



Medicinal & biological uses of *Cyperus rotundus*

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ABSTRACT

Cyperus scariosus R. Br. (Family Cyperaceae), is an important medicinal plant in Indian System of Medicine found wildy in different parts of the country. It is pestiferous perennial, delicate slender sedge wildy used for extraction of essential oil. Phytochemical studies have shown that the essential oil consists of polyphenol, flavonol, glycoside, alkaloid, saponins, sesquiterpenoids as major chemical components of this herb. The essential oil of rhizomes of *C. scariosus* have pleasant aromatic odour and possess various biological activities such as anti-inflammatory, anti-microbial, anti-fungal, antioxidants, growth regulating properties, analgesis, antidiabetic, hypotensive and splasmolytic. The phytochemical and pharmacological activities of *C. scariosus* have supported its traditional as well as prospective uses as a valuable ayurvedic plant. This review covers the phytochemistry and pharmacological activites of the plant and its essential oil.

Keywords

Cyperus scariosus, Essential oil, Pharmacological activities, Phytochemistry

HISTORY

C. rotundus was part of a set of starchy tuberous sedges that may have been eaten by Pliocene hominins.

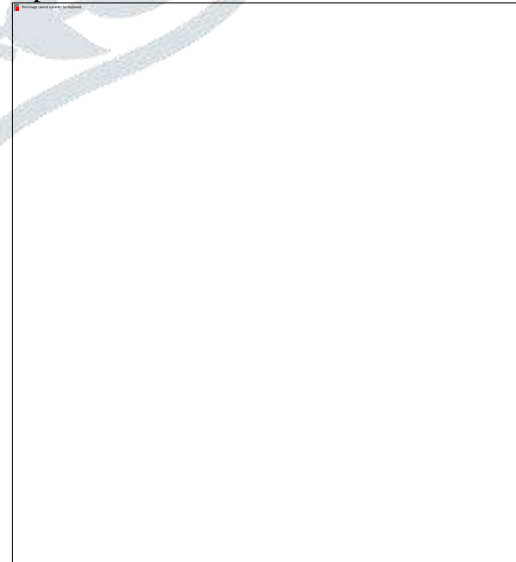
Biomarkers and microscopic evidence of *C. rotundus* are present in human dental calculus found at the Al Khiday.

archaeological complex in central Sudan dating from before 6700 BC to the Meroitic pre-Islamic Kingdom

of 300–400 AD. It is suggested that *C. rotundus* consumption may have contributed to the relatively low frequency of dental caries among the Meroitic population of Al Khiday because of its ability to inhibit *Streptococcus mutans*.

C. rotundus was employed in ancient Egypt, Mycenaean Greece, and elsewhere as an aromatic and to purify water.

It was used by ancient Greek physicians Theophrastus, Pliny the Elder, and Dioscorides as both medicine and perfume.



Morphology

It belongs to Kingdom- Plantae, order Poales, Family - Cyperaceae, Genus - *Cyperus* and species - *scariosus*.

The genus *Cyperus* is pantropical extending into warm temperate regions.

□ In India, *Cyperus scariosus* is widely distributed especially in Chhattisgarh, Bihar, Orissa, in damp places in Uttar Pradesh, Madhya Pradesh and Bengal (Chopra et al. 1986, Jain 1991)

□ It is also found in South Africa, China and Pacific Islands. The color of this plant is initially white, eventually turning brown or black and has the muddy odor.

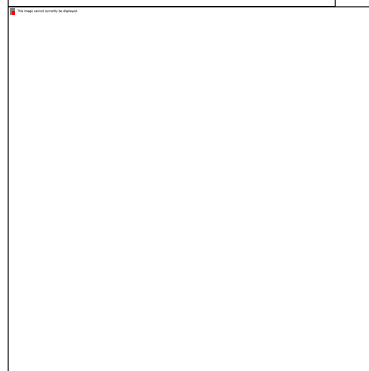
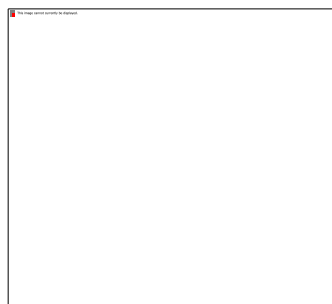
□ Stolons are 10-20 cm long crowded with a number of rhizomes that are bluntly conical and vary in size and thickness.

□ They are initially white, fleshy with scaly leaves and later with increase in age become fibrous and wiry.

□ These mixture of scattered vascular strands and ground parenchyma tissue, the latter showing all features of cortical parenchyma.

□ Each vascular strand is concentric with phloem in the center and xylem surrounding it. Some of the phloem cells also contain tannin, but rarely alkaloid-terpenoid complex (Adams et al. 2013)

Structure of the *Cyperus rotundus*



PHARMACOLOGICAL ACTIVITIES

□ Pharmacological activities *Cyperus* has numerous chemical constituents, mainly sesquiterpenoids most of which show pharmacological activity as investigated and reported by many workers

Anti-nociceptive activity

□ Anti-nociceptive activity of methanol extract of *C. scariosus* leaves was examined by Alam et al. (2011).

□ Mice were separated into five groups containing seven mice each. Group I served as control (1% Tween 80 in water, 10 mg/kg body weight). Aspirin was administered to Group-II mice at a dose of 200 mg/kg body weight. Groups-III to V was given 50, 100 and 200 mg/kg body weight of the extract, respectively orally 30 min before acetic acid injection. In all groups, pain was induced through intraperitoneal administration of 1% acetic acid at a dose of 10 ml/kg body weight. A period of 5 minutes was given to each animal and then, the number of writhings was counted for 10 min.



□ It was found that with methanol extract of leaves, the maximum inhibition of writhing (46.62%) was obtained at the dose of 200 mg extract/kg body weight ($p < 0.01$), whereas the standard, aspirin caused 56.74% ($p < 0.001$) writhing inhibition at the same dose.

Hypotensive and Spasmolytic activity

□ Intravenous administration of hydro-methanolic extract of *Cyperus scariosus* (3-10 mg/kg) produced hypotensive and bradycardiac effects. These effects remained unaltered in atropinized animals indicating that cardiovascular effects of the plant extract are not mediated through activation of muscarinic receptors.

□ In vitro studies, it suppressed the spontaneous contractions of guinea-pig paired atria, rat uterus and rabbit jejunum in a concentration-dependent (0.1-1 mg/ml) manner.

□ It also inhibited histamine or acetylcholine-induced contractions of guinea-pig ileum indicating nonspecific spasmolytic action.

□ In rabbit aorta, it inhibited norepinephrine (10 pM) as well as K^+ (80 mM)-induced contractions at similar concentrations (0.1-1 mg/ml).

○ These data indicate that *Cyperus scariosus* constituent(s) which may explain hypotensive effect observed in vivo and the general spasmolytic activity of plant may explain its folkloric use in diarrhea (Gilani et al. 1994)

Hepatoprotective activity

- The aqueous-methanolic extract of *Cyperus scariosus* was investigated for hepatoprotective activity against acetaminophen and CCl₄-induced hepatic damage.
- Complete mortality was observed at a dose of 1 g/kg in mice on treatment with Acetaminophen while pretreatment with plant extract (500 mg/kg) reduced the death rate to 30% of animals.
- Acetaminophen at a dose of 640 mg/kg resulted in rise in serum levels of alkaline phosphatase (ALP), glutamate

produced liver damage in rats. □ Pretreatment of rats with plant extract (500 mg/kg) significantly lowered ($P < 0.05$) the respective serum ALP, GOT and GPT levels. □ The same dose of plant extract (500 mg/kg) was able to significantly prevent ($P < 0.05$) CCl₄-induced rise in serum enzymes and also prevented CCl₄-induced prolongation in pentobarbital sleeping time (Gilani and Janbaz 1995)

Hypersensitivity

- *C. scariosus* chloroform fraction inhibits T cell responses in Balb/c mice in both humoral and cell mediated immune responses on p.o administration significantly $p < 0.01$ by suppressing primary (26.8%) and secondary (29.7%) antibody titres and also inhibited cell mediated delayed type hypersensitivity immune response (45.9%) at 600mg/kg dose phagocytosis both in vitro (37.4%) and ex vivo (37.8%) and delayed the graft rejection time (45.8%), thus confirming marked immunosuppression. Chloroform fraction significantly $p < 0.01$ suppressed CD8⁺/CD4⁺T cell surface markers (14.0/25.3%) and intra-cellular Th1 cytokines, viz IL-2(34.4%) and IFN- γ (34.7%) compared to cyclosporine-A,
- a standard T cell inhibitor 53.6% which was given to Balb/c mice at 200 mg/kg dose. *C. scariosus* did not show significantly $p < 0.01$ suppress Th2 (IL-4) system (Bhagwat et al. 2009)

Antidepressant activity

- The n-hexane extract of *C. scariosus* oil exhibited antidepressant activity in mice. With two dose levels at 100 and 200mg/kg antidepressant activity was screened using forced swim test and tail suspension test in mice and results were compared with standard drug (imipramine) at 15mg/kg.
- *C. scariosus* n-hexane extract oil significantly $p < 0.001$ reduced the immobility time in both dose levels at FST and TST which is similar to standard drug imipramine.
- The nhexane extract of *C. scariosus* oil may show antidepressant activity due to increase of nor epinephrine level in synapses (Ramesh et al. 2012)

Micro propagation

- oxaloacetate transaminase (GOT) and glutamate pyruvate transaminase and

□ *C. scariosus* axillary bud explants inoculated on SH medium, supplemented with different concentrations of Benzyl adenine, Kinetin and Indole-3-butyric acid for in vitro regeneration.

□ Maximum numbers of shoots observed on media containing 1.0mg/l BA and 1.0mg/l Kn after 2 weeks of culture inoculation. Kn 1mg/lit with Adenosine 1mg/lit and Charcoal 500mg/lit gave best results in rooting from shoots. Efficient flowering 80% was recorded on SH media with Kn 0.75mg/lit+ADS1.0mg/lit+activated charcoal 500 mg/lit. Multiple shooting and multiple rooting was effective on full strength SH medium supplemented .

□ with Kn 1.5mg/lit+ADS1.0mg/lit+ activated charcoal 500mg/lit+5% coconut water (Lavanya et al. 2005) .

Anti-hyperglycemic activity

□ Glucose tolerance property of *C. scariosus* leaves was determined on mice. Six groups of fasted seven mice each were made. Group-I served as control and received 1% Tween 80 in water, 10 ml/kg of body weight and, Group-II received standard drug (glibenclamide, 10 mg/kg of body weight) and the other four groups received four different doses of the methanol extract of *C. scariosus* leaves.

□ After a period of one hour, a dose of 2 g/kg of body weight of glucose were orally administered to all mice and after two hours of the glucose administration blood samples were collected. Serum glucose levels were measured by glucose oxidase method.

□ The results revealed that the methanol extract exhibited dose-dependent activity.

□ The increase in dose of the extract showed significant effect as compared to the control. The maximum inhibition effect was found with the dose of 400 mg extract/kg body weight (46.86%), which was close to that of the standard drug glibenclamide (57.62%) at 10 mg/kg body weight dose. (Alam et al. 2011)

Hypolipidemic activity

□ Chawda et al. (2014) [7] studied the lipid lowering and antioxidant activities of a hydroalcoholic extract of *Cyperus scariosus* Linn. root (HCS) on guinea pigs fed with a high cholesterol diet.

□ Both doses of hydroalcoholic extract of *Cyperus scariosus* decreased serum lipid profile and atherogenic indices ($P < 0.05$). The higher dose of hydroalcoholic extract also reduced serum AST, ALP, and LDH levels and rosuvastatin increased AST and ALP levels ($P < 0.05$).

□ In treated animals, decreased lipid accumulation and improvement in hepatocytes was observed on histology of the liver and it may be due to the antioxidant activity of extract contained phenolic compounds.

Acute toxicity study

□ Acute toxicity test was carried out by Alam et al. (2011)

□ Animals were divided into nine groups and each group contained six animals. The control group was given 1% Tween 80 in normal saline (2 ml/kg body weight).

□ The other groups received 100, 200, 300, 600, 800, 1000, 2000 and 3000 mg/kg of the methanol extract of leaves. For the next 8 hours the animals were remained under close observation and were sustained up to 14 days for any mortality to take place. No mortality was observed with any of the extract doses till the end of the observation period of 14 days. Other Acute toxicity study using albino rats was done.

Overnight fasted rats were administered with different fractions of essential oils at 5000 mg/kg, p.o. After 24 hrs no mortality was found. 250, 500, and 750 mg/kg, p.o. doses were selected for the further study.

Phytotoxicity activity

□ studied the phytotoxicity activity of *C. scariosus* plant against maize (*Zea mays*) seeds.

□ The results showed that methanolic extract of *C. scariosus* showed minimum stalk growth and maximum stalk and root inhibition using 3 mg/ml as compared to control. The order of effect of

□ *C. scariosus* plant on stalk and root growth after 5 and 10 days may be written as; 3mg/ml > 1.5mg/ml > 0.75mg/ml > 0.37mg/ml. The phytotoxic results obtained from the methanolic extract showed that inhibition of the germination of roots and shoots of the maize (*Zea mays*) plants occurred but not to a significant level as compared to the other

medicinal plants.

chromatographic technique.

Antioxidant activity

- The 50% methanolic extracts of *C. scariosus* obtained from different plant parts contained significant amounts of polyphenols with superior antioxidant activity as evidenced by the scavenging of DPPH·, ABTS·+, NO, ·OH, O₂·- and ONOO·-.
- It showed significant potential for preventing oxidative DNA damage and radical scavenging activity.
- The extracts showed significantly high total phenolic Content and total flavonoid contents which contribute to their antioxidant activities (Kalim et al. 2010)
- Investigate the T cell inhibition potential of 50% ethanol extract of *C. scariosus*

Antifungal activity

- Essential oils from leaves of 14 plants were tested for their antifungal properties against 6 dermatophytes (*Keratinomycesajelloi*, *Microsporum gypseum*, *Trichophyton equinum*, *T. mentagrophytes*, *T. rubrum* and *T. terrestris*). Essential oil from *Cyperus scariosus* showed high activity against all the dermatophytes, while oils from *Murraya koenigii*, *Thuj aorientalis*, *Mimusops elengi* and *Cymbopogon martini var. motia* were active against some of the fungi
- out the antifungal activity of steam distilled essential oil, hexane extract of fresh and distilled *C. scariosus* rhizome from Uttar Pradesh (India) and Madhya Pradesh (India) against the phyto-pathogenic fungus *Rhizoctonia solani*.
- The ED₅₀ of steam distilled oil of U.P. and M.P. was recorded as 512 and 517 µg/ml respectively, while fresh rhizomes from U.P. and M.P. showed the highest fungitoxicity with ED₅₀ of 448 and 478 µg/ml respectively.
- The oil obtained from distilled rhizomes showed least activity with ED₅₀ of 1007 µg/ml in case of up oil and 1032 µg/ml in case of M.P. oil.

Antibacterial activity

- Longiverbenone is a naturally occurring sesquiterpene isolated from ethanolic extract of *Cyperus scariosus* rhizome by solvent-solvent portioning and

- The antibacterial activity longiverbenone was evaluated against eleven potential human pathogenic bacteria using disc diffusion method.
- Minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) were determined by broth macrodilution method (Rahman and Anwar 2008)

Cytotoxic activity

- Cytotoxic activity (lethal concentration 50%, LC₅₀) of longiverbenone was determined on new borne brine shrimp (*Artemia salina*).
- It showed moderate to good antibacterial activity against the test organisms tested herein. It exhibited the lowest MIC (20 µg/ml) and MBC (80 µg/ml) against *Vibrio cholerae*. The LC₅₀ of the isolated sesquiterpene was found to be 14.38 µg/ml against new borne brine shrimp (Rahman and Anwar 2008)

Larvicidal and ovidical activity

- The larvicidal and ovidical effects of *Cyperus scariosus* essential oil was investigated against the fourth-instar larvae of *S.litura* by Elumalai et al. (2010)
- The essential oil showed moderate toxic effect on lepidopteran agricultural pest of armyworm after 24hr of exposure. The shoot of *C. Scariosus* showed good larvicidal activity (LC₅₀ = 27.3, 29, 30.6, 31.2, LC₉₅ = 43.6, 48.2, 56 and 51.4 ppm) and moderate ovidical effect.

#. Conclusions

- *C. scariosus* is a very popular medicinal herb in Indian Ayurvedic medicine systems with various pharmacological and traditional uses. Due to its various ethnomedical, pharmacological and therapeutic properties this plant species has been used to develop nutraceuticals and pharmacological products and indicating its effectiveness against several diseases.
- The rhizomes and tubers of *C. scariosus* contain varying concentrations of volatile oils, flavonoids, phenolic acids, coumarins, steroids, and iridoid glycosides.
- The volatile essential oil mainly consists

of sesquiterpenoids. So far, this plant species investigations have been limited to the extraction, identification and biological properties of extracts and essential oil.

- Therefore, more diverse studies on the chemical compounds present in the extracts and essential are needed to study to characterize the metabolites responsible for these activities. In conclusion, due to presence of several phytochemicals, *C. scariosus* has a great potential for use in pharmaceutical industries.

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