COMPARITIVE STUDIES REGARDING THE PHARMACOLOGICAL ACTIVITIES BETWEEN CALOTROPIS GIGANTEA AND CALOTROPIS PROCERA: A REVIEW

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ABSTRACT

Calotropis species is widely used in Ayurvedic medicines. There is Calotropis gigantea known as “SwetaArka” and Calotropis procera known as “RakthaArka”. Commonly, these are known as “milk weed” or “crown flower”. Botanical aspects as well as pharmacological effects are quite similar to each other. These are found on wasteland area and number of medicines are derived from them, either directly or indirectly. The plant is found to be effective in many ways. Latex is found to be used for the treatment of leprosy, eczema, inflammation, cutaneous infections. Traditionally, its roots were powdered and show effective results against Lungs disease and were even used for the treating cough and cold. Flowers are found to possess positive effect for curing piles. It was confirmed that medicinal properties of these herbal plants lie in their secondary constituents. Therefore, on performing, biochemical screening there was observed a good yield of phytoconstituents present in this plant and majority of them were belonging to alkaloidal, saponins, phenolic, flavanoidal and terpinoidal groups. The aqueous and alcoholic extracts were claiming to have anti-inflammatory, anti-pyretic, anti-microbial, analgesic, anti-bacterial properties. Methanolic extract was claimed to have anti-oxidant properties. This plant is considered as valuable source of medicinal compounds due to its medicinal properties.

KEYWORDS: Calotropis gigantea, Calotropis procera, Medicinal plant, Pharmacological activities.
INTRODUCTION
Genus Calotropis are one of the class of plants that produces the milky sap and hence also known as “milkweed”. It is also considered as the common weed. This belongs to the large Asclepiadaceae Family, which comprises of 175-180 genera and 2200 species which are widely distributed. In India, two most common type of genera are found which are Calotropis gigantea and Calotropis procera, both of them are very similar to each other regarding their physical and biological properties. These are drought resistance and generally grows upto the height of 900 meters. They are distributed on sandy soil with mean annual rainfall of 300-400mm. This is the weed that grows along the roadsides, lagoon edges and in overgrazed regions. The life span for Calotropis genus is 12 years. Several plants of this genus are identified with active biological compounds. Studies has reported that there are many phytochemicals that are present in Calotropis plants. This is the plant which is capable of accumulating secondary metabolites in them and hence, therapeutically active. This plant is not only enriched with distinctive properties rather it contains some of the most important constituents such as vitamins, minerals, proteins, carbohydrates and essential oil. Several genera of this family contain the biological active compounds. Calotropis gigantea is native to Cambodia, Indonesia, Malaysia, Philippines, Thailand, Sri Lanka, India and China. Calotropis procera, is native to North Africa, Tropical Africa, Western Asia, South Asia, Nigeria and Indochina. It’s very abundant in Nigeria with the local name: Bomu-bomu in Yoruba. Research has revealed that both the species are capable of showing excellent hepatoprotective, Anti-diarrheal, Anti-inflammatory, Anti-pyretic and Antioxidant properties. Studies helps to know that the plant possess anticancer properties as well and still more establishments need to be done for this side of the plant. Overall, one can state that this is plant which is found to be the hub of many useful and significant properties.

Morphological characteristics of Calotropis procera
The morphological studies revealed the plant is erect, tall, large, much branched and perennial with milky latex. Calotropis procera have large bushy shrub, leaves decussate, inflorescence extra axillary umbellate panicale, corolla purple, lobes erect. The leaves are sub- sessile, 6-15 cm by 4.5-8 cm, broadly ovate, ovate-oblong, elliptic or obovate acute, pubescent when young and glabrous on both sides when mature. The green globes are hollow but the flesh contains a toxic milky sap that is extremely bitter and turns into a gluey coating resistant to soap. The stems and leaves have a waxy appearance and contain a milky white sap. Branching occurs from the base of the plant upwards. Younger stems are greyish-green
in colour, smooth in texture, and have a covering of whitish coloured hairs known as hoary. Mature stems have a deeply fissured, cork-like, bark that is light brown in colour.\(^{28}\)

**Figure1: Calotropis Procera.**

**Taxonomical Classification\(^5\)**

Kingdom - Plantae  
Division - Magnoliophyta  
Class - Magnoliopsida  
Subclass - Asteridae  
Order - Gentianales  
Family - Asclpiadaceae  
Subfamily - Caesalpinioideae  
Genus - *Calotropis*  
Species - *procera*

**Morphological characteristics of Calotropis gigantea**

Morphological studies reveal that the plant is a large shrub or small tree, about 3-4(-10) m tall. Its stems are erect, up to 20 cm in diameter. The leaves are broadly elliptical to oblong-oval in shape, with the size of 9-20 cm x 6-12.5 cm but are subsessile. It has clusters of waxy flowers that are either white or lavender in colour. Each flower consists of five pointed petals and a small, elegant "crown" rising from the centre, which holds the stamens.\(^{13}\) Flowers are complete, bisexual, bracteate, actino-morphic, pentamorous, hypogynous and peduncu-late. Calyx has five sepals and lobe, shortly united at the base. Corolla is gamopetalous. The plant has oval, light green leaves and milky stem.\(^{30}\) The roots are
cylindrical, tortuous and often branched, externally yellowish grey while internally ceramic white and about 90 cm in length and 2.5-10 cm in diameter. Root bark is short, curved and is more rarely quilled pieces, 2-5 mm thick and 3-5 cm broad and has distinctly mucilaginous, bitter taste. Fruit is simple, fleshy, inflated, subglobose to obliquely ovoid. Seed is about 6 × 5 mm, flat compressed with silky white pappus.  

Figure 2: Calotropis Gigantea.

TAXONOMICAL CLASSIFICATION\cite{1}

Kingdom: Plantae  
Division: Magnoliophyta  
Class: Dicotyledones  
Sub class: Asteridae  
Order: Gentianales  
Family: Apocynaceae  
Subfamily: Asclepiadaceae  
Genus: Calotropis  
Species: Calotropis gigantea

Traditional Medicinal uses of Calotropis gigantea\cite{32}

Different parts of the plant have the different use. The milky weed, which is also known as latex helps to induce vomit and has purgative action. The plant is capable of showing astringent action and therefore, is used for the treatment of various skin disorders. This plant has the “vata” pacifying properties and helps in relieving the digestion disorders. It is found
to be very useful for treating and healing wounds, itching and helps to restore from various skin diseases, due to its Anti-inflammatory properties. Traditionally, it is used as a local applicant to treat haemorrhoids. This plant has a strong alkaline action and helps in shrinking the haemorrhoids tags. The leaves of Calotropis gigantea are used as an antidote against the snake bite.

**Pharmacological Effect of Calotropis Gigantea**

**Antibacterial activity:** The crude extract of leaf and stem of Calotropis gigantea was prepared. The antibacterial activity for this extract was analysed using agar well diffusion method. For the agar cup method, the culture of *Bacillus subtilis* is used and spreaded onto the agar plates. Wells of around 1.2 cm in diameter was prepared on the plates using cork borer and to them the different extractions of different volumes (Aqueous, Methanolic, Ethanolic and Ethyl Acetate) were added along with the controls. All the plates were kept under observation for 24 hours. From this study it can be concluded that the experimental plants showed strong antibacterial activity against bacteria. The extract of stem and leaf found to be rich in various metabolites and certain compounds were also isolated named Uscharin, gigantin, hydrocarbons and various saturated and unsaturated fatty acids. It has been observed that the ethanolic extracts exhibited significant antibacterial activity. Aqueous extract of *Calotropis gigantea* shows little excellent inhibitorier zone as compared to methanolic extract. From these, we can conclude that some of the component of leaf and stem extracts exhibit the synergistic action against bacteria.[32]

**Anti-inflammatory Effect:** Calotropis gigantea has found to show anti-inflammatory effect. When latex of Calotropis gigantea is combined along with ibuprofen the best ever results are shown. The main reason behind this is may be the release of various inflammatory mediators.[6] The Ethanolic extract of *C. gigantea* was prepared and used against carrageenan induced paw edema in Wister albino rats. The Oral administration has shown the significant anti-inflammatory activity in comparison to Ibuprofen. The laticifer fluid present in plant is rich with proteolytic enzymes, the main reason for this activity.[26]

**Anti-Diarrheal Effect:** The hydroalcoholic extract of aerial parts of Calotropis gigantea was prepared. The Rats were induced with castor oil and were kept under observation for 24hours. The intraparitoneal dose was administered to rats. The extract exhibits the reduction in faecal output and droppings in rats. Therefore, the extract has shown excellent Anti-diarrheal activity.[31] Aerial parts are used as digestive and during study new compounds have been
isolated named naphthalene derivative and two terpinoid derivative and they all collectively helps to keep the digestion in proper order.[44]

**Antioxidant Activity:** The hydroalcoholic extract prepared from leaves of Calotropis gigantea was reported to show antioxidant properties. The extract was claimed to possess excellent DPPH radical scavenging activity. On increasing the concentration of extract, the reducing power of extract was found to increase.[18-20] The hydroalcoholic extract of leaves contains alpha and beta-calotropeol, a mixture of tetracyclic triterpene compounds and mixture of both saturated and unsaturated fatty acids which are responsible for showing antioxidant activities.[44]

**Wound Healing:** Extract from root bark of Calotropis gigantea was prepared and its activity was observed in Wistar albino rats. The extract was formulated in form of an ointment for excision wound healing models and was applied topically. For the incision wound healing models, the extract was given orally. The result reveals that extract has fasten the wound healing capacity of rats.[14],[24]

The latex of Calotropis gigantea was also prepared to observe their effect on wound for both incision and excision wound models. The treatment shown that effective healing activity has been shown by the extract at the area of wound. The latex circulates in the entire plant and when isolated it was found rich in triterpinoids, esters of calotropeols and volatile long chain fatty acids which are found to be the basic reason for healing the wound.[33],[34]

**Vasodilation:** The latex from Calotropis gigantea was administered in green frog R hexadactyla and positive results were measured. In take, of this latex has led to significant increase in Cardiac output.[7] Research shows that latex has shown prime action on change in Cationic permeability specially, for Ca and Na. Due to consequent excitation of Ca channels in heart muscles, there is an increase in blood flow of coronary muscles and dilatation is observed. Latex contains the compound named calotropin, gigantin and uscharin which have the dilation effect on blood vessels similar to digitalis.[31]

**Hepatoprotective:** The stem extract of the Calotropis gigantea has shown the best ever results for Hepatoprotective activities. The study has revealed that, when rats treated with carbon tetrachloride are injected with stem extract of Calotropis gigantea, reduced lipid peroxidation has been observed in rats and hence, improved biochemical parameters were
The study reveals that the stem extract is rich in α-amyrin methylbutazone, β-amyrin methylbutazone, α-amyrin acetate and β-amyrin acetate, these are responsible for potent hepatoprotective activity in plants.\(^{[1]}\)

**Cytotoxic Effect:** When the Ethanolic extract, from roots of Calotropis gigantea was prepared, the cardenolide glycosides were collected and that possess cytotoxic activity, named Calotropin, Fruguside were found to be the active principle. They were report to have the inhibitory effect towards chronic myelogenous leukemia K562 and human gastric cancer SGC-7901 cell lines.\(^{[34]}\)

The ethyl acetate extract from flowers of Calotropis gigantea was prepared and when injected intraperitoneal to mice suffering from Ehrlich’s ascites cancer the significantly decreases the tumour cells and leads to increase in body weight of mice. The extract also helps to restores the various haematological and biochemical parameters, such as glucose, cholesterol, SGPT, SGOT and blood urea levels. Study indicates that various phytochemicals are present in roots such as alkaloids, tannins, glycosides, phenolic compounds, carbohydrates, proteins and amino acids, flavonoids and steroids.\(^{[38]}\)

**Antipyretic Effect:** The water: ethanol extract of Calotropis gigantea roots has shown potent Antipyretic activity. The extract has shown significant results both against yeast induced and TAB-vaccine induced fever, for this Albino swiss rats and rabbits were taken, the intraperitoneal injection was administered to animals.\(^{[11]}\) The extract has helped to reduce and fever and brings it back to normal body temperature. From the prepared root extract, stigasterol and β-sitosterol has been isolated and they are responsible for showing the antipyretic activity of the plant.\(^{[26]}\)

**Insecticidal Effect:** The methanolic extract of Calotropis gigantea root bark was prepared and they have shown the potent effect against the adult T castaneumand several inster of larvae that generally leads to destruction of food crops in various parts of the countries. Along with the methanolic extract, even the petroleum ether and chloroform extract has shown the significant insecticidal properties.\(^{[6]}\) The milky sap circulates in the entire plant and that is rich with enzymes named cysteine proteinase and aspartic proteinase, to these enzymes pathogens and insects are highly resistant and therefore, the plant is showing insecticidal effect.\(^{[32]}\)
**Pregnancy Interceptive Property:** Latex of Calotropis gigantea was observed with activity of exhibiting the pregnancy interception in rats. The extract shown 100% efficacy when administered during the 1-5 or 1-7 postcoitum schedules. The latex is considered bitter, caustic and acrid. It induces abortion and infanticide. Study reveals that it consists of plenty of lupeol, calotropin, calatoxin and uscharin.\(^{[12],[34]}\)

**Traditional Medicinal Uses of Calotropis Procera**

The active compound found in Calotropis procera is Asclepin and Mudarin. These two are basically responsible for showing bactericidal and vermicidel activity. There are certain compounds that have been isolated from plant, were found to possess emetic-cathartic property. Traditionally, bark powder is converted into an infusion and that was used for the treatment of Leprosy and Elephantiasis. The leaves were used for the treatment of Asthma. The latex also known as “milky sap” is used as rubefacient and that even have purgative properties. The twigs of the plant were used for the preparation of tonics that were related to stomach ache and diuretics.

**Pharmacological Effect of Calotropis Procera**

**Hepatoprotective Activity:** Hydro-ethanolic extract from flowers of Calotropis procera was prepared. And was tested for hepatoprotectic effect in paracetamol induced hepatitis in rats. The constant use of paracetamol has led to an increased level of SGPT, SGOT, ALP, bilirubin, cholesterol and has upset the serum level of Glutathione. When the rats were treated with hydro ethanolic extract of Calotropis procera, significant results were shown as that have brought back the normal level of biochemicals in rats.\(^{[2]}\) Hence, the flowers were found to have hepatoprotective activity. This activity is due to the reason that the extract is capable of decreasing the level of serum cholesterol and triglycerides which is probably because of saponin content present in the plant and that causes the intestinal interference in the absorption of cholesterol.\(^{[17],[36]}\)

**Anti-diarrhoecal:** The dry latex of Calotropis procera has been found to show potent anti-diarrheal activity. The rats were induced with castor oil and they were showing symptoms of intestinal fluid accumulation and electrolyte concentration in intestinal fluid. When they were administered with single dose of dry latex, they show significant reduction in frequency of defecation and severity of diarrhea was improved in more than 50% rats. Unlike, the atropine and phenyl butazone, the pharmacological effect of dry latex of Calotropis procera was found to be much better and relaxing. Upon the chemical screening of dry latex, it has been
observed that it this activity is due to presence of various cardenoids such as calotropin, calotoxin, uscharin, usechardin, glycoside calotropaginin.\[15\],[37]

**Anti-inflammatory:** The aqueous suspension of dry latex of Calotropis procera was prepared and was induced to carrageenan and formalin induced rat paw edema, to check the anti-inflammatory effect of dry latex. The single dose of dry latex of Calotropis procera was found to be much effective in producing positive results for acute inflammatory responses in rats. This activity is due to presence of various cardenoids such as calotropin, calotoxin, uscharin, usechardin, glycoside calotropaginin.\[15\],[37]

**Anticancer:** The methanolic extract from flowers of Calotropis procera was prepared and was evaluated for cytotoxic activity. For cytotoxic activity, MTT assay using Hep2 cell lines were used. The methaolic extract of Calotropis procera at a dose of 500µg/ml had shown the 100% result for Hep2 cell lines. The presence of Cardiac glycosides indicates that the plant is capable of showing anticancer properties. This plant has an ability to act as antiglioblastoma against the cancer cells and hence can be further evaluated for its anticancer properties.\[23\],[25]

**Antioxidant Activity:** Methanolic extract from leaves of Calotropis procera was prepared and was checked for antioxidant activity. The extract has shown excellent results in comparison to ascorbic acid when applied on fraction F3 of chromatographic elutes.\[21\] This study reveals that leaves of Calotropis procera has the greater capacity to scavenge the DPPH radicals. A polysaccharide has been isolated from the leaves along with the varying quantity of ash and proteins that has the ability to scavenge the free radicals.\[27\]

**Allelopathy Effect:** The aqueous leaf extract of Calotropis procera was prepared to examine the Allelopathy effect on the various species of plants. The study targets to check the allelopathic effect of Calotropis species on seed germination and seedling growth of Acacia species.\[3\] According to study, the leaf extract of Calotropis procera has inhibited seed germination, reduced seedlings growth, biomass yield was decreased in Acacia species. Besides, this the different concentration of Calotropis procera has allelopathic effect on seed germination of barley, cucumber, eggplant and tomato.\[9\] This has also revealed that by increasing the concentration of leaf extract the decreased growth in seed germination has been observed. In addition to this, they had also revealed that there might be the presence of water-soluble inhibitors in Calotropis procera. There are certain allelochemicals that are
present in leaves and stems of Calotropis procera that strongly inhibits the germination, seedling growth etc.\cite{39,40,45}

**Pesticidal effect:** The extract of Calotropis procera has been observed to contain certain biochemical in their latex such as alkaloids, nicotine, anabasin and lupitin. They observed to be very effective against the larvae of certain mosquitoes and high mortality was observed for them. Compound named uscharin was extracted from the latex of plant and found to be very toxic against the white garden territorial snake thepapisana.\cite{22,29} Hence, the use of plant as a pesticide has been increased from last few years. The latex has been assessed with high toxic rate among the rats as that enhances the rate of absorption in them and that enhances the rate of mortality among them.\cite{41,42}

**Renewable source of energy:** The various studies have helped to revealed that hexane extract of Calotropis procera can be used as a substitute for petroleum and petrochemical feedstock. Through their study it has been noticed that the high-density fluid has been generated from this plant and that is rich in hydrocarbon. During the extraction the ratio of hydrogen to carbon is found to be same as that of crude oil. The heat value was comparable to crude oil, fuel oil and gasoline.\cite{8} In the further studies it has been revealed that by increasing the temperature and conditions like draught for plant the concentration of saturated fatty acids and oil content is found to increase, hence suggesting that the plant also has the potential to be used as biodiesel feed stock.\cite{4}

**CONCLUSION**

Traditional system of medicine is the oldest system and is still followed, as there are many, who belief their mechanism to be natural and free from all kinds of side effects. *Calotropis gigantea* is one who’s various parts of plants such as roots, stem, leaves, flowers and milky sap is utilized for various kinds of effect (pharmacological) with in the body. While performing such tests, we came to know that there are many types of phytochemicals that are present in the plant and they are responsible for different kinds of ethnopharmacological effects within the body. Due to the wide pharmacological and therapeutic potentiality of this plant, there are chances of further investigation with this plant. The fourth coming generation can perform various studies to evaluate the more therapeutic impact of plant *Calotropis procera*, since this is very common among the local people and there are many who are involved in the trade of this plant throughout the world. People in villages are using this drug since ages and they are transferring their knowledge from one generation to another so as
make society and world aware about the indigenous drug. The studies have revealed that this plant is used for the treatment of the common ailments and hence, it could be taken as a baseline for the further research of this plant. Therefore, there is still more that need to be brought in front of the world through the medium of research.

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