Extract		
		Root	Root	Leaves	Stem	Root	Root	Flowers	Leaves	Stem	Flowers	Leaves	Stem
1	Alkaloids	+	+	+	+	+	+	+	-	-	-	-	-
2	Carbohydrates	+	-	-	+	+	-	-	-	-	+	+	-
3	Flavonoids	+	-	+	-	+	+	-	-	-	+	+	+
4	Glycosides	+	-	+	-	-	+	+	+	-	+	+	+
5	Tannins & Phenolic compound	+	-	+	-	+	-	-	-	+	+	+	+
6	Saponins	+	-	+	-	+	+	+	-	+	+	-	+
7	Proteins and amino acids	+	+	-	+	-	-	+	+	+	+	+	+
8	Fats and oils	-	+	+	+	-	+	+	-	+	+	-	+
9	Triterpenoids	-	+	+	+	-	-	-	+	-	+	+	-
10	Reducing sugar	+	-	-	+	+	-	-	-	-	+	-	-
11	Steroids	-	+	+	-	-	+	-	+	-	+	+	-

The phytochemical studies of *Calotropis gigantea*, *Calotropis procera* & *Calotropis acia* have been tabulated.

#-*Calotropis acia*: Relevant information not available.

Medicinal applications and Pharmacological activities of *Calotropis gigantea* and *Calotropis procera*

1. Anti-bacterial activity:-

In-vitro anti-bacterial activity of methanol extract of *Calotropis gigantea* leaves against *Salmonella typhi*, *Pseudomonas fluorescens*, *Pseudomonas aeruginosa* and *Escherichia coli* was done. This study showed clear indication that *Calotropis gigantea* had positive effect on *Pseudomonas fluorescens*. [2]

Studies on the growth and survival dynamics of *Escherichia coli*, *Staphylococcus aureus*, *Candida albicans* and *Xanthomonas campestris* of Ethanolic extracts of apical buds and flowers have shown higher growth in *Calotropis gigantea* which had a good effect on *E. coli*, *S. aureus* and *C. albicans*. [43]

The antagonistic activity of aqueous extract against *Staphylococcus aureus*, *Escherichia coli*, *Bacillus cerus*, and *Pseudomonas aeruginosa*, *Micrococcus luteus* and *Klebsiella pneumonia* revealed that *Calotropis gigantea* had the maximum zone of inhibition against *Escherichia coli* whereas lowest inhibition was seen against *Klebsiella pneumonia*. [44].

2. Hepatoprotective activity of Liver:

The suspension of alcoholic extract of root and bark of *Calotropis gigantea*, dissolved in 0.6% (carboxy methyl cellulose) CMC was evaluated for hepatoprotective activity in Wistar rats by inducing hepatic injury with D-galactosamine. [42].

3. Larvicidal and Repellent activities:-

The larvicidal efficiency of the latex of *Calotropis procera* against all three important vector species such as *Ae. aegypti*, *An stephesi* and *Cx. quinquefasciatus*, vectors of dengue, malaria and Lymphatic filariasis respectively in which it was proved that *Calotropis procera* latex is responsible for the larvicidal properties [45].

The anti-feedant activity of *Calotropis procera* leaves was seen against third instar larvae of *Spodoptera lithura* done by dip method in extract. The maximum activity detected in chloroform extract. [50]

4. Synthesis of Nanoparticles:-

The synthesis of silver nanoparticles (AgNPs) by using serum latex of *Calotropis procera* at 80°C inferred that

the AgNPs showed strong antibacterial activity against *Escherichia coli*, *Pseudomonas aeruginosa* and *Serratia sps* and Anti-fungal activity against *Trichophyton rubrum*, *Candida albicans* and *Aspergillus terreus*. [46]

The green synthesis of Zinc oxide (ZnO) particles by Zinc nitrate, utilizing the bio components of the leaf extract of *Calotropis gigantea* has been analysed by X-Ray Diffraction (XRD) and Scanning electron microscopy (SEM) and calculated using Debye-Scherrer's method and represented graphically. [47]

5. Cytotoxicity:-

The sub-acute toxicity study conducted for 28 days with ethanolic and methanolic extract of *Calotropis gigantea* latex in mouse models suggested that *Calotropis gigantea* latex does not cause sub-acute toxicity till the level of 1000mg/kg body wt./day for 28 days and hence is considered as a phyto medicinal therapeutic agent.

6. Abortifacient activity:-

Calotropin isolated from the roots of *Calotropis procera* when administered to gerbils and rabbits (25mg/kg b. wt) each day for a period of 30 days inhibited the process of spermatogenesis in male and induced abortion in pregnant females. [49]

7. Nephrotoxic Activity:-

The ethanolic extract of leaves of *Calotropis procera* kidney function and histological integrity in male albino rats indicated that *Calotropis procera* latex and ethanolic extract of leaves could induce marked toxicity in kidney and the same be more or less prone to those of abamectin. [48]

8. Anti-diarrhoeal activity:-

The anti-diarrhoeal effects of hydro alcoholic extract of aerial parts of *Calotropis gigantea* against castor oil induced diarrhoea model in rats indicated that it possesses anti-diarrhoeal effect against castor oil induced diarrhoea in a wide range of diarrhoeal states. [51]

It was observed that the anti-diarrhoeal activity of ethanolic extract of root of *Calotropis procera* against castor oil induced diarrhoea in rat showed that the extract controlled the condition. [53]

9. Anthelmintic activity:-

The anthelmintic efficiency of ethanolic and aqueous extracts of flower of *Calotropis procera* against

trematode parasite, *Gastrothylax indicus* showed that the motility and survival of the parasite and inhibition caused in the tegmental enzymes is due to the effect of *Calotropis procera* flowers which acted as a potential vermifuge or vermicide. [52]

10. Antioxidant activity:-

Methanolic extract of *Calotropisprocera* stem and leaves on potato dextrose agar medium (PDE) was used to extract and isolate eight endophytic fungi among them two fungi were found to be *Penicillium spp* and *Aspergillus spp*. The isolated fungal species showed the presence of flavonoids and phenolic compounds. [54]

11. Extraction of oil:-

The essential oil from the dried leaves of *Calotropis procera* was analysed by GC-MS. The two major components- 3, 7, 11, 15-tetramethyl-2-hexadecene-1-ol and 6, 10, 14-trimethyl-2-pentadecanone are used to control arthritis and malaria.[55]

12. Control of Struvite crystals

Struvite crystals comprised of calcium phosphate, calcium oxalate and magnesium phosphate. The results showed the increase in concentration of methanol extract of *Calotropis gigantea* leaves reduced the growth and nucleation rate of Struvite crystals. The compound identified and isolated/characterised by HPTLC and NMR techniques. [67]

Table.6:-Bio active compounds extracted from *Calotropis species*

S. no	Compounds	Common name or IUPAC name of the compound	Calotropis gigantea	Calotropis procera
1)	Phytol[55],[56]	3,7,11,15-tetramethyl-2-hexadecen-1-ol	Present	Present
2)	6,10,14-trimethyl-2-pentadecanone[55]	Farnesyl acetone	#	Present
4)	3,7,11,15-tetramethyl-2-hexadecene-1-ol[55],[56]	Phytol	Present	Present
5)	3-Buten-2-one-4,2,6,6-trimethyl-1-cyclohexene-1-yl[55]	Cyclocitryideneacetone	#	Present
6)	1-Nonadecene[55]	Nondec-1-ene	#	Present
7)	5,9,13-pentadecatriene-2-one-6,10,14-trimethyl[55]	Farnesyl acetone	#	Present
8)	Z-5-Nonadecene[55]	(Z)-nonadec-5-ene	#	Present
9)	Hexadecanal[55]	Palmitaldehyde	#	Present
10)	9-Nonadecene[55]	(E)-9-Nondecene	#	Present
11)	Octadecadienal[55]	Linoleyl aldehyde	#	Present
12)	1-Hexadecanol-2-methyl [55]	2-Methylhexadecan-1-ol	#	Present
13)	4,8,12,16-Tetramethylheptadecan-4-olide[55]	2(3H)-Furan one	#	Present
14)	2-Butanone-4,2,6,6-trimethyl-1-cyclohexen-1-yl [55]	Dihydro-beta-ionone	#	Present
15)	3-O-{-1-rhamnopyranosyl(1→2)-β-D-glucopyranoside}(1→2)-β-D-glycopyranosyl-(1→3)-β-D-glucopyranoside]-3β-hydroxyolean-12-ene-oic acid [56]	Oleanolic acid	#	Present
16)	3β-Hydroxy olean-12-ene-28-oic acid-28-O-β-D glucopyranoside [56]	Oleanolic acid	#	Present
17)	Furan-2-carbaldehyde [57]	Furfural	Present	#
18)	3-Hexyn-1-ol[57]	Cis-3-Hexen-1-ol;Blatteralkohol	Present	#
19)	Gentanol[57]	Heptan-1-ol	Present	#
20)	Benz aldehyde[57]	Melonol	Present	#

21)	2-Methyl-6-hepten-1-ol [57]	6-Hepten-1-ol,2 methyl	Present	#
22)	6-Methyl-5-hepten-2-ol [57]	Sulatacol	Present	#
23)	(+) β -citronellene [57]	D-Rhodinol	Present	#
24)	4-methyl-1-heptenol [57]	Isobutylene	Present	#
25)	Cis-Linalool oxide [57]	Linalool oxide-B	Present	#
26)	2,2,6-Trimethyl-1,4-cyclohexandione [57]	Tetrahydro-2,2,6trimethyloxane	Present	#
27)	Phenethyl alcohol [57]	Benzyl alcohol	Present	#
28)	Oct-3-en-2-ol [57]	CIS-3-Oct-1-ol	Present	#
29)	3-Thiophenemethanol [57]	Thiophen-3-ylmethanol	Present	#
30)	n-Eicosane[57],[59],[61]	Icosane	Present	Present
31)	Tetradecanoic acid, trim ethyl ester[57]	Methyl myrisate	Present	#
32)	Diisobutyl phthalate[57]	1,2-benzene dicarboxylic acid, bis(2-methyl propyl) ester	Present	#
33)	Stearic acid[57]	Cetylacetic acid	Present	#
34)	n-Tetracosane[57]	Lignocerane	Present	#
35)	n-Docasane[57]	Heneicosane	Present	#
36)	DL-Menthol[57]	Bis(hydroxymethoxy)ethane	Present	#
37)	Nerol [57]	Cis-Geraniol	Present	#
38)	α -Terpiene [57]	1-Isopropyl-4-methyl-1,3-cyclohexadiene,p-Menth-1,3,diene	Present	#
39)	Undecane[57]	Hendecane	Present	#
40)	2,3,epoxygeranyl acetate[57]	6,7-Epoxy-3,7-dimethyl-2-octene-1-ol acetate	Present	#
41)	2,4-dimethyl-Acetophenone[57]	Ethanone	Present	#
42)	Isocyclogeraniol [57]	2,4,6 Trimethyl-3-cyclohexene-1-methanol	Present	#
43)	n-Tridecane[57]	n-undecyclic acid	Present	#
44)	Gardenol [57]	Styrallyl acetate	Present	#
45)	Dill ether [57]	Anethofuran	Present	#
46)	Heptylidene acetone[57]	3-Decen-one	Present	#
47)	4-vinylguaicol[57]	2-Methoxy-4-vinyl phenol	Present	#
48)	p-Cymen-7-ol [57]	4-(1-methylethyl)benzene methanol	Present	#
49)	p-Cyclocitral [57]	Trimethylcyclohexene - 1-carbaldehyde	Present	#
50)	Pinocamphenol [57]	Isopinocampone	Present	#
51)	Eugenol [57]	4-Allyl-2-methoxyphenol	Present	#
52)	Pinocamphenol [57]	3-pinanone	Present	#
53)	Artemisia alcohol [57]	1,5-Heptadien4-ol,3,3,6 trimethyl	Present	#
54)	3-Phenyl-2-propenoicacid, methyl ester[57]	Cinnamic acid	Present	#
55)	(Z)-Amylcinnamaldehyde[57]	2-Benzylideneheptanal	Present	#
56)	Spathulenol [57]	1H-Cycloprop(E)azulen-7-ol	Present	#
57)	Ribitol,TMS [57]	Ribitol,1,2,3,4,5-pentakis-o-(trimethylsilyl)ether	Present	#
58)	Nerylacetone[57]	Cis-Geranylacetone	Present	#
59)	(E) β -Ionone[57]	Sesquiterpenes	Present	#
60)	5-hydroxy-3,7-dimethoxyflavone-4'-O- β -glucopyranoside [58]	7,4'Di-O-Methylapigenin-5-O-glucoside	#	Present

61)	2 β ,19-epoxy-3 β ,14 β -dihydroxy-19-methoxy-5 α -card-20(22)-enolide [58]	Digitoxins	#	Present
62)	β -andhydroepidigitoxigenin-3 β -O-glucopyranoside [58]	3,4,5Trihydroxy-6-(hydroxymethyl)oxan-2yl]benzoate	#	Present
63)	Uzarigenine[58]	Odorigenin-B	#	Present
64)	β -anhydroepidigitoxigenin [58]	Unidigin	#	Present
65)	1-Octanol-3,7-dimerhyl [59]	Dihydrocitonella	Present	#
66)	2-Methoxy 4-vinyl phenol ethanone [59]	4-ethenyl-2-methoxyphenol	Present	#
67)	Azulene [59]	Cycloheptane	Present	#
68)	Benalaxyl [59]	Galben	Present	#
69)	Beryllium sulphate tetra hydrate[59]	Beryllium monosulphate tetra hydrate	Present	#
70)	Biphenyl [59]	Limonene	Present	#
71)	Campesterol [59]	Campest-5-en-3-beta-ol	Present	#
72)	Cholest-5-en-3-ol,24,Propylidene(3 β)[59]	24-Propylidenecholest-5-en-3 β -ol	Present	#
73)	Levomamol [59]	Bisobolol	Present	#
74)	Profenofos[59]	Curacron	Present	#
75)	Butane-2,2-dimethyl [59]	Neohexane	Present	#
76)	Cis-vaccenic acid [59]	Asclepic acid	Present	#
77)	B-Tocopherol [59]	Cumotocopherol	Present	#
78)	Z-1,6-Tridecadiene[59]	1,11-Tridecadiene-3,5,7,9-tetrayne	Present	#
79)	L-Glutamic acid[59]	(S)-2-Aminopentanedioic acid	Present	#
80)	Phenol,2,5-bis(1,1-dimethyl)[59]	2,6,-Di-tert-butylphenol	Present	#
81)	5-Nondecen-1-ol [59]	-	Present	#
82)	D-Mannose-1-phosphate sodium salt [59]	α -D-Mannopyranosyl phosphate	Present	#
83)	Guanidine nitrate[59]	Guanidine mononitrate	Present	#
84)	2-Methoxy 4-vinyl phenol ethanone[59]	2-Methoxyacetophenone	Present	#
85)	Tricosane[59]	Docasane	Present	#
86)	1-[(T-butyl)-dimethyl silyl thin]butane[59]	3-oxo-23,24-bisnorchol-4-en-22 oic acid	Present	#
87)	Calotropone[60]	-	Present	#
88)	Gofruside[60]	(3S,5S,10R,13R,14S,17R)-14 hydroxy-13methyl-17-(5-oxo-2H—furan-3yl)-3[(2R,5S)-3,4,5Z-trihydroxy-6-methyloxan-2yl]oxy-1,2,3,4,5,6,7,8,9,11,12,15,16,17 tetradecahydrocyclopenta [a]phen-10-carbaldehyde	Present	#
89)	2,3,4-trimethyl hexane[61]	Hexane,2,3,4,trimethyl	#	Present
90)	Decane[61]	Decyl hydride	#	Present
91)	1,3,5 Triisopropyl benzene[61]	2,4,6-Triisopropyl benzene	#	Present
92)	4,hydroxy-4-methylpentan-2-one[61]	2-Methyl-2-pentanol-4-one	#	Present
93)	n-Pentadecane[61]	Pentadekan	#	Present
94)	2,6,10,15,19,23-Hexamethyl-2,6,10,14,18,22-	Pentahydrosqualene	#	Present

	tetracosahexane[61]			
95)	3,7,11-Trimethyl-2,6,10,12-pentadecatrien-1-ol [61]	2,3,4-trimethylhexane	#	Present
96)	2,6,dimethyl tetra-1,5-decane [61]	4,7,Epoxyisobenzofuran-1,3 dione, ,hexahydro-3a,7a-dimethyl	#	Present
97)	(6Z),(9Z) Pentadecadien 1-ol [62]	6,9,Pentadecadien-1-ol	#	Present
98)	Farnesol isomer [62]	Polyprenol	#	Present
99)	Tetratetracotane [62]	n-Tetratetracotane	#	Present
100)	2-Hexadecen-1-ol,3,7,11,15-tetramethyl-,[R-[R*,R*-(E)]]-[62]	Phytene-2	#	Present
101)	9,12,15-Octadecatrienoic acid, methyl ester,(Z,Z,Z)-[62]	Octadeca-9,12,15-trienoic acid	#	Present
102)	Naphthalene decahydro,2,6,dimethyl	Decahydro-2,6-dimethylnaphthalene	#	Present
103)	9-Octadecnoic acid(Z)[62]	Octadec-9-enoic acid	#	Present
104)	2-H Benzofuranone 5,6,7,7A tetrahydro 4,4,7A,trimethyl [62]	(2,6,6-Trimethyl-2-hydrocyclohexylidene)acetic acid lactone	#	Present

[# signifies that these do not provide any relevant information]

Isolation of Compounds from *Calotropis species*

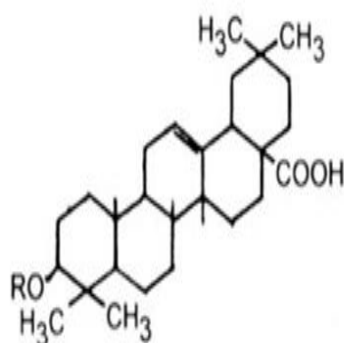


Fig.16. Two pentacyclic triterpenes Oleanic acid/ Olenic acid[56]

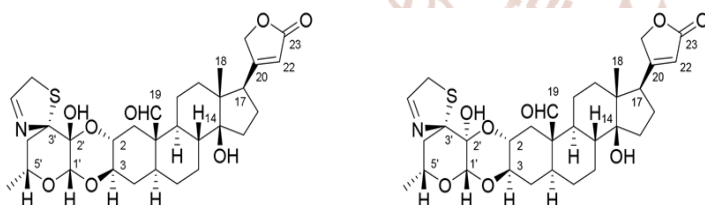


Fig.17. Chemical structures of (1)Uscharin and (2)Epi-Uscharin

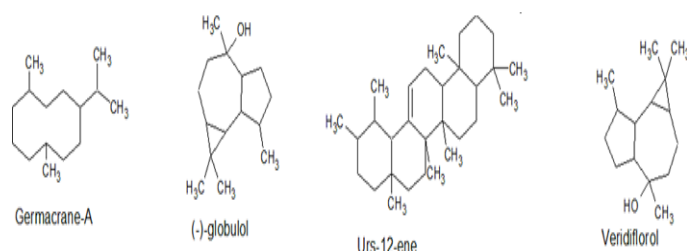


Fig.18. Compounds isolated from the stem bark plants of *Calotropis gigantea* [61]

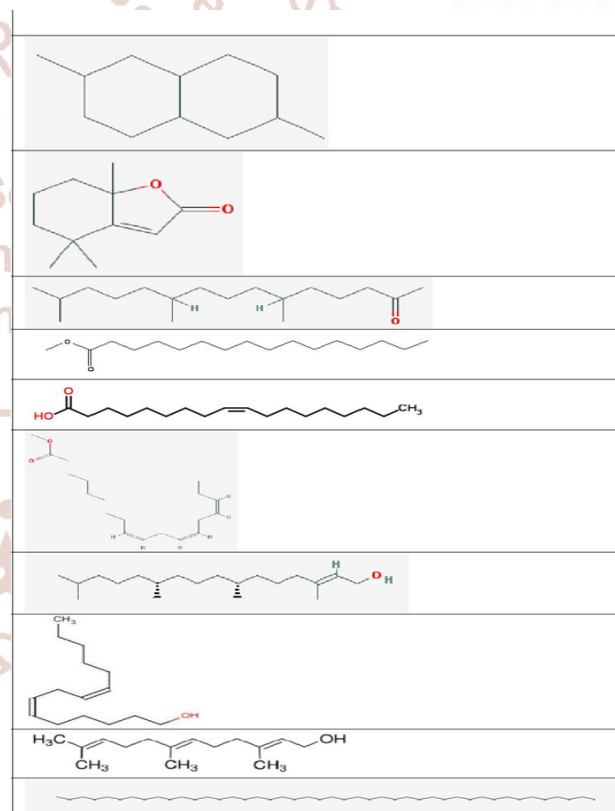


Fig.19: Naphthalene decahydro2,6 dimethyl; Compound-(2):2-H Benzofuranone 5,6,7, 7A tetrahydro 4,4,7A trimethyl;Compound-(3): 6, 10,14-trimethyl, Pentadecanone -2:Compound-(4): Hexadaconic acid, methyl esters; Compound(5):9-Octadecenoic Acid (Z)-:Compound(6):-9,12,15-Octadecatrienoic acid, methyl ester, (Z,Z,Z)-:Compound-7:2-Hexadecen-1-ol, 3,7,11,15-tetramethyl-, [R-[R*, R*-(E)]]-Compound-8:(6Z), (9 Z) Pentadecadien 1-ol.[62]

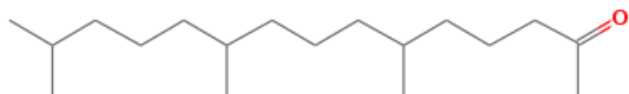


Fig.20. 6, 10, 14-trimethyl-2-Pentadecanone [63]

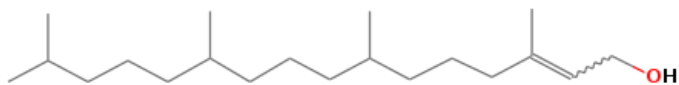


Fig.21. 3, 7, 11, 15-tetramethyl-2-hexadecen-1-ol [64]

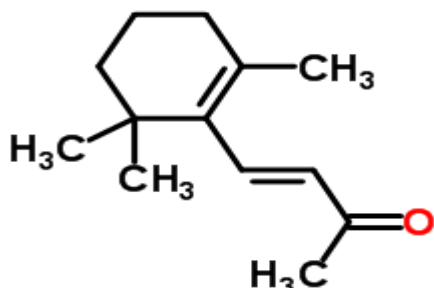


Fig.22.3-Butene-2-one-4, 2, 6, 6-trimethyl-1-cyclohexene-1-yl [65]

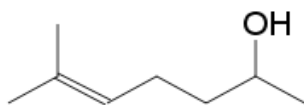


Fig.23.6-Methyl-5-hepten-2-ol [66]

Economic importance of *Calotropis species*

1. *Calotropis spp.*, acts as a soil binder and prevents soil erosion. It is also used as green manure and used for mulching.[66]
2. The extracts of *Calotropis spp.* leaves and latex are used for Nematicidal activity.[66]
3. The fine fibre obtained from the bark of *Calotropis gigantea* is used in making textiles, fishing net and bowstrings. It can be used to make pillows and mixed with other fibre to make clothes.[68],[71]
4. A strong fibre is obtained from the stem of *Calotropis procera* used for making ropes, gunny bags, fishing net, cot-ropes, bow strings and used in the manufacture of pulp and duplicating stencils (Mimeograph). [69],[72]
5. Strong inner barks from *Calotropis procera* are used to produce binding material and are processed into fabrics.[69],[70]
6. In Brazil, *Calotropis procera* is used as an animal feed as it produces green biomass and dry matter. [74]
7. The parts of *Calotropis* such as root, stem, leaf and flowers have vermifugal, bactericidal, emetocathartic (vomiting & purging) and dig italic properties.[6]

8. An infusion of bark powder of *Calotropis procera* is used for the treatment of leprosy and elephantiasis. [6]
9. The tonic prepared from *Calotropis procera* is used for asthma and catarrh[6]
10. The latex is used for treating ring worm, guinea worm blisters, scorpion stings, venereal sores and ophthalmic disorders.[6]
11. The milky sap of *Calotropis procera* act as a rubefacient, purgative and caustic compound[6]
12. *Calotropis* roots are used as bio-sorbent in waste water for copper remediation.[66]
13. *Calotropis* which yields 90tons of biomass twice a year and is a potential source of renewable energy.[66]
14. The bark and latex of *Calotropis procera* are used in brewing and to curdle milk.[19]
15. The twigs of *Calotropis procera* are applied for the preparation of diuretics, stomach tonic, anti-diarrhoeic, asthma, abortion, anthelmintic, cough, dysentery, head ache, lice treatment, jaundice, sore gums mouth toothache, sterility, swellings and ulcer.[19]
16. A macerated bark of *Calotropis procera* extract can be used for dehairing and tanning in the leather industry.[19]
17. *Calotropis procera* acts as an ideal plant for monitoring sulphur dioxide emissions in the air.[19]
18. Stems of *Calotropis procera* produce a type of charcoal. In India, they are used in making gun powder.[19]
19. Stems of *Calotropis procera* are used for roofing and building huts.[19]

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