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A Review: Exploring The Multifaceted Benefits of Calotropis Procera

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ABSTRACT:

Calotropis procera, commonly known as the "Apple of Sodom," is a versatile plant native to arid and semi-arid regions of Africa and Asia. This shrub or small tree is renowned for its medicinal, industrial, and ecological significance. Rich in bioactive compounds like alkaloids, flavonoids, and cardenolides, C. procera exhibits anti-inflammatory, antimicrobial, and anticancer properties, making it valuable in traditional medicine for treating ailments such as skin diseases, respiratory disorders, and fever.

Industrially, the plant's bark fibers are utilized in rope and textile production, while its latex serves as a coagulant in rubber processing. Ecologically, C. procera contributes to soil stabilization, land reclamation, and desertification mitigation. However, its adaptability and rapid growth also pose risks as an invasive species in non-native regions, requiring careful management to harness its benefits while minimizing ecological disruption**.**

KEYWORDS: Milkweed, Traditional medicine, Anti-inflammatory properties, Skin disorders

1. INTRODUCTION

Calotropis procera, commonly known as the "Apple of Sodom," is a resilient shrub or small tree from the Apocynaceae family, native to Africa and Asia. Thriving in arid and semi-arid regions, it is recognized for its thick leaves, milky latex, and vibrant flowers. Renowned for its medicinal, industrial, and ecological benefits, the plant provides bioactive compounds with anti-inflammatory, antimicrobial, and anticancer properties while contributing to soil stabilization and phytoremediation. Despite its many uses, its invasive nature requires careful management**.[1]**

This resilient plant has been deeply integrated into traditional practices and is known for its wide range of uses in medicine, industry, and ecological restoration. In conventional medicine, C. procera is utilized for treating various ailments, including skin diseases, respiratory disorders, and fever, owing to its rich repository of bioactive compounds like alkaloids, flavonoids, and cardenolides. These compounds exhibit a range of biological activities such as anti-inflammatory, antimicrobial, and anticancer properties.[2]

Beyond its medicinal significance, the fibers from its bark are used in producing ropes and textiles, while its latex has industrial applications, including as a coagulant in rubber processing. Ecologically, Calotropis procera contributes to land reclamation and soil stabilization, playing a key role in combating desertification. However, its rapid growth and adaptability also make it a potential invasive species in non-native regions, necessitating careful management.[3]

The multifaceted importance of Calotropis procera makes it a subject of interest in pharmacology, industry, and environmental science. This introduction sets the stage for exploring its biological, ecological, and economic potential, alongside sustainable utilization and management strategies.[4]


Fig.1 Calotropis Procera

2. OVERVIEW OF CALOTROPIS PROCERA

Calotropis procera, commonly known as the "Apple of Sodom," is a hardy, perennial shrub or small tree native to Africa and Asia, thriving in arid and semi-arid regions. Belonging to the Apocynaceae family, it is characterized by thick, leathery leaves, milky latex, and large, striking flowers. The plant is renowned for its ecological adaptability, medicinal properties, and industrial applications. Its bioactive compounds, including alkaloids, cardenolides, and flavonoids, exhibit anti-inflammatory, antimicrobial, and anticancer properties, making it valuable in traditional and modern medicine. Beyond medicine, its fibers are used in textiles and ropes, and its latex serves in rubber production and pest control. Additionally, C. procera aids in soil stabilization and phytoremediation, playing a crucial role in environmental conservation. However, its invasive potential necessitates careful management to ensure sustainable utilization.

2.1 Botanical Characteristics

The plant typically grows to a hight 2-4 meters, with a woody stem and broad,oval grayishgreen leaves covered in a fine, velvety texture. It produces large, attractive flowers that are purple or white with a characteristic crown like structure. One of its distinguing feaures is its milky latex, which is toxic and contains a variety compounds.

2.2 Ecological Importance

Calotropis procera plays a significant role in environmental sustainability. Its extensive root system stabilizes soils, prevents erosion, and contributes to reforestation in degraded lands. The plant is also a candidate for phytoremediation, as it can absorb and tolerate heavy metals, making it useful for cleaning polluted soils.

2.3 Medicinal Uses

The plant is a cornerstone of traditional medicine, where its parts—leaves, flowers, bark, and latex—are used to treat a variety of ailments. These include:

- **Skin diseases** such as eczema and wounds.
- **Respiratory conditions** like asthma and cough.
- **Digestive issues** including constipation.

The bioactive compounds in C. procera—alkaloids, cardenolides, flavonoids, and tannins—have demonstrated anti-inflammatory, antimicrobial, antioxidant, and anticancer properties in scientific studies.

2.4 Industrial Applications

The plant also has industrial value:

- **Fiber production:** Bark fibers are used to make ropes, paper, and textiles.
- **Latex utility:** The latex acts as a coagulant in rubber processing and has potential in bioplastics.
- **Natural pesticides:** Extracts from the plant are used to control pests and diseases in agriculture.

2.5 Challenges and Management

While C. procera offers numerous benefits, its invasiveness in some regions poses ecological risks. It can outcompete native flora and disrupt ecosystems. Sustainable management strategies are necessary to balance its advantages with ecological concerns.

Table 1: Medicinal utility of Calotropis procera.

S/No	Part Used	Medicinal Utility
1.	Flowers	Employed to treat colds, coughs, and asthma; known for their analgesic and antipyretic effects.
2.	Root	Used in traditional remedies for digestive disorders, fever, Eczema, leprosy, elephantiasis, asthma, cough respiratory issues. In case of diarrhoea, it changes the fecal matter into a semisolid mass within the first day of treatment
3.	Latex	Applied externally for wounds, boils, and skin infections; also used in treating toothaches and as an anthelmintic.
4.	Leaves	Used as poultices for swelling, joint pain, and skin diseases; anti-inflammatory and antimicrobial properties to prompt healing, used for joints and waist pain, for asthma. To cure malarial fever.

3 PHYTOCHEMISTRY OF CALOTROPIS PROCERA

Calotropis procera, commonly known as the "Apple of Sodom," is a plant rich in bioactive compounds. Its diverse phytochemical profile contributes to its traditional medicinal uses, including potential applications for skin conditions like dyshidrotic eczema. Below is a summary of its key phytochemicals and their properties:[5]

3.1 Leaves

The leaves of Calotropis procera are thick, round, and satiny, containing a rich array of bioactive composites similar to alkaloids, flavonoids, triterpenoids, saponins, and phenolic composites. Traditionally, the leaves are used in plasters, pastes, or infusions to treat inflammation, injuries, and skin diseases, including eczema. Their anti-inflammatory, antimicrobial, and skin-mending parcels make them particularly precious for managing conditions like dyshidrotic eczema, where they can help reduce itching, help infections, and promote skin hedge form. still, caution is advised due to the implicit toxin of their latex and the threat of antipathetic responses. [6]

3.2 Latex

The latex of Calotropis procera is a milky exudate rich in biologically active compounds, including proteolytic enzymes (eg calotropin), cardiac glycosides (eg calotropin and uscharin) flavonoids, alkaloids, saponins, and phenolic composites. These factors contribute to its potent antimicrobial,and anti-inflammatory crack-mending parcels, making it precious for treating skin conditions like dyshidrotic eczema. The latex helps reduce inflammation and itching, while its antimicrobial goods helps secondary infections. Still, its largely potent and can beget skin vexation or systemic toxin if used unmixed, talking conservative operation and expression[7]

3.3 Flowers

The flowers are calotropis prpcera small, star-shaped, and generally grandiloquent or lavender with white edges, percolating a delicate , moldable appearance. Rich in bioactive composites similar as flavonoids, alkaloids, and phenolic composites, the flowes retain antioxidant, antimicrobial and anti-inflammatory parcels. Traditionally,they ve been used in color full remedies to treat skin conditions, respiratory affections, and inflammation. Their essentioal canvases and excerpts may offer soothing benefits for conditions like dyshidrotic eczema, helping reduce vexation and support skin mending still, another corridor of the factory, careful use is necessary due to implicit toxin[8]

3.4 Bark

The bark of **Calotropis procera** is grayish-brown, thick, and corky, containing an array of bioactive compounds that contribute to its medicinal properties. It is rich in flavonoids, alkaloids, tannins, and triterpenoids, which exhibit antimicrobial, anti-inflammatory, and analgesic effects. Traditionally, the bark is used to treat skin conditions, digestive disorders, and respiratory ailments. Its extracts are known to aid in wound healing and reduce inflammation, making it potentially beneficial in managing conditions like dyshidrotic eczema. However, proper processing and dosage are crucial, as the plant's latex and other components can be toxic if not handled correctly.[9]

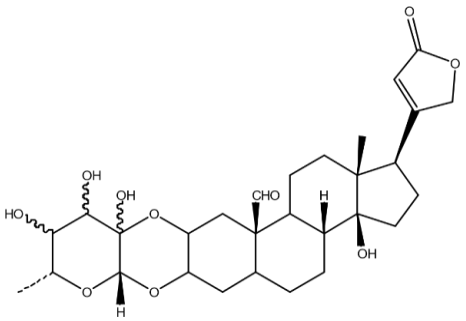

Fig.2 Calotoxin

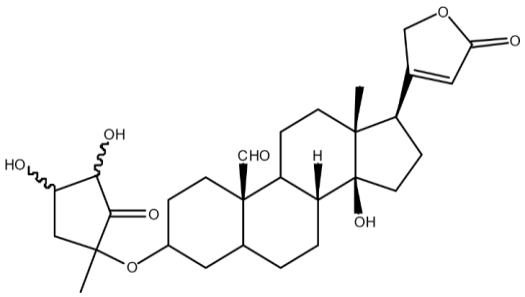

Fig.3 Calactin

4. Use in the factory

Calotropis procera, commonly known as the "apple of Sodom," is a versatile medicinal plant with a wide range of traditional and therapeutic uses. It is particularly valued for its anti-inflammatory, antimicrobial, and wound-healing properties, making it effective in treating skin conditions like eczema, psoriasis, and ulcers. The plant's latex and extracts are also used for pain relief in joint disorders, such as arthritis, and for promoting the healing of wounds and burns. In respiratory and digestive health, Calotropis procera is used to manage asthma, bronchitis, and indigestion. Additionally, its potential anti-cancer, anti-parasitic, and pest control properties highlight its broader utility. Despite its benefits, the plant contains potent bioactive compounds that require cautious use to avoid toxicity

4.1 Ayurvedic uses

The parts of the plant used in Ayurvedic medicine are the leaves, fresh or dried, the roots and root bark, and the flowers. The powdered leaves are used for the fast healing of wounds, as a purgative and to treat indigestion. They are also used to treat skin disorders and liver problems. The dried leaves are used to promote sexual health including penile dysfunction and are reputed to be an aphrodisiac. Hot poultices are made from the leaves and applied 47 Ayurvedic uses and Pharmacological activities of Calotropis procera Linn. / Asian Journal of Traditional Medicines, 2011, 6 (2) to the stomach to relieve pain, and stop headaches and also applied to sprains to ease the swelling and pain. The flowers are used as a milk drink to treat a variety of complaints including coughs and catarrh, asthma and indigestion, as well as cholera. They are collected from September to February and are also used to treat piles when prepared in the form of a paste. The plant is also known for its use in folk medicines. Traditionally, the plant has been used as an antifungal [10], antipyretic [11] and analgesic agent [12]. The dried leaves are used as an expectorant, and anti-inflammatory [13], for the treatment of paralysis and rheumatic pains [14]. The dried latex and dried root are used as an antidote for snake poisoning. It is also used as an abortifacient [15], for the treatment of piles [16] and intestinal worms. The tender leaves of the plant are also used to treat migraine. The capsulated root bark powder is effective against diarrhea and asthma [17]

5. PHARMACOLOGICAL ACTIVITIES OF CALOTROPIS PROCERA

The plant has attracted much attention due to the following biological activities: The previous IJOD, 2013, 1(2), 63-69 www.drugresearch.in pharmacological studies include reports of anticancer, antifungal, and insecticidal activity of C. procera (Ahmed et al., 2006). The flowers of the plant exhibit hepatoprotective activity, anti-inflammatory, antipyretic, analgesic, and antimicrobial effects, and larvicidal activity. The latex of the plant is reported to possess analgesic and wound healing activity as well as anti-inflammatory and antimicrobial activity while the roots are reported to have anti-fertility and anti-ulcer effects.[18]

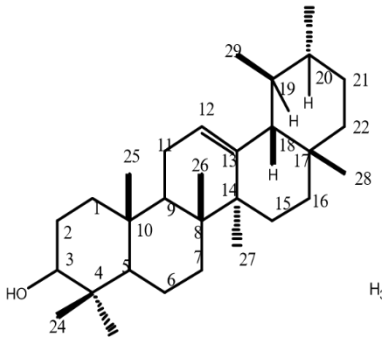

Fig.4 amyrin

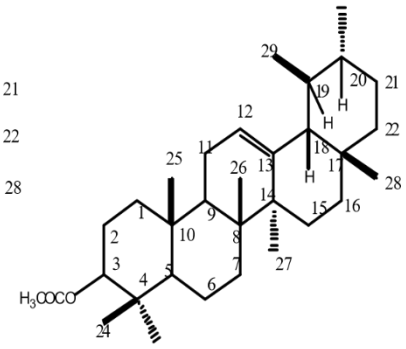

Fig. 5 amyrin acetate

5.1 Anti-Inflammatory Activity -The crude dry latex of Calotropis procera possesses a potent anti-inflammatory activity. The anti-inflammatory activity of petroleum ether, acetone, methanol, and aqueous extracts of dry latex of Calotropis procera was tested in a carrageenan-induced rat paw edema model. All the fractions exhibited anti-inflammatory activity but inhibition of edema was found to be greatest with the acetone and aqueous extracts. [19] The anti-inflammatory property of the latex of Calotropis procera was studied on carrageenin and formalin-induced rat paw edema model. A single dose of the aqueous suspension of the dried latex was effective to a significant level

against the acute inflammatory response.[20] A chloroform soluble fraction from Calotropis procera root showed significant dose-related anti-inflammatory activity in rats using the pharmacologic models of carrageenan-induced pedal edema, cotton pellet granuloma, and formaldehyde-induced arthritis.[21]

5.2 Antioxidant Activity -The antioxidant components were extracted using 80% aqueous methanol, 80% aqueous ethanol, and 80% aqueous acetone solvents.[22] The antioxidant yield from leaves and flowers of Calotropis procera ranged from 8.48 to 14.07 g/100 g dry weight. The total phenolic and flavonoid content were considerable with total phenolic yields (expressed as gallic acid equivalents) reported in the range of 0.11 to 0.32 g/100 g dry weight, and total flavonoid content (expressed as catechin equivalents) reported in the range of 0.01 to 0.10 g/100 g dry weight. C. procera extracts exhibited a reasonable DPPH radical scavenging activity (IC50 8.81 to 37.30 mg/ml) and inhibition of linoleic acid peroxidation (13.63 to 41.53%). [23]

5.3 Antimicrobial Activity- The antimicrobial activity of aqueous and ethanolic extract of roots and leaves of Calotropis procera against Staphylococcus aureus, Streptococcus pyogen, Escherichia coli, and Pseudomonas aeruginosa was studied on disc method.[24] Both ethanolic and aqueous extracts of Calotropis procera had an inhibitory effect on the growth of isolates.[25] The effect of ethanolic extract of leaves and roots was significantly greater than that of the aqueous extract of leaves and roots. [26]

5.4 Analgesic Activity- The analgesic activity of various parts of Calotropis procera viz. roots, aerial parts, and latex have been evaluated by Basu A. [27] The ethanol extract of aerial parts, chloroform extracts of roots, and the aqueous solution of dried latex were tested in an acetic acid-induced writhing model and exhibited significant analgesic activity.[28]

5.5 Wound Healing Activity- Based on its traditional use the Calotropis procera was evaluated for its wound healing potential. For this purpose, four full-thickness excisional wounds of 8.0 mm diameter were inflicted on the back of guinea pigs. Topical application of 20 µl of 1.0% sterile solution of the latex of Calotropis procera twice daily was followed for 7 days.[29] The latex significantly augmented the healing process by markedly increasing collagen, DNA, and protein synthesis and epithelisation leading to a reduction in wound area thus the study provided a scientific rationale for the traditional use of this plant in the management of wound healing.[30]

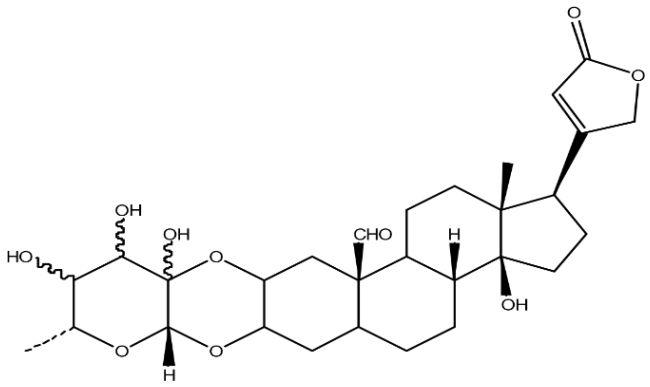

Fig.6 Calotoxin

5.6 Anticonvulsant Activity- Jalalpure reported the anticonvulsant activity of different root extracts of Calotropis procera which was studied in rats to evaluate the traditional use of this plant. [31] The anticonvulsant activity of different extracts of Calotropis procera roots was studied using seizures induced by maximal electroshock seizures (MES), pentylenetetrazol (PTZ), lithium-pilocarpine and electrical kindling seizures. In the MES test, the chloroform extract of Calotropis procera roots showed the most significant [32]

5.7 Anti-Ulcer Activity: The hydroalcoholic and chloroform extract of Calotropis procera stem bark was used for the evaluation of anti-ulcer and anti-inflammatory activity. The carrageenan-induced paw edema model was used for anti-inflammatory activity and ulcer induced by aspirin and ethanol for the evaluation of anti-ulcer activity in albino rats. The extract-treated animals showed significant activity when compared to standard drugs. The anti-ulcer activity of the extract was proved by histopathological examination. The chloroform and ethanol extract of Calotropis gigantea flowers were used for the evaluation of anti-ulcer and anti-inflammatory activity. The carrageenan-induced paw edema and cotton pellet-induced granuloma models were used for the study of anti-inflammatory activity. The aspirin and ranitidine were used for the study of anti-ulcer activity. The extract significantly reduced rat paw edema, and dry weight granuloma, and both the extract-treated groups protected from pyloric ligation and aspirin-induced gastric ulcers.[33]

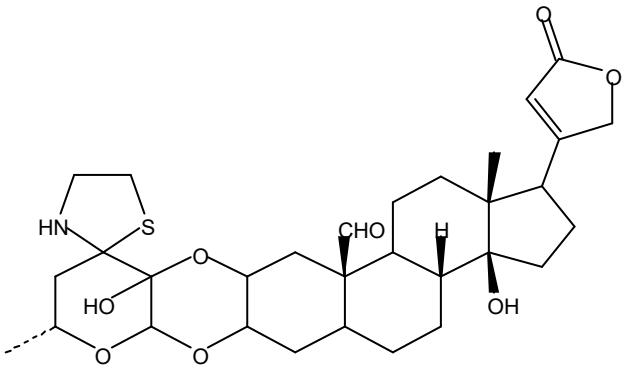

Fig.7 Voruscharin

5.8 Anthelmintic activity- to demonstrate significant anthelmintic activity, making it a useful plant in traditional medicine for treating parasitic worm infections. The plant's bioactive compounds, such as alkaloids, flavonoids, and cardiac glycosides, exhibit properties that help in expelling intestinal worms, including roundworms and hookworms. Studies have shown that extracts from various parts of the plant, including the leaves, bark, and roots, possess potent antiparasitic effects, disrupting the metabolic processes of the parasites and leading to their paralysis and expulsion from the body. However, due to the plant's toxicity, especially in higher doses, it is crucial to use it under proper supervision to ensure safety and efficacy in anthelmintic treatments.[34]

5.9 Anticonvulsant Activity

Jalalpure reported the anticonvulsant activity of different root extracts of Calotropis procera which was studied in rats to evaluate the traditional use of this plant. The anticonvulsant activity of different extracts of Calotropis procera roots was studied using seizures induced by maximal electroshock seizures (MES), pentylenetetrazol (PTZ),[35] the chloroform extract showed a highly significant ($p < 0.001$) effect, whereas the aqueous extract showed the most significant ($p < 0.01$) effect as compared to control by delaying the onset of convulsions. The extracts also inhibited convulsions induced by lithium-pilocarpine and electrical kindling. The results of this study indicate that the chloroform extract and aqueous extract of Calotropis procera roots may be beneficial in the absence (petit mal) and tonic-clonic (grand mal) types of seizures[36]

5.10 Anti-diarrhoeal activity

The dry latex (DL) of Calotropis procera, a potent anti-inflammatory agent has been evaluated for anti-diarrhoeal activity. Like atropine and phenylbutazone (PBZ), a single oral dose of DL (500 mg/ kg) produced a significant decrease in the frequency of defecation, and a variety of diarrhea, and afforded protection from diarrhea in 80% of rats treated with castor oil. To understand the mechanism of its anti-diarrhoeal activity [37] they compared both normal and castor oil-treated animals. Unlike atropine, dry latex significantly inhibited castor oil-induced enteropooling. However, it did not alter the electrolyte concentration in the intestinal fluid as compared to castor oil-treated rats.[38]

CONCLUSION

Calotropis procera, showcasing its medicinal, industrial, and ecological significance. Medicinally, it demonstrates anti-inflammatory, antimicrobial, and anticancer activities through bioactive compounds like alkaloids, flavonoids, and cardenolides, making it valuable in traditional and modern medicine. Industrially, its fibers and latex serve in rope production and rubber processing, reflecting its economic utility. Ecologically, the plant contributes to soil stabilization, desertification mitigation, and land reclamation. However, its invasive potential in non-native areas underscores the need for strategic management. These activities emphasize the importance of balancing its benefits with sustainable practices to ensure ecological and economic harmony.

However, its adaptability and rapid growth present challenges, as it has the potential to become an invasive species in non-native regions. Balancing its benefits with proper management strategies is essential to harnessing its potential while fully minimizing adverse ecological impacts. C. procera is a testament to the value of integrating traditional knowledge with modern applications to address human and environmental needs.

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