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Medicinal uses and Pharmacological activities of *Cyperus rotundus* Linn – A Review

Sri Ranjani Sivapalan

Unit of Siddha Medicine
University of Jaffna, Sri Lanka
saisiva7@yahoo.co.in

Abstract- *Cyperus rotundus* Linn belong to the family Cyperaceae. It is the world worst weed native to India. It grows in small clump up to 100cm high. The extensive distribution of the nut-grass is due to its ability to adapt to a wide range of soil types, altitudes, temperatures, soil pH and moisture levels. It therefore grows in a variety of different habitats and environments. It has wide range of medicinal and pharmacological applications. According to the Ayurveda, *C.rotundus* rhizomes are considered astringent, diaphoretic, diuretic, analgesic, antispasmodic, aromatic, carminative, antitussive, emmenagogue, litholytic, sedative, stimulant, stomachic, vermifuge, tonic and antibacterial. This paper provides review on medicinal uses and various pharmacological properties of *C.rotundus* rhizome.

Index Terms- Anti-inflammatory, Anti-pyretic, Anti-malarial, *Cyperus rotundus*, Nut grass.

I. Introduction

Herbal medicine is a major component in all traditional medical systems, and a common element in Siddha, Ayurvedic, Homeopathic, Naturopathic, Traditional Chinese medicine, and Native American medicine. Plant materials are used throughout developed and developing countries as home remedies, over-the-counter drug products and raw materials for the pharmaceutical industry, and represent a substantial proportion of the global drug market. A perfect example of medicinal plant credited with innumerable medicinal qualities validated by modern science and used since ancient times is *C.rotundus* Linn. Family - *Cyperaceae* are the largest family in the monocotyledons consisting of 109 genera and approximately 5,500 species [1].

C.rotundus L., (Family-Cyperaceae), also known as purple nutsedge or nutgrass, is a common perennial weed with slender, scaly creeping rhizomes, bulbous at the base and arising singly from the tubers which are about 1-3 cm long. The tubers are externally blackish in colour and reddish white inside, with a characteristic odour. The stems grow to about 25 cm tall and the leaves are linear, dark green and grooved on the upper surface. Inflorescences are small, with 2-4 bracts, consisting of tiny flowers with a red-brown husk. The nut is three-angled, oblong-ovate, yellow in colour and black when ripe. *C.rotundus* is indigenous to India, but are now found in tropical, subtropical and temperate regions [2].

In Asian countries, the rhizomes of *C. rotundus*, which are used as traditional folk medicines for the treatment of stomach and bowel disorders, and inflammatory diseases, have been widely, investigated [3-5]. *C. rotundus* is a traditional herbal medicine used widely as analgesic, sedative, antispasmodic, antimalarial, stomach disorders and to relieve diarrhoea [6-7]. The tuber part of *C. rotundus* is one of the oldest known medicinal plants used for the treatment of dysmenorrheal and menstrual irregularities [8-9]. Infusion of this herb has been used in pain, fever, diarrhoea, dysentery, an emmenagogue and other intestinal problems [10]. It is a multipurpose plant, widely used in traditional medicine around the world to treat stomach ailments, wounds, boils and blisters [11-14].

A number of pharmacological and biological activities including anti-*Candida*, anti-inflammatory, antidiabetic, antidiarrhoeal, cytoprotective, antimutagenic, antimicrobial, antibacterial, antioxidant, cytotoxic and apoptotic, anti-pyretic and analgesic activities have been reported for this plant [15-24].

Previous phytochemical studies on *C.rotundus* revealed the presence of alkaloids, flavonoids, tannins, starch, glycosides and furochromones, and many novel sesquiterpenoids [25- 29].

Edible Parts: Rhizome

II.Medicinal Uses

According to the Ayurveda, *C. rotundus* rhizomes are considered astringent, diaphoretic, diuretic, analgesic, antispasmodic, aromatic, carminative, antitussive, emmenagogue, litholytic, sedative, stimulant, stomachic, vermifuge, tonic and antibacterial.

It may be a good remedy for indigestion in the light of constituents present in it, for example, there are many enzymes for carbohydrates and minerals which act as catalyst for various biochemical reactions and helps indigestion. It is also useful for dietary management of psychotic diseases and metabolic disorders [30].

They are used in treatment of Nausea and vomiting, dyspepsia, colic, flatulence, diarrhoea, dysentery, intestinal parasites, fever, malaria, cough, bronchitis, renal and vesical calculi, urinary tenesmus, skin diseases, wounds, amenorrhoea, dysmenorrhoea, deficient lactation, loss of memory, insect bites, food poisoning, indigestion, nausea, dysuria, bronchitis, infertility, cervical

cancer and menstrual disorders, and the aromatic oils are made of perfumes and splash [31-35].

III.CHEMICAL CONSTITUENTS

Several chemical compounds have been isolated from world's worst weed *C. rotundus* [36] and some of these chemicals possess medicinal properties and are used in Latin America, China, India and elsewhere [37-39]. Various preparations of *C. rotundus* have been used for centuries in perfumes, spices and traditional medicines in India, China, Arab and Africa. It is also an important ingredient of anti-aging Ayurvedic neutraceutical Chyavanprash [39].

Different phytochemical studies on *C.rotundus* revealed the presence of alkaloids, flavonoids, tannins, starch, glycosides, furochromones, monoterpenes, sesquiterpenes, sitosterol, fatty oil containing a neutral waxy substance, glycerol, linolenic, myristic and stearic acids [25, 29, 40-41]. The major compounds isolated from essential oil and the extracts of *C.rotundus* rhizome 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-o-neohesperidoside, Oleic-acid, P-cymol, Patchoulenone, Pectin, Polyphenols, Rotundene, Rotundenol, Rotundone, Selinatriene, Sitosterol, Stearic-acid, Sugeonol, Sugetriol [42-45].

C.rotundus contains an essential oil that provides for the characteristic odour and taste of the herb, comprised mostly sesquiterpene hydrocarbons, epoxides, ketones, monoterpenes and aliphatic alcohols. Sesquiterpenes include selinene, isocurcumenol, nootkatone, aristolone, isorotundene, cypera-2,4(15)-diene, and norrotundene, as well as the sesquiterpene alkaloids rotundines A-C. Other constituents include the ketone cyperadione, and the monoterpenes cineole, camphene and limonene. *C.rotundus* has also been shown to contain miscellaneous triterpenes including oleanolic acid and sitosterol, as well as flavonoids, sugars and minerals [44-45]

The chemical composition of the volatile oils of *C.rotundus* has been extensively studied and four chemotypes (H-, K-, M- O-types), of the essential oils from different parts of Asia have been reported [46-52].

The H-type from Japan was found to contain a-cyperone (36.6%), ß-selinene (18.5%), cyperol (7.4%) and caryophyllene (6.2%). The M-type from China, Hong Kong, Japan, Taiwan and Vietnam had a-cyperone (30.7%), cyperotundone (19.4%), ß-selinene (17.8%), cyperene (7.2%) and cyperol (5.6%). The O-type from Japan, Taiwan, Thailand, Hawaii and the Philippines was characterized by cyperene (30.8%), cyperotundone (13.1%) and ß-elemene (5.2%). In addition, the Hawaiian O-type had cyperotundone (25.0%) and cyperene (20.7%) as the major compounds. Finally, the K-type, also from Hawaii, was dominated by cyperene (28.7%), cyperotundone (8.8%), patchoulenyl acetate (8.0%) and sugeonyl acetate (6.9%) [47-48].

IV.PHARMACOLOGICAL ACTIVITIES

Anti Inflammatory Activity

The alcoholic extract (70% alcohol) possessed anti inflammatory activity against carrageenan induced oedema and also found effective against formaldehyde induced arthritis in albino rats [53]. In another study the petroleum ether extract of the rhizomes showed anti-inflammatory activity against carrageenan induced oedema in albino rats. The triterpenoid obtained by chromatographic separation from petroleum ether extract revealed a high potent anti-inflammatory activity. This terpenoid was also found to possess significant antipyretic and analgesic effects similar to acetyl salicylic acid. *C.rotundus* has also reported as protective in inflammatory bowel disease.

In addition, the extract suppressed the production of O2- by phorbol ester stimulated RAW 264.7 cells in dose- and time-dependent manners. Collectively, these results suggest that the methanol extract of rhizomes of *C. rotundus* could be developed as anti-inflammatory candidate for the treatment of inflammatory diseases mediated by overproduction of NO and O2 [54].

Another study on alcoholic extract of *C. rotundus* showed highly significant ($P<0.001$) anti-inflammatory activity against the exudative and proliferative phases of inflammation in two animal models (carrageenan induced oedema and formaldehyde induced arthritis in rats). Its anti-inflammatory relative effect was higher than that of hydrocortisone (75.9% versus 47.3% in carrageenan-induced oedema model; 55.1% versus 35.6% in formaldehyde induced arthritis model [27, 55-57].

Antipyretic activity

The alcoholic extract of *C. rotundus* showed highly significant ($P<0.001$) antipyretic activity against pyrexia produced in albino rats by the subcutaneous injection of suspension of dried Brewer's yeast in gum acacia in normal saline. A specific fraction obtained by chromatographic method from the petroleum ether extract was found to possess a significant anti-pyretic effect similar to acetyl salicylic acid when used on the same animal model [58].

Analgesic activity

The petroleum ether extract and essential oil of *C.rotundus* are reported to possess analgesic activity [58-59].

Tranqulizing activity

The ethanolic extract of *C. rotundus* showed potent tranquilizing activity in various tests: reduced the spontaneous motor activity, potentiated the pentobarbital narcosis and deranged the motor coordination, abolished the conditioned avoidance response in animals [55]

Anticonvulsant activity

Pretreatment with ethanolic extract of *C.rotundus* caused significant protection against strychnine and leptazol-induced convulsions in mice [60].

The ethanol extract of rhizomes (100mg/kg, p.o.) reduced hind limb extension and duration of convulsion significantly, ($p<0.001$) which was comparable to standard drug Phenytoin (25mg/kg, i.p.) and Diazepam (4mg/kg, i.p.), respectively. These results suggest that the ethanol extract of its rhizomes is worthwhile to develop the potent phytoconstituent for treatment of epilepsy and the flavonoids present in ethanol extract could be attributed for aiticonvulsant activity [61].

Anti-emetic activity

The ethanolic extract of *C. rotundus* in the dose of 128.1± 11.6 mg/kg was found to protect 50% dogs against apomorphine induced vomiting [55].

Antispatic activity

Ethanolic extract of *C. rotundus* produced relaxation of rabbit ileum and spasmolytic effect against contractions induced by acetylcholine, barium chloride and 5-hydroxitriptamine, showing a direct relaxant action on the smooth muscle [55].

Inhibition of gastric motility activity

The rhizome of *C.rotundus* Linn. was assessed for its cytoprotective effects against ethanol induced gastric damage. Decoctions of Rhizoma Cyperi were given orally to rats 30 min. before ethanol was administered. The findings in this study suggest that the protective action of *C. rotundus* Linn. is related to its inhibition of gastric motility and endogeneous prostaglandins may play an important role [62]

Gastroprotective activity

C.rotundus extract protected against gastric mucosal injury induced by ischemia and reperfusion in rats. The mean ulcer index of rats treated with 200 and 100 mg/kg *C. rotundus* were significantly lower than that of control. The activities of glutathione-peroxidase and malondialdehyde were significantly affected by treatment of *C. rotundus* [64]. Cytoprotective effects of *C.rotundus* have been mentioned also in case of ethanol induced gastric damage in rats. Decoctions of Rhizoma Cyperi were given orally (1.25, 2.5, 4.0 g crude drug/kg) to rats 30 min before ethanol showed an ulcer inhibitory effect in a dose dependent manner. Pretreatment of rats with indomethacin (5 mg/kg) significantly reduced the gastric protective action of *C. rotundus*. The authors suggested that the gastroprotective action of *C.rotundus* is related to its inhibition of gastric motility and endogeneous prostaglandins [62].

Antidiarrhoeal Activity

The methanol extract of *C. rotundus* rhizome, given orally at the doses of 250 and 500 mg/kg showed significant antidiarrhoeal activity in castor oil induced diarrhoea in mice. Among the fractions, tested at 250 mg/kg, the petroleum ether fraction and residual methanol fraction were found to retain the activity, the latter being more active as compared to the control. The ethyl acetate fraction did not show any antidiarrhoeal activity [2]

Haemodynamic (hypotensive) activity

The alcoholic extract of *C.rotundus* produced gradual and persistent fall in blood pressure and stimulated the respiration. The responses of epinephrine and acetylcholine on blood pressure were not altered by the extract, but that of histamine was partially blocked [55]

Hypolipidaemic Activity

Wistar rats weighing 250-300 g were selected for the study. Animals were divided into 7 groups, each group comprising of 6 rats. Rats in the group1 received normal pellet diet and received 0.1% sodium CMC solution and served as vehicle control. The rats belonging to remaining 6 groups received high fat diet for the entire duration of the study that is for 25 days. High fat diet induced hyperlipidaemia is one of the common methods to induce hyperlipidaemia. Hence hyperlipidaemia was induced by oral feeding of high fat diet. The high fat diet was comprised of the chow enriched with high calorie and 1% cholesterol. After 10 days induction of hyperlipidaemia group 2 of animals was left untreated and served as high fat diet control. The rest of the groups received following treatment for 15 days. Group 3 and group 4 treated orally with the standard drugs Simvastatin (5 mg/kg/day) and Fenofibrate (20 mg/kg/day) respectively. Groups 5, 6, 7 treated orally with aqueous extract at dose level of 100 mg/kg/day, 200 mg/kg/day, 400 mg/kg/day respectively. All the drugs were suspended in 0.1% Na CMC (vehicle). Blood samples were withdrawn from retro orbital plexus after overnight fasting. Serum was separated from blood by centrifugation for ten minutes at three thousand rpm, subsequently analyzed for total cholesterol, triglycerides and HDL cholesterol using commercially available kits (Erba Diagnostics Germany). The serum LDL was calculated by Friedwald's formula [65]

In another study administration of *C. rotundus* extract restored the age associated change in serum lipids (total cholesterol, LDL cholesterol, DL cholesterol, triglycerides and VLDL triglyceride level) to the level of young control rats. In young rats, treatment of *C. rotundus* significantly increased HDL cholesterol level [66].

Hepatoprotective activity

Ethyl acetate extract and two crude fractions, solvent ether and ethyl acetate, of the rhizomes of *C. rotundus* (Cyperaceae) were evaluated for hepatoprotective activity in rats by inducing liver damage by carbon tetrachloride. The ethyl acetate extract at an oral dose of 100 mg/kg exhibited a significant protective effect by lowering serum levels of glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, alkaline phosphatase and total bilirubin. These biochemical observations were supplemented by histopathological examination of liver sections. Silymarin was used as positive control [67].

Inhibitory activity on Brain Na +/K+-ATP-ase

Extract of *C. rotundus* showed high potent inhibitory activity on crude enzyme Na+/K+-ATP-ase from rat brain [68]

Anti-obesity activity

C. rotundus preparations (powder in fine suspension, aqueous and alcoholic extracts) exhibited a lipolytic action and mobilized fat from the adipose tissues in rats, thus helping to reduce the obesity [69].

A pilot study carried out on 30 obese people who were administered the powdered tuber of *C. rotundus* for 90 days,

showed reduction in weight along with a decrease in serum cholesterol and triglycerides [70].

Antiarthritic activity

Singh and his co-workers were first to discover anti-inflammatory, anti-pyretic and anti-rheumatic activity of *C. rotundus* [27,29,35]. A double blind trial of crude powder of *C. rotundus*, *Withania somnifera* and their combination (1:1) was carried out in 200 patients suffering from rheumatoid arthritis. Out of the 200 patients selected for the study 196 completed the trial of 3 months. Each group (including placebo group) consisted of 50 patients. Each patient received 500 mg capsule three times a day for three months. During this period biweekly general assessment based on global criteria (duration of morning stiffness, grip strength, articular index, consumption of escape analgesic, erythrocyte sedimentation rate, haemoglobin, rheumatoid factor titre, x-ray findings) was made. *C. rotundus* was more effective than W. somnifera, and when both drugs were combined, the response was better than the response of single drug. Also the patients' preference (against escape analgesic) was highest in the case of combined herbs [55-56,58, 71-72].

Wound healing activity

An alcoholic extract of tuber parts of *C.rotundus* was examined for wound healing activity in the form of ointment in three types of wound models on rats: the excision, the incision and dead space wound model. The extract ointments showed considerable difference in response in all the above said wound models as comparable to those of a standard drug nitrofurazone ointment (0.2 % w/w NFZ) in terms of wound contracting ability, wound closure time and tensile strength [73].

Antioxidant activity

A combination of spices (*Piper nigrum*, *Piper longum* and *Zingiber officinale*), herbs (*Cyperus rotundus* Linn. and *Plumbago zeylanica*) and salts make up Amrita Bindu. The study was focused to evaluate the antioxidant property of individual ingredients in Amrita Bindu against the free radical 2,2'-azinobis-(3-ethylbenzothiazoline-6sulphonicacid)(ABTS). The analysis revealed the antioxidant potential of the ingredients in the following order: *Piper nigrum> Piper longum> Cyperus rotundus> Plumbago zeylanca> Zingiber officinale.* These results reveal that Amrita Bindu, a salt-spice-herbal mixture containing *C. rotundus* Linn. exerts a promising antioxidant potential against free radical induced oxidative damage [74].

Anticancer activity

Anticancer *C. rotundus* ethanolic extract was found to have only weak to moderate anticancer activity (LC50=2.528-4.939 mg/ml calculated from dose-dependent cell death) in a study which used neuro-2a cells for screening of plants with tumoricidal effects [75]. Another study showed that *C.rotundus* essential oil was very effective against L1210 leukaemia cells line. This result correlated with significantly increased apoptotic DNA fragmentation [21].

Antidiabetic activity

Oral daily administration of 500 mg/kg of the extract (once a day for seven consecutive days) significantly lowered the blood glucose levels in rats with alloxan induced diabetes. The scientists concluded that this antihyperglycemic activity can be attributed to its antioxidant activity as C. rotundus showed a strong 1,1-diphenyl-2-picryihydrazyl (DPPH) radical scavenging action *in vitro*. These results are convergent with C. rotundus potential to suppress AGE formation and protein oxidation in a model of fructose-mediated protein glycoxidation. Scientists concluded that, since non-enzymatic glycation has been shown to correlate with severity of diabetes and its complications, C. rotundus could be a candidate for targeting diabetic complications [17, 76].

Antimicrobial activity

In-vitro antimicrobial activity by agar disc diffusion and agar well diffusion method was evaluated for aqueous and ethanolic extracts. The ethanolic extract was active against all the investigated bacterial strains, while aqueous extract was inactive. In another study acetone and ethanol extracts showed significant broad spectrum antibacterial activity in disc diffusion method [9, 77]. Antimicrobial activity tests were carried out on human pathogens bacteria (gram negative and gm positive) and ungi viz. *C.albicans* and *A. niger*. The highest percentage of inhibition was observed against *K.pneumoniae* (133.33%). Amoxicillin 20µg/ml and ethanol (as fungicide) 70% were used as positive control. Moderate inhibition was observed in case of *A. niger* and *S. aureus* (90and 70% respectively). No zone of inhibition was observed in *Acinto bacter* and *Candida.*

Antibacterial Activity

The oil of *C.rotundus* showed a remarkable activity against gram-positive bacteria Staphylococcus aureus and Enterococus faecalis [73,78]. Another study stated that a marked inhibitory effect of *C. rotundus* was observed against Salmonella enteritidis, Staphylococcus aureus and Enterococcus faecalis with total oligomers flavonoids (TOFs) and ethyl acetate extracts [79, 80].

Antimalarial Activity

Activity guided investigation of sesquiterpenes *C.rotundus* rhizomes showed *in-vitro* antimalarial activity against Plasmodium falciparum [81]. Some Tanzanian medicinal plants were extracted and tested for in vitro antimalarial activity, using the multidrug resistant K1 strain of Plasmodium falciparum. Of the forty-nine plants investigated, extracts of three plants were found to have an IC50 between 5-10 mg/ml; extracts of 18 other plants showed an IC50 between 10 and 50 mg/ml, all others were less active. The three most active extracts were obtained from the tubers of *C. rotundus* Linn. the root bark of *Hoslundia opposita* Vahl. and the root bark of *Lantana camara* L [6].

The underground parts of several weedy species contain essential oils, about 0.5-1% in the case of the fresh tubers of *C. rotundus*, mainly consisting of terpenoids or sesquiterpenoids (e.g. cyperone, cyperol, cyperolone, cyperene, copadiene, epoxy-guiaene, rotundone, rotundol, patchoulenone (cyperotundon), kobusone, sugeonolacetate, sugetriol, oxido-eudesmenol, C.

rotunduskone and 'BETA'-selinene).When Tanzanian medicinal plants were screened, *C. rotundus* showed activity in a test for in vitro antimalarial activity [82].

Ovicidal and larvicidal activities
The ovicidal and larvicidal efficacy of essential oils extracted from the tubers of Cyperus giganteus and Cyperus rotundus Linn. was studied on eggs and fourth instar larvae of Aedes albopictus . The eggs and larvae were exposed to serial concentration of the oils ranging from 5-150 ppm and kept under observation for 24h. Both the oils showed remarkable ovicidal and larvicidal activities indicated by EC50 values of <5 ppm and LC50 and LC90 values of <20 ppm. The results obtained suggest that the essential oils of these Cyperus species can serve as a potential source of natural mosquitocidal agents [83]

Anti Candida activity,
Essential oils and alcoholic extracts from the leaves and/or roots of 35 medicinal plants commonly used in Brazil were screened for anti *Candida albicans* activity. Essential oils from 13 plants showed anti Candida activity, including *Aloysia triphylla, Anthemis nobilis, Cymbopogon martini, Cymbopogon winterianus, Cyperus articulatus,* ***Cyperus rotundus*** **Linn.,** *Lippia alba, Mentha arvensis, Mikania glomerata, Mentha piperita, Mentha sp., Stachys byzantina,* and *Solidago chilensis*. The ethanol extract was not effective at any of the concentrations tested. Chemical analyses showed the presence of compounds with known antimicrobial activity, including 1,8-cineole, geranial, germacrene-D, limonene, linalool, and menthol [84].

Cytoprotective effects
The rhizome of *C. rotundus* was assessed for its cytoprotective effects against ethanol induced gastric damage. Decoctions of Rhizoma Cyperi were given orally (1.25, 2.5, 4.0 g crude drug/kg) to rats 30 min before ethanol (40% v/v, 10mL/kg) was administered. The decoction showed an ulcer inhibitory effect in a dose dependent manner. Moreover, the activity was also observed when the decoction was given subcutaneously (0.3-0.6 g/kg), suggesting that the herb possessed systemic effects on protecting the stomach. Compared with controls, gastric motility of the ethanol-treated rats was delayed significantly by either oral (2.5-4.0 g/kg) or subcutaneous (0.3g/kg) administration of the decoction. Pretreatment of rats with indomethacin (5 mg/kg) significantly reduced the gastric protective action of *C. rotundus* [85].

Toxicological studies
Rats were divided into two groups of ten animals (five males, five females). The ethanol extract (2,500 mg/ml in 10% dimethylsulfoxide, DMSO) was orally administered to rats at a single dose of 5,000 mg/kg body weight, while the control group received only vehicle. The animals were monitored for the appearance of toxicity signs over 14 days. The animals that died within this period were necropsied. All rats were weighed and sacrificed on the 14th day following administration. Finally, the vital organs including heart, lungs, livers, kidneys, spleen, adrenals, sex organs and brain were grossly examined.

In the acute toxicity test at the dose of 5,000 mg/kg, all rats did not exhibit signs of toxicity and mortality after a single oral administration of 95% ethanol extract from the rhizomes of *C. rotundus*. Results of the subacute toxicity showed that administration of the ethanol extract from the rhizomes of *C. rotundus* at a dose of 1,000 mg/kg daily over 14 days did not cause mortality or behavioral changes [86].

Another study for the purpose of the test, in bred wistar strain rats (250-300 g) of both sexes were selected. The animals were housed in polypropylene cages (6rats per cage) under good hygienic conditions natural light / dark cycle. The animals were given free access to standard pellet diet and water. The acute toxicity study was carried out as per OECD guideline (OECD/OCDE 423 OECD Guideline for testing of chemicals Acute Oral Toxicity –Acute Toxic Class Method Adopted: 17th December 2001). Thus the oral acute toxicity tests revealed that the extract of *C.rotundus* rhizomes was safe up to the administered dose 2000 mg/kg.

Another acute toxicological studies showed no mortality or morbidity up to 2000mg/kg body weight in Wistar rats. Sub chronic toxicity study revealed that, food, water consumption and body weight of animals didn't vary significantly. But the hematological parameters showed an increase in WBC count and Hemoglobin level. The kidney function and liver function didn't change even after long term exposure [87].

V. Discussion

C. rotundus Linn., commonly known as nut grass and locally. It is said to possess antidiarrheal, anti-inflammatory and antipyretic activities. The tubers are used in Ayurvedic medicine and have been mentioned in ancient texts for various ailments. Some studies have reported antidiarrheal activity of *C.rotundus*. Antidiarrheal action in castor oil-induced diarrhoea and in irritable bowel syndrome in animal models has been demonstrated. Previous studies with the essential oil of *C. rotundus* showed it to be more bactericidal against Gram-positive bacteria.

The major constituents present in *C.rotundus* are essential oil, triterpenes, polyphenol, alkaloids and flavonoids. However, none of these have been attributed with antidiarrheal activity.

The decoction used showed the presence of carbohydrates, reducing sugars, proteins, amino acids, tannins, flavonoids and saponins. Tannins and flavonoids, in general, have been reported to have antidiarrheal activity.

This study shows that *C.rotundus* has limited antimicrobial action and have. *C. rotundus* with a large number of biologically active phytochemicals has diverse variety of pharmacological properties, as described above, has been found effective in the treatment of chronic disorders. Its therapeutic effects are excellent and no adverse reaction was observed.

VI. Conclusion

The above collected information suggest that *C. rotundus* has limited activity against different forms of infectious diarrhoea due to its selective activity against diarrheal pathogens. Traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and generally believed to be safe for human use. Thorough screening of literature available on *C. rotundus* depicted the fact that it is a popular remedy among the various ethnic groups, Ayurvedic and traditional practitioners for treatment of ailments. Researchers are exploring the therapeutic potential of this plant as it has more therapeutic properties which are not known.

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Author:
Dr.(Mrs).Sri Ranjani Sivapalan
M'Phil, PGDHM, Ph.D.
Senior Lecturer Gr 1,
Unit of Siddha Medicine,
University of Jaffna,
Sri Lanka
saisiva7@yahoo.co.in