REVIEW ARTICLE

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Calotropis procera: An Overview

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Abstract: India has a rich tradition of plant-based knowledge on healthcare. A large number of plants/plant extracts/decoctions or pastes are equally used by tribals and folklore traditions in India for treatment of cuts, wounds, and burns. Herbal medicines have been used from the earliest times to the present day. *Calotropis procera* Linn. is an ayurvedic plant which is used in several traditional medicines to treat a variety of diseases. In ancient ayurvedic medicine the plant *C. procera* was known as "Rakta arka". The pungent latex extracted from the leaves and flowers of *C. procera* is processed and used in the commercial preparation of eye tonics. In this review an attempt has been done to highlight the work on *C. procera* having pharmacological potential.

INTRODUCTION

The "science of life", ayurveda is known as world medicine more than 5,000 years old, holistic alternative medicine science of India with the most comprehensive and healing science in existence. The principle of ayurveda is naturally healthy living[1]. Arka (*Calotropis procera*) is an important herbal drug of ayurveda which is mention in vedic literature by the earliest Hindu writers, There are two common species of Calotropis, *viz. Calotropis gigantean* (Linn.) R. Br. and *Calotropis procera* (Ait.) R. Br belonging to asclepiadaceae family, described by the Sanskrit writers. [2] Both the species are used as substitutes for one another and are said to have similar effects. In Dhanvantari Nigantu three varieties of arka are mentioned *viz.* Rajarkah, Suklarkah and Sveta mandarah.

Plant Morphology

Calotropis procera Linn is often found as a weed throughout India in dry places, in Sub- Himalayan tracts, deccan to kanyakumari. It is an erect, tall, large, much branched with milky latex perennial shrubs grow to a height of 5.4 m, throughout. The bark of plant is soft and corky, branches are stout with fine cottony pubescence (especially on young) and leaves sub-sessile, broadly ovate-oblong, elliptic, acute, thick, green, covered with fine cottony pubescent hair. Flowers are in umbellate-cymes, calyx and corolla are glabrous, ovate and acute. Follicles Seeds are broadly ovate, acute, flattened, brown in color and silky coma is 3.2 cm long. [2] It is used for the treatment of several diseases namely leprosy, ulcers, piles and diseases of the spleen, liver and abdomen in the Sudanese, Unani, Arabic and Indian traditional medicinal system. [3] The latex is used as an abortifacient, [4] spasmogenic and carminative properties. [5] antidysentric, anti-syphilitic, anti-rheumatic, antifungal, diaphoretic and for the treatment of leprosy, bronchial asthma and skin affiction. [6, 7] Different parts of the plant have been reported to possess a number of biological activities such as proteolytic, [8] antimicrobial, [9] larvicidal, [10] nematocidal, [11] anticancer, [12, 13] anti-inflammatory. [14] Its flowers possess digestive and tonic properties and the powdered root bark relieves in diarrhea and dysentery. [15]

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Scientific Classification [16, 17]

1. Kingdom: *Plantae*
2. Subkingdom: *Tracheobionta*
3. Super division: *Spermatophyta*
4. Division: *Magnoliophyta*
5. Class: *Magnoliopsida*
6. Subclass: *Asteridae*
7. Order: *Gentianales*
8. Family: *Asclepiadaceae*
9. Genus: *Calotropis*
10. Species: *Calotropis procera*

Geographic Distribution

C. Procera is native to India, Pakistan, Nepal, Afghanistan, Algeria, Iran, Iraq, Israel, Kenya, Kuwait, Niger, Nigeria, Oman, Saudi Arabia, United Arab Emirates, Vietnam, Yemen and Zimbabwe. [18]

Chemical Constituents

Phytochemical screening on *Calotropis procera* reported various phytoconstituents, such as Cardenolide, triterpinoids, alkaloids, resins, anthocyanins and proteolytic enzymes, flavonoids, tannins, sterol, saponins, and cardiac glycosides. Flowers contain terpenes, multiflorenol, and cyclisadol gigantin, giganteol, isogiganteol, uscharidin, uzarigenin voruscharin and a-calotropeol, 3-epimoretenol. [19, 20] Leaves of plant contain amyrin, amyrin acetate, ß-sitosterol, urosolic acid, cardenolides, calotropin, calotropagenin while latex contains caoutchouc, calotropin, calotoxin 0.15%, calactin 0.15%, uscharin 0.45%, trypsin, voruscharin, uzarigenin, syriogenin and proceroside. [21] Root bark of plant contains triterpenes, Calotropterpenyl, and two unknown pentacyclic triterpinoids, namely calotropursenyl acetate and calotropfriedelenyl acetate, akundarol isovalerate, mundarol isovalerate and quercetin -3- rutinoside. [22, 23]

Properties and Action [24]

1. Rasa: Katu, Tikta
2. Guna: Laghu
3. Virya: Usna
4. Vipaka: Katu
5. Karma: Dipana

Pharmacologic Activity

Antimicrobial Activity

The ethanolic extract of *Calotropis procera* (Ait). R. Br. (Asclepiadaceae) flowers, young bud, mature leaves and

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stems shows good effectiveness in star larvae of *Anopheles stephansi* for antimicrobial (agar dilution method). [25]

Antibacterial Activity

The alcoholic extract of *calotropis procera* shows good antibacterial activity against E.coli with MLC 1:4 and S. aureus with MLC 1:8. The aqueous extract of *c. procera* shows antibacterial activity against E.coli with MLC 1:2 and S. aureus with MLC 1:2 dilutions. [26]

Antioxidant Activity

The antioxidant activity (scavenging of free radicals) by *C. procera* extract was evaluated by the *In-vitro* DDPH Scavenging assays spectrophotometrically at 517 nm against the absorbance of DPPH radicals. The free radical scavenging capacity of the methanolic extracts of *C. procera* was determined using DPPH. [27, 28, 29] The IC50 of the *Calotropis procera* studied by the above mention method was found below 100 µg/ml which indicates the potent antioxidant activity of the plant and the root extract of *Calotropis procera* used in antioxidant activity. [30]

Larvicidal Activity

The aqueous extract of *C. procera* leaves (1,000 ppm) shows 100% larvicidal activity against fourth instar larvae of *culex tritaeniorhynchus* and *cx. Gelidus*. Extract treatment (1,000 ppm) of both mosquitoes' eggs resulted in to 100% ovicidal activity. At 1,000 ppm, extract provided complete protection from mosquito bite for 240 min against both mosquitoes; however at lower doses the protection time was less. [31]

Antidiarrhoeal Activity

The latex collected from the aereal parts of *Calotropis procera* (Ait.) R. Br., Asclepiadaceae, produces a significant decrease in frequency of defecation, severity diarrhoea and afforded protection from diarrhoea in 80% rats treated with castor oil. The latex also produced a decrease in intestinal transit, and inhibited castor oil-induced enteropooling. [32]

Antiinflammatory Activity

The anti-inflammatory effect of *C. procera* was evaluated in the carrageenan induced paw oedema model where carrageenan was unable to incite the expected oedema of the paw in the rats administered with the extract. The mechanism of anti-inflammatory action is mediated more *via.* the central than the peripheral mechanism of anti-inflammation. [33] The methanolic extract of plant *Calotropis procera* (Asclepiadaceae), has been reported to exhibit potent anti-inflammatory activity against carrageenan induced paw oedema and cotton pellet induced granuloma in albino Wistar rats. The paw oedema was induced by the sub plantar injection of carrageenan aqueous solution (0.1 ml of 1% in saline) into the plantar side of the hind paw and the paw volume is measured plethysmographically immediately after injection, again 0.5 h, 1 h, 2 h, 3 h, 4 h and eventually 5 h after challenge. The latter model was characterized for granulomatous lesions were induced by surgically implanting two cotton pellets subcutaneously in the dorsal region of the rats, one near each axilla in rats. The different extracts of the roots of *C procera* and standard anti-inflammatory drugs were administered orally 1 hour before inducing of inflammation. The increase of paw volume after 3 or 5 h is calculated as Mean±SEM, compared with the volume measured immediately after injection of the irritant for each animal. Thus, in preview of this results indicates that methanolic extracts (180 mg/kg.p.o) of roots of *C. Procera* has potential to inhibit sub-acute inflammation by interruption of the arachidonic acid metabolism in both paw oedema as well as cotton pellet model and shows inhibition of inflammation (**p<0.01and ***p<0.001) very close to the inhibitory effect of diclofenac sodium (25 mg/kg i.p). [34]

Anticancer Activity

Treatment of dried Latex of c. procera on mice shows a complete protection against hepato carcinogenesis. No adverse effect was observed in these animals. The serum VEGF level was significantly lowered in the treated mice as compared to control animals. Cell culture studies revealed that the methanolic extract of dried latex as well as its fraction 8 induced extensive cell death in both Huh-7 and COS-1 cells while AML12 cells were spared. This was accompanied by extensive fragmentation of DNA in Huh-7 and COS-1 cells. No change in the levels of canonical markers of apoptosis such as Bcl2 and caspase 3 was observed. [35]

Wound Healing Activity

Wound healing effect of Calo-protein significant wound healing activity was recorded in the mice treated with Calo-protein after 14 days compared to control. There was a considerable reduction in wound area from the day 4 onwards in treated mice compared to mice receiving fusidic acid. The treatment with Calo-protein accelerated the rate of wound closure or repair much faster than the control mice. In the histopathological examination, there was notably less noticeable infiltration of inflammatory cells, greatly increased blood vessel formation, the wounds of animal treated with Calo-protein showed full-thickness of epidermal regeneration that covered-completely the wounded area. The epidermis was thick and disorganized especially compared with the adjacent normal skin and complete epithelialization, vascularization and hair follicles formation were observed in treated mice. This protein exerted a positive impact on wound healing by enhanced cellular proliferation, granular tissue formation and epithelialization, early dermal and epidermal regeneration. In addition, topical application of the Calo-protein of mice pronounced in more collagen content than the FA treated mice versus control mice. [36]

Antihyperglyceamic Activity

The extracts of *Calotropis procera* for its anti-hyperglycemic, effect in male wistar albino rats. The pet ether, methanol and aqueous extracts of leaves of *C. procera* at dose of 250 mg/kg, per oral were administered

as single dose per day to diabetes-induced rats for a period of 15 days. The effect of *C. procera* on blood glucose level was measured in the diabetic rats. Serum lipid profile (Total cholesterol, triglycerides, phospholipids, low density, very low density and high density lipoprotein) also were measured in the diabetic rats. The activities were also compared to that effect produced by a standard anti-diabetic agent, glibenclamide 500 µg/kg. The present investigation established pharmacological evidence to support the folklore claim that it is an anti-diabetic agent. [37]

Analgesic Activity

A single oral dose of dry latex ranging from 165 to 830 mg/kg produces a significant dose-dependent analgesic effect against acetic acid-induced writhing. In addition, dry latex (830 mg/kg) produces marginal analgesia in a tail-flick model which is similar to that of aspirin. The analgesic effect of dry latex is delayed 1 h by naloxone at a dose of 0.5 mg/kg, which completely blocks the analgesic effect of morphine (10 mg/kg). However, the effect of aspirin was not blocked by naloxone. An 830 mg/kg oral dose of dry latex did not produce any toxic effects in mice and the LD50 was found to be 3000 mg/kg. [38]

Antimalarial Activity

The ethanolic extracts of the different parts of *Calotropis procera* shows IC50 values ranging from 0.11 to 0.47 mg/ml against *P. falciparum* MRC20-CQ-sensitive and from 0.52 to 1.22 mg/ ml against MRC76-CQ-resistant strains, flower and bud extracts being the most active. Although 220-440 times less effective than CQ, these extracts deserve further study aimed at identification of the active constituents. The results obtained support the ethno botanical use of this plant. [39]

Anticonvulsant Effects

The anticonvulsant activity of different root extracts of *Calotropis procera* examined in rats to evaluate the anticonvulsant activity of different extracts of roots. In the MES test, the chloroform extract of *Calotropis procera* roots shows the most significant (P<0.01) anticonvulsant effect by decreasing the duration of hind limb extension (extensor phase), clonus and also the duration of the stupor phase, compared with the controls. In the PTZ test, the chloroform extract exhibits a highly significant (P<0.001) effect, and the aqueous extract had the most significant (P<0.01) effect compared with the controls by delaying the onset of convulsions. The extract also inhibits convulsions induced by lithium-pilocarpine and electrical kindling. [40]

Oestrogenic Functionality

The effects of ethanolic and aqueous extracts of *Calotropis procera* roots on the oestrous cycle and on some parameters of oestrogenic functionality in rats. Both extracts were found to interrupt the normal oestrous cycle in 60% and 80% of rats treated. The rats exhibited a prolonged dioestrous stage of the oestrous cycle with consequent temporary inhibition of ovulation. The contemporary administration of a commercial oestro-progestinic preparation exhibited the same effects in 100% of rats treated. However, the extracts had no oestrogenic activity when tested in immature female bilaterally ovariectomized rats. [41]

Hepatoprotective

An aqueous ethanolic extract (70%) of Calotropis procera flowers evaluated for its hepatoprotective effect against paracetamol-induced hepatitis in rats. Changes in the levels of biochemical markers of hepatic damage, like SGPT, SGOT, ALP, bilirubin, cholesterol, HDL and tissue GSH, were investigated in both treated and untreated groups. Paracetamol (2000 mg/kg) has been reported to enhance SGPT, SGOT, ALP, bilirubin and cholesterol levels and reduce serum levels of HDL and the tissue level of GSH while treatment with an aqueous ethanolic extract of *C. procera* flowers (200 mg/kg and 400 mg/kg) restored the altered levels of biochemical markers to almost normal levels in a dose-dependent manner. [42]

Anthelmintic Activity

The anthelmintic activity of *Calotropis procera* Linn. A flower, in comparison with levamisole, was evaluated in a series of *in-vitro* and *in-vivo* studies. For the *in-vivo* studies, *Calotropis procera* flowers were administered as a crude powder (CP), CAE and CME to sheep naturally infected with a mixed sample of gastrointestinal nematodes. It was found that *Calotropis procera* flowers possess good anthelmintic activity against nematodes, although this was less than that exhibited by levamisole (97.8%–100%). [43]

Antifertility Activity

The ethanolic extract of the roots of *Calotropis procera* evaluated in albino rats to explore its antifertility and hormonal activities. Strong anti-implantation (inhibition 100%) and uterotropic activity was observed at a dose of 250 mg⁄kg (1⁄4 of LD50). No antiestrogenic activity was detected. [44]

CONCLUSION

The World Health Organization has estimated more than 80% of the world's population in developing countries depends primarily on herbal medicines for their basic healthcare needs. *Calotropis procera* is one of the potential candidates for petro farming. The latex obtained from *Calotropis procera* may be hydro cracked to obtain hydrocarbons. There is need to more research work on *calotropis procera* to obtain petroleum products. In recent years, ethno-botanical and traditional uses of natural compounds, especially those of plant origin, have received much attention as they are well known for their efficacy and are generally believed to be safe for human use. It is best to use the classical approach in the search for new molecules to manage a variety of diseases. Researchers are exploring the therapeutic potential of this plant as it is likely to have more therapeutic properties than are currently known.

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