

## *Calotropis procera* (Arka): A Tribal Herb of Utmost Significance

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### ABSTRACT

Nature has gifted humans a vast variety of medicinal plants, which are the rich source of bioactive compounds. *Calotropis procera* is an important medicinal plant that belongs to the family *asclepiadaceae*. It is commonly known as madar and milkweed plant in english and arka in hindi. It is mostly found in the tropics of asia and africa. *Calotropis procera* is a highly valued plant in the folk medication system. Each part of the plant is richly endowed with diverse nature of phytochemical constituents like alkaloids, proteins, vitamins, carbohydrates, saponins, terpenes, and flavonoids, etc. These phytochemicals are significantly associated with various therapeutic and pharmacological properties such as anti-microbial, anti-oxidant, anti-inflammatory, anti-ulcer, antifertility, anti-diarrheal, and spasmolytic. In this review article, the therapeutic and pharmacological value of this important plant has been summarized along with its utilization in the folklore and ayurvedic medicinal system.

**Keywords-** Arka, Rasapanchak, Cardiac glycosides, Calotoxin, Anti-microbial, Anti-fertility.

### I. INTRODUCTION

Medicinal plants have a great impact on the ecosystem as they are a precious natural resource of bioactive compounds. They are the source of raw material in nature which is used in the pharmaceutical industry, modern and traditional medicinal systems [1,2]. Numerous plants have been conserved by humans due to the associated divine and cultural beliefs and such important plants are protected as a marker of genetic resource and used as food, fodder, fiber, fertilizer, fuel, febrifuge, medicine, and in many other ways [3,4]. The practice of using medicinal plants as a therapeutic tool has started by mere accidents i.e. without even knowing the chemical constituents and actual biological activities of these plants, since the early days of origin of the human race on the planet earth. But the gradual advancement in the field of science and technology led to effective and keen analytical research on herbal plants for therapeutic purposes [5-7]. Plant-derived products and natural preparations of Indigenous systems of medicine are greatly promoted by the rural population as the primary treatment for various human ailments. Rural people have gained the knowledge of utilization of

medicinal plants for health maintenance from their ancestors, which is based on life-long experiences. It has been observed that the urban population is influenced by these indigenous practices too. In the modern era, mostly prescribed drugs are either modified forms of natural products or isolated from plants [8,9]. Medicinal plants also provide employment and income opportunity by assessing the conservation of biodiversity and traditional knowledge about such plants [10]. One such important medicinal plant is *Calotropis procera* (figure 1) which is commonly known as Giant milkweed, Madar, Sodom apple, Swallow wort, Milkweed, Calotrope cabbage tree, and Rubber tree. It is known by many different names, which are based on its habitat. For instance, in Arabic it is known as Ushar or Osha [11-13]. *Calotropis procera* belongs to the family *Asclepiadaceae* which has 180 genera and 2200 different species distributed primarily in the tropical and subtropical regions all over the world. The Greek meaning of genus *Calotropis* are 'beautiful' and 'keel of a boat' which indicates the flower scales of the plant. Whereas *Procera* meanings in Latin are 'in favor of' and 'wax' which refers to the waxy appearance of the plant and the family name *Asclepiadaceae* is derived from the Greek word Asklepios, who is the Greek God of medicine. *Calotropis procera* is a wild-growing plant and a popular traditional medicinal plant in India. The earliest Hindu writers mentioned this plant many times in ancient works of literature. In Vedic literature, it is named as Arka. In India, it is commonly called as Alarka, Surya, Suuryaahvya, Vikirna, Vasuka, Tapan, Tuulaphala, Kshirparna, Arkaparna, Aasphota Aakh, Madaar and Ashar. Each part of the plant is used for treating several human ailments. It is found growing throughout the tropics of Asia and Africa. In some regions, it is also called jealousy cotton, silk, flower-silk, milk or queimadeira. It is believed that it was brought to Brazil by Asians as an ornamental plant [14-20]. *C. procera* subsp. *procera* and *C. procera* subsp. *hamiltonii* are the two subspecies of *Calotropis procera* that are known to exist in the nature. The major distinction between the two subspecies can be observed from the characteristics of their flowers [21]. *Calotropis procera* has gotten its name 'milkweed' due to the production of latex (a milky liquid) in the plant. A high amount of latex is extracted from the green parts of the plant when they are wounded. The main constituent of latex is

rubber which is locally used to treat fungal infections in some areas [22,23]. *Calotropis procera* is considered as a great source of renewable energy [24]. The dry stem of this plant is used as a good source of fuel, firewood, and timber in some areas of the world [25]. The ash obtained from the plant is used to make gunpowder. The latex of the plant is processed for use in the treatment of vertigo, baldness, hair fall, toothaches, intermittent fevers, rheumatoid/joints swellings, and paralysis [26]. The silky strong and durable bark fiber is used in the manufacturing of cordage, ropes, carpets, fishing nets and lines, bowstrings and twines, and sewing thread whereas the seed floss is used for stuffing purposes [27]. It is a plant of great significance in nature as it maintains the functioning of the ecosystem by acting as a host plant for butterflies and it is also served as a food plant for arthropods [28]. Its silky hair was used in pillow stuffing in the past times. It is also a natural insecticide present in nature [29]. It is a famous tribal shrub around the world and used in many folk remedial practices to treat skin disease, elephantiasis, toothache, asthma, leprosy and rheumatism [30]. *Calotropis procera* also plays a significant role in Ayurveda. It is used in many polyherbal formulations to treat diseases. It is one of the tested herbs in Ayurveda for anticonvulsant activity [31]. The whole dried plant acts as a good tonic, expectorant and antihelminthic agent [32]. *Calotropis procera* contains phytochemical constituents like saponins, alkaloids, tannins, flavonoids, glucosides, and terpenoids which exhibit therapeutically important properties such as anti-microbial, anti-oxidant, anti-inflammatory, analgesic, spasmolytic, anti-fertility and anti-ulcer etc. [33,34]. Vernacular names and taxonomy of *Calotropis procera* are given in table no. 1 and 2 respectively.



Figure 1: *Calotropis procera* Plant

Table 1: Vernacular Names of *Calotropis procera* [35,36]

English	Giant Indian Milkweed, Sodom Apple, Small Crown Flower, Rooster tree, French Cotton, Calotrope
Hindi	Aaka, Aanka, Ark

Sanskrit	Arka, Arka, Alaka, Ravi
Kannada	Arkagida
Malayalam	Bukam, Dinesam
Marathi	Akanda, Lalakara
Spanish	algodón de seda, Bomba
French	Cotton-France, Arbre De Soie, and Bois Canon, Pomme de Sodome
Italian	Calotropo
German	Wahre Mudarpflanzer, Gomeiner
Turkish	Ipekag
Arabic	Oshar
Thailand	Rak
Philippines	Kapal-kapal
Laos	DokHak
Malaysia	Remiga
Vietnam	Nam t[it] b[at]
Indonesia	Rubik

Table 2: Taxonomy of *Calotropis procera* [37]

Taxonomic Rank	Taxon
Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclepiadaceae
Genus	<i>Calotropis</i> R. Br
Species	<i>Calotropis procera</i> (Aiton) W.T. Aiton

## II. MORPHOLOGICAL DISTRIBUTION OF *Calotropis procera*

*Calotropis procera* is a small perennial shrub of about 5.5 m in height with a soft, corky, and light grey bark. The plant contains 7 to 18 cm long and 5 to 13 cm broad opposite, sessile, oblong-obovate leaves whose apex is pointed to blunt. The leaves are covered with a slightly leathery soft hair coat. *Calotropis procera* plant is covered with white flowers. There is presence of inflated, grey-green fruits, which are almost 8-12 cm in size. The seeds are flat in structure and are of brown color whose one end has a tuft of white hair. There is the presence of simple roots, which are whitish-grey. The appearance of roots is wrinkled, curved and woody. A milky sap called latex is present in the aerial parts of the plant [38].

### III. GEOGRAPHICAL DISTRIBUTION OF *Calotropis procera*

*Calotropis procera* is native to West Africa as far south as Angola, North and East Africa and found in Southern Asia and Indo-China to Malaysia, Macaronesia, West Africa North and East Africa, Madagascar, and Arabian Peninsula. The plant is found growing well in Australia, Central America, North, South America, and West Indies. The species is now also cultivated in countries like Mexico, Central and South America, Pacific Islands, Australia, and the Caribbean. In India, it is found up to 1,000 m elevation which includes states like Assam, West Bengal, Rajasthan, Punjab [39,40]. *Calotropis procera* is a drought and salt-tolerant species. The seeds of this plant are dispersed through wind and animals [41].

### IV. PHYTOCHEMICALS OF *Calotropis procera*

As per the reported study on phytochemical analysis of *Calotropis procera*, phytochemical constituents like alkaloids, flavonoids, tannins, saponins, anthraquinone, sesquiterpene, steroids, terpenes, and cardiac glycosides are present in high amounts in *Calotropis procera* [42,43]. The latex of the plant also contains proteins, carbohydrates, lipids, vitamins, carbonates and resins, flavonoids, cardenolides, triterpenoids, alkaloids, resins, anthocyanins, tannins, saponins, and proteolytic enzymes [44,45]. The main cardioactive glycosides present in *Calotropis procera*

are calactin, calotoxin, usharin, usharidine and vouscharin [46]. The major phytochemicals present in the stem bark are giganteol,  $\alpha$ ,  $\beta$  calotropeol and  $\beta$ -amyryn [47]. Chloronaphthalene [naphthalenederivative], calotropisesquiterpenol, calotropisesterterpenol [terpene derivatives], calotropbenzofuranone [aromatic product], and sucrose are primarily found in the root of this plant [48]. Ester of  $\alpha$ -and  $\beta$ -calotropeols are present in flowers. The seed oil of plant contains palmitic, oleic, linoleic and linolenic acid. Phytosterol, stigmasterol, melissyl alcohol and laurane are the unsaponifiable fractions present in the seeds. The leaves primarily contain saponogens, holarrhetine, cyanidin-3-rhamnoglucoside, taraxasterolisovalerate, mudarine, ascorbic acid, calactin, calotoxin, calatropagenin, calotropin, polysaccharide containing D-arabinose, D-glucose, D-glucosamine and L-rhamnose, calotropagenin, and 3-proteinase and three glycosides calotropinusharin, calotoxin [49,50].  $\alpha$ -amyryn,  $\beta$ -amyryn, calotropin, taraxasterol,  $\alpha$ -amyryn acetate,  $\beta$ -amyryn acetate, proceraursenolide, calotropoceron-a, calotropenyl acetate, gofruside, lupeol, procerursenyl acetate, benzoyllineolone, benzoylisolineolone, calotropoceryl-a, calotropoceryl acetate a, pseudo-taraxasterol acetate, calotropursenyl acetate-b, terpenoid glycosides, 1,2-dihexadecanoyl -3-phosphatyl glycerol, (E)-octadec-7-enoic acid methyl myrisate, methyl behenate, acetic acid, isovaleric acid, cardenolides, two isomeric crystalline alcohols, giganteol and isogiganteol are present in the root bark of *Calotropis procera*. [51-57].

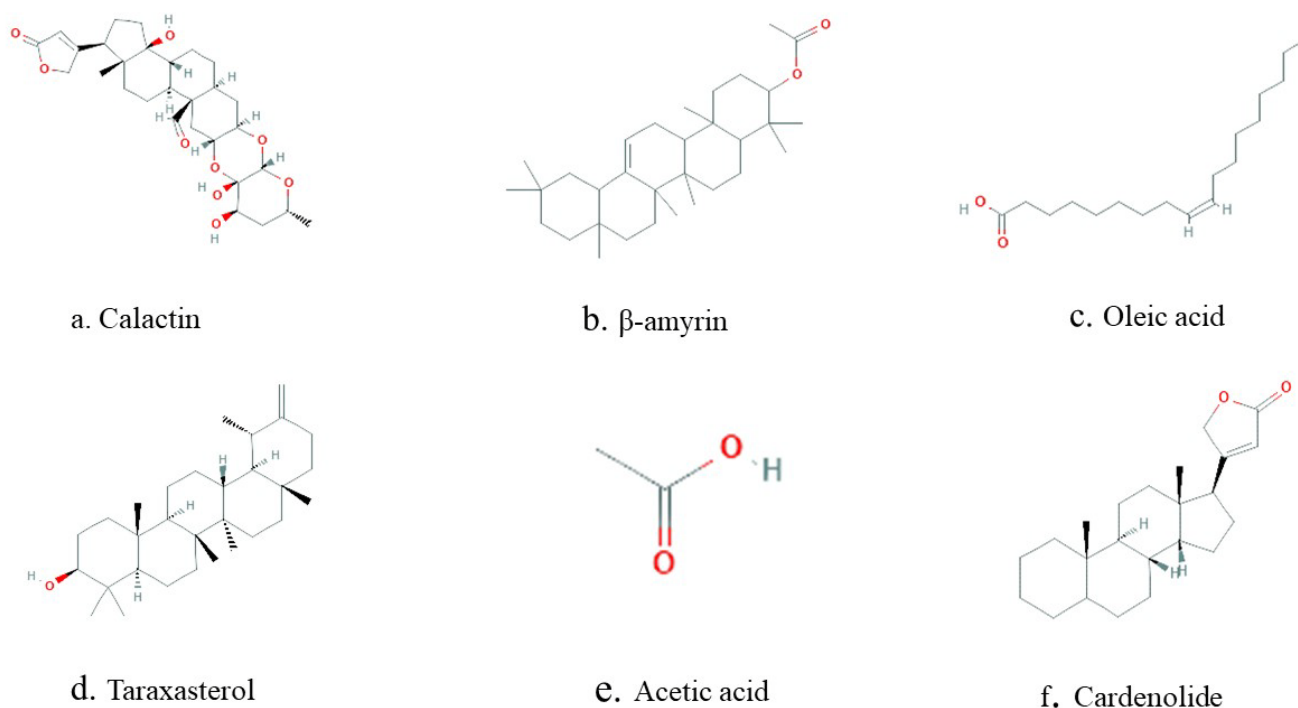


Figure 2: Chemical Structures of Some of Phytochemical Constituents of *Calotropis procera*

## V. TRADITIONAL AND MODERN VIEW OF *Calotropis procera*

### Ayurvedic View

Ayurveda is an ancient field of medicine that is about 2500 and 500 BC old. The word Ayurveda signifies the meaning "science of life". Ayurveda maintains an equilibrium between the three body components/doshas of the body i.e. Kapha (water and earth), pitta (fire) and Vata (space and air) [58-60]. *Calotropis procera* is an important medicinal plant named as 'Raktaarka' in the monograph of Ayurveda [61,62]. It is mainly used to balance the Kapha and Vatadosha of the body. Each part of the plant is used in Ayurvedic practices to treat many human ailments. Traditional Ayurvedic healers use *Calotropis procera* leaves to enhance reproductive health by working on penile dysfunction. Leaves are considered as an aphrodisiac. Leaves hot poultices help to get relief from stomach pain, headaches, sprains. The flowers are used to treat cough, catarrh, asthma, indigestion, and cholera. The flower paste is useful in treating piles [63,64]. In Ayurveda, *Calotropis procera* as a whole plant is used in the treatment of leprosy [65]. Rasapanchak of *Calotropis procera* is given in table no. 3

**Table3:** Rasapanchak of *Calotropis procera* [66]

Sanskrit/English	Sanskrit/English
Virya/Potency	Ushan/Hot
Viapk/Metabolic Property	Katu/Pungent
Guna/Physical Property	Laghu/Light, Ruksha/Dry, Tikshna/Sharp
Rasa/Taste	Katu/Pungent, Tikta/Bitter

### Actions and Properties of *Calotropis procera* as per Ayurveda [67,68]

**Sansthanik karmawah sansthan:** It acts as an analgesic, anti-inflammatory, antiseptic and antimicrobial. It is used to treat rheumatoid arthritis, alopecia, toothache, earache, and loss of hearing.

**Abhyantar pachan sansthan:** It acts as an anti-helminthic agent. It enhances digestion. It treats constipation and liver-related problems. It is used to induce vomiting and loose motion.

**Raktwah sansthan:** It acts as a blood purifier and increases the blood flow. It is used to treat syphilis, filariasis and strengthening the heart muscles.

**Swasan sansthan:** It is used as an expectorant to treat asthma.

**Twach:** It is useful in treating skin diseases like psoriasis.

**Taapkarm:** It acts as an anti-pyretic.

**Saatmikaran:** It is useful in the treatment of cancer.

### Ayurvedic Formulations of *Calotropis procera* [69]

Mahavishagarbha tail, dhanvantaraghrta, and arkalavana are some Ayurvedic formulations of *Calotropis procera*.

### Folk view

The term ethnobotany is as old as mankind. India is the popular tropical country in the world, which is enriched with numerous natural resources and traditional knowledge regarding the utilization of such resources [70]. *Calotropis procera* is one of those important medicinal plants, which hold great pride in India due to their rich ethnobotanical utilization and high economical values [71]. For instance, in some folk practices, people use dried latex and roots of *Calotropis procera* as snake anti-venom. The plant is also used as an abortifacient [72]. Tribal people of Western Madhya Pradesh, use *Calotropis procera* root bark and leaves as a remedy to jaundice [73]. Some folk remedies include the use of roots as a carminative to treat dyspepsia [74]. People in Ujjain Madhya Pradesh, traditionally treat migraine with the tender leaves of *Calotropis procera*. They also use root bark powder to treat diarrhea and asthma [75]. The tribal people of Sonbhadra district, Uttar Pradesh, use root powder to treat spleen complaints, elephantiasis, and rheumatism. They use the roots of this plant along with black pepper in protracted labor. They use latex to get relief from stings, toothache, ringworm, and leprosy. They apply leaves to treat sores, skin diseases, and rheumatic joints. The flower powder is used as a remedy to treat cough, cold, and asthma [76]. Bhotia tribal of Pithoragarh, uses leaf powder in a mixture with gur to treat migraine [77]. People in the Gwalior Forest Division in Madhya Pradesh, use latex to cure arthritis, and floral stigma in some formulations to treat cholera. They use floral bud pills in formulation with black pepper seeds as a remedy to treat malaria. They treat migraine traditionally by flowers of *C. procera* in some formulations. Conjunctivitis is cured traditionally by them with the latex filled in spaces present between nails and finger tips of the patient twice a day for a few days [78]. In Saudi Arab, people use the decoction of aerial parts traditionally to get relief from fever, joint pain, constipation, and muscular spasm [79]. As per the ethnobotanical survey report on the use of *Calotropis procera* in Cholistan Desert, Punjab, Pakistan, the plant is used as a curative agent in many diseases. They use whole plant or its parts such as leaves, flowers, root bark, and latex in various formulations to treat diseases such as scabies, cough, asthma, pains, jaundice, swellings, malaria, pneumonia, scorpion stings, fever, stomach pain, piles, cholera, paralysis, chest diseases, diabetes, women diseases, wound, and against snakebite [80]. In Qadanwari of Nara Desert, people traditionally treat asthma, cough, joint pain, and digestion related issues with the *Calotropis procera* salt. The young twig poultice is applied topically to get relief from pain and inflammation [81]. The observations of a comparative

study on traditional knowledge of *Calotropis procera* and *Calotropis gigantea* in the rural localities of Kurukshetra, revealed that *Calotropis procera* is used in many folk practices to cure joint pain, toothache, skin related problems, asthma, cough, boils, stomachache, cyclic fever, earache, and flatulence. People also use this plant against snake and wasp bites [82]. In some folk medicinal practices in Gourma district, Mali, people use flowers of *Calotropis procera* to treat asthma whereas yellow leaves are used against earache [83]. In Rajasthan, *Calotropis procera* root along with many other herbs, are used in the treatment of asthma [84].

#### Modern View

Herbal products having undeclared pharmaceuticals indicate the signs of adulteration which is the global issue faced by herbal markets [85]. Species adulteration has been observed for a long time in the trading of herbal drugs [86]. Species adulteration can be intentional or unintentional. Factors like unavailability of required species due to extinction, deforestation, high price, resemblance in morphological characteristics, co-occurrence, mislabeling, improper handling and storage, conflict in vernacular names as well scientific names, and unauthorized or fraudulent substitution have a marked contribution to the species adulteration in the herbal products. Adulteration has a very clear and direct impact on the promotion of herbal products [87-91]. It is very important to authenticate the herbal products for their safety and efficacy purposes and of course for the use in the discovery of novel drugs [92]. DNA barcoding is the most preferred technique, which is employed nowadays to detect adulteration. It is designed to give rapid and accurate species identifications with the help of internal species tags in the form of short and standardized gene regions. DNA barcoding is efficiently capable of identifying species and gives quality access to the pharmaceutical industry for control and standardization of herbal products [93-95].

## VI. THERAPEUTIC PROPERTIES OF *Calotropis procera*

*Calotropis procera* exhibits many important therapeutic properties. Some of its reported studies on therapeutic actions are summarized below:

#### Anti-microbial

Kareem et al., studied the anti-microbial behavior of *Calotropis procera* in an *in-vitro* study conducted on bacterial and fungal strains. They use six bacterial strains viz. *Escherichia coli*, *Staphylococcus aureus*, *Staphylococcus albus*, *Streptococcus pyogenes*, and *Streptococcus pneumoniae*. The fungal strains used were *Aspergillus niger*, *Aspergillus flavus*, *Microsporium bouldarii* and *Candida albicans*. It was observed that ethanolic extract of the leaf and latex of the plant exhibited great antimicrobial actions against bacterial strains. Ethanol and chloroform extract showed antifungal actions. *Candida albicans* was significantly

inhibited by the ethanol extract. The study concluded that plant possess good anti-microbial activity [96]. Mainasara et al., study on analysis of phytochemicals and antibacterial potential revealed that the water extracts of *Calotropis procera* at 30, 60, 90 and 120 mg/ml concentrations had effective actions against *Pseudomonas aeruginosa*, *Salmonella typhi*, *Escherichia coli*, *Staphylococcus aureus*, and *Streptococcus pyogenes*. The study has successfully drawn attention towards the isolation of important antibacterial compounds from water extract of *Calotropis procera* [97].

#### Anti-oxidant

As per the reported study conducted by Yesmin et al., to evaluate the anti-oxidant potential of *Calotropis procera*, methanolic extract of the plant is strongly associated with the anti-oxidant activities. Methanolic extract was found to be effective in radical scavenging of 1,1-diphenyl-2-picryl hydrazyl (DPPH) free radical during the analysis. The study suggested that *Calotropis procera* can be a good source of anti-oxidant drugs [98].

#### Anti-ulcer

Bharti et al., investigated the anti-ulcerative potential of *Calotropis procera* in rat models. The models were artificially induced with ulcers by ethanol, pyloric ligation and aspirin. The results revealed that dried latex (DL) and methanol extract (MeDL) both significantly inhibited the gastric mucosal damage in the aspirin and ethanol models. These also maintained the integrity of tissue and maintained the levels of oxidative stress markers like glutathione, thiobarbituric acid reactive substances, and superoxide dismutase. In the pyloric ligation models, DL and MeDL helped in decreasing the gastric acidity and decreasing the gastric pH [99].

#### Wound Healing

Rasik et al., studied the anthelmintic potential of *Calotropis procera* in an *in-vivo* study. Back of guinea pigs were inflicted with thickness excisional wounds of 8.0 mm diameter. It was observed that 1.0% sterile solution of the latex on topical application significantly healed the wound by increasing collagen, DNA, and protein synthesis and epithelization, which leads to the reduction of the wound area [100].

#### Anti-diarrhoeal

Kumar et al., carried out an *in-vivo* study on rat models to study the anti-diarrheal behavior of *Calotropis procera*. The models were administered with castor oil to induce diarrhoea artificially. It was observed that the oral administration of dry latex (DL) of *Calotropis procera* at the dosage of 500 mg/kg significantly decreased the frequency of defecation and diarrhoeal severity. DL significantly provided protection against diarrhea. DL also decreased intestinal transit and showed inhibitory actions against enter pooling induced by castor oil [101].

#### **Anti-helminthic**

Shivkar et al., studied the anti-helminthic property of *Calotropis procera* in adult earthworms. The study revealed that fresh and aqueous extracts of dried latex had anti-helminthic actions in dose-dependent manner as they inhibited the spontaneous motility (paralysis) and evoked responses to pin-prick. The study suggested that *Calotropis procera* has anti-helminthic property [102].

#### **Anti-fertility**

Circosta et al., studied the effect of *Calotropis procera* in female rat models. They observed that ethanolic and aqueous extracts of roots significantly interrupted the estrous cycle of the models. A consequent temporary inhibition of ovulation was also noticed in the models treated with ethanolic and aqueous extracts. The findings of the study suggested the use of *Calotropis procera* as anti-fertility agent [103]. To evaluate the anti-fertility behavior of *Calotropis procera* plant Kamath et al., carried out an *in-vivo* study on female albino rat models. It was observed that ethanolic root extract markedly inhibited the implantation at the dose level of 250 mg/kg. The study suggested the use of *Calotropis procera* as an antifertility agent [104].

#### **Anti-inflammatory**

Kumar et al., studied the anti-inflammatory behavior of *Calotropis procera* in rat models. They use carrageenin and formalin to induce paw edema in the models artificially. It was observed that aqueous suspension of the dried latex at the single dosage effectively produced an acute anti-inflammatory response [105]. Parihar et al., performed *in-vivo* study on experimental animal models and suggested that the ethanolic extract of *Calotropis procera* at the dosage of 100 and 200 mg/kg had preventive actions against Complete Freund's Adjuvant (CFA) induced arthritis in models. The inhibition of associated polyarthritic index was also noticed in (CFA) induced arthritic inflammation. Whereas in the models with acetic acid-induced vascular permeability, ethanolic extract effectively helped in the reduction of dye leaking. The extract significantly changed the lipid peroxidation, glutathione content (GSH) [106].

#### **Spasmolytic**

Iwalewa et al., investigated the spasmolytic potential of *Calotropis procera* using *in vitro* trachea smooth muscle chain of Guinea-pig. The aqueous extract in the dose-dependent manner (50, 100, and 200 µg/ml) exhibited relaxant activity that most probably happened due to the direct relaxant action of the extract on the smooth muscle [107].

#### **Analgesic**

Deewan et al., carried out an *in-vivo* study on mice models to evaluate the analgesic potential of *Calotropis procera*. The dry latex (DL) of the plant was tested against acetic acid induced writhings and tail-flick models. It was revealed from the study that oral administration of a single dose of DL (165 to 830

mg/kg) produced the analgesic effect. The results were compared with the standard drug aspirin. The analgesic impact was more pronounced in case of 415 mg/kg dosage of DL than the oral dosage of 100 mg/kg of aspirin. A marginal analgesia was observed at the dosage of 830 mg/kg of DL. The study supported the use of *Calotropis procera* as an analgesic agent [108].

#### **Anti-cancer**

Choedon et al., conducted an investigatory study on the X15-myc transgenic mouse model to test the anti-cancer potential of dried latex (DL) of *Calotropis procera* against hepatocellular carcinoma. The oral administration of aqueous suspension of (DL) at the dosage of 400 mg/kg for 5 d/week for 15 significantly protected the models against hepatocarcinogenesis. It also lowered down the serum levels of vascular endothelial growth factor (VEGF) [109].

#### **Anti-asthmatic**

Aliyu et al., showed the anti-asthmatic property of *Calotropis procera* in *in-vitro* and *in-vivo* tests by investigating anti-histaminic and bronchodilator activity. For *in-vitro* test analysis, they used isolated guinea pig tracheal chain with histamine-induced contraction and isolated guinea pig ileum strip with histamine-induced contraction. Whereas they performed *in-vivo* test on haloperidol-induced catalepsy test in rat models. The aqueous and methanol extracts both gave effective inhibitory results in the *in-vitro* test. But aqueous extract failed to produce any effective result in *in-vivo* test whereas methanol extract significantly showed inhibitory action in the *in-vivo* test. The study suggested that *Calotropis procera* plant can be used in allergic conditions like asthma [110].

## VII. TOXICITY STUDY OF CALOTROPISPROCERA

Latex contains several phytochemical constituents, which are considered to be toxic [111]. Basak et al., reported the toxic effects of *Calotropis procera* latex in 29 patients who had accidental ocular contact or injury with the latex of *C. procera*. Patients suffered from sudden painless vision with photophobia. Conjunctival congestions and mild to severe corneal edema with descemet folds were noticed in all the patients. The study also concluded that the damage caused by *Calotropis procera* latex can be prevented by proper health knowledge [112]. The very first ocular injury caused by latex of *Calotropis procera* in India was reported by Muthayain 1949 [113].

## VIII. CONCLUSION

*Calotropis procera* is a popular tribal shrub used extensively in the folk medicinal system to treat a variety of diseases. The main objective of this review was to illustrate the therapeutic potential of *Calotropis*

*procera*. From the literature study, it is quite evident that *Calotropis procera* plant is associated with various medicinal properties such as anti-microbial, anti-inflammatory, anti-asthmatic, anti-ulcer, wound healing, and anti-oxidant etc. Explorative studies by scientists and researchers using different animal models suggest the utmost significance of this plant. Although, the plant needs more experimental studies and clinical research to identify its more pharmacological and therapeutic properties which will be beneficial in development of important therapeutic drugs from the active phytochemical constituents of *Calotropis procera*.

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### CONFLICT OF INTEREST

None

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