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A Review Onphytochemicals and Pharmacological Activity of Medicinal Plant *Cyperus rotundus*

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ABSTRACT

This innovative endeavor is to offer comprehensive details about *Cyperus rotundus*, a member of the Cyperaceous[1] family and referred to as "Motha" or "Mutha." In the herbal medicine system, this plant is widely renowned for its remarkable ability to treat a wide range of illnesses. The herb has been shown to have both pharmacological and biological properties, such as anti-inflammatory, antipyretic, anti-amoebic, anti-emetic, hypolipidemic, wound-healing, anticancer, coronary vasodilator, anti-alcoholic, anti-ulcer, ovicidal and larvicidal effects, antipyretic, antiviral, anti-malarial, anti-convulsant, central nervous system influence, influence on platelet function, antioxidant activity, and anti-diarrheal properties. The current review paper emphasizes the importance of the following: species, botanical name, phytocomponents, chemical structures, microscopic traits, traditional applications, life cycle, and pharmaceutical efficacy. Future scholars will find significant value in this vast material.

INTRODUCTION

Herbal medicine is the oldest kind of medicine that is currently recognized. It formed the foundation of numerous ancient cultures and is still the most widely utilized kind of medicine worldwide[1].

First of all by World Health Organization's estimates, around 80% of the global population mostly obtains medical care from conventional medicines. For instance, in the developed world, between 1959 and 1980, plant-based extracts or active compounds derived from higher plants were included in 25% of all medication filled at neighborhood pharmacies in the USA[2].

Taxonomic classification

Kingdom : Plantae
Subkingdom : Tracheobionta
Superdivision : Spermatophyta
Division : Magnoliophyta
Class : Liliopsida
Subclass : Commelinidae
Order : Cyperales
Family : Cyperaceae
Genus : Cyperus L
Species : *Cyperus rotundus*[1&3].

Common names

In India, the herb *C. rotundus*, commonly referred to as “Motha” or “Mutha,”[4]

English: Coco-grass,red nut sedge Arabic: Sa'ed; Chinese: Suo cao, Xiang fu zi; French: Souchetrond; German: Knolliges Zypergras; Italian: Zigoloinfestante; Japanese: Hamasuge; Korean: Hyangbuja; Portuguese: Alho-bravo, Capim-alho, Capim-dandá, Tiririca, Tiririca-vermelha; Spanish: Castañuela, Cipero, Coquito, Juncia real; Swedish: Nötag[5].

Synonyms

Ground-almond, Java-grass, Nut sedge, Nut-grass, purple nut, Sedge, and Purple nut-grass[1].

Distribution

Asia: China, Japan, Korea, Taiwan, India, Nepal; Pakistan, Sri Lanka, Myanmar; Thailand, Vietnam, Indonesia, Malaysia, Philippines; Europe; Pacific; the United States of America; and Southern America were among the regions it was dispersed in[12].

Life cycle

Despite some small differences, there are significant similarities in the life cycle cycles of purple and yellow nutsedge species. Plants of both species are vegetative, meaning they produce a complex underground network of basal bulbs, rhizomes, and tubers. The basal bulbs are the building bricks of vegetative growth because they contain meristems that are responsible for leaves, rhizomes, roots, and flower stalks. Similar to yearly seeds, the tubers are the primary mechanism of dispersal and feature latent buds[6].

Characteristics of *C. rotundus*

Growing from a rhizome, the common perennial *C. rotundus* can reach heights of between 15 and 30 centimeters as well as 50 cm in tropical and subtropical areas. It produces tiny, nut-shaped tubers at the center of its stem (Figures 1 and 2). The leaves among the plant are upright and orientedin three distinct directions[11].

Figure: 1

Figure: 2

Areal part of *C. rotundus*[2&5].

Macroscopy

Stem: These leaves are usually taller (20–100 cm) and have a smooth, triangular cross form. Usually, they are longer than the base leaves. These culms align with the blossoming axis. At the increased base of the plant, a thickening layer called a basal bulb grows.

Leaf: The basal leaves are linear, pointed, and directed in three directions. They vary in length from 10 to 50 cm. Their source is the upright fertile stem that arises from very compact nodes in three-row basal clusters.

Glabrous blade with border and section that are shiny and dark green, folded twice. Fruit-Nuts: elliptical or oblong-ovate, 1.5 mm long, 0.8 mm broad, three-angled, and stigma-topped; olive-gray to brown or black in hue.

Figure 3: Nut-shaped tubers of *C. rotundus*[2].

Microscopic features of *C. rotundus*

The microscopic examination of *C. rotundus* root structures, as seen in Figure 4, reveals an epidermis composed of parenchymatous cells with a distinctive brownish tint. The cortex is made up of parenchymateous cells, while the hypodermis is made up of 1-2 distinct layers of thickly walled cells. The internal portion is parenchymatous and features wide intercellular gaps, whereas the exterior portion is compacted. Sharma and Singh (2011) report that brownish oleo resinous material and additional starch grains are present in particular cells in the frontal area[13-18].

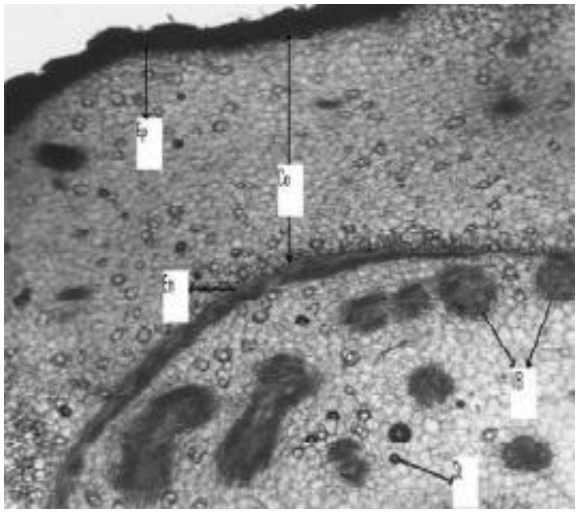


Figure 4: T.S of *C. rotundus*[2].

A great deal of dyed cells wrapped into a reddish-brown oleo-resin material, basic round or expanded starch grains, current passing through the cortex and stele, vascular bundles encircled by fiber bundle sheaths, vessels spiraling to simple pithed, scattered in this region, vessels that are the xylem vessels' lignified secondary wall thickenings could be extended, oval, or simply round [13-18].

Traditional uses

The herb *Cyperus rotundus* was used for intestinal cramps, problems with the stomach, nausea, vomiting, parasitic infections of the intestines, food poisoning, indigestion, and colon irritability. It was also used to treat respiratory conditions like amenorrhea and dysmenorrhea, fevers, bruising, and carbuncles; malaria; cough, bronchitis, renal and vesical calculi; urinary tenesmus; insect bites; loss of memory; infertility; cervical cancer; and menstrual disorders.The astringent, diaphoretic, diuretic, analgesic, antispasmodic, aromatic, carminative, antitussive, emmenagogue, litholytic, sedative, stimulant, stomachic, vermifuge, tonic, and antibacterial qualities of *Cyperus rotundus* rhizomes were recordedthroughout the literature on Ayurveda[13, 18-22].

Chemical constituents

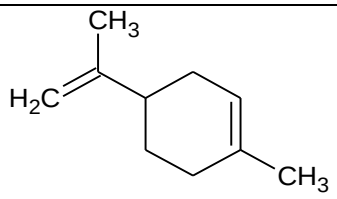
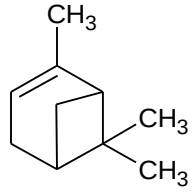
Phytochemical examinations revealed that *Cyperus rotundus* contained a wide range of secondary metabolites, such as flavonoids, tannins, glycosides, furochromones, monoterpenes, sesquiterpenes, sitosterol, alkaloids, saponins, terpenoids, essential oils, starch, carbohydrates, proteins, and amino acids as well [23-27].

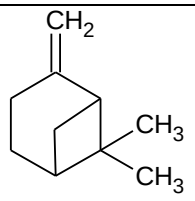
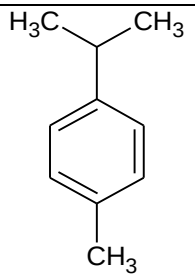
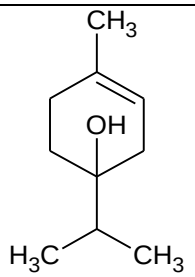
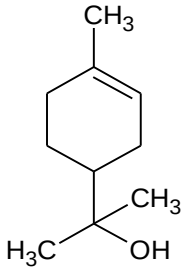
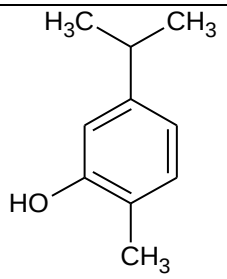
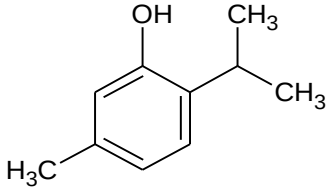
Quinones, phenolic acids: salicylic acid, protocatechuic acid, caffeic acid, and p coumaric acid; flavonoids: visnagin, khellin, ammiol, isorhamnetin, and tricin; saponins; alkaloids; coumarins; and steroids: steroidal glycoside, sitosterol-(6'-hentriacontanoyl)-ß-d-galactopyranoside[28].

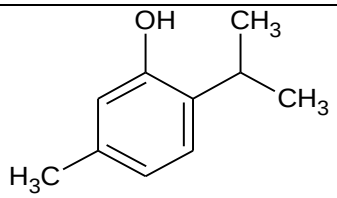
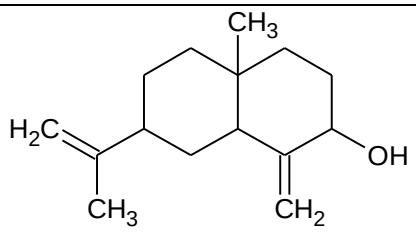
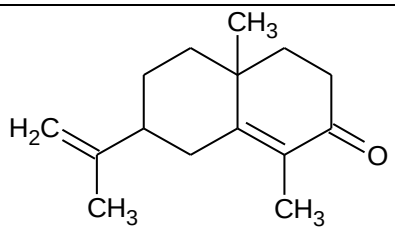
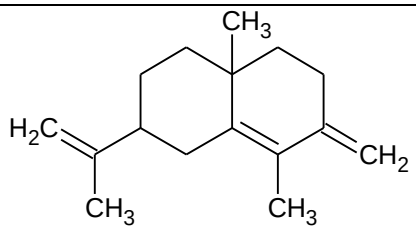
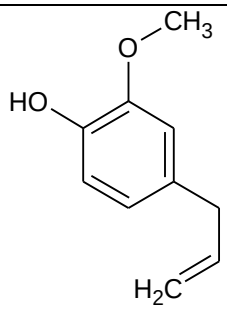
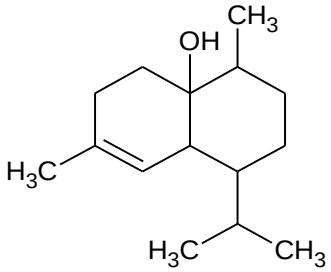
The concentration of essential oils in *Cyperus rotundus* tubers is 0.19%, and the tubers have a specific gravity of 0.9689 and a refractive index of 1.54511. Fifty two compounds were acquired from the Egyptian plant *Cyperus rotundus*. The main components of the oil were trans-pinocarveol (7.92%), cyperene (7.83%), (+) oxo-α ylangene (9.35%), and (+) α-cyperone (9.07%)[29,30].

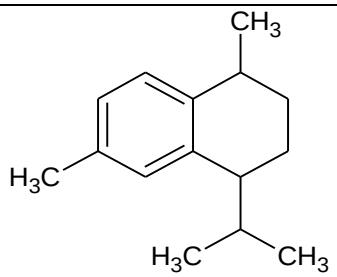
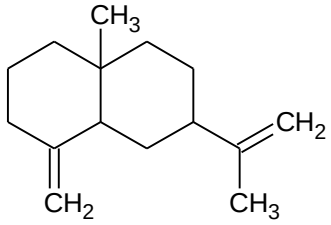
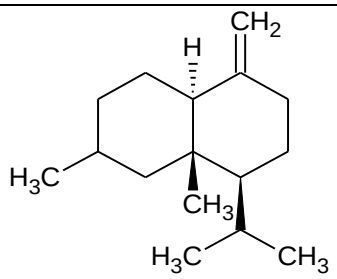
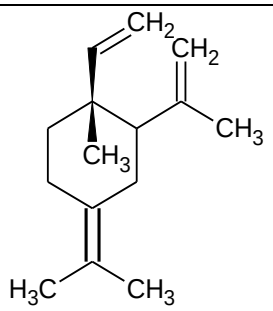
However, 0.2% (w/w) of the tuber of *Cyperus rotundus*, a plant that grows naturally in the Isfahan area of Iran,was discovered to hold onto essential oils. The essential oil contained 60 compounds that were found to exist naturally. Sesquiterpenes accounted for most of the compounds in the oil. The primary components of the oil were Cyrene (16.9%), caryophyllene oxide (8.9%), α-longipinane (8.4%), and β-selinene (6.6%)[31].

Comparing ethanol extracts (6.44–13.77 mg CE – (Catechin equivalents)/g of dry matter) with the methanol extract from *Cyperus rotundus* revealed higher total flavonoid contents (8.15–18.25 mg CE/g of dry matter). In addition, *Cyperus rotundus* extracted with methanol had higher total phenolic contents (27.40–37.85 mg GAE/g of dry matter) than extracts made with ethanol (25.21–30.23 mg GAE/g of dry matter)[32, 33].

1.		Limonene
2.		α-Pinene

3.		β-Pinine
4.		ρ-Cynene
5.		4-Terpinol
6.		α-Terpinol
7.		Carvacrol
8.		Thymol

9		o-Cadinol
10.		Isocyperol
11.		o-Cyperone
12.		Cyperol
13.		Eugenol
14.		Cubenol

15.		Trans-Calamenene
16.		β Selinone
17.		γ Cadinene
18.		γ Elenone

Pharmacological activity of *Cyperus rotundas*

Anti-inflammatory activity

Gupta M et al. found that 400–600 mg/kg methanol and chloroform extract of *Cyperus rotundus* rhizomes was effective in treating Wistar rats' carrageenan-induced paw edema. Twelve when taken orally at levels between 300 and 500 mg/kg, the herbal compound showed anti-inflammatory characteristics, accordance to a study by Ahamad M et al[34-37].

Antipyretic activity

Pyrexia was seen in albino rats that were subcutaneously administered with a solution of dried Brewer's yeast in gum acacia in regular saline. Versus these rats, the alcoholic extract exhibited a very significant (P<0.001) antipyretic effectiveness. When an extract of petroleum ether was administered to the same animal model, a particular portion that was made by chromatography had a significant antipyretic activity that was similar to acetylsalicylic acid[38-40].

Anti-amoebic activity

Additionally, In vitro, investigations revealed that the whole *Cyperus rotundus* plant had greater anti-amoebic efficacy towards *Entamoeba histolytica trophozoites*. After 96 hours of additional research, the entire plant *Cyperus rotundus* extract of ethanol showed 100% inhibition at 500 µg/ml[41, 42].

Anti-emetic activity

It has been demonstrated that the ethanol extract of *C. rotundus* at a concentration of 128.1± 11.6 mg/kg prevented 50% of dogs from vomiting produced by apomorphine[38- 44].

Anti-hyperlipidemic activity

In this investigation, a high-fat diet was used to produce hyperlipidemia since it is a helpful tool for evaluating drugs that obstruct the absorption, breakdown, and excretion of cholesterol. Serum levels of low-density lipoprotein (LDL), triglycerides (TG), and total cholesterol (TC) increased significantly ($P < 0.05$) after feeding a high-fat meal compared to the baseline. High-density lipoprotein (HDL) levels increased while on a high-fat diet, although this effect was not shown to be statistically significant. After 15 days of intervention, treatment with the standards and various extract dosages resulted in a statistically significant ($P < 0.05$) decrease in blood levels of TC, LDL, TG, and HDL in the current study[11, 60].

Based on a study by Okwu1 et al., bioactive substances in *Cyperus rotundus* rhizome are having hypolipidemic potentials.An alcoholic extract of *Cyperus rotundus* at dose levels of 70 mg/kg/day, 140 mg/kg/day, and 280 mg/kg/day showed higher improvement in cholesterol levels after taking medication for 15 days, according to Chandra et al[41, 45].In an alloxan-induced diabetes model, Sprague Dawley rats demonstrated antihyperglycemic

effects from the various hydro ethanol extract fractions (methanol, acetone, chloroform, and ethyl acetate). Because of the high phenolic content, it has an antioxidant characteristic that contributes to its anti-hyperglycemic activity[3, 45, 52].

Wound healing property

Cyperus rotundus's active ingredients appear to be what give the herb its curative properties; they both quicken the healing process and give the healed wound its tearing strength. Based on the findings of the research, it is possible to conclude that the ointment containing *Cyperus rotundus* extract has potent wound-healing qualities at all tested doses[41, 47-49].

Anticancer activity

Anti-tumor the ethanolic extract of *C. rotundus* has been demonstrated to have only weak to moderate anticancer activity (LC50=2.528-4.939 mg/ml estimated from dose-dependent cell death) in a study that used neuro-2a cells for testing plants with tumoricidal capabilities. Subsequent research proved that *C. rotundus* essential oil was effective in combating the leukemia cell line L1210. This result was linked to a significant increase in apoptotic fragmentation of DNA[38, 50].

Coronary vasodilator activity

A water-based extract of a *C. rotundus* rhizome given IV has positive results in cats, rabbits, and frogs[3, 51].

Anti-alcoholic activity

The fermenting tuber of *C. rotundus* showed effectiveness in the rats' diet when given at a level of 5.0 ml/animal. The effects of alcohol on the electroencephalogram (ECG), liver fat accumulation, symptoms of bleeding, demyelination, and spongiosis were reversed by taking a daily dose for ninety days[3, 53].

Anti-ulcer activity

Utilizing a 1.25 g/kg dose of *Cyperus rotundus* tuber powder, the ulcer index was considerably decreased in the histamine-induced stomach ulcer approach. This research suggests that this substance may also have anti-ulcer qualities[41, 42].

The powdered rhizome of *C. rotundus* has ulcer-prevention properties. Two distinct models of animals were used in the investigation. Histamine (50 mg base i.p) accustomed to causing stomach ulcers in guinea pigs, whereas aspirin (500 mg/kg orally) accustomed to causing ulcers in albino rats. Oral administration of *C. rotundus* powdered rhizome was administered 45 minutes before the histamine and one hour before the aspirin. In every instance, *C. rotundus* significantly reduced the ulceration index and yielded results equivalent to the individuals of the reference drug ranitidine. Because *C. rotundus* possesses a powerful antioxidant profile, it offers antiulcer properties[3].

Ovicidal and larvicidal effects

Investigations were conducted into the ovicidal and larvicidal effects of *C. rotundus* essential oils. Research has been done on the eggs and larvae of *Aedes albopictus* (Skuse). The eggs and fourth instar larvae were treated with the essential oil for an entire day, at concentrations ranging from 5 to 150 ppm. The essential oil of *C. rotundus* had a potent larvicidal and ovicidal action, as demonstrated by its half-maximal effective concentration (EC_{50}) of 5 ppm and fatal dosage (LD_{50}) of 20 parts per million (ppm)[3, 54].

Anti-pyretic activity

The alcohol extract of *C. rotundus* efficiently avoids pyrexia in albino rats who have received a subcutaneous injection of a dehydrated yeast solution acacia in a saline solution. The *C. rotundus* rhizome's methanol extract was regularly isolated using column chromatography into its soluble fractions so that the structure of the separated components could be examined using UV, IR, H-NMR, and MS spectra (2016). After injecting a solution of dried Brewer's yeast in gum acacia in normal saline subcutaneously, albino rats were effectively treated with the alcohol extract of *C. rotundus*. In the same animal model, the extract was found to have an antipyretic effect comparable to acetylsalicylic acid[3, 39,40, 55].

Anti-fungal activity

Rhizome was found to be effective towards *Phytophthora capsid*, *Colletotrichum chardonianum*, and *Sclerotinia scleroliorum* in an agar plate test. On an agar plate, *Helminthosporium turcicum* did not react to an undiluted fresh shoot water extract[3, 56].

Anti-viral activity

The hydroalcoholic extract of *C. rotundus* and the antiviral properties of forty-one Egyptian medicinal plants were tested. Three viruses were tested against the extract (vesicular stomatitis virus): HSV1, POLIO (poliomyelitis-1 virus), and VSV (herpes simplex-1 virus). The end-point titration approach was employed to determine the antiviral activity. *C. rotundus* showed virucidal effects from HSV[3, 57].

Anti-malarial activity

Through activity-guided research, compounds such as 4,7-dimethyl-l-tetralone, 10,12-peroxycalamenene, caryophyllene oxide, and patchoulenone were isolated from *C. rotundus* tubers. The new ndoperoxide sesquiterpene, 10, 12-peroxycalamenene, has the highest impact at EC_{50} 2.33 × 106 M. These compounds have anti-malarial activity within the range of EC_{50} 10-4-10-6 M[11, 58,59].

Anti-convulsant activity

Given the significant prevalence of epilepsy in human civilization and the lack of effective treatments, the anticonvulsant activity of *C. rotundus* extract was investigated experimentally in the current study. Six groups of sixty male mice each were created by random selection: (1) control group, (2) group mice that had been given pentylentetrazole (PTZ), (3) group is a positive control group that was given valproate (100 mg/kg) as an anticonvulsant medication, and (4-6) a group that was given *C. rotundus* rhizome extract at three different doses of 100, 200, and 400 mg/kg intra-peritoneally [11].

Eleven intraperitoneal (i.p) administrations of PTZ (35 mg/kg; 48 h apart) were administered to all animals, excluding the control group. Every group—aside from the control group was evaluated for the PTZ challenge dosage (75 mg/kg) after the twelfth injection. After the PTZ injection, the seizure phases (0–6) that were displayed were watched and recorded for 30 minutes. After the mice's brains were completely removed, the amounts of nitric oxide (NO), superoxide dismutase (SOD), and malondialdehyde (MDA) in the brain tissues were measured. Data research revealed that *C. rotundus* hydroalcoholic extract might lessen seizure duration and intensity. Moreover, the extract may raise SOD and NO levels while lowering MDA levels in mice's brains. The conclusion is that the *C. rotundus* rhizome extract may have had a strong antiepileptic impact due to its antioxidant qualities[11].

Central nervous effect

In several experiments, the ethanolic extract of *Cyperus rotundus* showed strong tranquilizing effects. In rats, it eliminated the conditioned avoidance response, decreased spontaneous motor activity, increased pentobarbital narcosis, and disrupted motor coordination.[61] The neuropharmacological effects of 300 and 500 mg/kg of *Cyperus rotundus* extract were studied using open field, head dip, rearing traction, and forced swimming tests. All tests on the crude extract revealed a small reduction, and it also demonstrated a minor muscle relaxant action[62]. The ethanol extract of *Cyperus rotundus* showed CNS depressing action, according to behavioral investigations conducted on mice. In a dose-dependent way, the ethanol extract of *Cyperus rotundus* markedly increased the amount of time that mice slept while hypnotized with conventional drugs (pentobarbitone sodium, diazepam, and meprobamate)[18].

Effect on platelet function

The antiplatelet properties of *Cyperus rotundus* ethanolic extract (CRE) and eight of its component compounds were assessed by measuring the impact on mice tail bleeding times and rat platelet aggregations both In vitro and In vivo. In the In vitro platelet aggregation study, CRE shown notable and concentration-dependent inhibitory effects on platelet aggregation produced by thrombin, collagen, and arachidonic acid (AA). It was discovered that among its eight constituents, (+) nootkatone has the most inhibitory action against platelet aggregation produced by thrombin, collagen, and AA. Furthermore, mice treated with CRE and (+) nootkatone showed considerably longer bleeding times. Moreover, the ex vivo rat platelet aggregation was significantly inhibited by (+)-nootkatone. *Cyperus rotundus* can enhance all hemorrhoeological indices, including erythrocyte electrophoresis, plasma-specific viscosity, whole blood-specific viscosity, and others, according to research on the plant's impact on hemorrhage alterations in normal rats[18, 63].

Anti-oxidant activity

In vitro tests using reactive oxygen species and free radicals were used to assess the antioxidant activity of *Cyperus rotundus* rhizomes extract (CRRE), and IC_{50} (Inhibitory concentration) values were found. With respect to superoxide anion radicals, hydroxyl radicals, nitric oxide radicals, hydrogen peroxide, and the ability of metals to chelate and reduce, CRRE demonstrated its scavenging function in a concentration-dependent way. Using both young and old rat brain mitochondria, the extract was examined in more detailed for the

lipid peroxidation assay by thiobarbituric acid-reactive compounds (TBARS). Additionally, in a concentration-dependent manner, the extract was successful in reducing mitochondrial lipid peroxidation caused by $FeSO_4$ ascorbate. The current study's findings suggest that the rhizomes of *C. rotundus* extract might be a useful natural antioxidant source [64, 65].

Anti-diarrhoeal

In mice with castor oil-induced diarrhea, the methanol extract of *Cyperus rotundus* rhizome, administered orally at dosages of 250 and 500 mg/kg bowl, had strong antidiarrheal action. Following testing at 250 mg/kg, it was discovered that the residual methanol fraction (RMF) and petroleum ether fraction both retained their activity, with the RMF being significantly more active than the control group. There was no evidence of antidiarrheal activity in the ethyl acetate fraction [65, 66].

CONCLUSION

Due to its and potency, *Cyperus rotundus* is a potential medicinal plant. This study covers its life cycle, characteristics, microscopic features, chemical composition, pharmacological properties, and medicinal benefits.

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