Review article

Bridging tradition and evidence: the pharmacological potential of *Cyperus rotundus* L.

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Receipt: 29.12.2025 *Revised: 17.02.2026* *Acceptance: 19.02.2026*
DOI: https://doi.org/10.53552/ijmfmap.12.1.2026.6-10

ABSTRACT

Cyperus rotundus L. *is a perennial medicinal plant used in traditional folk medicine to treat inflammatory diseases, gastrointestinal disorders, gastric ulcers, and other associated diseases. Various studies have shown that the rhizomes of the plant contain biologically active compounds such as ascorbic acid, beta sitosterol, flavonoids, terpenes, and essential oils, which are responsible for the therapeutic effects of the plant. A detailed review of the literature on the ethnobotanical uses, phytochemical constituents, and pharmacological activities of Cyperus rotundus L was done by searching scientific literature and collecting data on the anti-inflammatory, antioxidant, antimicrobial, and gastroprotective activities of this plant using in vitro and in vivo approaches. The gathered literature on the ethnobotanical uses, phytochemical constituents, and pharmacological activities of Cyperus rotundus L indicates the medicinal importance of this plant in the Ayurvedic system and reiterates its traditional uses.*

Keywords: Ayurveda, pathological of *Cyperus rotundus L*, Pharmacological action, phytochemistry constituents.

INTRODUCTION

Cyperus rotundus L., commonly known as purple nutsedge, nutgrass, or Nagarmotha, is a perennial, grass-like herbaceous plant in the the family Cyperaceae is extensively found in tropical and subtropical areas. It propagates via rhizomes and tubers they have been used for a very long time in traditional medical systems like Ayurveda and Traditional Chinese Medicine, and Unani. This herb is recognized for its multifaceted therapeutic properties and ethnomedicinal applications, especially for gastrointestinal, gynecological, inflammatory, and neurological disorders and cosmetic values (Shravani *et al*., 2022)

Pharmacological properties

Anti-malarial activity

The activity-guided phytochemical analysis of the tubers of *Cyperus rotundus* L isolated some sesquiterpenes with strong antimalarial activities against *Plasmodium falciparum*. The compounds exhibited antimalarial activity with EC50 values of 10^{-4} to 10^{-6} M. Additionally, extracts from *Cyperus rotundus L*, including its volatile oil and alkane series extracts, have demonstrated anti-protozoal effects against P. falciparum, further supporting the protective role of these sesquiterpenes in malaria. This evidence confirms that *Cyperus rotundus L* possesses significant in vitro antimalarial activity primarily due to these specific sesquiterpene constituents (Aurange *et al*., 2024).

Anti-diabetic activity

Compounds that prevent diabetes-related cataract genesis, vision impairment, or clouding of the lens of the eye caused by glucose. By preserving electrolyte balance and osmotic pressure, the hydro-alcoholic extract was found to lower copper, zinc, and iron levels at higher doses (2.5 mg/kg body

weight) Which in turn increased adenosine triphosphatase activities (Bajpay *et al.,* 2018) these modifications show promise in preventing cataracts by limiting the production of free radicals and protein aggregation.

Anti-bacterial activity

Cyperus rotundus L essential oil, primarily obtained from rhizomes by steam distillation or hydrodistillation, displays strong traditional medicinal use demonstrating limited efficiency towards certain gram-negative germs like *Pseudomonas aeruginosa* and *Proteus vulgaris*. The extraction process utilizes steam distillation as the conventional method, with recent advancements including ultrasonic-assisted hydrodistillation and natural deep eutectic solvents to increase oil yield and extraction efficiency; Thin Layer Chromatography (TLC) is commonly used to analyze components, often with a 1:1 ethyl acetate: toluene eluent system (Yadav *et al*., 2024).

Antioxidant activity

C. rotundus is an organic antioxidant, reactive oxygen species terminator, and immune-modulator found that *C. rotundus* extracts made with aqueous and methanol had an antagonistic activity, indicating its capacity to chelate iron and scavenge radicals. The methanol and aqueous extracts had maximum inhibitory levels of 27.1% and 25.3%, respectively, which stopped the hydroxyl radicals from being produced. However, at 62.5%, the methanol extract *of C. rotundus* has better chelating iron ability over the water-soluble extract. The stable 2,2-diphenyl-1-picrylhydrazyl free radical was maximally reduced by the *C. rotundus* rhizome chloroform extract, reaching 74.19–87.62 at 0.125–1 mg/ml, indicating radical scavenging activity (Aeganathan *et al.,* 2015).

Ovicidal and larvicidal activities

The *Aedes albopictus* larvae and eggs that were in their fourth instar were utilized to assess the insecticide and larval killer characteristics of essential oils extracted from *Cyperus giganteus* and *Cyperus rotundus Linn* tubers (Arshad and Hassan, 2022). The larvae and eggs were examined for twenty-four hours upon getting exposed to oils with serial levels that ranged from 5 to 150 parts per million. Based on their respective EC50 values, both oils demonstrated exceptional larvicidal and ovicidal properties.

Wound healing activity

The alcoholic extract ointments provided remarkable enhancement in tensile strength, wound closing time, and wound contraction in all models of wound. These actions were similar to that with a reference nitrofurazone ointment (0.2% w/w). The experiment reaffirmed that the alcoholic extract of *Cyperus rotundus L* tubers contains strong wound-healing activity in these test models (Shravani *et al.,* 2022).

Anti-laceration activity

Activity of lactogens notably, *C. rotundus* rhizomes was extensively utilized to stimulate the growth of mammary glands and boost human breast milk supply. Recently, rats were used to examine the lactogenic potential of rhizomes. The pups' body weight (8.82–35.78 g/pup per day) and milk supply (23–40%) significantly increased after receiving 300–600 mg of C. rotundus aqueous extract orally .The aqueous extract raised the amount of protein and carbs in the mammary glands, promoted the production of prolactin, and increased the weights of the mother and pups (Singh *et al*., 2023)

Anti-pyretic activity

Nut grass tubers, ethanol, and petroleum oil ether extracts are tested for pyretic activity. Proteins, flavonoids, and tri-terpenoids give *C. rotundus* its defense against pyrexiais. In contrast, a specific component of the petroleum ether extract showed potent antipyretic properties that were similar to those of acetyl salicylic acid. Analgesic effects were seen in both the extract of petroleum ether and the vital oil of *C. rotundus* (Manoj *et al*., 2024).

Anti-spatic

The neurotransmitters 5-hydroxitriptamine and metal chloride, which have an instantaneous relaxing impact on smooth muscles, have been used to investigate the intestinal relaxation and therapeutic effects of *C. rotundus* extract against iatrogenic contractions. According to Ullah *et al*. (2022) study, the ethanolic extract of *C. rotundus* directly relaxed the smooth muscle, causing the ileum to relax and acting as a spasmolytic to prevent contractions brought on by 5-hydroxitriptamine, acetylcholine, and barium chloride.

Anti-obesity activity

It was discovered that CREP (Cyperus rotundus Extract + Piperine) was safe, well-tolerated, and successful in controlling obesity by lowering circulating lipid levels and central obesity. Compared to lifestyle changes alone, the combination of CREP supplementation and a nutritious diet and at least half an hour of daily physical exercise resulted in larger decreases in cholesterol levels and body weight (Majeed *et.al*. 2025).

Anti-cancer properties

The extract of ethanol and volatile oils of *C. rotundus* have anti-cancer qualities. Neuro-2a cells were successfully screened for tumoricidal activity using the ethanol extract of *C. rotundus*. Its volatile oil was quite effective against the L1210 leucaemia cell line, which causes cancer. The protective role of *C. rotundus* may possibly be facilitated by the presence of component sesquiterpenes (Hemanth Kumar *et al,* 2021). Anti-cancer: ethanolic extracts and volatile oils are effective against leukemia and neuroblastoma cell lines.

Anti-platelet action

The terpenoid components of *Cyperus rotundus L* ethanolic extract exhibit potent anti-platelet action. Hemanth Kumar *et al.* (2021) report that the extract and its active ingredient (+)-nootkatone considerably reduce platelet aggregation brought on by thrombin, collagen, and arachidonic acid. Nootkatone demonstrated the most antiplatelet impact among the substances examined, underscoring the potential of *C. rotundus* in the management of cardiovascular conditions linked to platelets.

Anti-fungal action

The idea that polyherbs are useful therapeutic agents is now being investigated in both experimental and clinical contexts. This concept is becoming more and more important to even big pharmaceutical businesses that produce poly botanical formulations. The many therapeutic properties that each herb possesses led to this development **(**Yadav *et al.,* 2024).

Gastro-protective activity

The stem of *C. rotundus* has an ethanolic extract that has anti urolithiatic properties. The antiurolithatic effects of *C. rotundus* are due to phytoconstituents like terpenoids, flavonoids, and saponins. Stem ethanolic extract has been demonstrated to prevent kidney stones, gastrointestinal and cytoprotective (Lim *et al.,* 2016).

Hepato-protective activity

Cyperus rotundus L extract markedly maintained the integrity of liver cell membranes through elevated lactate dehydrogenase (LDH) levels. It also increased antioxidant defense by increasing liver GSH-Px, GST, and GSH content, thus decreasing lipid peroxidation. Furthermore, the extract reduced the levels of serum bilirubin, glucose and transaminase also illustrated the protective action of methanol extract against carbon tetrachloride induced hepatotoxicity in rats (Kalam *et al.,* 2025).

Hair removal

The strong anti-androgenic effect of *Cyperus rotundus L* is probably due to the presence of active antioxidants. Furthermore, it might aid in controlling the hair growth cycle through as-yet-unidentified processes, which calls for more research into these pathways. It has been demonstrated that utilizing cosmoperine to increase *Cyperus rotundus L* skin penetration increases its effectiveness. According to folklore, daily application has no negative consequences. Concerns about the safety of chemical

depilatories continue, despite the fact that many consumers prefer hairless skin, making *Cyperus rotundus L* a viable natural substitute. Practitioners must have a complete understanding of the product's activity and refrain from promising permanent hair removal, and users should be warned against unlawful use (Ghada Farouk *et al.,* 2025).

Anti-convulsant activity

The potential of *C. rotundus* rhizomes to reduce tonic seizures was tested in albino rats with pentylenetetrazole (PTZ) and maximal electroshock (MES) seizure models. Ethanol extract from hot Soxhlet extraction at a dose of 100 mg/kg orally markedly suppressed the duration of hind limb extension and convulsions and had the same efficacy as phenytoin and diazepam, respectively. In addition proposed flavonoids contained in the ethanolic extract might be the major phytoconstituents responsible for the anticonvulsant action demonstrated. Seizure inhibition in both PTZ and MES models was mainly due to the activity of flavonoids and sesquiterpene in the extract (Pirzada *et al.,* 2015).

CONCLUSION

Cyperus rotundus L. is an important medicinal plant that has been employed in traditional medicine, including Ayurveda, for the management of inflammatory conditions, gastrointestinal disorders, fever, wounds, and infections. The rhizomes and tubers of this plant, despite being characterized as invasive weeds, possess biologically active secondary metabolites such as sesquiterpene, flavonoids, phenolic acids, and essential oils, which are responsible for its wide range of pharmacological effects. Experimental studies have established the efficacy of this plant in supporting traditional claims of its ovicidal, larvicidal, antioxidant, anti-inflammatory, antimicrobial, and wound-healing potential.

However, despite these promising findings, research on *C. rotundus* is scattered. The majority of existing research has focused on crude extracts, while detailed investigations on isolating active compounds and determining their molecular mechanisms have yet to be conducted. Moreover, differences in phytochemical content due to geographical location and extraction protocols make it difficult to standardize this herb. Toxicological studies and well-designed preclinical and clinical investigations are scarce.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest, including financial interests, personal relationships, or affiliations, that could have influenced the work reported in this paper.

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