Advances in Biology & Earth Sciences
Vol.8, No.1, 2023, pp.27-35

CALOTROPIS PROCERA (AIT) R. BR, A VALUABLE MEDICINE PLANT: A REVIEW

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Abstract. *Calotropis procera* (Ait) R. Br. belongs to the family Asclipiadaceae. It is widely used in the traditional medicinal system for the treatment of various common ailments such as fever, rheumatism, colds, eczema, diarrhea, elephantiasis, asthma, cough, leprosy, intestinal worms, ulcers and other diseases. *C. procera* contains a wide range of phytochemical compounds such as cardenolides, steroids, glycosides, sugars, tannins, terpenoids, phenols, flavonoids, saponins and alkaloids. This paper reviews information pertaining its traditional uses, phytochemistry and biological activities such as analgesic activity, antioxidant activity, anticancer activity, anthelmintic activity, antidiabetic activity, hepatoprotective activity, antiinflammatory activity, antimicrobial activity, antimalarial activity and other activities. It is hoped that the information provided here will encourage additional research that could eventually result in the creation of medicinal medicines from this plant.

Keywords: *Asclipiadaceae, Calotropis procera, traditional uses, phytochemistry, biological activities.*

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Received*: 16 January 2023;* ***Accepted****: 9 February 2023;* ***Published****: 18 April 2023.*

1. Introduction

In ethnomedicine, herbs are typically employed as traditional formulations or as derivatives of their pure active components (Zulkhairi *et al.,* 2010). Medicinal plants are natural sources of substances that can be used to treat a variety of illnesses (Kubmarawa *et al.,* 2007). The World Health Organization reports that a significant portion of the populace in poorer nations relies primarily on medicinal plants for fundamental healthcare requirements (Pourmohammad, 2013). Due to their abundance in bioactive natural compounds, medicinal plants have been essential in the process of discovering new drugs (Cragg *et al.,* 1997). Due to their significant therapeutic characteristics, various families of bioactive chemicals, including saponins, phenolics, lignans, glycosides, flavonoids, terpenes, and alkaloids, have been used in the contemporary drug system (Saadabi *et al.,* 2006; Agrawal *et al.,* 2011). However, because they are presented in the local population's language and are only available there, certain information on plants used in traditional medicine is not easily accessible to the scientific community (Luczaj & Szymanski, 2007). The idea of incorporating traditional

How to cite (APA):
Lakhdar, M. (2023). *Calotropis procera* (Ait) R. Br. a valuable medicine plant: A review. *Advances in Biology & Earth Sciences*, *8*(1), 27-35.

medicine within the public health system has been brought up by numerous researchers (Alves & Rosa, 2007). This necessitates the gathering, organizing, and widespread dissemination of all information regarding conventional medicine. One of the most popular plants in traditional medicine in the northern Sahara of Algeria and other parts of the world is *Calotropis procera* (Ait) R. Br. In this review, the phytochemistry, diverse folk applications, and pharmacological characteristics of *Calotropis procera* are highlighted.

2. Classification of *Calotropis procera*

The classification and vernacular names of *C. procera* are given in Tables 1 and 2.

Table 1. Classification of *Calotropis procera*

Kingdom	Plantae	(Kirtikar & Basu, 1998)
Division	Magnoliophyta	
Class	Magnoliopsida	
Subclass	Asteridae	
Order	Gentianales	
Family	Asclipiadaceae	
Subfamily	Caesalpinioideae	
Genus	*Calotropis*	
Species	*procera*	
Binomial name	*Calotropis procera*	

Table 2. Vernacular names of *Calotropis procera*

Region	**names**	**Reference**
England	Calotrope, calotropis, dead Sea fruit, desert wick, giant milkweed, swallow-wort, mudar fibre, rubber bush, rubber tree, sodom apple.	(Navdeep *et al.*, 2017)
	Madar tree	(Shoaib *et al.*, 2013)
Arabic	Dead sea plant, debaj, usher, oshar, kisher	(Navdeep *et al.*, 2017)
Malaysia	Remiga, rembega, kemengu	
German	Wahre mudarpflanzer, gomeiner	
Philippines	Kapal-kapal (Tagalog)	
Spanish	Bomba, algodón extranjero, cazuela	
Indonesia	Bidhuri (Sundanese, Madurese), sidaguri (Javanese), rubik (Aceh)	
Chinese	Bai hua niu jiao gua	
Somali	Boah, bo'ah	
French	Faux arbre de soie, mercure vegetal	
Turkish	Ipekag	
Thailand	Po thuean, paan thuean (northern), rak (central).	
Laos	Kok may, dok kap, dok hak	
Persian	Kharak	
Nigeria	Tumfafia	
Pakistan	Ak	
Arabic (*south west* of *Algeria*)	Kronka	(Mebarki)
India	Aak, Akavana, Madar	(Shoaib *et al.*, 2013)

3. General botanical description of *Calotropis procera*

C. procera is a small shrub or tree that can grow to a height of 2.5 meters (maximum 6), with a stem that is typically simple, rarely branched, woody at the base,

and covered in a fissured, corky bark. The branches are somewhat succulent and densely covered in white tomentose, and they are early glabrescent. When cut or snapped, the entire plant exudes a white latex. The root is taproot, about 3 to 4 m deep (Al Sulaibi *et al.,* 2020). The leaves are opposite, simple, subsessile, stipule-free, and have an oblong-obovate to widely obovate shape (Figure 1). They measure 5 to 30 x 2.5 to 15.5 cm, are succulent, and are initially white tomentose before becoming later glabrescent and glaucous (Rastogi & Mehrotra, 1999). The flowers are hermaphroditic, pentamerous, and in a dense, multiflowered, umbellate cyme that emerges from the nodes and appears axillary or terminal. The calyx is 5-lobed, briefly joined at the base, and the lobes are ovate, 4-7 x 3-4 mm, and glabrescent (Batool *et al.,* 2020). The fruit is a simple, fleshy, inflated, subglobose to obliquely ovoid follicle with a diameter of 10 cm or more; seeds are many (350–500 seeds), flat obovate, 6 x 5 mm, and have a silky white pappus that is at least 3 cm long (Batool *et al.*, 2020). All year long, there are flowers and fruits to be found.

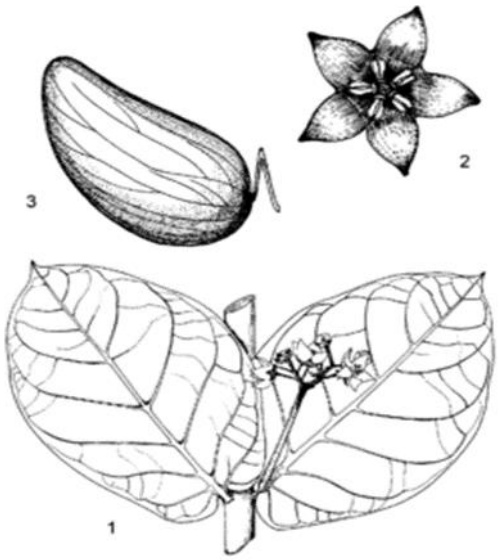

Fig. 1. *Calotropis procera*
1 - part of flowering branch; 2 - flower; 3 - fruit.
(Akoègninou *et al*., 2006**)**

4. Geographical distribution of *Calotropis procera*

Africa, the Arabian Peninsula, Western Asia, the Indian Subcontinent, and Indo-China are the natural home ranges of *C. procera*. But due to the plant's introduction outside of its original range, it is now naturalized in Australia, many Pacific Islands, Mexico, Central and South America and the Caribbean islands (Crothers *et al*., 1998).

5. Phytochemistry of *Calotropis procera*

Numerous studies have revealed the presence of metabolites in diverse plant sections of *C. procera*, including flavonoids, tannins, terpenoids, saponins, alkaloids, steroids, and cardiac glycosides. Table 3 contains a list of several secondary metabolites that have been identified in the plant and some of which are illustrated in the Figure 2.

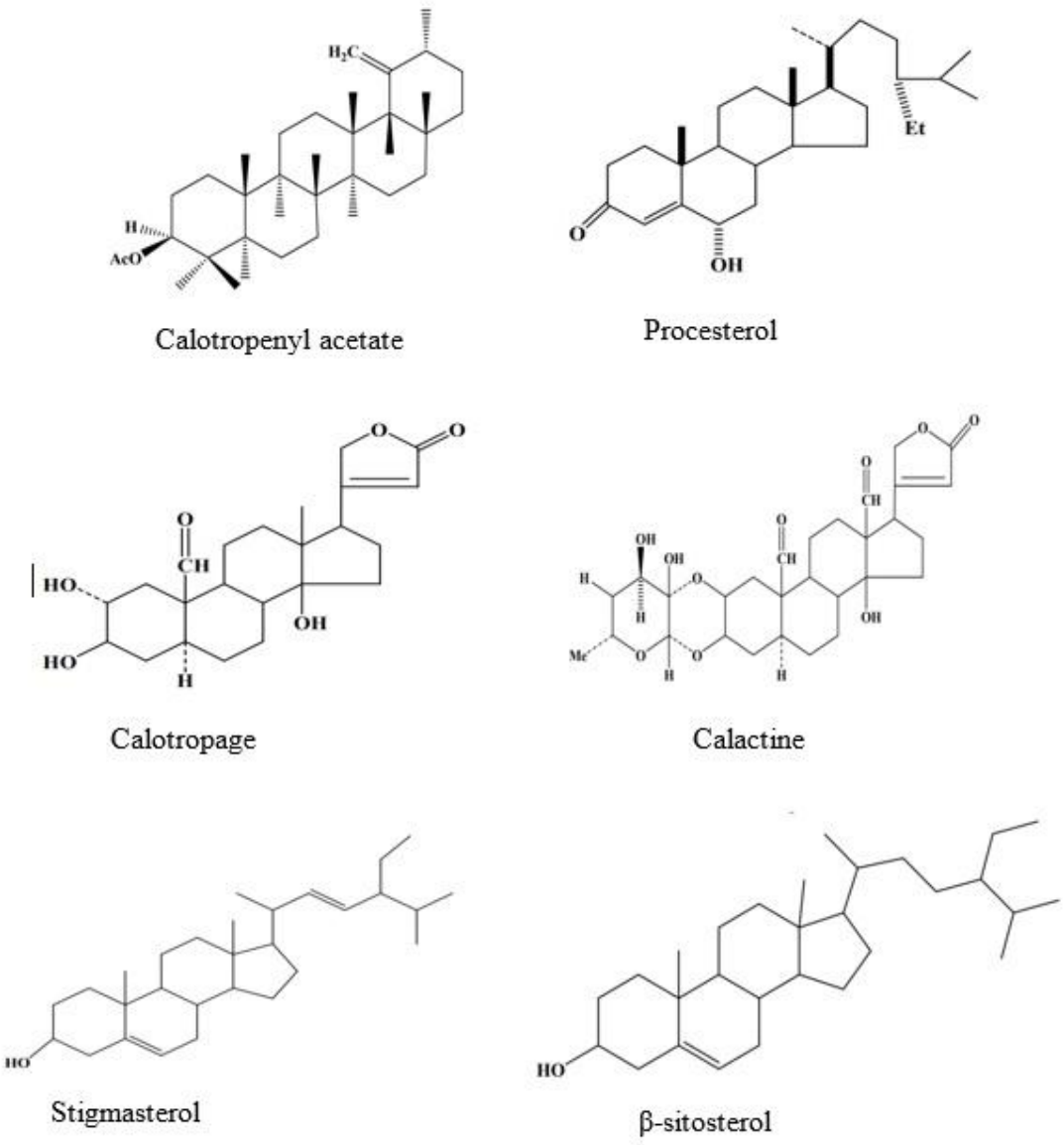

Fig. 2. Structure of some *Calotropis procera* secondary metabolites (Khan *et al*., 1988; Olea *et al*., 2002)

6. Traditional uses of *Calotropis procera*

Traditionally, *C. procera* is extensively used to treat several diseases. In this contexte, common illnesses like fever, rheumatism, indigestion, colds, eczema, diarrhoea, boils, and jaundice were all treated using the whole plant. Eczema, leprosy, elephantiasis, asthma, cough, rheumatism, and diarrhea were all treated with the root. Leprosy, intestinal worms, leucoderma, and leprosy were all treated with the stem (Abhishek *et al*., 2010; Esmail & Al-Snafi, 2015; Al-Rowaily *et al*., 2020). In addition, liver and spleen illnesses, ulcers, pain, dyspepsia, and bronchitis are all treated with *C. procera* (Parihar *et al*., 2011).

Table 3. Phytochemistry of *Calotropis procera*

Plant parts	Compounds	References
Latex	Cardenolides : 12β-Hydroxycoroglaucigenin ; 15β-Hydroxy calactin ; 15β-Hydroxy uscharin ; Afrogenin ; Afroside ; Calactin ; Calactoprocin ; Calotoxin ; Procegenin A ; Procegenin B ; Uscharin.	(Mohamed *et al.*, 2015)
	Steroids : 3β,27-Dihydroxy-urs-18-en-13,28-olide ; Urs-19(29)-en-3-yl acetate ; Urs-19(29)-en-3-β-ol ; β-Sitosterol	(Chundattu *et al.*, 2016)
	Proteins and Enzymes : CpGLP1 ; CpGLP2	(Freitas *et al.*, 2017)
	Proteins and Enzymes : cysteine peptidases (CpCP-1 ; CpCP-2 ; CpCP-3); Procerain ; Procerain B ;	(Ramos *et al.*, 2013)
	Lignans : (+)-Pinoresinol 4-O-[600 -Oprotocatechuoyl]-β-D-glucopyranoside ; (+)-Pinoresinol 4-O-[600 -O-vanillyl]-β-Dglucopyranoside ; (+)-Pinoresinol ; Eucommin A ; Pinoresinol-40 -O-[600 -O-(E)-feruloyl]-βD-glucopyranoside	(Abdel-Mageed *et al.*, 2016)
Root	Cardenolides : Calotoxin ; Proceragenin	(Kakkar *et al.*, 2012)
	Steroids : Cyclosadol ; Multiflorenol ; Procesterol ; Stigmasterol ; β-Sitosterol	
	Terpenes : Calotropenol ; Calotropenyl acetate ; β-Sitostenone	
	Terpenes : Dihydrophytoyl tetraglucoside ; Phytyl iso-octyl ether ; Procerasesterterpenoyl triglucoside	(Mittal & Ali, 2015)
Leaves	Flavonoids : 5-Hydroxy-3,7-dimethoxyflavone-40 -Oβ-Glucopyranoside ; Isorhamnetin ; Kaempferol ; Rutin	(Nenaah, 2013)
	Esters : Tridecyl ester	(Rani *et al.*, 2019)
	Volatiles : 1-Hexacosene ; Mannosamine ; Pentatriacontane ; R-Limonene ; Tridecane	
	Cardenolides : calotropagenin ; calactin ; Calotoxin	(Olea *et al.*, 2002)
	Steroids : Stigmasterol ; β-Sitosterol	
Flower	Lignans : 70 -Methoxy-30 -O-demethyl-tanegool-9- O-βD-glucopyranoside	(Al-Taweel *et al.*, 2017)
	Terpenes : calotropenyl acetate (urs-19(29)-en-3β-yl acetate)	(Khan *et al.*, 1988)
	Steroids : Procesterol	

7. Pharmacological Activities of *Calotropis procera*

The plant has garnered a lot of interest because of the biological processes listed below: There have been reports of *C. procera*'s anticancer, antifungal, and insecticidal properties in past pharmacological research. The plant's blooms have hepatoprotective, antiinflammatory, antipyretic, analgesic, antibacterial, and larvicidal properties. The plant's latex is said to have analgesic, wound-healing, anti-inflammatory, and antibacterial properties, while the roots are said to have antifertility and antiulcer properties (Table 4).

8. Toxicity of *Calotropis procera*

C. procera is poisonous. This plant is a member of the Asclepiadaceae family and shares many of the same chemical and physiological characteristics as other members of the family (Shanker, 2005). Roots, stems, and leaves are toxic components. More harmful among these are the roots and stems (latex). A particularly potent poison exists in the root of *C. procera*. Mudarine, a bitter yellow acid, resin, and the three poisonous glycosides calotropin, uscharin, and calotoxin are the main active components found in the leaves. In order to defend against insect or grasshopper attack, the latex includes the highly poisonous glycoside calactin, whose concentration is increased (Ajay & Ajay, 2011). Uscharin, calotoxin, caactin, caotropin, and caotropage are the toxic principles. Due to its irritating, neurotoxic, and anticholinergic effects, milk can be poisonous and present in a number of lethal ways. A extremely virulent toxin is present in serum that contains 3% gigantin (Shanker, 2005). Juice and latex produce an unpleasant, bitter taste and a burning discomfort in the mouth, throat, and stomach when consumed

internally in excessive concentrations. Then come dilated pupils, tetanic convulsion, collapse, and death.

Table 4. Pharmacological activities of *Calotropis procera*

Plant parts	Extracts	Activities	Organisms tested	References
Latex	dry latex	Analgesic effect	mice	(Kumar *et al*., 2000)
	latex protein fraction	Antinociceptive effect	mice	(Vasconcelos, 2005)
	dry latex	Antidiabetic activity	rats	(Kumar *et al*., 2005)
	dry latex	Antidiarrhoeal activity	rats	(Kumar et *al*., 2001)
	latex protein fraction	Antiinflammatory activity		(Kumar *et al*., 2011)
	cysteine peptidases	Antifungal activity	*Fusarium oxysporum*	(Cleverson *et al*., 2020)
Root	ethanolic extract	Antifertility activity	albino rats	(Ranab *et al*., 2002)
	methanolic, hexane and ethyl acetate extract	Antitumor activity	Hep2 cancer cells	(Mathura *et al*., 2009)
	chloroformic and aqueous extract	Anticonvulsant effects	rats	(Jalalpure, 2009)
	Water, methanol and ethanol extracts	Antimicrobial activity	*Streptococcus pyrogenes*, *Staphylococcus aureus*, *Salmonella typhi*, *Escherichia coli*, *Pseudomonas aeruginosa*	(Mainasara *et al*., 2012)
	ethanolic extract	Antifertility activity	albino rats	(Saxena & Saxena, 1979)
Leaves	water extracts (methanol extract, ethanol extract)	Antibacterial activity	*Streptococcus pyrogenes*, *Staphylococcus aureus*, *Salmonella typhi*, *Escherichia coli*, *Pseudomonas aeruginosa*	(Mainasara *et al*., 2012)
	methanolic extract	Antioxidant activity	/	(Murti *et al*., 2011)
	/	Antidiabetic activity	/	(Nadeem *et al.*, 2019)
	/	Antibacterial activity	*Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Escherichia coli*	(Mehmood *et al.*, 2020)
Flower	crude aqueous and crude methanolic extracts	Anthelmintic activity	Haemonchus contortus	(Iqbal *et al*., 2005)
	aqueous ethanolic	Hepatoprotective activity	rats	(Setty *et al*., 2007)
	ethanolic extracts	Antimalarial activity	*Plasmodium falciparum*	(Sharma & Sharma, 2000)
Seeds	chloroform and methanol extracts	Antimicrobial activity	/	(Bhaskar, 2000)
Bark	water extract	Antifungal activity	*Trichophyton* sp. *Epidermophyton* sp.	(Olatunde *et al*., 2013)
	chloroform extract and hydroalcoholic extract	Antiulcer activity	albino rats	(Nagesh & Gokul, 2011)

These are followed by salivation, stomatitis, vomiting, diarrhea, and vomiting. Delirium may occur occasionally. The lethal dose is unknown. The lethal time span ranges from 30 minutes to 8 hours (Modi, 2006). A few studies suggested that the plant induces acute cardiotoxicity and hepatotoxicity (De Lima *et al.*, 2011). In another study, intraperitoneal administration of latex proteins of the plant caused death after 1 h in response to a dose of 150 mg kg−1 (Bezerra *et al.*, 2017).

The toxicity-bioactivity relationship of *C. procera* hasn't been thoroughly studied yet, though. To confirm the therapeutic potential of *C. procera*, additional investigations are needed on these toxic features, which have not been well investigated.

9. Conclusions and prospective futures

This study suggested that *C. procera*. may be beneficial. *C. procera* is a well-known medicine in a number of, as well as traditional practitioners, for the treatment of a range of ailments, according to a thorough study of the available literature on the

plant. *C. procera* is widely used for both therapeutic and toxic purposes, depending on the dosage and form of application. If used correctly, even an acute toxin can develop into a great medication. On the other side, if a medication is not taken as directed, it can quickly turn poisonous. The plant Calotropis procera has a variety of chemical components that have a wide range of pharmacological effects. *C. procera* has received a lot of support for the development of innovative medications to treat a variety of human ailments. As this plant is expected to have more therapeutic characteristics than are now recognized, researchers are investigating its therapeutic potential.

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