REVIEW ARTICLE

A review on *Cyperus rotundus* as a tremendous source of pharmacologically active herbal medicine

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Abstract

In this review, the potential pharmacological activities of *Cyperus rotundus* Linn. are evaluated along the foundation of literature survey. Being a world worst weed, the positive side of this plant having huge beneficial effects and here the beneficial side of this plant is highlighted which are used to treat different physiological conditions like stomach and bowel disorders, inflammatory diseases, and as traditional folk medicines. The extracts of different parts of the plant (aerial part, tuber, rhizomes, etc.) contain huge medicinal active compounds along with the chemical structures of the phytochemical constituents are included in this review.

Key words: *Cyperus rotundus* Linn, different species, morphology, pharmacological activities, phytochemical aspects

INTRODUCTION

The handling of diseases with pure pharmaceutical agents is a relative phenomenon.[1] Drugs which are gained from natural products are usually secondary metabolites and their derivatives.[2,3] *Cyperus rotundus* is one of them which grows naturally in tropical, subtropical and temperate regions is widespread in the northeast considered as one of the world worst weed has been used in medicine for thousands of years. A number of these organisms have been proposed as potential agents for nutsedge control, such as *Aleurocybothus* sp., *Antonia australis*, *Athesapeuta cyperim*, *Bactra minima*, *Bactra verutana*, *Bactra truculenta*, *Bactra venosana*, *Chorizococcus rostellum*, *Dercadothrips caespitis*, *Phenacoccus solani*, *Rhizoecusi cacticans*, *Shoenabius* sp., *Sphenophorus phoenicicensi,* and *Puccinia canaliculata.*[4] *C. rotundus* L., is an herbaceous perennial plant vernacularly called Nagarmotha (Bengali: Nagarmotha, Burma: Vomonniu; Hindi: Nagarmotha; Gujarat: Nagaramothaya; English: Nut grass; Sanskrit: Chakranksha, Charukesara) is considered one of the most persistent species in the world[5] and is the main weed species in cultivated soils in tropical areas.[6,7]

The word *Cyperus* derived from Greek "*kuperos*" and *rotundus* from Latin meaning "round." The family *Cyperaceae* includes approximately 3000 species of which about 220 species are identified as weeds and of which 42% of these are in the genus *Cyperus*.[8,9]

The parts of the *Cyperus* used are its tuber, leaves, seeds, rhizomes and oil. The whole plant extract is used as anti-nociceptive[10] and as a tonic for the liver and heart, a digestion stimulant, and aid against hypertension. The tuber portion is used as antimalarial.[11] The leaves were found to potentiate the sleeping time induced by standard hypnotics,[12] as food flavor, especially in the Middle East and South East Asia. The rhizomes are used as a cooling, intellect promoting, nervine tonic, diuretic, antiperiodic, analgesic, anti-inflammatory, antipyretic and to treat diarrhea, dysentery, leprosy, bronchitis, amenorrhea, and blood disorders.[13] The tuber part having anti-obesity properties,[14] as an infusion or as soup in fever, diarrhea, dysentery, vomiting, and cholera. In India, the fruits were considered as carminative, diuretic,

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tonic, stomachic, antibilious, and refrigerant. The oil is fungicidal and bactericidal.

DIFFERENT SPECIES

In general, two types of *Cyperus* are discussed here, which are known as purple nutsedge (Figure 1) and yellow nutsedge (Figure 2). Both purple nutsedge (*C. rotundus* L.) and yellow nutsedge (*Cyperus esculentus* L.) are problem weeds in many parts of the world. Usually, yellow nutsedge is found in low, moist areas while purple nutsedge is found on well-drained soils.[15] In mixed stands, purple nutsedge is distinguished by it's red, reddish-brown, or purplish-brown loosely arranged inflorescence, dark green leaves which grow low to the ground with boat-shaped leaf tips, and scaly rhizomes which when mature become wiry and hard to break, and produce tubers and bulbs in chains.[16] Yellow nutsedge has a yellowish-brown or straw-colored inflorescence which is arranged along an elongated axis in the shape of a bottle brush. It has pale green leaves which grow upright with long needle-shaped leaf tips and weak, easy-to-break rhizomes which often end in bulbs or single tubers but rarely form chains of tubers.[15]

MORPHOLOGY

Cyperus species are a monocotyledonous, perennial plant which belongs to Cyperaceae family.[17] Kingdom: Plantae, subkingdom: Tracheobionta, super division: Spermatophyta, division: Magnoliophyta, class: Liliopsida, subclass: Commelinidae, order: Poales (Cyperales), genus: *Cyperus*, species: *Rotundus*.[18]

Plant Morphology

It contain long rhizomes in ellipsoid form; sometimes tuberous; black colored, with characteristic aromatic odor and taste, up to 60 cm high; leaves are 2-6 mm wide; spikes ovate, on rays to 6 cm long; spikelets linear 1-2 cm long, 12-30 flowered, the rachilla winged; scales are purplish, carinate, obtuse; achene sub-obovoid, trigonal, 1.5 mm long, black, minutely papillate.[17]

Morphology and Macroscopy of the Rhizomes

The length of the rhizome is 1.5-3 cm and diameter is 0.8-1.6 cm. Its stolons are elongated and about 1.5-3.5 cm long. Externally, the rhizome is dark brown or black in color and internally creamish yellow. The rhizomes are bluntly conical with a number of wiry and tough slender roots, often attached to one another by a thin and tough connective (Figure 3). Each rhizome is tumicate varies in size and thickness, crowned with the remains of the stem and leaves forming a hairy to scaly covering (Table 1).[19]

Macroscopic examination of powder shows the presence of the pitted vessels and fiber.

PHYTOCHEMICAL ASPECTS

Phytochemical studies have shown that the major chemical components of this herb are essential oils, flavonoids, terpenoids, mono-and sesquiterpenes.[21,22] The plant contains the following chemical constituents – Cyproterone, cypera-2, 4-diene, a-copaene, cyperene, aselinene, rotundene, valencene, ylanga-2, 4-diene, g-gurjunene, trans-calamenene, d-cadinene, g-calacorene, epi-a-selinene, a-muurolene, g-muurolene, cadalene, nootkatene by comparison with a spectral library established under identical experimental conditions,[23] cyperotundone,[24] mustakone, cyperol,[25] isocyperol,[26] and a-cyperone.[27,28] The volatile oil constituents of *C. rotundus* were distinguished quantitatively with high amounts of sesquiterpenes (70%), with a low proportion of oxygenated monoterpenes (10%) and monoterpene compounds (5%).[29] The chemical composition of the volatile oils of *C. rotundus* has been extensively evaluated, and four chemo types (H-, K-, M- sO-types) of the essential oils from various parts of Asia have been reported.[30] H. M. Sayed *et al*. reported the presence of another two more compounds isolated after a phytochemical investigation of the aerial parts of *C. rotundus* Linn. They are sitosteryl (6'-hentriacontanoyl)-β-D-galactopyranoside and three furochromones. It also found to contains proteins[31] and traces of Mg, Vs, Cr, Mn, and Co (Figure 4).[32]

PHARMACOLOGICAL ACTIVITIES

Anti-inflammatory Activity

To evaluate the anti-inflammatory activity in adult albino wistar rats' *C. rotundus* extract of the tuber part was used. The test group was treated with ether, ethanol, and distilled water extract of three equal portions of the powder. On the basis of the literature survey, it was found that the extract showed significant anti-inflammatory activity against carragenan induces rat paw edema by the application of tuber extract of *C. rotundus*. The percentage inhibition of edema was calculated by the formula:

$$(Vc-Vt/Vc) \times 100$$

Where, Vc - Volume of paw edema in the control group and Vt - Volume of paw edema in the treated group. The ethanolic extract showed good anti-inflammatory effect than other solvents system.[33]

Anticonvulsant Action

In this study, the anticonvulsant activity of ethanolic extract of *C. rotundus* (EECR) roots and rhizomes was evaluated

against convulsions induced by chemo convulsive agents (pentylenetetrazole) in mice. The anticonvulsive conclusion was made by estimating the biogenic amines level in the whole brain. The action of EECR was found to be dose dependent. The level of catecholamine in mouse brain was increased. The levels of GABA, glutamine, and glutamate were also elevated. In this way, EECR shows anticonvulsant activity.[34]

Antioxidant Activity

The evaluation of antioxidant property of EECR was carried out by *in vitro* non-enzymatic glycosylation of hemoglobin method. Since non-enzymatic glycosylation of hemoglobin is an oxidation reaction, an antioxidant is expected to inhibit the reaction based on this principle in this article showed that the presence of flavonoids, ascorbic acid, and polyphenols within the ethanolic extract of the plant might be responsible for this activity.[35]

Anti-dirroheal Activity

The aqueous extract of *C. rotundus* tubers shows anti-giardial activity against infectious diarrhea. To establish the anti-diarrohea study adherence of enteropathogenic *Escherichia coli* and invasion of enteroinvasive *E. coli* and *Shigella flexneri* to HEP-2 cells was evaluated as a measure of effect on colonization. Effect on enterotoxins such as enterotoxigenic *E. coli*, heat labile toxin (HLT), heat stable toxin (HST), and cholera toxin (CT) was also assessed. It was found that the decoction reduces bacterial adherence to and invasion of HEP-2 cells. The production of HLT increased and binding with ganglioside mono sialic acid receptor (GM1) was decreased. The CT production was decreased and no effect on binding to GM1, as well as there was no effect on ST.[36]

Antiulcer Activity

The antiulcer activity of *C. rotundus* tuber powder extract was studied in two different animal models. The first one was histamine-induced ulcer in guinea pigs, and another one was aspirin-induced gastric mucosal damage in rats. In the both cases, the plant extract showed maximum reduction of ulcer which was comparable to ranitidine.[37]

Cardio Protective and Anti-hyperlipedimic

Methanolic extract of the rhizomes of *C. rotundus* exerts cardioprotective, as well as hypolipidemic action. To perform this study isoproterenol was used to induce myocardial infraction in rabbits. In this experiment the level of serum cardiac marker enzymes (creatine kinase-MB, lactate dehydrogenase, aspratate transaminase and alanine transaminase), serum lipids (cholesterol, triglycerides, low-density lipoprotein, high-density lipoprotein) and antioxidant enzymes in heart tissues (superoxide dismutase, catalase, and peroxidase) was evaluated. After administration of *C. rotundus* extract showed significant reduction in isoproterenol induced elevated level of lipids and cardiac enzymes. The reduced level of antioxidant was also restored to normalization.[38]

Figure 1: Purple nutseg (*Cyperus rotundus*) and flower spikes

Figure 2: Yellow nutseg (*Cyperus esculentus*)

Figure 3: Rhizome of *Cyperus rotundus* Linn

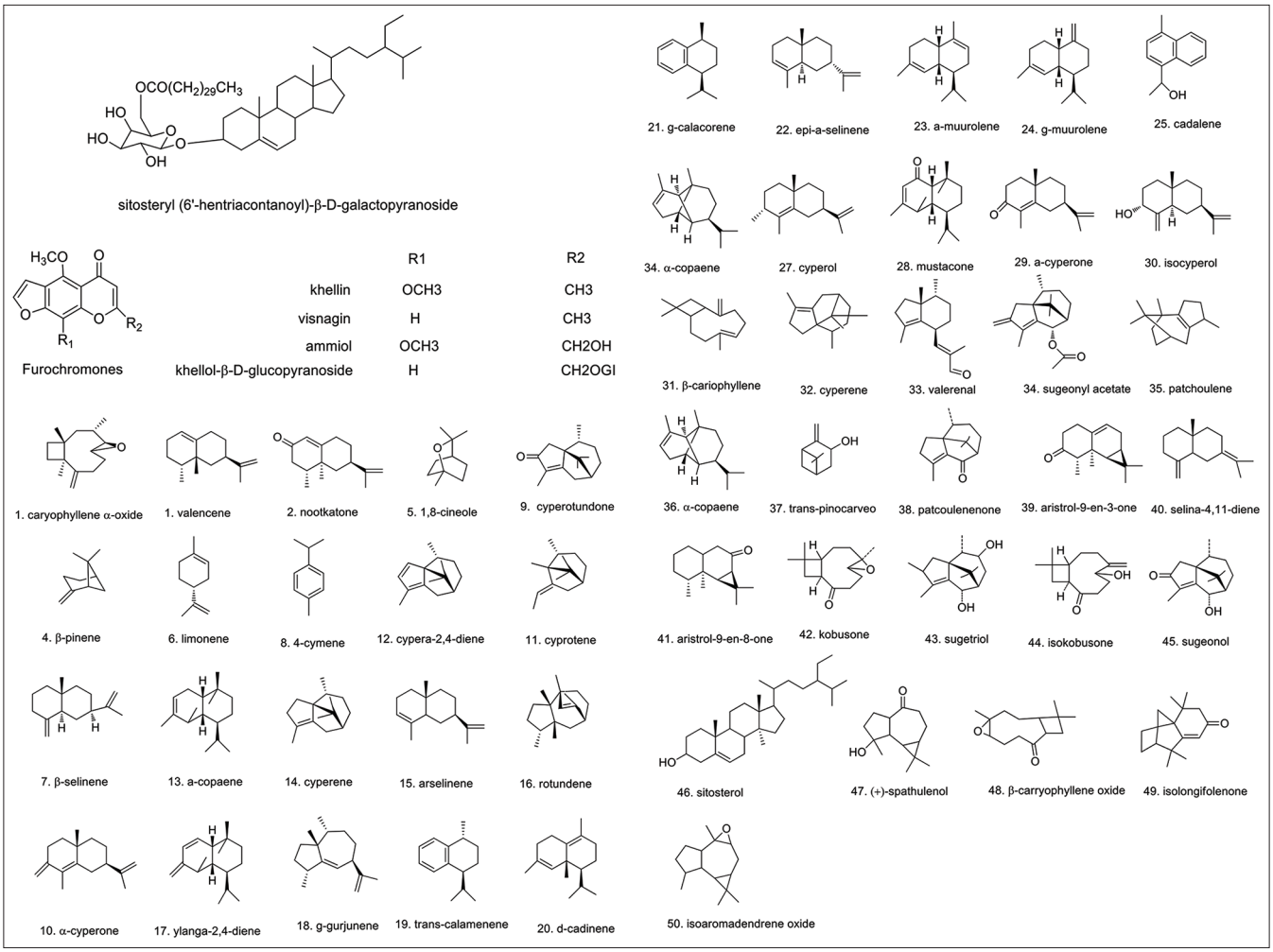

Figure 4: Chemical structure of some important constituents of *Cyperus rotundus*

Table 1: Organoleptic characters of rhizomes of *C. rotundus*[20]

Organoleptic characters	Rhizomes of *C. rotundus*
Type	Simple
Color	Dark brown or black externally and internally creamish-yellow
Odor	Pleasant
Taste	Slightly pungent, bitter and astringent
Shape	Elongated, broadly obovoid, trigonous
Surface	Slightly tuberous at the base

C. rotundus: Cyperus rotundus

Antidiabetic Activity

The antidiabetic activities of hydro alcoholic extract of *C. rotundus* rhizomes were performed on Sprague-Dawley rats. In this study, alloxan monohydrate was administered intraperitonially to induce diabetes which shows significant rise in the blood glucose level. On the 15th day, after administration of the plant extract the blood glucose level reduced as compared to the metformin. This observation suggests that the aqueous ethanolic extract of *C. rotundus* rhizomes have significant hypoglycemic activity.[39]

Anti-allergic Activity

Sesquiterpenes isolated from the ethanolic extract of the rhizomes of *C. rotundus* (CRE) were found to possess anti-allergic activity, these sesquiterpenes are valencene, nootkatone, carryopyllene α-oxide, β-pinene, limonene, 4-cymene, and 1, 8-cineole. To evaluate this study protocol three things were studied those are – Measurement of 5-lipoxygenase (5-LOX) catalyzed production of leukotrienes (LTs), action on antigen-induced degranulation of β-hexosaminidase through the initial activation of Lyn phophorylation in immunoglobulin E stimulated RBL-2H3 cells and effect on picryl chloride-induced delayed type hypersensitivity reaction. It was observed that sesquiterpenes inhibited the 5-LOX catalyzed production of LTs. They also inhibited β-hexosaminidase release, as well as its degranulation. The delayed type hypersensitivity reaction was also delayed by valencene and nootkatone present in the CRE.[40]

Hepatoprotective Action

C. rotundus has many different uses, and these were based on the different parts of plant extracted by different solvents. To study the hepatoprotective activity ethyl acetate extract of rhizomes were used against carbon tetrachloride induced hepatotoxicity in rats. For evaluation of this study, the values of different biochemical parameters were taken into consideration. Furthermore, this study was supported by histopathological studies. Plant extract in the dose of 100 mg/kg was found to be the safest dose in this study which causes significant reduction in all the four biological parameters but no significant changes in histological profile.[41]

Ovicidal and Larvicidal Effect

The ovicidal and larvicidal effects of essential oil of *C. rotundus* extracted by hydrodistillation on eggs, and fourth instar larvae of *Aedes albopietus* were identified. It was found that the essential oil possesses ovicidal and larvicidal property when exposed to serial concentrations ranging from 5 to 150 pmm, and this essential oil had also been attributed to its insecticidal activity on moths and beetles. However, it is until now mystery to confirm the actual compound(s) responsible for such activities. Hence, repeated bioassay coupled with analytical fractionation of the oil is to be carried out.[42]

Wound Healing Activity

This study evaluates the wound healing property of EECR tubers on the basis of traditional use and literature references. In this study three types of wound models: the excision, the incision, and dead space wound models which were treated with an ointment containing the alcoholic plant extract. Wound healing potential was monitored by wound contraction, wound closure time, the wound area and tensile strength respectively. The present investigation revealed that the test extract in varying concentrations in the ointment base was capable of producing a significantly different response in wound healing activity on both wound models as compared to the standard nitrofurazone and increase in tensile strength as compared to the control group may be due to increase in collagen concentration. The results obtained suggest that the alcoholic extract of these *Cyperus* species can serve as a potential source as natural wound healing agent which may be due to the presence of its active principles.[43]

CONCLUSION

In this review, different activities of *C. rotundus* L. were re-evaluated for their respective pharmacological activities with current research articles. Because it is traditionally used from past decades to treat various common disorders. Human clinical trials may be performed on the existing pharmacological activities of this plant to establish this plant as medicinally active plant. Chemical constituents obtained from different parts and their medicinal uses have been established, but many bioactive constituents and pure compounds have so far been neglected by phytochemists and pharmacologists and a large amount of work has been done only on extracts and not on the isolated fractions. With this point of view, the present review article aims at focusing the attention of research scholars in the unexplored and untouched areas related to *C. rotundus* Linn.

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