



Beneficial Medicinal Utilization of *Cyperus rotundus* Plant Parts

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Received: 📅 August 01, 2023

Published: 📅 August 30, 2023

Abstract

Cyperus rotundus is a smooth, erect, and perennial herb having wiry, slender, scaly, creeping, dark and persistent rhizomes. The rhizomes of *C. rotundus* are used as traditional folk medicines for the treatment of stomach and bowel disorders, and inflammatory diseases. The tuber part of *C. rotundus* is one of the oldest known medicinal plants used for the treatment of dysmenorrhoeal and menstrual irregularities. Infusion of this herb has been used in pain, fever, diarrhoea, dysentery, an emmenagogue and other intestinal problems. Tubers are used to treat loss of appetite, excess bleeding, blisters, boils, cough, diarrhea, fevers, inflammation, lacteal disorders, rheumatoid arthritis, stomach ailments, skin rashes, excessive thirst, vomiting, worm infestation and wounds. It is a multipurpose plant, widely used in traditional medicine around the world to treat stomach ailments, wounds, boils and blisters. The tubers improve blood circulation and are effective in gynecological diseases caused by blood stagnation. The tuber extracts are more effective for repellency of the entire mosquito vector even at a low dose. *C. rotundus* ranked first because after 10 s, all the test animals (ants) died (10); Organophosphate ranked second with 9 ants dead after 10 s; and the last was Carbamate with seven dead after 12s.

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 carried out by this plant. 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. rotundus* cone, Myristic-acid, Oleanolic-acid, Oleanolic-acid-3-o-neohesperidoside, Oleic-acid, P-cymol, Patchoulone, Pectin, Polyphenols, Rotundene, Rotundenol, Rotundone, Selinatriene, Sitosterol, Stearic-acid, Sugeonol, Sugetriol. The alcoholic extract (70% alcohol) possessed anti-inflammatory activity against carrageenan induced oedema and found effective against formaldehyde induced arthritis in albino rats.

Methanol extract of rhizomes of *C. rotundus* could be developed as an anti-inflammatory candidate for the treatment of inflammatory diseases mediated by overproduction of NO and O₂. 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). The petroleum ether extract and essential oil of *C. rotundus* possess analgesic activity. 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 anticonvulsant activity. Pretreatment with ethanolic extract of *C. rotundus* caused significant protection against strychnine and leptazol-induced convulsions. The plant contains the following chemical constituents; cyprotene, acopaene, cyperene, aselinene, rotundene, valencene, cyperol, gurjunene, trans-calamenene, dcaadinene, gcalacorene, cadalene, amurolene, gmuurolene, cyperotundone, mustakone, isocyperol, acyperone, 4,11-selinadien-3-one and 1,8-cineole.

The oil of *C. rotundus* was mainly composed of cyperol, α -cyperene, rotundine, α -cyperone, α -copaene, valeranal, myrtenol, β -pinene, α -pinene and α -Selinene, sesquiterpene hydrocarbons (Caryophyllene). In Ayurvedic medicine, the rhizomes are considered as an analgesic, antiseptic, antispasmodic, antitussive, aromatic, astringent, carminative, diaphoretic, diuretic, emmenagogue, litholytic, sedative, stimulant, stomachic, vermifuge and tonic; prescribed to treat amenorrhea, bronchitis, cervical cancer, colic, cough, diarrhea, dysentery, dysmenorrhea, dyspepsia, dysuria, fever, flatulence, food toxicity, indigestion, infertility, insect bites, intestinal parasites, deficient lactation, malaria, loss of memory, menstrual disorders, nausea, renal and vesical calculi, skin diseases, urinary tenesmus, vomiting and wounds. The rhizome mixed with ginger and honey is ingested against dysentery and gastric and intestinal troubles. A fresh tuber paste is applied to the breast as a galactagogue.

Keywords: *Cyperus rotundus*; traditional folk medicines; loss of appetite; blisters; inflammation

Introduction

Cyperus rotundus is reported as both native and introduced to the majority of the world based on various sources [1,2]. Purple nutsedge and yellow nutsedge are the most troublesome weeds of vegetable crops in Alabama, Georgia, Mississippi, Tennessee, and Texas [3-5]. Based solely on the lack of nutsedge control with methyl bromide alternatives, a critical-use exemption for methyl bromide was granted for several vegetable crops in Georgia beyond 2005 [6,5]. In the United States, it is considered that it was unintentionally introduced during the 1800s [7]. Rogers and colleagues [8] tested the effects of a rise in atmospheric CO₂ on purple nutsedge in controlled studies. Purple nutsedge exposed to elevated CO₂ had greater total dry weight, leaf area, root length and numbers of tubers and tended to increase allocation belowground, which led to greater root-to-shoot ratio (R:S). These findings suggest that purple nutsedge may be more invasive in a future high-CO₂ world [8], however, the experiment did not account for the competitive impact of other biota. The use of chickens and geese to control nut grass *Cyperus rotundus* has also been promoted in Palau and the United States [9].

It is less tolerant of low temperatures and shaded areas than yellow nutsedge [8]. Travlos and colleagues [10], however, claim that purple nutsedge is one of the most serious weed problems of arid and semiarid environments. Moreover, *C. rotundus* is one of the most common weeds of the secondary succession occurring in abandoned and dry fields of arid environments [10]. A single purple nutsedge tuber can produce 100 tubers when allowed to grow for 12 weeks [11]. A patch originating from a single tuber can expand up to 5.5m² and produce 750 shoots within 6 months [11,12]. Several chemical compounds have been isolated from world's worst weed *Cyperus rotundus* [13,14] and some of these chemicals possess medicinal properties and are used in Latin America, China and elsewhere [15]. For example, decoctions of the plant in Brazil are used for their anti-infective and anti-inflammatory properties [15]. Various preparations of *C. rotundus* have been used for centuries in perfumes, spices and traditional medicines in India, China, Arab and Africa [15]. *C. rotundus* is also an important ingredient of anti-

aging Ayurvedic nutraceutical Chyavanprash [herbal supplement] [15].

Pigs eat its tubers; however, it makes a poor fodder species; it is also reportedly used as a soil stabilizer [16]. *Athesapeuta* [sic] cyperi Marshall (Coleoptera: Curculionidae) was released in 1981 as a biocontrol agent against *C. rotundus* and probably failed to establish [17]. The larvae feed internally, and adults feed externally on foliage [17]. Purple nutsedge and yellow nutsedge are the most troublesome weeds of vegetable crops in Georgia and many states in the southern United States [4]. Cyperaceae are the largest family in the monocotyledons consisting of 109 genera and approximately 5,500 species [19]. 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 [20]. 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 [21]. The tuber part of *C. rotundus* is one of the oldest known medicinal plants used for the treatment of dysmenorrheal and menstrual irregularities [21, 23]. Infusion of this herb has been used in pain, fever, diarrhoea, dysentery, an emmenagogue and other intestinal problems [23].

It is a multipurpose plant, widely used in traditional medicine around the world to treat stomach ailments, wounds, boils and blisters [24,25]. A number of pharmacological and biological activities including anti-Candida, anti-inflammatory, antidiabetic, anti-diarrhoeal, cytoprotective, antimutagenic, antimicrobial, antibacterial, antioxidant, cytotoxic and apoptotic, anti-pyretic and analgesic activities have been reported for this plant [26-30]. Previous phytochemical studies on *C. rotundus* revealed the presence of alkaloids, flavonoids, tannins, starch, glycosides and furochromones, and many novel sesquiterpenoids [32]. Several chemical compounds have been isolated from the world's worst weed *C. rotundus* [14] and some of these chemicals possess medicinal properties and are used in Latin America, China, India and elsewhere [15,16]. 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. rotundus* kone, Myristic-acid, Oleanolic-acid, Oleanolic-acid-3-o-neohesperidoside, Oleic-acid, P-cymol, Patchoulone, Pectin, Polyphenols, Rotundene, Rotundenol, Rotundone, Selinatriene, Sitosterol, Stearic-acid, Sugeonol, Sugetriol [31-32].

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 [25,29].

The alcoholic extract (70% alcohol) possessed anti-inflammatory activity against carrageenan induced oedema and also found effective against formaldehyde induced arthritis in albino rats [33]. 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 [21]. 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 [34]. The petroleum ether extract and essential oil of *C. rotundus* are reported to possess analgesic activity [35,36]. Pretreatment with ethanolic extract of *C. rotundus* caused significant protection against strychnine and leptazol-induced convulsions in mice [29]. 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 anticonvulsant activity [3].

The plant contains the following chemical constituents; cyprotene, acopaene, cyperene, aselinene, rotundene, valencene, cyperol, gurjunene, trans-calamenene, dcadinene, gcalacorene, cadalene, amuurolene, gmuurolene, cyperotundone, mustakone, isocyperol, acyperone, [38] 4,11-selinnadien-3-one and 1,8-cineole [39]. The oil of *C. rotundus* was mainly composed of cyperol, α -cyperene, rotundine, α -cyperone, α -copaene, valeranal, myrtenol, β -pinene, α -pinene and α -Selinene, sesquiterpene hydrocarbons (Caryophyllene) [40,41]. Diuretic, carminative, emmenagogue, anthelmintic, stomachic, stimulant, analgesic, hypotensive, anti-inflammatory, antidysenteric, antirheumatic [42]. The essential oil (0.5-0.9%) from the tuber is used in perfumery, soap making and insect repellent cream [43]. The decoration of rhizome with leaves of *Fuaria indica*, *Swertia chirayita*, black pepper and ginger was used to treat typhoid fever. Rhizome juice is given in the dose of 25 ml thrice daily for 3 days to treat constipation [44]. The results obtained suggested that the essential oils of these *Cyperus* species can serve as a potential source of natural mosquitocidal agents [45].

The *C. rotundus* tuber extract was used to determine their effect on mosquito vector and comparison with the N, N-diethyl-3-methylbenzamide. Results obtained from the laboratory experiment showed that the tuber extracts are more effective for repellency of the entire mosquito vector even at a low dose [46]. Result shows that *C. rotundus* ranked first because after 10 s, all the test animals (ants) died (10); Organophosphate ranked second with 9 ants dead after 10 s; and the last was Carbamate with seven dead after 12 s [47]. Total oligomers flavonoids (TOF), ethyl acetate and methanol extracts showed IC₅₀ values of 15, 14 and 20 g/ml, respectively [29]. These results indicated that ACR produces its anti-diarrheal effect through decreasing intestinal secretions and anti-spasmodic effect by inhibiting the intestinal motility [48]. The inflorescence consists of a few slender branches with the longest, usually not more than about 7.5cm spikes. The nut is oblong, ovate, and nearly half as long as the glume, strongly 3-angled, yellow or black when ripe [49].

The reported chemical compounds of *C. rotundus* are α -cyperone, α -rotunol, β -cyperone, β -pinene, β -rotunol, Beta-selinene, Calcium, Camphene, Copaene, Cyperene, Cyperenone, Cyperol, Cyperolone Cyperotundone Dcopadiene, D-epoxyguaiene, D-fructose, D-glucose, Flavonoids, Gamma-cymene, Isocyperol, Isokobusone, Kobusone, Limonene, Linoleic-acid, Linolenic-acid, Magnesium, Manganese, *Rotundus* kone, Myristic-acid, Oleanolic-acid, Oleanolic-acid-3-oneohesperidoside, Oleic-acid, p-cymol, Patchoulone, Pectin, Polyphenols, Rotundene, Rotundenol, Rotundone, Selinatriene, Sitosterol, Stearic-acid, Sugeonol, Sugetriol [13,29,32,50]. Previously Arshad et al. [51] reported the antiulcer activity on *C. rotundus* by single high dose but in this study in the continuation of our previous work [52,53] we used low dose sub chronic study (14 days) in which *C. rotundus* extract was administered orally at 300 and 500 mg/kg. Since ulcer is present in acute and chronic conditions [54] therefore, this antiulcer study on *C. rotundus* gives an additive beneficial profile. Microscopic study has been carried out by Sharma and Singh [15] and Rai et al. [28] but this is expanded work to see the active constituents and markers by powder drug study (using three solvents) and FTIR spectroscopy.

It is a smooth, erect and perennial herb having wiry, slender, scaly, creeping, dark and persistent rhizomes [44]. Its tubers are used to treat loss of appetite, excess bleeding, blisters, boils, cough, diarrhea, fevers, inflammation, lacteal disorders, rheumatoid arthritis, stomach ailments, skin rashes, excessive thirst, vomiting, worm infestation and wounds [55]. In Ayurvedic medicine, the rhizomes are considered as an analgesic, antiseptic, antispasmodic, antitussive, aromatic, astringent, carminative, diaphoretic, diuretic, emmenagogue, litholytic, sedative, stimulant, stomachic, vermifuge and tonic; prescribed to treat amenorrhea, bronchitis, cervical cancer, colic, cough, diarrhea, dysentery, dysmenorrhea, dyspepsia, dysuria, fever, flatulence, food toxicity, indigestion, infertility, insect bites, intestinal parasites, deficient lactation, malaria, loss of memory, menstrual disorders, nausea, renal and vesical calculi, skin diseases, urinary tenesmus, vomiting and wounds [56,57]. The

rhizome mixed with ginger and honey is ingested against dysentery and gastric and intestinal troubles. A fresh tuber paste is applied to the breast as a galactagogue [58]. The tubers improve blood circulation and are effective in gynecological diseases caused by blood stagnation [59]. The rhizomes contained cyperene, cyperone, nor-rotundone, isorotundone, cypera-2,4 (15)-diene, cyperadione and other essential oil components [60-77].

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DOI: [10.32474/RRHOAJ.2023.08.000291](https://doi.org/10.32474/RRHOAJ.2023.08.000291)



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