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A review on Potential Medicinal Properties of plant Aak (*Calotropis procera*)

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ABSTRACT: Traditional herbal medicine has made a significant contribution to human health, particularly in the twenty-first century. One of the most successful strategies for the discovery of new drugs is the use of phytoconstituents derived from natural products. *Calotropis procera* belongs to the family *Asclepiadaceae*. It is commonly known as Madar and is well known for its medicinal properties. *C. procera* is an herb from which many drugs have been derived and that has been used for medicinal purposes since ancient times. Abu Hanifa (circa 270 A.H.) described Aak (*C. procera*) in his book of plants. Different parts of the plant have been reported to possess various phytochemicals containing cardiotonic agents such as Calotropagenin, Calotoxin, Calotropin and Voruscharine, Steroids, di and triterpenes like Stigmasterol, β-sitosterol, Flavonoids, Polyphenolic compounds, and Proteins. This shrub is known to possess a wide range of pharmacological activities such as anticancer, antimicrobial, anthelmintic, insecticidal, anti-inflammatory, analgesic, antiarthritic, antidiarrheal and larvicidal activities. This review is a thorough attempt to compile data on the phytochemical and pharmacological properties, biological activity, and toxicity of the *C. procera* shrubs.

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INTRODUCTION:

Aak (*Calotropis procera*) is an herb-derived drug (Fig 1) that has been used for medicinal purposes since ancient times. Although comparatively toxic, the drug has effectively been employed for the treatment of various ailments like arthritis, inflammatory conditions, leprosy and asthma etc. There are four species of genus *Calotropis*, but only *C. procera* and *C. gigantea* are well recognized for their medicinal properties [1,2].

Plant parts such as leaves, roots, barks, flower, fruits, stem, and latex have been reported to contain a variety of phytochemicals that may have pharmacological

activities. The coarse shrub possesses acaricidal, antimicrobial, anthelmintic, anti-inflammatory, antidiarrheal, anti-cancerous, antiarthritic and larvicidal activities with other beneficial properties. The plant is described as a golden gift to humanity becau se it contains cardiotonic agents such as Calotropin (Fig 2), Calotoxin, Calactin, Uscharidin, Coroglaucigenin,Cal otropagenin, and Voruscharine, which are used in therap eutic treatment.

This review is a thorough attempt to compile data on the phytochemical and pharmacological properties, biological activity, and toxicity of the *C. procera* shrubs [3].

Fig 1. *Calotropis procera* plant.

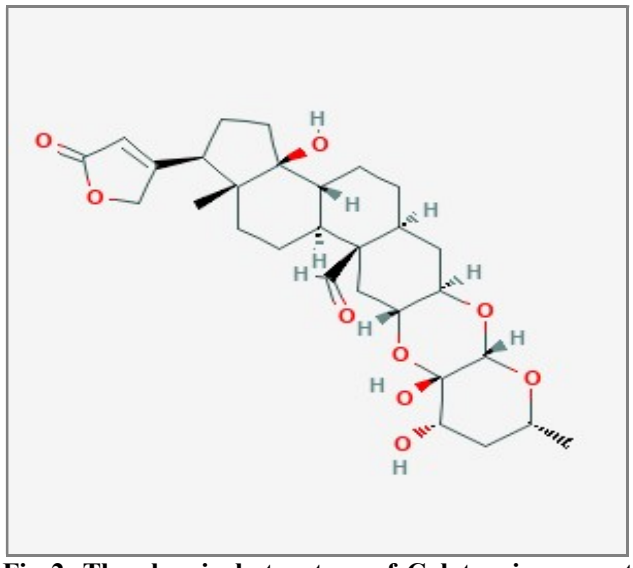

Fig 2. The chemical structure of Calotropin present in *Calotropis procera*.

Habitat:

C. procera favors open habitat with little competition. The plant of this species grows in dry habitat where rainfall is limited to 150 to 1000 mm and also found in the area of excessive drained soil as much as 2000 mm of annual precipitation. It can also be found in common habitats such as roadside, seaside dunes, and urban regions, where it is widely disturbed. *C. procera* is also found at the elevated areas up to 1000m. Because the plant is easy to propagate and manages and can grow under the xerophytic condition, sometimes it also grows as an ornamental plant in dry and coastal areas [4,5].

Geographical Distribution:

C. procera is native to Southern Asia and Indo-China, as well as Malaysia, Macau, West and East Africa, Madagascar, and the Arabian Peninsula. Naturalized populations of the plant can be found in Australia, Central America, North and South America, and the West Indies. The species is now accepted and culture in many countries like Central and South America, Australia, Mexico, Pacific islands and the Caribbean [4,6].

Scientific Classification:

Kingdom: Plantae
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Asteridae
Order: Gentianales
Family: *Asclepiadaceae*
Genus: *Calotropis*
Species: *procera*

Synonyms:

Asclepias procera Aiton, common vernacular names Arka (Sanskrit); Aaka, Giant Indian Milkweed (Hindi); Sodom Apple, Small Crown Flower (English); French Cotton, Remiga (Malaysia); Dok Hak (Laos); Kapal-kapal (Philippines), Pomme de Sodome (French), Rubik (Indonesia); Mudarpflanzer (German), Algodon Extranjero (Spanish) and Rak- central (Thailand) [4,7].

Botanical Description:

The plant is an evergreen, soft-wooded, perennial shrub; small tree attains a maximum height up to 2.5 m. A large amount of white sap generates whenever any part of the plant is cut. Corky, furrowed, and light grey bark. The root is simple, branched, and woody at the base, and it is covered in a fissured, corky bark. The branches have a

very deep, stout root with few branches. The leaves are opposite-decussate, simple, subsessile, and exstipulate; they are slightly leathery with a fine coat of soft hairs that occasionally sting. Flowers are shallow bell shaped, like a campanula, bisexual, actinomorphic, bracteate,multiflowered, umbellate, peduncled cymes with axillary or terminal inflorescence, actinomorphic, pentamerous, hypogynous, pedicellate, five sepals, lobed shortly united that are 4 to 5 mm long. Five-lobed petals (Corolla), gamopetalous, twisted aestivation. Androecium has five stamens, anther dithecous, gynandrous, coherent. Gynoecium bicarpellary, apocarpus, and styles are united at their apex, peltate stigma with five lateral stigmatic surfaces. Anthers are adnate to the stigma forming a gynostegium.Fruit is simple, inflated, fleshy and sub globose to obliquely ovoid follicle. Seeds are present in large amounts, flat, small, 3 cm or more long and compressed with silky white pappus at the one end [4,7,8].

Medicinal Properties:

The description of activity of *C. procera* parts with their activities is given in Table 1.

Table 1. Description of activity of *Calotropis procera* parts with their activities.

Part of plant	Activity	Ref.
Latex	Histaminic activity, Hyperalgesia effect, Interleukin-1beta inducer, Morphogenetic abnormalities, Anti-arthritis and monoarticular arthritis model, Asthma	17,21,33, 37, 40
Leaves	Anti-arthritis, Anti-implantation, Antitussive, Hypotensive and Anti-hyperbilirubinemic activities	20,34,39, 41
Aerial part	Reproductive potential, Effect on diverse muscles	35
Whole plant	*In-vitro* spasmolytic effect	36, 38
Root	Estrogenic functionality	20
Latex, leaves, bark	Wound healing, anti-keloidal activity, and surgical wounds	28

***Analgesic and Antinociceptive Activities*:**

In this study, analgesic activity of dry latex of *C. procera* has been evaluated. The effect of latex (DL) at a dose of 415 mg/kg against acetic acid-induced writhing was more pronounced as compared to an oral dose of aspirin (100 mg/kg). DL (830 mg/kg) produced marginal analgesia in the tail-flick model which was comparable to aspirin [21,22]. Antinociceptive effect of proteins from the *C. procera* latex using three different experimental models of nociception-acetic acid, formalin-induced abdominal constrictions, and hot plate test in mice was evaluated. The latex protein fraction at the doses of 12.5, 25, and 50 mg/kg showed the antinociceptive effect in a dose-dependent manner, which is independent of the opioid system [9,10].

Anti-inflammatory Activity:

The latex (DL) of the plant *C. procera* has been reported to exhibit potent anti-inflammatory activity against carrageenan and formalin that are known to release inflammatory mediators. The anti-inflammatory effect of aqueous and methanolic extracts of DL was more pronounced than phenylbutazone (PBZ) against carrageenan, whereas it was comparable to chlorpheniramine and PBZ against histamine and prostaglandin E2, respectively. Both extracts produced about 80, 40, and 30 % inhibition of inflammation induced by bradykinin, compound 48/80, and serotonin. The histological analysis revealed that the extracts were more potent than PBZ in inhibiting cellular infiltration and subcutaneous edema [11,12]. A single dose of the DL aqueous suspension was significantly effective against the acute inflammatory response. The crude DL of *C. procera* possesses a potent anti-inflammatory activity [13].

The effect of methanolic dried extract MeDL was compared to that of PBZ, a non-selective COX inhibitor, and rofecoxib, a selective COX-2 inhibitor. MeDL of *C. procera* markedly reduces cell influx, release of mediators, and oxidative stress associated with arthritic condition, and therefore, has the potential to be used for an antiarthritic agent. Chaudhary, *et al*. reported a protective effect of a high molecular weight protein sub fraction of latex in monoarthritis rats [14,15].

Antioxidant and Antidiabetic Activities:

The antioxidant activity of dried latex of *C. procera* and antidiabetic effect against alloxan-induced diabetes rats was evaluated. The oral dose of dried latex (DL) at 100 and 400 mg/kg was administered. The result revealed that there I decrease in blood glucose and increase in the hepatic glycogen content. Tsala, *et al*. evaluated the antioxidant activity of the ethanol extract of *C. procera* bark against surgical wounds [16-19].

Antiulcer Activity:

The antiulcer activity of *C. procera* using different *in vivo* ulcer models was performed. The results of the study revealed that it significantly inhibited aspirin, reserpine, absolute alcohol, and serotonin-induced gastric ulcerations in rats and also protecting the gastric mucosa from aspirin-induced ulceration in pyloric ligated rats, and significant protection was observed in histamine induced duodenal ulcers in Guinea pigs [20].

Antifertility Activity:

The effect of an ethanolic extract of the roots of *C. procera* was studied in albino rats and to explore its antifertility and hormonal activities. Strong anti-implantation (inhibition 100 %) and heterotrophic activity was observed at a dose of 250 mg/kg (1⁄4 of LD50). No antiestrogenic activity was detected [21].

Antidiarrheal Activity:

The DL of *C. procera* was evaluated for its antidiarrheal activity. Like atropine and PBZ, a single oral dose of DL (500 mg/kg) was produced a significant decrease in the frequency of defecation and the severity of diarrhoea as well as protecting from diarrhoea in 80 % rats treated with castor oil [22]

Estrogenic Functionality:

The effects of ethanolic and aqueous extracts of *C. procera* roots were studied on the estrous cycle and on some parameters of estrogenic functionality in rats. Both extracts were found to interrupt the normal estrous cycle in 60 and 80 % of rats treated [23,24].

Toxicological Study:

Calotropis procera (giant milkweed) has been reported to have numerous medicinal arid economic importances [25,26] but was observed to be potentially injurious to the body especially after prolonged or chronic use [27,28]. Calotropin which is found in latex causes slowing of heart beat and gastroenteritis if injected into the lymph sac of frogs [29]. It is supposed to cause death if it is given more than 0.12 mg/kg. Latex is skin and mucous membrane irritant and said to cause blindness. Approximately 4 to 5 ml of latex may lead to death. It may rupture the muscle of intestine and colon and death may occur. The plant may cause severe bullous dermatitis, slowed but stronger heartbeat, laboured respiration, increased blood pressure, convulsions and death [30,31]. Latex is highly toxic to human eyes presented with sudden painless dimness of vision with photophobia [32]. According to Dunean [33] the root bark is said to be similar to Ipecacuanha because of the presence of madaralban which shows emetic effects [34].

CONCLUSION:

The plant Calotropis is one of the most widely distributed along the world geographical area. The whole summation of information about the use of *C. procera* in the entire world is matched with available literature. It is well mentioned in the Indian materia medica; there is broad categorization according to its various uses in the pharmacological as well as in traditional use. The literature showed us that it is the plant that is forgotten as the time passes. Still many scientists have worked to reveal its phytochemicals and pharmacological activities. The plants are a rich source of phytoconstituents. Searching for new therapeutic agents is a big challenge for the scientists of the present modern era and plants are the biggest source of these agents. Screening of plants for their pharmacological properties with the hope of finding safe and effective agents is very essential. A large number of synthetic compounds are available but due to their environmental pollution and adverse effect on the human body their use is restricted. To find the safe, effective, and environmentally friendly agent from a plant source, *C. procera* is a plant that may present as an effective one. In conclusion, the literature on *C. procera* suggests a huge biological potential of this plant. It is believed that the present manuscript may be useful to provide additional information with regard to its identification and in accordance to carry out further research on its use in the treatment of various diseases.

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