



## REVIEW ON PHYTOCHEMISTRY AND PHARMACOLOGICAL ACTIONS OF *CYPERUS ROTUNDUS* L. A TRADITIONAL MEDICINAL HERB

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### ABSTRACT

Nowadays due to the increasing demand for the herbal drugs for the treatment of various ailments or diseases of human as well as animals, the researchers are showing their interest in exploring health benefits of these herbal drugs, making an essential impact to work in the field of phytopharmaceuticals or phytotherapeutics. The herbal drugs are still the choice for the treatment of many diseases as these drugs are pharmacologically very potent and having no side effect or low side effect, when used as preventive medicine. Amongst many herbal medicinal plants *Cyperus rotundus* (family-cyperaceae) commonly

known as motha or more commonly nagarmotha in local languages, additionally called purple nut grass or sledge, is available all over the country, is an important plant as it shows various reported pharmacological activity viz. anti-inflammatory activity, analgesic activity, antimicrobial activity, anti-lesion activity, antipyretic activity, anti-emetic activity, tranquilizing activity, anti-urolithatic activity, anti-spastic activity, anti-diarrhoeal activity, anti-obesity activity, wound healing activity, antimalarial activity, metastatic tumor activity, antidiabetic activity, anti-allergic activity, anti-platelet activity, hypolipidaemic activity, gastro-protective activity, hepato-protective activity, hypotensive activity, ovicidal and larvicidal activity, antifungal activity. This paper provides review on phytochemical properties and pharmacological activities of motha.

**KEYWORDS:** *Cyperus rotundus*, phytotherapeutics, anti-inflammatory activity, antimicrobial activity, anti-arthritis activity.

## INTRODUCTION

Herbal plant drugs are used for the treatment of many different diseases or ailments by the people all over the world. Herbal plants play key role in the treatment of many diseases or ailment of human as well as animal throughout the world. In developing countries there is increase in number of researcher working on herbal plants and plant derived medicinal products as the demand for medicinal plant is increasing due to its effectiveness and less toxicity or fewer side effects, so the adoption of herbal medicine is growing. Nowadays herbal drugs play an important role in both traditional and modern system of medicine.<sup>[1][2]</sup>

The plant genus name *Cyperus* is derived from the ancient Greek name of the genus 'cypeiros' and the *rotundus* is derived from Latin word used for round which refers to the tuber.<sup>[2][3]</sup> *Cyperus rotundus* is an indigenous plant to India but nowadays found in tropical, subtropical and temperate areas.<sup>[4]</sup> *Cyperus rotundus* is commonly known as Nagarmotha or more commonly Motha belonging to family *Cyperaceae*. This plant is also known as sledge, purple nutsledge, purple nutgrass, varida, musta etc. the plant is perennial weed with slender scaly rhizomes, tuberous at the bottom grown individually from the tubers that square measures about 1-3 cm long.<sup>[4][5][6]</sup> This plant parts are traditionally used as anti-inflammatory, anti-diabetic, anti-diarrhoeal and anti-pyretic medicine.<sup>[7][8][9]</sup> Roots are mainly used to improve memory power whereas it also shows protective action on liver, spleen and pancreas. This is also used for the many other diseases as it possesses various pharmacological actions like anthelmintic activity, anti-fungal activity, anti-parasitic activity, anti-rheumatic activity, anti-spasmodic activity, analgesic activity, antimicrobial activity, anti-lesion activity, antipyretic activity, anti-emetic activity, tranquilizing activity, antiurolithatic activity, antispastic activity, antidiarrhoeal activity, anti-obesity activity, wound healing activity, antimalarial activity, metastatic tumor activity, anti-diabetic activity, anti-allergic activity, anti-platelet activity, hypolipidaemic activity, gastro-protective activity, hepato-protective activity, hypotensive activity, ovicidal and larvicidal activity, antifungal activity, aphrodisiac activity and astringent activity.<sup>[10][11][12][13]</sup>

The rhizomes of motha, widely used in traditionally throughout the world to treat various diseases like dysentery, constipation, abdominal distention, chest pain, irregular catamenia, painful catamenia, skin diseases, staphylococcal infections, leprosy, sprains and bruises, fever, malaria, abdominal disorders and diarrhea.<sup>[14][15]</sup>

Traditionally this plant is used by the practitioners from thousands of years; this medicine is especially used in Chinese system of medicines. All parts of the motha plant are suggested useful in many disease conditions.<sup>[16]</sup> The plant also exhibits enzymatic activity as it shows higher growth rate in fish.<sup>[17]</sup> Many previous phytochemical studies of *Cyperus rotundus* shows presence of many secondary metabolites like alkaloids, flavonoids, furochromones, glycosides, starch, steroids, tannins, reducing sugars, resin compounds, sesquiterpenoids which are responsible for the above mentioned pharmacological activities.<sup>[18][19]</sup> By considering growing interest in the field of phytopharmaceutical or plant drug evaluation of various pharmacological activities. In this review articles we have discussed about chemical constituents and pharmacological activity of the plant motha.

### **Morphology**<sup>[20]</sup>

*Cyperus rotundus* is a monocotyledonous slender, erect, perennial plant belonging to the family Cyperaceae. The plant spreads by the means of fibrous root system. The slender known as rhizomes when grown underground, initially white when fresh and covered with scaly modified leaves, become woody and brown with age. The rhizomes of motha grow as tuber with time.

### **Vernacular name**

Hindi	- Motha, Nagarmotha
Marathi	- Barik motha, Bimbal
Sanskrit	- Muthakasu, Musta, Varida
Gujarati	- Nagarmothaya
Assamese	- Keyabon
Malayalam	- Korakizanna
Canada	- Koranari-gadde
English	- Nutgrass, Purple nutsdge

### **Taxonomical classification**<sup>[21]</sup>

Kingdom	- Plantae
Subkingdom	- Tracheobionta
Superdivision	- Spermatophyta
Division	- Magnoliophyta
Class	- Liliopsida
Subclass	- Commelinidae

Order	- Poales (Cyperales)
Family	- Cyperaceae
Genus	- Cyperus
Species	- Rotundus

## PHYTOCHEMISTRY AND MEDICINAL USES

### Phytochemistry

The phytochemical screening of extracts of rhizomes of the plant *Cyperus rotundus* revealed presence of various chemical constituents as major active chemical composition like essential oil, Terpenoids, Flavonoids, Sesquiterpenes, Monoterpenes, Sitosterol, Glycoside sulpharotunol, Beta-cyperone, Beta-selinene, Camphene, Calcium cyperene, Cyperenon, Cyperol, Cyperolon, Selinene, Cyperotundone, D-copadiene, Linolenic acid, Linoleic acid, Oleic acid, Rotundene, Rotundenol, Rotundone, Polyphenols, Pectin, Stearic acid, Camphene, Sugeonol, Sugetrio, Myristic acid.<sup>[22][23][24]</sup>

Major chemical constituents isolated from the essential oil extracted from the rhizomes of the plant *Cyperus rotundus* are Alpha- cyperone, Alpha-rotunol, Beta- cyperone, Beta-pinene, Beta-rotunol, Beta-selinene, Calcium, Camphene, Copaene, Cyperene, Cyperenone, Cyperol, Cyperolone, Cyperotundone, D- copadiene, D-epoxyguaiene, D-fructose, D-glucose, Flavonoids, Gamma-cymene, Isocyperol, Isokobusone, Kobusone, Limonene, Linoleic acid, Linolenic acid, Magnesium, Manganese, C. rotunduskone, Myristic acid, Oleanolic acid, Oleanolic acid-3-Oneohesperidoside, Oleic acid, P-cymol, Patchoulone, Pectin, Polyphenols, Rotundene, Rotundenol, Rotundone, Selinatriene, Sitosterol, Stearic acid, Sugeonol, Sugreanol, Sugetriol.<sup>[25][26][27][28]</sup>

*Cyperus rotundus* plant extract contains essential oil that responsible for providing characteristic odour and taste of the herb, the oil majorly consists of sesquiterpene hydrocarbons, epoxides, ketones, monoterpenes and aliphatic alcohols. Sesquiterpenes that present in essential oil includes selinene, isocurcumenol, nootkatone, aristolone, isorotundene, cypera-2, 4(15)-diene, and norrotundene, moreover sesquiterpene alkaloids rotundines A-C. Oil contains other constituents like ketone, cyperadione, and monoterpenes include cineole, camphene, limonene.<sup>[27][28][29]</sup>

### Medicinal uses

*Cyperus rotundus* used in traditional system of medicines like Ayurveda system of medicine, Siddha system of medicine, Unani system of medicine, Chinese system of medicine to treat various diseases or to give relief from post treatment symptom of any disease. Ayurveda suggested *Cyperus rotundus* as astringent, diaphoretic, diuretic, analgesic, antispasmodic, aromatic, carminative, antitussive, emmenagogue, litholytic, sedative, stimulant, stomachic, vermifuge, bitter tonic and antibacterial. According to Ayurveda it is a good remedy for indigestion as *Cyperus rotundus* contains many enzymes for carbohydrates and minerals that acts as catalyst for many different biochemical reactions thus helpful in indigestion. It is useful for dietary management of psychotic diseases and metabolic disorders too.<sup>[30]</sup>

*Cyperus rotundus* used traditionally in the treatment of nausea, vomiting, dyspepsia, colic, flatulence, diarrhea, dysentery, intestinal parasitic infections, fever, malaria, cough, bronchitis, renal and vesicle calculi, urinary tenesmus, skin diseases, wounds, amenorrhoea, dysmenorrhea, deficient lactation, memory loss, insect bites, food poisoning, dysuria, bronchitis, fertility problems, cervical cancer, menstrual irregularities.<sup>[31][32][33][34][35]</sup>

### PHARMACOLOGICAL ACTIVITIES

#### Anti-inflammatory activity

Methanolic and chloroform extract of *Cyperus rotundus* rhizomes shown very prominent anti-inflammatory activity against the carrageenan- induced paw edema in Wister rats at the dose of 400-600 mg/kg.<sup>[36]</sup>

Oral administration of the *Cyperus rotundus* extract at the dose of 300-500 mg/kg shown a vivid anti-inflammatory activity.<sup>[37]</sup>

Anti-inflammatory activity of alcoholic, fossil oil ether extract of *Cyperus rotundus* was reported against carrageenan iatrogenic edema and additionally against aldehyde iatrogenic edema in disease eldritch patient rats. Highly potent medicinal drug activity was reported by fossil oil ether extract. The protecting role of *Cyperus rotundus* reported probably due to the presence of flavonoids, triterpenoids and proteins as active chemical constituent.<sup>[38]</sup>

Alcoholic extracts (70% alcohol) of *Cyperus rotundus* reported to possess marked anti-inflammatory activity against carrageenan induced paw edema and additionally found effective against formaldehyde induced arthritic when tested in Albino rats.<sup>[39][40][41][42][43]</sup>

Ether, ethanol and distilled water extract of *Cyperus rotundus* tuber was evaluated for anti-inflammatory activity against the carrageenan induced rat paw edema in adult albino wistar rats. The anti-inflammatory activity of tuber extract was found very prominent, the powdered *Cyperus rotundus* tuber was extracted in equal portion by using ether, ethanol and distilled. The ethanolic extract shown better anti-inflammatory activity than other solvent system.<sup>[44][45]</sup> The percentage inhibition of paw edema was calculated by the formula:

$$(V_c - V_t / V_c) \times 100$$

Where,

$V_c$  - volume of paw edema in the control group

$V_t$  - volume of paw edema in the treated group.

### **Anti-pyretic activity**

Ethanolic extract of *Cyperus rotundus* found to show highly significant ( $P < 0.001$ ) anti-inflammatory activity against pyrexia in albino rats, the pyrexia was induced by subcutaneous injection of dried Brewer's yeast suspension in gum acacia in normal saline.<sup>[46][47]</sup>

The alcoholic and fossil oil ether extract of *Cyperus rotundus* reported to oppose pyretic activity against the symptom induced in eldritch person rats by injecting dried Brewer's yeast suspension in gum Arabica prepared in traditional saline.<sup>[48]</sup>

Alcoholic extract of *Cyperus rotundus* was found to possess prominent anti-pyretic activity against pyrexia induced in albino rats by the injection of dried Brewer's yeast suspension subcutaneously. The suspension was prepared by suspending dried Brewer's yeast in gum acacia in normal saline. The chromatographic fraction obtained from petroleum ether extract of *Cyperus rotundus* was found to possess equal anti-pyretic activity to acetyl salicylic acid in the same animal model. Due to its anti-inflammatory and anti-pyretic activity *Cyperus rotundus* suggested being useful remedy for arthritic conditions.<sup>[49][50]</sup>

### **Analgesic activity**

Analgesic activity of hydro-alcoholic extract of *Cyperus rotundus* was reported at the dose of 50, 100 and 200mg/kg, when investigated for anti-nociceptive activity in mice. Maximum percentage inhibition of licking in early (61.60) and late phase (87.41) was found at the dose of 200mg/kg.<sup>[51]</sup>

Petroleum ether extract and essential oil of *Cyperus rotundus* was found to possess prominent analgesic activity.<sup>[52]</sup>

The total decoction product of rhizomes of *Cyperus rotundus* was found to possess analgesic activity in acetic acid writhing test.<sup>[53]</sup>

### **Anti-diarrhoeal activity**

The methanolic extract of *Cyperus rotundus* rhizomes was reported possess vivid anti-diarrhoeal activity at the dose of 250 to 500mg/kg given against castor oil induced diarrhea in mice. Amongst the number fractions tested at 250 mg/kg, petroleum ether fraction and residual methanol fractions were found to preserve anti-diarrhoeal activity, the methanolic extract was found to more effective as compared to reference drug. The ethyl acetate fraction was found to possess no anti-diarrhoeal activity.<sup>[54]</sup>

The aqueous extract of *Cyperus rotundus* tubers was reported to possess anti- giardial activity against diarrhoeal infections. Additionally it was found that *Cyperus rotundus* possess anti-diarrhoeal activity against enteropathogenic *Escherichia coli* adherence and enteroinvasive *Escherichia coli* invasion. It was also reported to effective against the adherence to *Shigella flexneri* to human epithelial type 2 (HEP- 2) cells. Enterotoxins like enterotoxigenic *Escherichia coli*, heat labile toxin (HLT), heat stable toxin (HST), and the cholera toxin (CT) was assessed for anti-diarrhoeal activity. It was clearly seen that the extract reduces bacterial invasion of and adherence to HEP- 2 cells. HLT production increased and ganglioside monosialic acid receptor (GM<sub>1</sub>) binding was decreased. The cholera toxin production was diminished and no noticeable effect on binding to GM<sub>1</sub>.<sup>[55]</sup>

### **Anti-bacterial activity**

The essential oil of *Cyperus rotundus* was reported to possess significant anti-bacterial activity when anti-microbial activity was performed by inhibition zone technique. The activity was determined by calculating minimum inhibitory concentration and minimum antiseptic concentration against every microorganism. It was reported that the oil possess marked anti- bacterial activity against gram – positive bacterium *cocci aureus* and *enterococcus faecalis*.<sup>[56][57][58]</sup>

*Cyperus rotundus* found to possess mild anti- bacterial activity in higher doses. The noteworthy inhibitory action of *Cyperus rotundus* was reported against *Salmonella*

*enteritidis*, *Staphylococcus aureus* and *enterococcus faecalis* with total oligomers flavonoids (TOFs) and ethyl acetate extracts.<sup>[58][59][60]</sup>

Essential oil of *Cyperus rotundus* was reported to possess noteworthy anti-bacterial activity against gram-positive bacteria and lesser anti-bacterial activity against gram-negative bacteria. The oil was reported to possess no anti-bacterial activity against *Pseudomonas aeruginosa* and *Proteus vulgaris*. It was also reported that *Cyperus rotundus* oil possess anti-microbial activity against microbes like: *Staphylococcus aureus*, *Klebsiella pneumonia*, *Proteus vulgaris*, *Staphylococcus pyrogenes* and *Escherichia coli*.<sup>[61][62]</sup>

### **Anti-amoebic activity**

Whole plant of *Cyperus rotundus* shown highly significant anti-amoebic activity in *In-vitro* studies against *Entamoeba histolytica* trophozoites. Another study for anti-amoebic activity was reported that ethanolic extract of whole plant of *Cyperus rotundus* was found to exhibit 100% inhibitory activity at the dose of 500µg/ml after four days.<sup>[63]</sup>

### **Anti-microbial activity**

*Cyperus rotundus* was reported to possess prominent anti-microbial activity when their binary compound and ethanolic extracts were tested by using agar disc diffusion and agar well diffusion methods. The ethanolic extract was shown inhibitory activity against the entire test microorganisms strain used. Anti-microbial activity was reported against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterobacteria pneumonia*, *Moraxella catarrhalis*, *Acinetobacter*, *Monilia albicans*, *Aspergillus niger* and *Escherichia coli*. The inhibitory or protecting role was suggested probably due to the presence of terpenoids as their constituents.<sup>[64][65]</sup>

The antimicrobial activity of the oil of *Cyperus rotundus* was evaluated by agar disc diffusion methodology. The area of zone of inhibition of was measured and compared with the negative control, as well as ofloxacin, rifampicin and amphotericin (5 µg/disc) as positive control for each test organisms. The oil was found completely inactive against all the Gram-negative microorganisms but found significantly active against Gram-positive microorganisms like *Staphylococcus aureus* and *Streptococcus species*, moderately active against *Sarcina lutea*, *Bacillus subtilis* and acid fast bacteria *Mycobacterium phlei* and fungi like *Candida species*.<sup>[66]</sup>



**Anti-oxidant activity**

Anti-oxidant activity of methanolic extract of *Cyperus rotundus* was tested against atom induced aerophilic injury and accordingly shown prominent anti-oxidant activity. Phenols and flavonoids are suggested to be active constituents for *Cyperus rotundus* protecting role.<sup>[67][68]</sup>

Antioxidant and  $\alpha$ - amylase inhibitory activities of some of the selected phenolic compound isolated from aerial part of *Cyperus rotundus* were studied. *In vitro* study for antioxidant activity of methanolic extract of *Cyperus rotundus* clearly suggested that methanolic extract possess more antioxidant activity than that of ethanolic extract, because of its high flavonoid contents. The reducing capacity and 1, 1-diphenyl-2-picryl hydrazyl (DPPH) free radical inhibitory activity is more in methanolic extract than that of ethanolic extract. A comparative study for antioxidant property reveals antioxidant potential in following order: *Piper nigrum* > *Piper longum* > *Cyperus rotundus* > *Plumbago zeylanca* > *Zingiber officinale*. This result revealed a salt-spice-herbal mixture containing *Cyperus rotundus* exerted significant antioxidant activity against free radical induced oxidative damage.<sup>[69]</sup>

**Antimalarial activity**

Volatile oil of *Cyperus rotundus* reported to possess prominent antiprotozoal activity against the test microorganism (*Plasmodium falciparum*), the protecting activity is suggested because of the presence of sesquiterpene units in their constituents.<sup>[70][71]</sup>

**Wound healing activity**

Alcoholic extract of *Cyperus rotundus* tubers was found to possess wound healing activity when applied as styled ointment in three style of wound models in rats: the excision, the incision and dead house wound models.<sup>[72]</sup>

**Antiulcer activity**

*Cyperus rotundus* found to possess antiulcer activity when *Cyperus rotundus* tuber powder administered orally against the scale back lesion induced by iatrogenic peptic ulcer method. Motha has shown significant peptic ulcer curing effect and cytoprotective effect against grain alcohol induced iatrogenic stomach ulcer in rats. The protecting role of motha is supposed to attributed to the presence of the flavonoids unit found jointly to its constituents.<sup>[73][74]</sup>

*Cyperus rotundus* tuber powder extract has shown antiulcer activity when studied in two different animal models. First model was histamine induced ulcer in guinea pig and the second one was aspirin induced gastric mucosal damage in rats. In both condition, *Cyperus rotundus* tuber extract showed prominent maximum ulcer reduction activity which was comparable to ranitidine.<sup>[75]</sup>

### **Anti-arthritic activity**

Essential oil of *Cyperus rotundus* was reported to possess anti rheumatoid activity, the test study was performed against gas induced inflammatory model in eldritch Wistar rats. The protecting role supposed because of presence of flavonoid, sesquiterpenes and glycosides united to their constituents.<sup>[76]</sup>

A double blind trial was carried out for anti-arthritic activity of *Cyperus rotundus* in combination with *Withania somnifera* in the ratio of 1:1 in 200 patients suffering from rheumatoid arthritis. Three capsules of the dose of 500mg was given in the same day for a month, biweekly assessment was carried out based on global criteria includes (duration of morning stiffness, grip strength, articular index, consumption of escape analgesic, erythrocyte sedimentation rate, haemoglobin, rheumatoid factor titre, x-ray findings, anti-arthritic activity of *Cyperus rotundus* was found more than that of *Withania somnifera*. Combination of these drug showed better activity as compared to single drug.<sup>[77][78]</sup>

### **CONCLUSION**

*Cyperus rotundus* is a perennial herbal medicine used from thousands of year as a traditional medicine for various diseases and ailments. The above data suggests that the plant shows limited activity against different forms of bacterial and pathogenic infection due to its selective activity against infectious bacteria and diarrhoeal pathogens. It is the most preferred traditional remedy amongst many ancient ethnic practitioners. The plant remedy is better choice for many ailments due to no or less toxicity and side effects. Researchers suggested that yet many activities have to assess which are not known, can be utilized for the treatment of many diseases. In current the drug is used as a remedy for rheumatoid arthritis as it is known for anti-inflammatory, analgesic, antipyretic and anti-arthritic activities. Hence it is the drug of choice for patients with rheumatoid arthritis.

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