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Original Article

CALOTROPIS PROCERA: RECENT STUDIES ON DESCRIPTION, CHEMICAL CONSTITUENTS AND PHARMACOLOGICAL ACTIVITIES

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ABSTRACT

Calotropis Procera (Aiton) Dryand is a soft-wooded, perennial shrub that is a member of the Asclepiadaceae subfamily of the Apocynaceae family. The Latin name Procera means "Presence of Wax" in the plant's shooting portion, while the Greek word Calotropis means "Beautiful," referring to the flowers. It is primarily found in the wastelands of Assam, West Bengal, Rajasthan, and Punjab in India. The bush Calotropis Procera can reach a height of five meters. Its enormous, green, obovate leaves, which are around thirty centimeters in length, are what identify it. All parts of the plant release white latex when they are cut or broken, which serves as a barrier against viruses, fungus, and insects. The cardiac glycosides calotopin, uscharin, calotoxin, calactin, uscharidin, and gigantin contained in this plant's white, milky latex have been shown to have significant wound-healing properties. Because of their pharmacological and therapeutic qualities, plants have been utilized for ages as a source of natural treatments. The dried leaves of Calotropis Procera are used in Ayurveda as an expectorant and to relieve rheumatic pain and paralysis. In particular, migraines are treated with the delicate leaves. Its root bark is used in India to treat intestinal worms, skin conditions, and enlargements of the abdominal viscera. Milky latex is used to treat skin conditions in Senegal.

Keywords: *Calotropis Procera*, Chemical Constituents, Pharmacological Properties, Toxicological Profile, Industrial and Novel Applications, Traditional Uses.

INTRODUCTION

Calotropis Procera (Aiton) Dryand is a soft-wooded, perennial shrub that is a member of the Asclepiadaceae subfamily of the Apocynaceae family. It has long been used in traditional medical applications in North Africa, the Middle East, South Asia, and Southeast Asia. It has been utilized for fuel, fiber, feed, and lumber since ancient times [1]. It is a lactiferous, xerophytic plant that grows naturally in arid and droughty areas. The Latin name Procera means "Presence of Wax" in the plant's shooting portion, while the Greek word Calotropis means "Beautiful," referring to the flowers. Traditional medicine has traditionally employed it [2]. It is a perennial shrub that is a member of the Apocynaceae family and is also referred to as Aak, King's Crown, Rubber Bush, Sodom Apple, and Rubber Tree. This xerophytic, evergreen, softwood plant is found all over the world, although it is particularly prevalent in the arid and semi-arid tropical and subtropical regions of Asia and Africa [3]. Aiton, Milkweed, Calotrope, Giant Milkweed, Indian Milkweed, Wild Cotton, Rubber Tree, Usha, Aak, and Madar are some of its other names [4]. *Calotropis Procera* usually grows to a height of 2.5–4 m in arid and semi-arid environments. This plant is of importance due to its ecological, economic, and antibacterial

qualities [5]. It is distinguished by enormous pale green leaves (Figure 1) and a toxic milky sap in its green fruits. In extremely stressful situations, such as high temperatures and aridity, drought, high vapor pressure deficit, saline and wet environments, and high photosynthetic active radiation, it can withstand, adapt, and sustain growth and productivity. With a yearly rainfall of up to 150 mm, it can flourish throughout extended dry spells. Without irrigation or fertilizer, it thrives rapidly on a range of soil types in dry, desert environments [6]. The Asclepidaceae family includes the flowering plant *Calotropis Procera*, which is indigenous to Saudi Arabia, North Africa, Pakistan, tropical Africa, Western Asia, South Asia, Israel, and the Indo-China region [7]. It is primarily found in the wastelands of Assam, West Bengal, Rajasthan, and Punjab in India [8].

Figure: 1. Calotropis Procera.

Classification of Calotropis Procera

The Vernacular Names and Taxonomical Classification of *Calotropis Procera* are given below in **Tables 1 and Table 2** [9,10].

Table 1: Vernacular Names of Calotropis Procera [9].

Country	Names
India	**Hindi-** Aak, Madar
	Urdu- Madar, Aak
	Sanskrit- Arka, Ganarupa, Mandara, Vasuka, Svetapushpa, Sadapushpa, Alarka, Pratapass
	Tamil and Malayalam- Erukku
	Telugu- Jilledi, Puvvu
	Marathi- Rui, Mandara
	Punjabi-Ak
	Gujrati-Akado
	Oria- Arakha
	Kashmiri- Acka
	Bengali- Akanda, Akone
	Assami- Akand, Akan
Malaysia	Remiga, Rembega, Kemengu
Indonesia	Sundanese and Madurese- Bidhuri
	Javanese- Sidaguri
	Aceh- Rubik
Philippines	Tagalog- Kapal-kapal
Laos	Kok May, Dok Kap, Dok Hak
Thailand	Northern- Po Thuean, Paan Thuean
	Central- Rak
Vietnam	Bootng, Lashen, Nam Tit Bat
French	Faux arbre de soie, Mercure vegetal
English	Giant Indian milked weed, Madar and Sodom apple
Turkey	Ipekag
Arab	Oshar or Ushar
Persia	Kharak

Table 2. Taxonomical Classification of Calotropis Procera [10].

Taxonomic	Calotropis Procera
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclipiadaceae
Subfamily	Caesalpinioideae
Genus	*Calotropis*
Species	*Procera*
Binomial Name	*Calotropis Procera*

Botanical Description

The bush *Calotropis Procera* can reach a height of five meters. Its enormous, green, obovate leaves, which are around thirty centimeters in length, are what identify it (Neuwinger, 1996) [11]. Dicot, shrub. The plant has upright stems that branch upward from the base and contain a milky white sap **(Figure 2)**. Younger stems have a whitish-colored hair covering, a smooth texture, and a greyish-green tint. The light brown bark of mature stems is severely fissured and resembles cork. A cluster of three to fifteen flowers is formed by inflorescence axillary cymose **(Figure 3)**. White flowers with purplish tips that are hermaphrodite, actinomorphic, free, imbricate, sepals (5), united, valvate, stamens (5), united, epipetalous, ovary superior, and two locular [12]. Fruits are huge, sub-globose, greyish-green follicles with many brown, flattened seeds and a tuft of long, white, silky hairs on the axile placenta [13]. Simple leaves **(Figure 4)**, on the other hand, have a milky white sap, are oval in shape, sessile, have an acute apex, and have a glabrous upper surface. The underside may have a tuft of stiff hairs **(Figure 5)** at the base of the midrib or be heavily coated in small white hairs [14].

Figure: 2. Calotropis Procera Aiton (Milky Sap from Stem and Leaves).

Figure: 3. Calotropis Procera Aiton (Flowers & Fruit).

Figure: 4. Calotropis Procera Aiton (Stem & Leaves).

Figure: 5. Calotropis Procera Aiton (Tuft Seeds).

Chemical Constituents

All parts of the plant release white latex when they are cut or broken, which serves as a barrier against viruses, fungus, and insects. A and B amyrin, giganteol, gigantin, teraxasterol, and b-sitosterol isogiganteol are present throughout the entire plant. Numerous flavonoids, triterpenes, cardiac glycosides, and sterols are among the many secondary metabolites that this plant has generated [15]. The cardiac glycosides calotopin, uscharin, calotoxin, calactin, uscharidin, and gigantin contained in this plant's white, milky latex have been shown to have significant wound-healing properties [16]. Numerous chemicals, including cardenolide, triterpenoids, alkaloids, resins, anthocyanins and proteolytic enzymes in latex, flavonoids, tannins, sterol, saponins, and cardiac glycosides, have been identified through phytochemical research on Calotropis [17]. However, *Calotropis gigantea* leaves contain five main chemicals: Pleurone, Calotropagenin, Calotoxin, (+)-dehydrovomifoliol, and Methyl β-carboline-1-carboxylate [18]. Numerous compounds, including carenolide, triterpinoids, alkaloids, resins, anthocyanins, and proteolytic enzymes in the latex, have been identified by studies on the phytochemistry of Calotropis. Flowers contain terpenes, cyclisadol, and multiflorenol. The main substances included in the leaves are amyrin, amyrin acetate, -sitosterol, urosolic acid, cardenolides, calotropin, and calotropagenin [19].

Phytochemical Screening

The method of qualitatively identifying secondary metabolite chemicals in plants is known as phytochemical screening [20]. The first step in an extraction procedure is choosing a suitable solvent, such as water, ethanol, acetone, ethyl acetate, n-hexane, and other organic solvents [21, 22]. The separation of active compounds from a plant, such as polar, semi-polar, or non-polar secondary metabolite compounds like alkaloids, flavonoids, tannins, saponins, terpenoids, and phenols, is significantly influenced by the polarity of a solvent [23]. Variations in C. gigantea's secondary metabolite composition can be attributed to genetics, growth circumstances, and geography [24]. According to a number of research, the results of phytochemical screening of C. gigantea plant extracts vary depending on the different regions of Aceh province, including geothermal sites [25], mountainous [26], and coastal areas [27].

Pharmacological Properties

Because of their pharmacological and therapeutic qualities, plants have been utilized for ages as a source of natural treatments [28]. *Calotropis Procera's* pharmacological qualities were once widely employed to cure a variety of human ailments, such as fever, leprosy, asthma, rheumatism, dermatitis, dysentery, indigestion, diarrhea, and elephantiasis. Alkaloids, flavonoids, steroids, tannins, terpenoids, saponins, and cardiac glycosides are among the metabolites found in many plant sections that have been identified by numerous investigations as potential materials for the green synthesis of metal ions [29]. The dried leaves of *Calotropis Procera* are used in Ayurveda as an expectorant and to relieve rheumatic pain and paralysis [30, 31]. In particular, migraines are treated with the delicate leaves [31]. These leaves' powdered form is also used to improve wound healing, act as a laxative, and treat indigestion. A decoction prepared from the aerial portions of *Calotropis Procera* is used in traditional Saudi Arabian medicine to treat fever, joint pain, constipation, and muscle soreness [32]. Additionally, *Calotropis Procera* has shown promise in treating sinus fistula, diarrhea, and a variety of skin conditions [33]. Its root bark is used in India to treat intestinal worms, skin conditions, and enlargements of the abdominal viscera. Milky latex is used to treat skin conditions in Senegal [34].

Anti-Cancer Activity

Hexane, dichloromethane, ethyl acetate, acetone, and methanol extract of *Calotropis Procera* stem [36, 37], as well as aqueous extracts of dry latex [35]. have been described as having anticancer properties. The DL of Calotropis Procera was found to offer complete protection against the formation of hepatocarcinogenesis when tested in a transgenic hepatocellular cancer model in mice. While Huh-7 and COS-1 cells had severe cell death and a marked drop in serum vascular endothelial growth factor levels, AML12 cells were found to be alive. Calotropis gigantea's cardiac glycosides have the ability to stop the growth of cancer and tumor cells. In vitro, the expression of p53 and Bcl-2 genes in breast cancer CF-7 can be influenced by cardiac glycosides like calactin, calotropin, asceplin, and cymarin. It is more plausible that Bcl-2 regulation, which disrupts antiapoptotic activity, was responsible for the tumor suppression actions on the mediated test sample than p53, which promotes apoptosis [38].

Antifertility

Albino rats were utilized in the study to examine the hormonal and antifertility effects of an ethanolic extract of Calotropis Procera roots. Significant anti-implantation (100% inhibition) and uterotropic action were observed at a dosage of 250 mg/kg (1/4 of LD50). Antiestrogenic effect was not demonstrated [Saxena and Saxena, 1979] [39].

Larvicidal Activity

Calotropis procera showed high larvicidal effect when tested against Anopheles labranchiae mosquito larvae, with an LC50 (24 hours) ranging from 28 to 325 ppm. The detrimental effects of crude extracts of Calotropis Procera (from both leaves and flowers) on the termite species Heterotermes indicola and Coptoter mesheimi have been studied [40]. The ethanolic extract of Calotropis gigantea has been shown in earlier studies to have larvicidal effects on Ae. aegypti larvae, with an LD50 value of 351.43 ppm. Calotropis gigantea and Calotropis procera had similar effects on Ae, as evidenced by the LC50 values of all sections for the larvicidal action. larvae of Aegypti [41]. Calcotoxin and calcotropin are the main compounds that may be responsible for the larvicidal characteristics of the Calotropis species.

Analgesic Activity

The dry latex (DL) of *Calotropis Procera* has been shown to have analgesic qualities [42]. A dose of 415 mg/kg of DL was more effective in suppressing writhing brought on by acetic acid than an oral dosage of aspirin (100). The alcoholic extract of *Calotropis gigantea* flowers has analgesic properties. An oral dosage of this extract generated a notable result in the activity, which was conducted using the writhing test caused by acetic acid and the hot plate technique. The effects of an alcoholic peeling extract of *Calotropis gigantea* roots (at oral dosages of 250 and 500 mg/kg body weight) on the central nervous system (CNS) of albino rats were investigated. Both the writhings caused by acetic acid and Eddy's hot plate approach demonstrated significant analgesic advantages [43].

Antiviral Activity

To measure antiviral efficacy, two-fold serial dilutions of both RFL (rubber free latex) and SLP (soluble laticifer proteins) ranging from 10 mg/mL to 0.019 mg/mL were mixed with a standard quantity of the virus and incubated for 30 minutes at 37 °C. 22 Nine-day-old chicken embryos from Big Bird Laboratories in Lahore were injected with the mixture via an allantoic cavity route under sterile settings. The negative control was created by injecting PBS (phosphate-buffered saline) into the embryo, whereas the positive control was created by injecting the virus alone. Every embryo was incubated at 60% humidity and 37 °C. Every day, an egg candler was used to assess the embryos' viability. The spot hem agglutination approach was used to detect the presence of virus in chorioallantoic fluid that was collected in sterile test tubes [44].

Allelopathic And Insecticidal Potential

The growth of *Brassica oleracea* var. botrytis (broccoli), suppression of some plant species, and allelopathic potential of *Calotropis Procera* (giant milk weed) have all been observed [45, 46]. Additionally, *C. procera's* allelopathic activity was evaluated against a variety of weeds, including Portulaca oleracea (pigweed), Dactyloctenium aegyptium (Crowfoot grass), *Bidens pilosa* (Spanish needle), and *Chenopodium murale* (salt green) [47]. Aqueous extracts from *Calotropis Procera* shown insecticidal efficacy against *Henosepilachna elaterii* Rossi, the melon lady bird beetle [48].

Assessment of the Antimicrobial Activity of *Calotropis Procera* Using Agar Well Diffusion

The agar well diffusion method was used to assess the antibacterial activity of plant extracts from *Calotropis Procera* leaves. After the test organisms were inoculated on Muller Hinton agar and given two minutes, five 5.0 mm wells were drilled into the agar plates using a sterile corked borer. Four of the wells received 0.3 mL of various plant extract concentrations (200, 100, 50, and 25 mg/mL). For a whole day, agar plates were incubated at 37°C. The test for the fungi was conducted on SDA plates and incubated for 72 hours at 30 degrees Celsius. Following incubation, the diameter of the inhibitory zones was measured and recorded to the closest millimeter [49].

In Vitro Anti-Sporozoite Activity of Calotropis Procera

The length of the incubation period and the extract concentration rate were used to measure the sporozoite vitality rate in Calotropis Procera. When compared to the control treatment (K2Cr2O7), 1,000 µg/mL of extract and 25 µg/mL toltrazuril were found to exhibit statistically significant alterations ($p < .05$) in the viability rate of E. magna sporozoites after 12 and 24 hours of incubation. However, at lower extract concentrations (500, 250, and 125 µg/mL), the sporozoites showed different levels of vitality **(Figure 6)** [50].

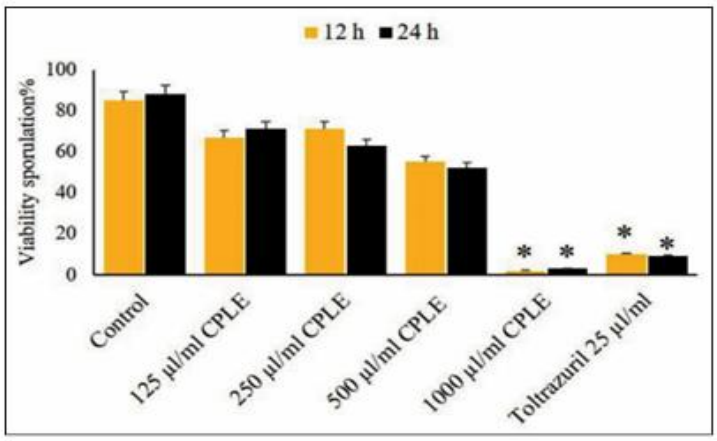

Figure: 6. The Results of the Effects of *Calotropis Procera* Leaf Extract In Vitro

*Vitality on E. magna Sporozoites after 12 and 24 hours. Note: * significant differences compared to the control and 25 µl/mL of toltrazuril ($p < 0.05$, $n = 3$).*

Antifungal Activity

With differing degrees of growth inhibition, the aqueous leaf and root extracts of *Calotropis Procera* showed significant antifungal efficacy against A. niger and R. stolonifer. The fungal isolates' mycelia growth was suppressed by both leaf and root extracts, although the leaf extract was more effective, suppressing 81.1% and 79.4% of A. niger and R. stolonifer, respectively. These results are in line with earlier research by Hassan et al. [51] and Aliyu et al. [52], which also demonstrated Calotropis Procera's strong antifungal qualities against a variety of fungal species and supported its potential as a fungistatic or fungicidal agent at comparatively low concentrations.

Antimicrobial Potential Against Fungal and Bacterial

Researchers found that the *Calotropis Procera* plant extract was effective against a few pathogenic bacteria [53–59]. *Calotropis Procera* leaf extract at different doses (1%, 2.5%, 4%, 5.5%, and 7%) shown antifungal potential against *Macrophomina phaseolina* (Tassi) Goid on mung beans, a significant pulse crop [60]. The antibacterial properties of the *Calotropis Procera* essential oil therapy were tested against two fungal and seven bacterial species. Similarly, when *Calotropis Procera* leaf extract was present, the iron Phyto-nanoparticles demonstrated their antifungal ability against *Alternaria alternata* [61]. Calotropis Procera roots contain bioactive chemicals that were used to treat infections. *Calotropis Procera* latex has been shown to have anthelmintic properties against Haemonchus contortus infection in Najdi sheep [62]. White rot fungi were identified by Aswal et al. [63] in order to break down the lignin in Calotropis Procera fiber.

Anthelmintic Activity

The in vitro and in vivo anthelmintic activity of the *Calotropis Procera* flower extract was compared to that of levamisole. The crude aqueous ex tract (CAE) and crude methanolic extract (CME) of flowers had a substantial impact ($P<0.05$) on live Hemonchus, according to the in-vitro investigation. For an in-vivo investigation, sheep that were naturally infected with gastrointestinal nematodes were given the crude powder (CA) and extract. At 3000 mg/kg, the proportion of eggs in the sheep treated with CAE and CP decreased by 88.4 and 77.8%, respectively, on days 7 and 10. However, lambs treated with CME only displayed a 20.9% decrease in egg count. Based on the aforementioned results, it was determined that the plant extract had notable activity against nematodes, whereas levamisole's activity was 97.8–100% [64].

Wound Healing Activity

The body goes through a healing process called wound healing when the skin or other soft tissues are damaged. The underlying cells experience an inflammatory reaction and increase the creation of collagen when the skin is damaged. New epithelial cells develop over time. A sterile latex solution (20 µL) was administered topically once day for seven days. The latex stimulated the creation of collagen, DNA, and proteins as well as epithelization, which decreased the size of the wound [65]. After the extract was administered, the epithelialization time decreased statistically significantly ($p<0.001$) in both normal and dexamethasone-treated rats. This reduced the task's completion time from 28 days to 17 or 18 days. Rats treated with dexamethasone showed comparable increases in breaking strength after consuming the same extract [66]. The wounds in the honey and triamcinolone groups with 50% latex were much smaller after 7 days, and they were even smaller after 14 and 21 days [67]. Triterpenoids -amyrin, flavonoids, cardiac glycosides, cardenolide anthocyanins, mudarine, lupeol, -sitosterol, flavanols, resin, a powerful bacteriolytic enzyme called calactin, a nontoxic proteolytic enzyme called calotropin, and a wax are all found in the plant, according to its phytochemistry [68]. The extract significantly increased strength upon breaking. Additionally, the rate of wound contraction was significantly increased, and wounds treated with extract underwent faster epithelialization.

Anti-Hyperglycemic Effect

In the current study, found the antioxidant and anti-hyperglycemic properties of *Calotropis Procera* dry latex (DL), which has strong anti-inflammatory action, against alloxen-induced diabetes in rats. Hepatic glycogen content increased and blood glucose decreased in a dose-dependent manner when DL was taken orally every day at doses of 100 and 400 mg kg-1. DL's anti-diabetic and antioxidant properties were on par with glibenclamide, a common anti-diabetic medication [69].

Anti-Malarial Activity

The IC50 values of the ethanolic extracts of the various Calotropis Procera parts against P. falciparum MRC20-CQ-sensitive ranged from 0.11 to 0.47 mg/ml. Additionally, flower and bud extracts were the most effective against MRC76_CQ-resistant bacteria, ranging from 0.52 to 1.22 mg/ml. These extracts are 220–440 times less effective than CQ, yet they nonetheless merit more research to identify the key ingredients. The ethnobotanical use of this plant is supported by the results [70].

Anti-Diabetic Activity

The antidiabetic properties of compounds extracted from various plant sections can be investigated. A review paper about Calotropis Procera's components and pharmacological characteristics shed light on a few of the plant's isolated chemicals. It has been claimed that various portions of the plant contain compounds like calotropin, calotropagenin, isorhamnetin-3-O-rutinoside, calotoxin, calactin, uscharin, and others [71]. Numerous in silico investigations discovered inhibitors from a wide range of natural compounds that target important receptors in the disease mechanisms, such as alpha glucosidase [72–78]. Finding potentially novel AGIs from plants is a crucial foundation for drug discovery since inhibition of these enzymes is directly linked to the treatment of diabetic mellitus [79–84].

Miscellaneous Activities

Sayed et al. (2016) investigated the antiapoptotic activity of *Calotropis Procera* latex on catfish exposed to 4-nonylphenol (100 µg L−1) as a chemical pollution. The antiapoptotic effect of the crude latex against the toxicity of 4-nonylphenol was confirmed by a significant ($P<0.05$) decrease in apoptotic cells, ions, and enzymes (Superoxidase dismutase, acetylcholinesterase, cortisol, etc.). Therefore, 4-nonylphenol's toxicity was countered by the antiapoptotic effects of crude latex. Phenylhydrazine and paracetamol-induced Wistar rats were used to assess the anti-hyperbilirubinemic effect of leaves. The bilirubin-lowering effect of *Calotropis Procera* aqueous extracts was

demonstrated by a significant ($P<0.05$) drop in serum total bilirubin concentrations in hyperbilirubinemic rats. Because *Calotropis Procera* contains bioactive phytochemicals with therapeutic potential, recent research has shown that it has a much wider variety of positive effects. Basic research has demonstrated additional actions, but only cytotoxic tests on cancer cell lines have been thoroughly established in clinical trials. The majority of research is restricted to in vitro investigations that do not examine the molecular mechanism of action. In order to understand the underlying mechanism associated with traditional usage, mechanism-based in vitro and in vivo research should be conducted [85].

Toxicological Profile

Calotropis Procera's toxicity has been extensively studied in a variety of biological systems. Despite having a number of pharmacologically active ingredients, it has been shown in multiple trials to have harmful consequences, particularly when used in non-standardized doses or improperly prepared. The heatmap for the toxic compounds of Calotropis Procera Shrub [86] and acute and chronic toxicity, cytotoxicity, genotoxicity, neurotoxicity, and dermal and ocular risks are all included in the toxicological profile (Dogara, 2023).

The Commercial Use of Drugs

Drug resistance for the treatment of infectious diseases in human pathogenic microorganisms has developed as a result of the commercial usage of medications. Furthermore, antibiotics are seldom linked to a number of adverse effects, including hypersensitivity, immunological suppression, and allergic reactions. Prehistoric use of natural goods, including as herbal fractions and isolation of anti-microbes, has been shown to be safe and beneficial in a number of ancient systems. The most recent advancement in the usage of herbal antimicrobials has grown and demonstrated their significance. Tumors and other swellings of the neck are treated externally using the boiling residue of the *Calotropis Procera* plant, particularly paste. Plant aqueous extract is a common cancer treatment in the ethnic medical system [87].

Industrial And Novel Applications

Calotropis Procera has drawn interest for a number of industrial and biotechnological uses in addition to its therapeutic value. Strong, lightweight, and moisture-resistant fibers from the plant's stem bark can be used to make ropes, carpets, fishing nets, and environmentally friendly textiles [88]. Rubber-like substances and proteolytic enzymes found in Calotropis Procera latex have been investigated for use in biodegradable materials, bioadhesives, and enzyme-based businesses. Additionally, because of their capacity to effectively break down proteins, its proteases have demonstrated promise in waste management and leather processing [89]. The plant's function in the green synthesis of nanoparticles, where extracts are employed as stabilizing and reducing agents for the creation of metal nanoparticles like silver and gold, has also been highlighted in recent studies. These nanoparticles show improved antibacterial and anticancer properties, suggesting potential uses in drug delivery systems and nanomedicine [90].

Traditional Uses

India is a well-known tropical nation rich in natural resources and traditional knowledge about how to harness them. One such important medicinal plant that is highly prized for its numerous ethnobotanicals uses and huge commercial significance is *Calotropis Procera* [91]. Certain plant parts have historically been used medicinally to treat a variety of illnesses. Rheumatism, fever, indigestion, colds, eczema, diarrhea, boils, and jaundice have all been treated with the entire plant. Eczema, leprosy, elephantiasis, asthma, cough, rheumatism, and diarrhea have all been treated with the root; leukoderma, intestinal worms, and leprosy have all been treated with the stem [92,93]. Due to its antifungal qualities, latex is used in drugs to treat tinea capitis in children. However, there is a history of more extreme uses of latex that cause abortions in women [94]. The blossoms were believed to improve appetite, reduce mucus accumulation, and improve digestion. The blossoming tips were used to treat asthma. Additionally, the root bark was used to treat elephantiasis [95,96].

Conclusions and Future Prospects

Calotropis Procera is a plant with a variety of biological traits that make it both a potentially invasive species and a significant therapeutic and socioeconomic species. The goal of this discussion is to evaluate its growing worldwide spread, important biological and ecological characteristics, applications in both conventional and cutting-edge fields, and infestation as an environmental weed. Additionally, it is an effort to identify the areas of ongoing study that have received less attention and knowledge gaps.

The plant's general biological and ecological characteristics-especially those pertaining to adaptations or plasticity-have not been thoroughly studied, despite the fact that its medicinal and industrial uses have received the attention they deserve. Furthermore, there hasn't been much attention paid to *Calotropis Procera's* toxicity-bioactivity relationship, which is crucial for confirming its therapeutic characteristics. Assessing these fundamental aspects could enhance its economic use and open the door to other uses. In addition, filling in these knowledge gaps can aid in comprehending its invasive behaviour and any future dangers to the environment or biodiversity.

In order to control or contain *Calotropis Procera* in a timely manner, it is also necessary to map its existing and potential spread. Mechanical, chemical, or biological techniques can be used to effectively inhibit the spread of Calotropis Procera in the invaded ranges. This can be followed by ongoing monitoring over the following few years to prevent the emergence of new plantlets. Acknowledging the plant as a significant environmental weed can enhance scientific, legislative, stakeholder, and municipal control initiatives. Additionally, encouraging its use on both commercial and non-commercial levels may be a financially feasible, or more accurately, profitable, approach to its management.

References

1. Saddiq AA, Tag HM, Doleib NM, Salman AS, Hagagy N. Antimicrobial, antigenotoxicity, and characterization of Calotropis procera and its rhizosphere-inhabiting Actinobacteria: In vitro and in vivo studies. Molecules. 2022 May 13;27(10):3123. https://doi.org/10.3390/molecules27103123.
2. Singh NK, Bhushan B, Agrahari Y. An overview on the phytochemical and therapeutic potential of Calotropis procera. Pharmacological Research-Modern Chinese Medicine. 2024 Jun 1;11:100441.
3. Habeeb A, Ramesh S, Shanmugam R. Calotropis procera and the pharmacological properties of its aqueous leaf extract: A review. Cureus. 2024 May 15;16(5). 10.7759/cureus.60354.
4. Ahmad Nejhad A, Alizadeh Behbahani B, Hojjati M, Vasiee A, Mehrnia MA. Identification of phytochemical, antioxidant, anticancer and antimicrobial potential of Calotropis procera leaf aqueous extract. Scientific reports. 2023 Sep 7;13(1):14716.
5. Rodríguez-Macías JD, Saurith-Coronell O, Martínez Parra L, Carrascal-Hernández DC, Fuentes-Gandara F, Insuasty D, Márquez-Brazón EA. Integrated in vitro and in silico evaluation of the antimicrobial and cytotoxic potential of Calotropis procera leaf ethanolic extract: From GC-MS profiling to molecular docking and dynamics. International Journal of Molecular Sciences. 2025 Oct 30;26(21):10574. https://doi.org/10.3390/ijms262110574.
6. Iqbal U, Hameed M, Ahmad F. Structural and functional traits underlying the capacity of Calotropis procera to face different stress conditions. Plant Physiology and Biochemistry. 2023 Oct 1;203:107992.
7. Nagime PV, Shaikh NM, Shaikh SB, Lokhande CD, Patil VV, Shafi S, Syukri DM, Chidrawar VR, Kumar A, Singh S. Facile synthesis of silver nanoparticles using Calotropis procera leaves: unraveling biological and electrochemical potentials. Discover Nano. 2024 Sep 3;19(1):139.
8. Singh P, Dhole B, Choudhury J, Tuli A, Pandey D, Velpandian T, Gupta S, Chaturvedi PK. Calotropis procera extract inhibits prostate cancer through regulation of autophagy. Journal of Cellular and Molecular Medicine. 2024 Mar;28(6):e18050. https://doi.org/10.1111/jcmm.18050.
9. Bansal P, Choudhary S, Taneja T, Sangwan S, Gupta B, Goyal S, Kumar R, Sharma P. Exploring the potential of Calotropis procera in pharmacological approaches. InMedicinal Plants-Chemical, Biochemical, and Pharmacological Approaches 2023 Nov 14. IntechOpen. 10.5772/intechopen.113161.
10. Lakhdar M. Calotropis Procera (Ait) R. Br, A Valuable Medicine Plant: A Review. Advances in Biology & Earth Sciences. 2023 Jan 1;8(1).
11. Chaveriat L, Jean-Hugues R, Hanitriniaina C, Patrick M. Extraction Optimization for Comparative Phytochemical Profiling and Antioxidant Properties of Calotropis procera Leaves and Zanthoxylum decaryi Barks. https://doi.org/10.9734/ejmp/2025/v36i61316.
12. Ahmed A, Hassaballa L, Guma'a A. Morpho-Taxonomic Study Based on Wild Weed Plant Species Calotropis procera (Aiton)—Whole Plant. American Journal of Plant Sciences. 2022 Aug 26;13:1158-66.
13. Navarrete-Sauza E, Rojas-Aréchiga M, Pérez-Pacheco MK, Márquez-Guzmán J. Fruit and seed morphometry and seed structure of the potentially invasive Calotropis procera (Aiton) WT Aiton (Apocynaceae). Botanical Sciences. 2024 Jun;102 (2):447-63.
14. Konno K (2011) Plant latex and other exudates as plant defense systems: roles of various defense chemicals and proteins contained therein. Phytochemistry 72:1510–1530.
15. Abo-Elyousr KA, Ali EF, Sallam NM. Alternative control of tomato wilt using the aqueous extract of Calotropis procera. Horticulturae. 2022 Feb 23;8(3):197. https://doi.org/10.3390/horticulturae8030197.
16. Alam MA, Habib MR and Farjana N. "Insecticidal Activity of Root Bark of Calotropis gigantea L. Against Tribolium castaneum (Herbst)." World J Zoo 4 (2009): 90-95.
17. Kedare SB and Singh RP. "Genesis and Development of DPPH Method of Antioxidant Assay." J Food Sci Technol 48 (2011): 412-422.
18. Kumar G, Karthik L and Rao KVB. "Antimicrobial Activity of Latex of Calotropis gigantea Against Pathogenic Microorganisms-An in vitro Study." Pharmacologyonline 3 (2010): 155-63.
19. Rajeshwari BS. Evaluation Of Hepatoprotective Potential Of Hydroalcoholic Leaf Extract Of Calotropis Gigantea Against Thioacetamide-Induced Hepatic Injury In Wistar Albino Rats. International Journal of Scientific Research and Technology. 2024 Dec 18.
20. De Silva G O, Abeysundara A T and Aponso M M W 2017 Extraction methods, qualitative and quantitative techniques for screening of phytochemicals from plants Am. J. Essent. Oils Nat. Prod. 5 29–32.
21. Hidayah N, Huda C and Tilarso D P 2020 Uji Aktivitas Antibakteri Fraksi Daun Biduri (Calotropis gigantea) terhadap Staphylococcus aureus JOPS (Journal Pharm. Sci. 4 40–5
22. Abubakar A R and Haque M 2020 Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes J. Pharm. Bioallied Sci. 12 1
23. Suryanti V, Sariwati A, Sari F, Handayani D S and Risqi H D 2022 Metabolite bioactive contents of Parkia timoriana (DC) Merr seed extracts in different solvent polarities Hayati J. Biosci. 29 681–94.
24. Kumari A, Sharma S and Sharma M 2018 Effect of physicochemical properties of soil on secondary metabolites of Calotropis gigantea (L.) collected from Shivalik hills of Himachal Pradesh, India Biol Forum vol 10 pp 146–57.

25. Kemala P, Idroes R, Khairan K, Ramli M, Jalil Z, Idroes G M, Tallei T E, Helwani Z, Safitri E, Iqhrammullah M and Nasution R 2022 Green Synthesis and Antimicrobial Activities of Silver Nanoparticles Using Calotropis gigantea from Ie Seu-Um Geothermal Area, Aceh Province, Indonesia Molecules 27 1–13.
26. Fakri F, Harahap S P, Muhni A, Khairan K, Hewindati Y T and Idroes G M 2023 Antimicrobial Properties of Medicinal Plants in the Lower Area of Ie Seu-um Geothermal Outflow, Indonesia Malacca Pharm. 1 55–61.
27. Safrida S, Mardiana R and Husna N 2021 Uji Efek Antifungi Ekstrak Daun Biduri (Calotropis Gigantea L.) Terhadap Pertumbuhan Jamur Trichophyton Mentagrophytes J. Pharm. Heal. Res. 2 8–11.
28. Malhab LJ, Bajbouj K, Shehab NG, Elayoty SM, Sinoj J, Adra S, Taneera J, Saleh MA, Abdel-Rahman WM, Semreen MH, Alzoubi KH. Potential anticancer properties of calotropis procera: an investigation on breast and colon cancer cells. Heliyon. 2023 Jun 1;9(6).
29. Nagime PV, Singh S, Shaikh NM, Gomare KS, Chitme H, Abdel-Wahab BA, Alqahtany YS, Khateeb MM, Habeeb MS, Bakir MB. Biogenic fabrication of silver nanoparticles using calotropis procera flower extract with enhanced biomimetics attributes. Materials. 2023 May 30;16(11):4058. https://doi.org/10.3390/ma16114058.
30. Al-Rowaily SL, Abd-ElGawad AM, Assaeed AM, et al. Essential Oil of Calotropis procera: Comparative Chemical Profiles, Antimicrobial Activity, and Allelopathic Potential on Weeds. Molecules. 2020;25(21):5203. Available at: http://doi.org/10.3390/molecules25215203.
31. Sebastian MK, Bhandari MM. Medico-ethno botany of Mount Abu, Rajasthan, India. J Ethnopharmacol. 1984;12(2):223–230. Available at: http://doi.org/10.1016/0378-8741(84)90050-3.
32. Mossa JS, Tariq M, Mohsin A, et al. Pharmacological Studies on Aerial Parts of Calotropis Procera. Am J Chin Med. 1991;19(3–4):223–231. Available at: http://doi.org/10.1142/S0192415X91000302.
33. Rasik AM, Raghubir R, Gupta A, et al. Healing potential of Calotropis procera on dermal wounds in Guinea pigs. J Ethnopharmacol. 1999;68(1–3):261–266. Available at: http://doi.org/10.1016/S0378-8741(99)00118-X.
34. Kareem SO, Akpan I,Ojo OP.Antimicrobial activity of Calotropis procera on selected pathogenic microorganisms. Afr J Biomed Res 2008; 11: 105–110.
35. Choedon T, Mathan G, Arya S, Kumar VL, Kumar V. Anticancer and cytotoxic properties of the latex of Calotropis procera in a transgenic mouse model of hepatocellular carcinoma. World J Gastroenterol. 2006;12: 2517-2522.
36. Magalhães HI, Ferreira PM, Moura ES, Torres MR, Alves AP, Pessoa OD, Costa-Lotufo LV, Moraes MO. In vitro and in vivo antiproliferative activity of Calotropis procera stem extracts. An Acad Bras Cienc. 2010;82: 407-416.
37. Juncker T, Schumacher M, Dicato M, Diederich M. UNBS1450 from Calotropis procera as a regulator of signaling pathways involved in proliferation and cell death. Biochem Pharmacol. 2009;78: 1-10.
38. Bhat KS, Sharma A, Venkatramana DK. Antiproliferative effect of Calotropis gigantea (L.) R. Br. on breast cancer cell MCF-7. Int J Pharm Sci Res. 2014;5(9):3918-3923.
39. Kumari R, Singh C, Adlakha M, Purvia RP. A review article on calotropis procera. 10.20959/wjpr202213-25499.
40. Quazi S, Mathur K, Arora S, Wing P. Calotropis procera: An overview of its phytochemistry and pharmacology. Indian J Drugs. 2013;1(2):63-9.
41. Alafnan A, Sridharagatta S, Saleem H, Khurshid U, Alamri A, Ansari SY, et al. Evaluation of the phytochemical, antioxidant, enzyme inhibition, and wound healing potential of Calotropis gigantea (L.) Dryand: A source of a bioactive medicinal product. Front Pharmacol. 2021;12: 701369.
42. Parihar G, Balekar N. Calotropis procera: A phytochemical and pharmacological review. Trop J Pharm Res. 2016;40(3):115-31.
43. Argal A, Pathak AK. CNS activity of Calotropis gigantea roots. J Ethnopharmacol. 2006;106:142–5.
44. Saher U, Omer MO, Javeed A, Anjum AA, Rehman K, Awan T, Saleem G, Mobeen A. Functional studies of cytogenotoxic potential of laticifer proteins of Calotropis procera against viral disease. ACS omega. 2023 Feb 13;8(7):7119-27. https://doi.org/10.1021/acsomega.2c08102.
45. Gulzar A, Siddiqui MB. Allelopathic effect of Calotropis procera (Ait.) R. Br. on growth and antioxidant activity of Brassica oleracea var. botrytis. Journal of Saudi Society Agricultural Science, 2017:16: 375–382. doi: 10.1016/j.jssas.2015.12.003.
46. Hussain F, Rasool A, Aziz K, Raisham S, Aziz S, Badshah L. et al. Allelopathic inhibition of germination, seedling growth and cell division of selected plant species by Calotropis procera (Ait.) Ait. Plant Science Today, 2020: 7:1 8. doi: 10.14719/pst.2020. 7.1.606.
47. Al-Harbi NA. Allelopathic effect of Calotropis procera, Hyoscyamus muticus and Pulicaria undulata extracts on seed germination of Portulaca oleracea and Chenopodium murale. Pakistan Journal of Biological Sciences, 2020:23:1260–1266. doi: 10.3923/pjbs.2020.
48. Ahmed UAM, Zuhua S, Bashier NHH, Muafi K, Zhongping H, Yuling G. Evaluation of insecticidal potentialities of aqueous extracts from Calotropis procera Ait. against Henosepilachna elaterii Rossi. Journal of Applied Sciences, 2006:6: 2466-2470. doi: 10.3923/jas.2006.2466.2470. URL: https://scialert. net/abstract/? doi=jas.2006.2466.2470.
49. Bashir M, Isa H, Kachalla NA, Ikrimah UM, Salihu A, Shitu AS. Evaluation Of The Phytochemical Properties And Antimicrobial Activity Of Calotropis Procera Extracts. Bayero Journal of Pure & Applied Sciences. 2024 Dec 1;17(2):58. http://dx.doi.org/10.4314/bajopas.v17i2.7.

50. Murshed M, Al-Tamimi J, Alzaylaee H, Al-Quraishy S. Evaluating the Effectiveness of Calotropis procera Extract Against Eimeria magna Oocysts and Sporozoites in Rabbits In Vitro. Pharmacognosy Magazine. 2026 Jun;22(2):651-60. https://doi.org/10.1177/09731296251391596.
51. Hassan SW, Bilbis FL, Ladan MJ, Umar RA, Dangoggo SM, Saidu Y, et al. Evaluation of antifungal activity and phyto chemical analysis of leaves, roots and stem barks extracts of Calotropis procera (Asclepiadaceae). Pak J Biol Sci 2006; 9(14):2624-9. [DOI:10.3923/pjbs.2006.2624.2629].
52. Aliyu RM, Abubakar MB, Kasarawa AB, Dabai YU, Lawal N, Bello MB, et al. Efficacy and phytochemical analysis of latex of Calotropis procera against selected dermatophytes. J Intercult Ethnopharmacol. 2015; 4(4):314-7. [DOI:10.5455/ jice.20151012012909] [PMID] [PMCID].
53. Akhtar N, Malik A, Ali SN, Kazmit SU. Proceragenin, an antibacterial cardenolide from Calotropis procera. Phytochemistry, 1992: 31:2821–2824.
54. Jain S, Sharma R, Jain R, Sharma R. Antimicrobial activity of Calotropis procera. Fitoterapia, 1996: 67:275–277.
55. Mann A, Abalaka M, Garba S. The antimicrobial activity of the leaf extracts of Calotropis procera. Biomedical Letter, 1997: 55:205–210.
56. Kareem S, Akpan I, Ojo O. Antimicrobial activities of Calotropis procera on selected pathogenic microorganisms. African Journal of Biomedical Research, 2008: 11:105–110.
57. Joshi M, Kaur S. In vitro evaluation of antimicrobial activity and phytochemical analysis of Calotropis procera, Eichhornia crassipes and Datura innoxia leaves. Asian Journal of Pharmaceutical and Clinicl Research, 2013:6:25–28.
58. Bilal H, Ali I, Uddin S, Khan I, Said A, Rahman MU, Khan AM, Shah AB, Khan AA. Biological evaluation of antimicrobial activity of Calotropis procera against a range of bacteria. Journal of Pharmacognosy and Phytochemistry, 2020: 9:31–35.
59. Amini MH, Ashraf K, Salim F, Lim SM, Ramasamy K, Manshoor N, Sultan S, Ahmad W. Important insights from the antimicrobial activity of Calotropis procera. Arabian Journal of Chemistry, 2021:14(7): 2021, 103181. doi: 10.1016/j.arabjc.2021.103181
60. Waheed N, Jabeen K, Iqbal S, Javaid A. Biopesticidal activity of Calotropis procera L. against, Macrophomina phaseolina. African Journal of Traditional, Complementary and Alternative Medicines, 2016: 13(6):163-167. doi: 10.21010/ajtcam.v13i6.23. PMID: 28480374; PMCID: PMC5412188.
61. Ali M, Haroon U, Khizar M, Chaudhary HJ, Munis MFH. Facile single step preparations of phyto-nanoparticles of iron in Calotropis procera leaf extract to evaluate their antifungal potential against Alternaria alternata. Current Plant Biology, 2020a:23:100157. doi: 10.1016/j. cpb.2020.100157
62. Al-Qarawi A, Mahmoud O, Sobaih M, Haroun E, Adam S. A preliminary study on the anthelmintic activity of Calotropis procera latex against Haemonchus contortus infection in Najdi sheep. Veterinary Research Communications, 2001: 25:61–70, PMID: 11214673 doi: 10.1023/a:1026762002947.
63. Aswal S, Chauhan S, Bhatnagar P. Identifying efficient isolates of white rot fungi for lignin degradation of Calotropis procera fibre in handmade papermaking. Journal of Scientific Research, 2020:64: 183–191. doi: 10.37 398/JSR. 2020.640226
64. Bairagi SM, Ghule P, Gilhotra R. Pharmacology of Natural Products: An recent approach on Calotropis gigantea and Calotropis procera. http://dx.doi.org/10.4321/S2340-98942018000100004.
65. Rasik A, Raghubir R, Gupta A, Shukla A, Dubey M, Srivastava S, Jain H, Kulshrestha D (1999) Healing potential of *Calotropis procera* on dermal wounds in Guinea pigs. J Ethnopharmacol 68:261–266.
66. Tsala DE, Nga N, Thiery BNM, Bienvenue MT, Theophile D (2015) Evaluation of the antioxidant activity and the healing action of the ethanol extract of *Calotropis procera* bark against surgical wounds. J Intercult Ethnopharmacol 4:64–69.
67. Aderounmua A, Omonisib A, Akingbasotec J, Makanjuolad M, Bejide R, Orafidiya L, Adelusolae K (2013) Wound-healing and potential anti-keloidal properties of the latex of *Calotropis procera* (Aiton) Asclepiadaceae in rabbits. Afr J Tradit Complement Altern Med 10:574–579.
68. Patil RA, Makwana AB (2015) Anti-hyperbilirubinemic and wound healing activity of aqueous extract of *Calotropis procera* leaves in Wistar rats. Indian J Pharmacol 47:398–402.
69. Paul A, Kumar A, Paul A. Review on pharmocological properties of Aaka (Calotropis procera). International Journal of Economic Plants. 2018;5(3):157-62. https://doi.org/10.23910/IJEP/2018.5.3.0261.
70. Quazi S, Mathur K, Arora S, Wing P. Calotropis procera: An overview of its phytochemistry and pharmacology. Indian Journal of Drugs. 2013;1(2):63-9.
71. Al-snafi, A.E. The Constituents and Pharmacological Properties of Calotropis Procera-An Overview. *Int. J. Pharm. Rev. Res.* 2015, *5*, 259–275. [Google Scholar]
72. Antony, P.; Vijayan, R. Identification of novel aldose reductase inhibitors from spices: A molecular docking and simulation study. *PLoS ONE* 2015, *10*, e0138186. [Google Scholar] [CrossRef]
73. William, J.; John, P.; Mumtaz, M.W.; Ch, A.R.; Adnan, A.; Mukhtar, H.; Sharif, S.; Raza, S.A.; Akhtar, M.T. Antioxidant activity, α-glucosidase inhibition and phytochemical profiling of Hyophorbe lagenicaulis leaf extracts. *PeerJ* 2019, *7*, e7022. [Google Scholar] [CrossRef]

74. Kalhotra, P.; Chittepu, V.C.S.R.; Osorio-Revilla, G.; Gallardo-Velázquez, T. Structure–activity relationship and molecular docking of natural product library reveal chrysin as a novel dipeptidyl peptidase-4 (DPP-4) inhibitor: An integrated in silico and in vitro study. *Molecules* 2018, *23*, 1368. [Google Scholar] [CrossRef]
75. Baira, S.M.; Sigalapalli, D.K.; Bathini, N.B.; Srinivas, R.; Talluri, M.V.N.K. LC/QTOF/MS/MS characterization, molecular docking and in silico toxicity prediction studies on degradation products of anagliptin. *J. Pharm. Biomed. Anal.* 2018, *159*, 92–99. [Google Scholar] [CrossRef]
76. Jia, Y.; Ma, Y.; Cheng, G.; Zhang, Y.; Cai, S. Comparative Study of Dietary Flavonoids with Different Structures as α-Glucosidase Inhibitors and Insulin Sensitizers. *J. Agric. Food Chem.* 2019, *67*, 10521–10533. [Google Scholar] [CrossRef] [PubMed]
77. Rahman, N.; Muhammad, I.; Nayab, G.-E.; Khan, H.; Aschner, M.; Filosa, R.; Daglia, M. Molecular Docking of Isolated Alkaloids for Possible α-Glucosidase Inhibition. *Biomolecules* 2019, *9*, 544. [Google Scholar] [CrossRef] [PubMed]
78. Singh, P.; Singh, V.K.; Singh, A.K. Molecular docking analysis of candidate compounds derived from medicinal plants with type 2 diabetes mellitus targets. *Bioinformation* 2019, *15*, 179–188. [Google Scholar] [CrossRef] [PubMed]
79. Benalla, W.; Bellahcen, S.; Bnouham, M. Antidiabetic Medicinal Plants as a Source of Alpha Glucosidase Inhibitors. *Curr. Diabetes Rev.* 2010, *6*, 247–254. [Google Scholar] [CrossRef] [PubMed]
80. Chiba, S. Molecular Mechanism in α-Glucosidase and Glucoamylase. *Biosci. Biotechnol. Biochem.* 1997, *61*, 1233–1239. [Google Scholar] [CrossRef]
81. Lee, Y.S.; Lee, S.; Lee, H.S.; Kim, B.K.; Ohuchi, K.; Shin, K.H. Inhibitory effects of isorhamnetin-3-O-β-D-glucoside from salicornia herbacea on rat lens aldose reductase and sorbitol accumulation in streptozotocin-induced diabetic rat tissues. *Biol. Pharm. Bull.* 2005, *28*, 916–918. [Google Scholar] [CrossRef]
82. Hakamata, W.; Kurihara, M.; Okuda, H.; Nishio, T.; Oku, T. Design and Screening Strategies for α-Glucosidase Inhibitors Based on Enzymological Information. *Curr. Top. Med. Chem.* 2009, *9*, 3–12. [Google Scholar] [CrossRef]
83. Tundis, R.; Loizzo, M.R.; Menichini, F. Natural Products as α-Amylase and α-Glucosidase Inhibitors and their Hypoglycaemic Potential in the Treatment of Diabetes: An Update. *Mini-Rev. Med. Chem.* 2010, *10*, 315–331. [Google Scholar] [CrossRef]
84. Yue, L.M.; Lee, J.; Zheng, L.; Park, Y.D.; Ye, Z.M.; Yang, J.M. Computational prediction integrating the inhibition kinetics of gallotannin on α-glucosidase. *Int. J. Biol. Macromol.* 2017, *103*, 829–838. [Google Scholar] [CrossRef]
85. Wadhwani BD, Mali D, Vyas P, Nair R, Khandelwal P. A review on phytochemical constituents and pharmacological potential of Calotropis procera. RSC advances. 2021;11(57):35854-78. 10.1039/D1RA06703F.
86. Iqbal T, Altaf S. Calotropis procera Shrub: A toxicological review of its potential hazards for human use. African Research Reports. 2026 May 14;2(5):452-61. https://doi.org/10.65221/0206.
87. Rasul S, Rashid A, Akram M, Laila U, Zainab R, Khalil MT, Mbaye HS, Said MB, Alharbi HS, Alabed HH, Abdel M. Anti-Cancer and Anti-Fungal Activities of Calotropis procera: a Narrative Review. World Journal of Cancer and Oncology Research. 2023;2(2):102-21. 10.31586/wjcor.2023.727.
88. Wadhwani BD, Mali D, Vyas P, Nair R, Khandelwal P. A review on phytochemical constituents and pharmacological potential of C. procera. RSC Adv. 2021;11(57):35854-78.
89. Freitas CDT, Oliveira JS, Miranda MRA, Macedo NMR, Sales MP, Villas-Boas LA, et al. Enzymatic activities and protein profile of latex from C. procera. Plant Physiol Biochem. 2007;45(10–11):781-9.
90. Nagime PV, Shaikh NM, Shaikh SB, Lokhande CD, Patil VV, Shafi S, et al. Facile synthesis of silver nanoparticles using C. procera leaves: Unraveling biological and electrochemical potentials. Discover Nano. 2024;19(1):139.
91. Verma R, Satsangi GP, Shrivastava JN. Ethno-medicinal profile of different plant parts of Calotropis procera (Ait.) R. Br Ethnobot Leafl. 2010; 14: 721-42.
92. Abhishek D, Chaturvedi M, Gupta A, Argal A. Medicinal utility of Calotropis procera (Ait.) R. Br. as used by natives of village Sanwer of Indore District, Madhya Pradesh. Int J Pharm Life Sci. 2010; 1(3): 188-90.
93. Al-Rowaily SL, Abd-ElGawad AM, Assaeed AM, Elgamal AM, Gendy AE, Mohamed TA, et al. Essential oil of Calotropis procera: comparative chemical profiles, antimicrobial activity, and allelopathic potential on weeds. Molecules. 2020; 25(21): 5203. doi: 10.3 390/molecules25215203, PMID 33182287.
94. Aliyu RM, Abubakar MB, Kasarawa AB, Dabai YU, Lawal N, Bello MB, et al. Efficacy and phytochemical analysis of latex of Calotropis procera against selected dermatophytes. J Intercult Ethnopharmacol. 2015; 4(4): 314-7. doi: 10.5455/jice.20151012012909, PMID 26649237.
95. Parihar G, Balekar N. Calotropis procera: a phytochemical and pharmacological review. Thai J Pharm Sci. 2016; 40(3): 115-31. doi: 10.56808/3027-7922.1918.
96. Ahmed KK, Rana AC, Dixit VK. Calotropis species (Asclepiadaceae): a comprehensive review. Pharmacogn Mag. 2005; 1(2): 48-52.