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REVIEW ON A MEDICINAL HERB *CALOTROPIS PROCERA* LINN.

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ABSTRACT

Herbal medicines have been practiced since the ancient times to the present day. The ethnobotanical pharmacology is as old as man himself. Herbal medicines exhibit a remarkable therapeutic diversity. Medicinal plants have remained the major sources of drugs; in fact, many of the currently available drugs were derived either directly or indirectly from them. The approach to new drugs through natural products has proved to be the single most successful strategy for the discovery of new drugs. In the past decade, research has been focussed on scientific evaluation of traditional drugs of plant origin for the treatment of various diseases. *Calotropis procera* is an Ayurvedic plant which is used in several traditional medicines to treat a variety of diseases. It is small, erect and compact shrub, which is used in several traditional medicines to cure various diseases. This shrub has been known to possess various pharmacological activities including antidiabetic, anti-inflammatory, hepatoprotective, anthelmintic, antidiarrhoeal, antimalarial, etc.

KEY WORDS: *Calotropis procera*; Phytochemistry; Traditional uses; Ayurvedic uses; Pharmacological activities.

INTRODUCTION

India has a wealth of medicinal plants, most of which have been traditionally used in Ayurveda, Unani systems of medicine and by tribal healers for generations. In ancient Indian literature, it is mentioned that every plant on this earth is useful for human beings, animals and other plants. Medicinal plants constitute the major constituents of most indigenous medicines and a large number of Western medical preparations contain one or more ingredients of plant origin. Medicines that are used today are definitely not the same as those

that were used in ancient times or even in the recent past. Several modifications, improvement, sophistication and newer discoveries contribute continuously to the type, quality, presentation and concept of medicinal preparation. The therapeutic use of development of human knowledge, scientists endeavored to isolate different chemical constituents of plants, put them to biological and pharmacological tests and thus have been used to prepare modern medicines.[1]

The use of medicinal plants as a source of relief from illness can be traced back over five millennia to written documents of the early civilization in China, India and the Near East, but it is doubtless an art as old as mankind.[2] Medicinal plants represent a rich source of antimicrobial agents. Plants are used medicinally in different countries and are a source of many potent and powerful drugs.[3] A wide range of medicinal plant parts are used to extract as raw drugs and they possess varied medicinal properties. The different parts used include root, stem, flower, fruit, twigs exudates and modified plant organs. While some of these raw drugs are collected in smaller quantities by the local communities and folk healers for local use, many other raw drugs are collected in larger quantities and traded in the market as the raw material for many herbal industries.[4]

For a long period of time, plants have been a valuable source of natural products for maintaining human health, especially in the last decade, with more intensive studies for natural therapies. Now a day, the use of phytochemicals for pharmaceutical purpose has gradually increased in many countries. According to World Health Organization (WHO) medicinal plants would be the best source to obtain a variety of drugs. About 80% of individuals from developed countries use traditional medicine, which have compounds derived from medicinal plants.[5] The herbal medicines occupy distinct position right from the primitive period to present day. The ethnobotanical pharmacology is as old as man himself. These medicines have less side effects and man can get the herbs easily from nature. India is a tropical country is blessed with vast natural resources and ancient knowledge of its judicious utilization. However, in order to make these remedies acceptable to modern medicine, there is a need to scientifically evaluate them, to identify the active principles and to understand the mechanism of action.[6]

Herbal remedies are gaining their revival as many sufferers shifting from modern drugs and embracing complementary medicine. Worldwide most clinical useful prescription drugs are of plant origin.[7] India is considered as the storehouse of medicinal

plants. Around 45 % of flowering plants are estimated to have medicinal importance. Also, India is the tenth among the plant rich countries of the world and fourth among the Asian countries. Having time tested traditional system of medicine based on the natural products is the privilege of India. India is the largest producer of medicinal herbs and is appropriately called the botanical garden of the world.[8]

Calotropis procera Linn. is a perennial, hardy, erect, evergreen shrub ranging from 0.5 to 3m in height with white or pink flowers tinged with purple in umbellate cymes (Figure 1). Medicinal uses of different parts of *C. procera* in the Indian system of medicine are well known and their chemical constituents in root, stem, bark, leaves, flower and latex have also been analyzed.[9, 10, 11] *C. procera* is a plant of wastelands, ruderals and even croplands in dry zones, especially deserts have been put to a wide variety of uses including medicinal by the desert dwellers in India, many of which are now documented.[12] The present review summarizes the information concerning the phytochemistry as well as various uses of *C. procera* Linn.

Figure 1: Photo of *Calotropis procera* Linn. Plant

Phytochemistry

C. procera plant contains the cardenolide, proceragenin, while the root bark contains benzoylinesolone and benzoylisolinelone. The leaves and stalk contain calotropin, and calotropagenin while the flower contains calotropenyl acetate, and multiflavenol and the latex

contains uzarigenin, and terpenol ester.[13] Chemical investigation of this plant has shown the presence of triterpenoids, calotropursenyl acetate and calopfriedelenyl, a norditerpenyl ester alotropternyl ester oleanene triterpenes like calotropoleanyl ester, procerleanol A and B[14] and cardiac glycosides calotropogenin, calotropin, uscharin, calotoxin and calactin. The plant also has been investigated for the presence of cardenolides and anthocyanins.[15]

Phytochemical investigation of the roots yields two new phytoconstituents,procerursenyl acetate and proceranol, together with the known compounds N-dotriacont-6-ene, glyceryl mono-oleolyl-2-phosphate, methyl myrisate, methyl behenate and glyceryl-1, 2-dicapriate-3-phosphate. The structures of the new compounds have been identified as urs-18 alpha-II-12, 20 (30)-diene-3 beta-yl acetate and n-triacontan-10 beta-ol on the basis of spectral data analysis and chemical reactions. The root bark has also been found to possess α-amyrin, β-amyrin, lupeol, β-sitosterol and flavanols like quercetin-3-rutinoside.[16]

In the leaves, mudarine is the principal active constituent as well as a bitter yellow acid, resin and 3 toxic glycosides calotropin, uscharin and calotoxin. The latex contains a powerful bacteriolytic enzyme, a very toxic glycoside calactin (the concentration of which is increased following insect or grasshopper attack as a defense mechanism), calotropin D I, calotropin D II, calotropin F I, calotropin F II and a non toxic protealytic enzyme calotropin (2-3%). This calotropin is more proteolytic than papain, and bromelain coagulates milk, digests meat, gelatin and casein. The whole plant contains a- and b- amyrin, b-amyrin, teraxasterol, gigantin, giganteol, isogiganteol, b-sitosterol and a wax.[13]

Traditional uses

C. procera plant has been widely used in the Ayurvedic, Unani, Arabic and Sudanese-Indian traditional system of medicine for the treatment of various ailments. It has been employed as a purgative, anthelmintic, digestive, stomachic, emetic, sedative, blood purifier, an antidote for snake bite poisoning and for the treatment of ulcers, tumors, leprosy, asthma, boils, dysentery, eczema, piles and diseases of the liver, abdomen and spleen.[17]

Ethnobotanical uses

Nearly all the parts of *C. procera* have been documented to possess medicinal values in ethnobotanical surveys conducted by researchers in India. The Kol tribes of Banda district, Uttar Pradesh are using leaves to cure the cold, cough and latex for toothache and scorpion bite.[18] The tribals of Sagar district of Madhya Pradesh using latex for the treatment of

dropsy, rheumatism, leprosy and taeniasis while roots for elephantiasis. Taxo-ethnobotanical studies of rural areas in Rajouri district of Jammu have reported that the native villagers are using latex for application on wounds and as a masticatory. In other surveys, latex has been described to possess abortifaciets, antiseptic and laxative properties. The roots of the plant reported to be beneficial in cough, asthma, fever and swellings; while flowers for the treatment of cholera and stomach disorders.[19]

Ayurvedic uses

The plant is attributed medicinal in a number of classical texts of Ayurveda like Ashtang Hridays, Bhavprakash Nigantu, Dhanvantri Nigantu, Raj Nigantu, Shaligram Nigantu, Sushruta Samhita, etc. It is reported to have tikta rasa, laghu guna, ushna virya and katu vipaka. It is mentioned as a bitter tonic, laxative, anthelmintic, expectorant and to cure ulcers. The leaves are applied hot to the abdomen to relieve the pain inside. The flowers are described as tonic, appetizer, stomachic, antisialagogue, to cure piles and asthma. The roots of the plant are reputed to be useful and utilized in preparation of Dhanvantri Ghrita, Chitrakadi taila, PrabhanjanaVimardana taila, Mahanarayantaila, Saindhavadi taila, Arka lavana, Abhaya lavana, Vajraka kshara, Ekangveera rasa, Bhrihat Kasturibhairva rasa, Vatavidhavamsana rasa, etc. All these are classical Ayurvedic preparations.[19]

Non- therapeutic utilities

Latex obtained from the plant is employed to a limited extent in the tanning industry for the purpose of deodorizing, removing hairs and imparting a yellow color to the hides. The stem of the plant yields fibers, which are used in rural parts of India for making fishing nets and lines, bowstrings and twine. The floss, being short stapled, by admixing with cotton used for stuffing mattresses and pillows.[19]

Pharmacological activities

Antidiabetic activity

Dry latex of *C. procera* was evaluated for its antioxidant and anti-hyperglycemic effects against alloxan-induced diabetes in rats. Daily oral administration of dry latex decreases the level of blood glucose and increase in the hepatic glycogen content. Dry latex also prevented the loss of body weight in diabetic rats and brought down the daily water consumption to values comparable to normal rats. Dry latex also produced an increase in the hepatic levels of the endogenous antioxidants, namely superoxide dismutase (SOD), catalase and glutathione, while it brought down the levels of the thiobarbituric acid-reactive substances (TBARS) in

alloxan- induced diabetic rats. The efficacy of dry latex as an antioxidant and as an antidiabetic agent was found comparable to the standard antidiabetic drug, glibenclamide.[20] In one study the various parts of the plant, viz. roots, aerial parts and latex have been evaluated for analgesic activity. The ethanol extract of aerial parts, chloroform extracts of roots and the aqueous solution of dried latex were tested in acetic acid induced writhing model and exhibited significant analgesic activity. The ethanolic extract of the flowers of the plant found to possess a weak analgesic activity.[21]

Anti-inflammatory activity

Crude dry latex of *C. procera* possesses a potent anti-inflammatory activity. The anti-inflammatory activity of petroleum ether, acetone, methanol and aqueous extracts of dry latex of *C. procera* was tested in the carrageenan induced rat paw oedema model. All the fractions exhibited rat paw oedema model. All the fractions exhibited anti-inflammatory activity but inhibition of oedema was found to be greater with the acetone and aqueous extracts.[22] The anti-inflammatory property of the latex of *C. procera* was studied on carrageenin and formalin-induced rat paw oedema model. A single dose of the aqueous suspension of the dried latex was effective to a significant level against the acute inflammatory response.[23] A chloroform-soluble fraction from *C . procera* root showed significant dose-related anti-inflammatory activity in rats using the pharmacologic models of carrageenan-induced pedal oedema, cotton pellet granuloma and formaldehyde-induced arthritis.[24, 25]

Hepatoprotective activity

C. procera latex was evaluated for its hepatoprotective effect against carbontetrachloride (CCL4) induced hepatotoxicity in rats. Subcutaneous injection of CCL4 administered twice a week, produced a marked elevation in the serum level of aspartate transaminase (AST), factor alpha (TNF-α). Histological analysis of the liver of these rats revealed marked necro-inflammatory changes that were associated with an increase in the levels of TBARS, PGE2 and catalase and decrease in the levels of glutathione (GSH), superoxide dismutase (SOD) and glutathione peroxidase (GPχ). Daily oral administration of aqueous suspension of dried latex of *C. procera* reduced the serum levels of liver enzymes and inflammatory mediators and attenuated the necro-inflammatory changes in the liver.[26] Hydro-ethanolic extract (70%) of *C. procera* flower was tested for its hepatoprotective effect against paracetamol- induced hepatitis in rats. In one study, evaluated hepatoprotective activity of chloroform extract of

roots of *C. procera* against CCL4 induced liver injury and found to possess significant protective activity.[27]

Anthelmintic activity

The latex of *C. procera* has been shown to possess anthelmintic activity against *Haemonchus contortus* infection in Najdi sheep. Inappetence, dullness, erosive abomasitis, decreased haemoglobin concentration and increased eosinophils were the main features of haemonchosis in the sheep. Sheep treated with latex significantly decreased the egg production and fewer adult *Haemonchus* worms were found in the abomasums. Although the appetite improved, the hemoglobin concentration and serum copper, iron, and zinc levels were still reduced after therapy with *Calotropis* latex. Both fresh and aqueous extracts of dried latex were evaluated for their anthelmintic potential using adult earthworms as test worm. Both fresh and aqueous extract exhibited a dose-dependent inhibition of spontaneous motility and evoked responses to pin-prick. With higher doses of fresh latex, the effects were comparable with that of 3% piperazine. The study suggested that it might be effective against parasitic infections in both animals and humans caused by *Ostertagia*, *Nematodirus*, *Dictyocaulis*, *Taenia*, *Ascaris* and *Fasciola*. The anthelmintic activity in comparison with levamisole through *in vitro* and *in vivo* studies and found activity against nematodes.[28]

Antidiarrhoeal activity

Dry latex of *C. procera* has been evaluated for antidiarrhoeal activity. Like atropine and phenylbutazone, single oral dose of dry latex produced a significant decrease in frequency of defecation, severity of diarrhoea and afforded protection from diarrhoea in 80% rates treated with Castor oil. Dry latex produced a decrease in intestinal transit as compared to both normal and Castor oils 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.[29]

Antimalarial activity

Screening of ethanolic extracts of *C. procera* leaves, stems, roots, flowers and flower buds, for their *in vitro* antimalarial activity against chloroquine sensitive and chloroquine resistant *Plasmodium falciparum* strains. In further investigation *in vitro* haemolysis of human erythrocytes have been studied with above extracts. The putative anti-plasmodium activity of the extracts was correlated to their cytotoxicity as represented by the *in vitro* rate of haemolysis.[30]

Spasmolytic activity

The aqueous extract of *C. procera* was evaluated for its spasmolytic effect using *in vitro* trachea smooth muscle chain of guinea pigs. The extract showed a dose dependent relaxant activity probably exhibited through the direct relaxant action on the smooth muscles.[31]

Antiasthmatic activity

Flowers of *C. procera* have been evaluated for its usefulness in the treatment of asthma. A clinical study on human beings showed the good recovery from the symptoms of asthma.[19]

Wound healing activity

The latex of *C. procera* significantly augmented the wound healing process by markedly increasing collagen, DNA, protein synthesis and epithelisation leading to reduction in wound area.[32]

Antipyretic activity

The ethanolic extract of the aerial parts, aqueous extract of flowers and aqueous solution of the dry latex of *C. procera* showed significant antipyretic activity in animal models that was comparable to aspirin.[10]

Adverse effects

Although *C. procera* is associated with a variety of medicinal virtues, but has been observed to be potentially injurious after prolonged or chronic use. In one study, the effect of flower extract of plant on testicular function of the Indian desert male gerbil meriones hurrianae. The extract was given orally for 30 days and caused widespread testicular necrosis.[33] Consumption of *C. procera* is reported to cause blisters, lesions and eruptions when taken by patients for the treatment of joint pains and gastrointestinal problems. The preparations of *C. procera* need to be used under the careful surveillance of a trained medical practitioner.[13]

CONCLUSION

In the present scenario, traditional knowledge system in our country is fast eroding and there is an urgent needs to inventoried, record all ethno-botanical and cultural information among the diverse ethnic communities before the traditional cultures is completely lost. Therefore, documentation of information on ethnomedicinal uses will help in conserving the knowledge. Many traditional plant based remedies are back in use and find increasing application as a source of direct therapeutic agents, as raw materials based for the elaboration of more

complex semi synthetic compounds, as models for new synthetic compounds and as taxonomic markers for the discovery of new compounds. *C. procera* has been used as traditional folk medicine by many cultures, and it has been the subject of extensive phytochemical and bioactive investigations. The ethno-medico-botanical study of this plant has revealed the enormous diversity of its medicinal uses in several traditional and Ayurvedic uses to cure various diseases. It had shown significant pharmacological importance, representing as a strong contender in the medical arena.

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