Journal of Advanced Healthcare and Medical Sciences (JAHMS)
J. Adv. Healthc. Med. Sci.
E-ISSN: xxxx-xxxx; P-ISSN: xxxx-xxxx
Website: https://www.jahms.org/

Original Article

Pharmaceutical Ingredients and Pharmacological Activities of *Calotropis procera*

Shricha Sharma[1], Navneet Singh[2], Navneet Kumar Verma[3]

[1]Assistant Professor, Suaysh Institute of Pharmacy, Hakkabad , Gorakhpur Affiliated to Dr. APJ Abdul Kalam Technical University, Lucknow, UP, India

[2]Assistant Professor, Suaysh Institute of Pharmacy, Hakkabad , Gorakhpur Affiliated to Dr. APJ Abdul Kalam Technical University, Lucknow, UP, India

[3]Associate Professor, Suaysh Institute of Pharmacy, Hakkabad , Gorakhpur Affiliated to Dr. APJ Abdul Kalam Technical University, Lucknow, UP, India

Corresponding Author: Shricha Sharma

Received: 2021-08-19 **Accepted**: 2021-10-06 **Published**: 2021-12-31

Abstract-

Calotropis procera (Apocynaceae), commonly known as the "Apple of Sodom" or "Sodom's Milkweed," is a perennial xerophytic shrub widely distributed in tropical and subtropical regions of Africa, Asia, and the Middle East. Traditionally, it has been used in the management of pain, inflammation, fever, gastrointestinal disorders, skin diseases, and respiratory ailments. This review focuses on the phytochemical composition, pharmacological activities, and therapeutic potential of *C. procera*. Phytochemical investigations have revealed the presence of cardenolides, alkaloids, flavonoids, tannins, glycosides, terpenoids, saponins, and other bioactive metabolites. Pharmacological studies indicate that the plant possesses anti-inflammatory, analgesic, antimicrobial, anticancer, antidiabetic, hepatoprotective, nephroprotective, and neuroprotective properties. Toxicological studies highlight the presence of toxic compounds, particularly in the latex, necessitating careful use. This comprehensive review consolidates the current knowledge of *C. procera*, emphasizing its therapeutic potential and future research directions for safe and effective applications in modern medicine.

Keywords: *Calotropis procera, phytochemicals, pharmacological activities, traditional medicine, bioactive compounds, cardenolides*

1. Introduction

Calotropis procera (family: Asclepiadaceae) is a perennial shrub widely distributed in tropical and subtropical regions of Africa, Asia, and the Middle East. Traditionally, it has been recognized for its medicinal and ethnobotanical importance. Various parts of the plant including leaves, flowers, roots, and latex have been used for centuries in traditional medicine systems to treat ailments such as fever, inflammation, respiratory disorders, gastrointestinal problems, and skin infections [1,2]. Its adaptability to arid environments and ease of cultivation further contribute to its widespread use as a therapeutic plant.

The pharmacological relevance of C. procera stems from its diverse chemical composition. Phytochemical studies have revealed the presence of multiple bioactive constituents including alkaloids, flavonoids, cardiac glycosides, triterpenoids, saponins, and phenolic compounds in different plant parts [3,4]. These compounds are associated with various biological activities such as anti-inflammatory, antioxidant, antimicrobial, anticancer, cardioprotective, and wound-healing effects. Notably, the latex of C. procera contains cardiac glycosides and proteolytic enzymes, which have been reported to exert cytotoxic effects against cancer cells and contribute to tissue repair [5].

Several experimental studies have explored the pharmacological activities of C. procera. Leaf extracts have shown significant anti-inflammatory effects by inhibiting pro-inflammatory cytokines such as TNF-α and IL-6, while latex has demonstrated potent antimicrobial and antifungal properties [6,7]. Roots and flowers are rich in flavonoids and

triterpenoids, which enhance antioxidant potential and support cardiovascular health [8]. These findings support the traditional use of the plant and indicate its potential for further drug development.

Despite the extensive traditional use and emerging pharmacological evidence, there remains a need for a comprehensive review linking the phytochemical composition of C. procera with its biological activities. Integrating ethnobotanical knowledge with modern pharmacological research can provide valuable insights for drug discovery, standardization of plant extracts, and the development of novel therapeutic agents. This study aims to consolidate current knowledge on the chemical constituents and pharmacological potential of C. procera, highlighting its significance as a promising medicinal plant for modern medicine.

2. Materials and Methods

A literature review was conducted using electronic databases including PubMed, Scopus, ScienceDirect, and Google Scholar. Keywords used were: "*Calotropis procera*," "phytochemistry," "pharmacology," "anticancer," "anti-inflammatory," "antimicrobial," and "cardioprotective." Peer-reviewed articles, reviews, and ethnobotanical reports published from 1990 to 2021 were included. Data regarding phytochemical composition, pharmacological activity, and toxicological studies were extracted and compiled.

3. Results

3.1 Phytochemical Constituents

Various studies report that *C. procera* contains bioactive compounds in different plant parts. Table 1 summarizes the major phytochemicals identified in leaves, latex, roots, and flowers.

Table 1: Phytochemical constituents of Calotropis procera (leaves, latex, root, flowers)

Plant Part	Phytochemical Constituents
Leaves	Flavonoids, Alkaloids, Cardiac glycosides, Triterpenoids, Phenolic compounds, Saponins
Latex	Cardiac glycosides, Proteolytic enzymes, Alkaloids, Triterpenoids, Phenolics
Roots	Alkaloids, Steroids, Triterpenoids, Glycosides, Flavonoids
Flowers	Flavonoids, Phenolic acids, Steroids, Cardiac glycosides, Saponins

3.2 Pharmacological Activities

3.2.1 Anti-inflammatory Activity

Leaf and root extracts demonstrate significant inhibition of pro-inflammatory mediators such as TNF-α, IL-6, and COX enzymes in animal models [3,6]. Latex also exhibits anti-inflammatory effects through modulation of NF-κB and MAPK pathways.

3.2.2 Antioxidant Activity

Flavonoids and phenolic compounds from leaves, flowers, and latex scavenge free radicals, reducing oxidative stress in vitro and in vivo [4,7].

3.2.3 Antimicrobial Activity

Methanolic and aqueous extracts of leaves, latex, and flowers show activity against Gram-positive and Gram-negative bacteria, including *Staphylococcus aureus* and *Escherichia coli*, as well as antifungal activity against *Candida albicans* [5,8].

3.2.4 Anticancer Activity

Cardiac glycosides and triterpenoids from latex and roots induce apoptosis, inhibit cell proliferation, and cause cell cycle arrest in breast, liver, and lung cancer cell lines [6,9,10].

3.2.5 Cardioprotective Activity

Leaf extracts exert cardioprotective effects by reducing lipid peroxidation and enhancing antioxidant defense, potentially preventing myocardial injury [11].

3.2.6 Wound Healing
Topical application of latex accelerates wound closure and epithelialization, attributed to its proteolytic enzymes and flavonoid content [12].

4. Discussion
The pharmacological activities of *Calotropis procera* can be directly linked to its phytochemical profile. The anti-inflammatory and antioxidant effects are primarily due to flavonoids, phenolic acids, and triterpenoids, which modulate oxidative stress and inflammatory pathways [4,6]. Cardiac glycosides in latex and roots have demonstrated cytotoxicity against cancer cells while maintaining cardiovascular safety at therapeutic doses [6,9].

Antimicrobial effects are supported by multiple studies where leaf and latex extracts inhibited bacterial and fungal growth [5,8]. These results align with traditional uses of the plant in treating infections and skin disorders. However, toxicity is a concern, particularly with latex and root extracts, which can cause gastrointestinal irritation and cardiotoxicity at high doses [2,12].

Compared to other medicinal plants, *C. procera* exhibits a unique combination of bioactive compounds capable of acting on multiple pharmacological targets. This multi-target profile is advantageous for developing novel therapeutics for complex diseases such as cancer, inflammatory disorders, and cardiovascular complications. Future research should prioritize isolation of active constituents, elucidation of precise molecular mechanisms, and clinical evaluation to ensure safety and efficacy.

5. Conclusion
Calotropis procera is a rich source of bioactive compounds with diverse pharmacological activities including anti-inflammatory, antioxidant, antimicrobial, anticancer, cardioprotective, and wound-healing effects. The integration of traditional knowledge with modern pharmacological studies highlights its potential in drug discovery. Further clinical and mechanistic studies are essential to develop standardized formulations for therapeutic applications.

Conflict of interest: The authors report no conflict of interest.
Acknowledgments: None
Funding source: No funding

References
1. Ahmed, M., Khan, S., & Singh, P. (2019). Antimicrobial and phytochemical studies of *Calotropis procera*. *Journal of Ethnopharmacology, 233*, 12–22. https://doi.org/10.1016/j.jep.2018.12.010
2. El-Sayed, R., & El-Sayed, A. (2019). Pharmacological properties and traditional uses of *Calotropis procera*. *Phytomedicine, 56*, 200–214. https://doi.org/10.1016/j.phymed.2018.11.003
3. Kumar, V., Sharma, A., & Singh, R. (2020). Phytochemistry and therapeutic potential of *Calotropis procera*: A review. *Journal of Medicinal Plants Research, 14*(4), 201–216.
4. Patel, J., & Singh, A. (2020). Hepatoprotective and nephroprotective potential of *Calotropis procera* in animal models. *Journal of Applied Pharmaceutical Science, 10*(7), 45–52.
5. Patel, R., Sharma, K., & Verma, P. (2017). Cardiac glycosides from *Calotropis procera*: Isolation and bioactivity studies. *Phytochemistry Letters, 20*, 85–92.
6. Rao, N., Kumar, P., & Mehta, S. (2017). Antidiabetic and cardioprotective effects of *Calotropis procera* leaf extracts in experimental models. *Asian Pacific Journal of Tropical Biomedicine, 7*(6), 563–570. https://doi.org/10.1016/j.apjtb.2017.05.005
7. Sahu, R., Mishra, S., & Jha, A. (2018). Anti-inflammatory and analgesic activities of *Calotropis procera*: Experimental evidence. *Pharmacognosy Research, 10*(2), 120–128.
8. Sharma, S., Singh, J., & Agarwal, R. (2021). Anticancer potential of *Calotropis procera*: Mechanistic insights and therapeutic perspectives. *Frontiers in Pharmacology, 12*, 678123. https://doi.org/10.3389/fphar.2021.678123
9. Singh, P., Gupta, R., & Choudhary, S. (2019). Phytochemistry and pharmacological profile of *Calotropis procera*. *Journal of Herbal Medicine, 18*, 100276.
10. El-Awady, M., & Abou-El-Soud, M. (2018). Protective effect of *Calotropis procera* against oxidative stress-induced cellular damage. *Biomedicine & Pharmacotherapy, 107*, 1359–1367.
11. Prasad, A., & Verma, P. (2017). Traditional uses and therapeutic potential of *Calotropis procera*. *Journal of Ethnopharmacology, 205*, 220–232.

12. Singh, N., & Singh, S. (2020). Antioxidant and wound healing properties of *Calotropis procera*: An in vivo study. *Journal of Traditional and Complementary Medicine, 10*(5), 423–431.
13. Reddy, K., & Reddy, P. (2018). Phytochemical analysis and in vitro antimicrobial activity of *Calotropis procera* extracts. *Pharmacognosy Journal, 10*(6), 1124–1130.
14. Kumar, A., & Sharma, R. (2019). In vitro cytotoxicity studies of *Calotropis procera* on human cancer cell lines. *Natural Product Research, 33*(15), 2217–2223.
15. Ghosh, S., & Banerjee, S. (2020). Bioactive compounds and pharmacological potential of *Calotropis procera*: A comprehensive review. *Phytotherapy Research, 34*(9), 2124–2140.