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So'd Kūfī (Cyperus rotundus): A Review on Pharmacological Actions and Therapeutic Uses of a Unani Drug

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Abstract

Cyperus rotundus, commonly known as *So'd Kūfī*, is a worldwide weed that grows in all tropical, subtropical, and temperate climates. Belonging to the family Cyperacea, it is often called Nāgarmotha in India. It contains Flavonoids, tannins, glycosides, furochromones, monoterpenes, sesquiterpenes, sitosterol, alkaloids, saponins, terpenoids, essential oils, starch, carbohydrates, proteins, separated amino acids and many other secondary metabolites. The plant exhibits various pharmacological activities such as anti-inflammatory, diuretic, carminative, astringent, hepatoprotective, anti-microbial, deobstruent, nerve-tonic, brain-tonic, and cardio-tonic properties. The present review centres on the most recent data from numerous scientific studies and publications that are accessible concerning the phytoconstituents, pharmacology, and medicinal applications of *So'd Kūfī* in the Unani system of Medicine.

Keywords: Cyperus Rotundus; Nagarmotha; Sesquiterpenoids; Muqawwī-I-A'sāb; Diuretic; Unani Medicine

Introduction

So'd Kūfī is a rhizome/tuber obtained from *Cyperus rotundus* of the Cyperaceae family. It is one of the important compounds with significant medicinal advantages that may be discovered through the great diversity available in the plant kingdom [1]. All across India, it is known as *Nagarmotha.* The family has around 5000 species and 104 genera worldwide, while the exact number varies widely among researchers because of their varied perspectives on taxonomy. With over 2000 species worldwide, Carex is the biggest genus, followed by Cyperus with roughly 550 species [2]. It is a troublesome perennial weed that emerges from subterranean tubers and has dark green, glabrous culms. It is a field weed called Nut grass throughout the Southern States. The plant produces rosettes of leaves, scapes, and umbels above ground, as well as rhizomes, tubers, basal bulbs, and fibrous roots below ground [3]. This perennial herb can reach a height of 15 to 60 cm and has smooth, upright, glabrous, grass-like roots with fibrous roots. It spreads widely by rhizomes and tubers. One of the deadliest weeds in the world is Cyperus rotundus L., also known as *Nāgarmotha*, and *So'd Kūfī* in unani medicine [4]. *Cyperus rotundus* is a common perennial plant with scaly creeping rhizomes that are bulbous at the base and emerge singly from tubers that are approximately 1-3 cm long. The tubers have a distinctive odour and are reddish white inside with a blackish outside hue. Africa, South America, the Middle East, North America, Mexico, New Zealand, Australia, and the Pacific Islands are among the tropical and warm-temperate regions where *Cyperus rotundus* is found as a weed [5].

The presence of polyphenol, flavanol glycoside, alkaloid, saponin, sesquiterpenoids and essential oil were revealed from phytochemical investigations of Cyperus rotundus Linn. rhizome [6]. Many Pharmacological and medicinal characteristics like antidiarrheal, anti-inflammatory, nerve-tonic, astringent, diuretic, antipyretic, analgesic, lipolytic, anti-diabetic, hepatoprotective, antioxidant, anti-microbial are exhibited by this plant and has proved to be a multi-purpose medicinal herb [7]. This current review aims to highlight the medicinal properties of Nagarmotha because of its phytoconstituents and pharmacological activities; to signify its potential in the treatment of various ailments as mentioned in the USM and to explore its pre-clinical studies.

Materials and Methods

The plant was searched in the classical Unani literature with keywords '*Nāgarmotha, S'od Kūfī*, Cyperus rotundus, and mentioned in detail with reference to its description, *Mizāj,* medicinal properties and therapeutic uses. Published works available on PubMed, Google Scholar, and Research Gate were referred to collect all the available information regarding its phytochemicals and pharmacological studies. All relevant articles were referred including classical Unani books, English books, research and review papers. Standard Unani medical terminology published by the Central Council for Research in Unani Medicine was used for the appropriate Unani terminologies.

Observations

Geographical distribution

It is a plentiful species occurring throughout the plains of India, especially in South India [8], 1,800m above the sea level [7]. Global weed *Cyprus rotundus* grows well throughout Asia, Africa, Europe, and North America. It can be found in tropical, subtropical, and temperate climates. Being an invasive plant, it is also referred to as the 'World's Worst Weed' because it spreads quickly through rich, wet soil, with its tangles of roots and rhizome, Cyprus weed covers an area with 40,000kg of plant material per hectare [9,10].

Botanical Description

Cyprus rotundus grows throughout the year and spreads through fibrous root system [11]. It is a perennial, glabrous, erect, stoloniferous herb, stolon bearing ovoid, tunicate, black, fragrant tubers [12].

Stem: Stems sub-solitary, 10-75cm long, hollow and overlapping with the leaves, triquetrous at the top, sometimes tuberous at the base [11,13].

Leaves: Leaves shorter or longer than the stem, numerous, narrowly linear, 5-20cm long, 4-8mm broad, finely acuminate, flat, 1-nerved, dark green and grooved on the upper surface [11,13,7].

Flowers: Flowers borne in a compound umbel, spikes loosely spicate of 3-8 spikelets [14], Cyperus rotundus produces a square, petite inflorescence with 2-4 bracts that is composed of tiny flowers with scarlet husks [15], There are 3 stamens; anthers 2.5mm long, style1.6mm long; stigmas 3, elongate, reaching 4mmlong, much exerted [13].

Fruit: Fruit oblong, trigonous achene, greyish-black [12].

Seed: Seeds are three-angled, oblong-ovate, golden in colour, and the shape of trigonous nuts [16].

Tubers: Tubers grow to form rhizomes that are reddish-white inside (fresh) and brownish yellow (dried), blackish on the outside (Figure 1 a & b), measuring 1-3 cm. It has a distinctive smell…

Rhizomes: Rhizomes are bulbous at the base, scaly and crawling. They emerge independently from the tubers (Figue 1 a & b, Figure 2).

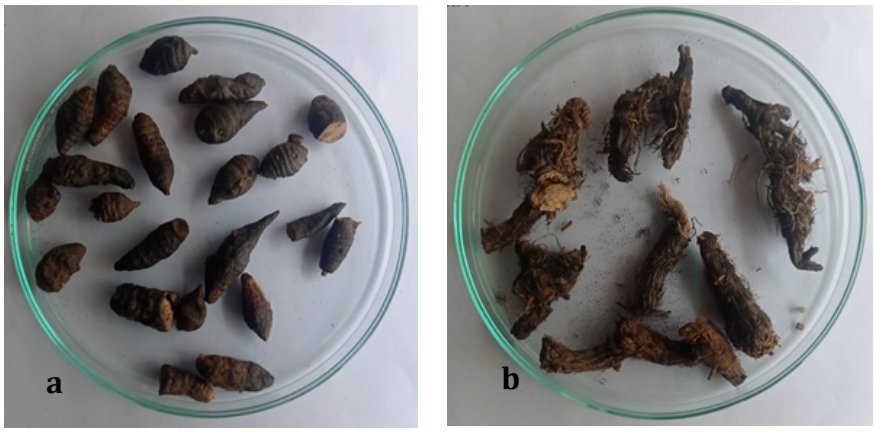

Figure 1: Rhizome and tubers of *So'd Kūfī* a. (higher variety) and *Nagarmotha b.* (lower variety) from the *plant Cyperus rotundus*.

Figure 2: Shows plant *Cyperus rotundus* a. & b; Leaves, Stem, Rhizomes and tuber in fresh plant and from market sample c.

Flowering & Fruiting Period: October to December [12]

Taxonomical Classification [17]

Kingdom : Plantae
Sub-kingdom : Tracheobionta
Super division : Spermatophyte
Division : Magnoliophyta
Class : Liliopsida
Subclass : Commelinidae
Order : Cyperales
Family : Cyperaceae
Genus : Cyperus
Species : Rotundus

Description of the Drug in Unani literature

So'd Kūfī grows abundantly in the fields, gardens and moist soil of Punjab, Pakistan and is more common in Uttar Pradesh and Bengal. It is the root of a pedicellate plant. The stem is larger than the stalk of the barley plant and smaller than the stalk of the wheat plant. It is about one hand or more in length and resembles the steam of *Izkhir*. Each plant has about 12 leaves which arise from the sides of the steam just like the onion roots. The leaves are broad, and hairy similar to the leaves of Sorghum, long and rough. The roots and rhizomes are round tubers, long like an olive fruit. Roots are black from the outside and white inside, pungent in taste and smell, and hard to chew [18-20].

Mutarādifāt (Vernacular Names)

Arabic : So'd, *So'd Kūfī* [20, 21].
Bengali : Nagarmotha, Moothoo, Mutha, Sada-kufee [8,21], Musta.
English : Coco grass, Nut-grass, Purple nut-grass, Nutsedge, Purple nutsedge [12, 8].
Gujarat : Motha [21].
Hindi : Nagarmotha, Korchi-Jhar, Motha, Mutha [8,20].
Malaya : Karimuttan, Kora-Kizanna, Muttanna [8,7].
Persian : Mushk Zer-i-Zamīn, Feqarus [18,20].
Sanskrit : Musta, Mustaka, Bhadramusta, Kurubilva [8].
Telugu : Tunga [12].

Wajah Tasmiya (Causes of the Naming of the Drug)

Cyperus is the genus name that is derived from Cypeiros, the ancient Greek term for the genus, rotundus-the Latin word for round-refers to the tuber [22]. In Persian, it is called as '*Mushk Zer-i-Zamīn*, which translates to "musk of the earth". *Nagarmotha* is called this due to its aromatic rhizomes, which emit a musky fragrance when crushed. Therefore, it highlights the plant's aromatic qualities and its connection to the earth. In Arabic, Nagarmotha is referred to as "*Sod Kufi*". The term "*So'd*" means "root" and "*Kufi*" is related to the region of Kufa. The association with "Kufi" could refer to traditional uses or cultivation practices that are prevalent in areas historically linked to Kufa or its cultural heritage, especially medicinal herbs.

Ajzā-i-Musta'mala (Parts Used)

Tuber or rhizome or bulbous root [8,23].

Mizāj (Temperament)

As per some physicians, it is hot and dry in 3rd part of 2nd degree and according to others, it is hot in 1st degree and dry in 2nd degree [24].

Miqdār Khūrāk (Dose)

The therapeutic dose of So'd Kūfī is mentioned as 3.5gm to 9gm, according to others it is 1.75gm to 4.5gm [18].

Af'āl (Action)

The tuber/rhizome has *Muqawwī-i-Mi'da* (Stomachic), *Mudirr-i-Bawl* (diuretic), *Mudirr-i-Ḥayḍ* (emmenagogue), *Dafi'-i-Samūm* (antidote), *Muqawwi-i Ḥāfiza* (increases memory), *Taḥlīl-i-Riyah* (carminative), *Muqawwī -i-A'sāb* (nerve tonic), *Mufattit-i-Hasāt* (lithotriptic), *Muqawwī-*

i-Dimāgh (Brain tonic), *Muqawwī-i-Qalb* (Cardio tonic), *Muḥallil-i-Awarām* (anti-inflammatory), *Mudammil-i-Quruˉh* (healing agent), *Dafi'-i-Ḥumma* (antipyretic), *Musakkin-i-Alam* (Analgesic), *Mujaffif* (desiccative), *Mufattiḥ* (deobstruent), *Qābiḍ* (astringent) [1,18-20,25-27].

Iste'mālāt (Therapeutic Uses)

Du'f-i-Mi'da (gastric weakness), *Du'f-i-Dimāgh* (weakness of brain), *Khafaqān* (palpitation), *Yaraqān* (jaundice), *Taqṭīr al-Bawl* (dribbling of urine), *Bawāsīr* (piles), *Du'f-i-Mi'da* (gastric weakness), *Hasāt-i-Mathāna* (bladder stone), *Laqwā* (facial palsy), *Fālij* (hemiplegia), *Du'f-i-Haḍm* (indigestion), Istisqā (ascites), *Ishāl* (diarrhoea), *Jurūḥ wa Quruˉh* (ulcer and wounds), *Ḥumma* (fevers), *Pechish* (dysentery), Qa'i (vomiting), *Waja' al-Mafāsil* (arthralgia), *Waram* (inflammation), '*Usr-i-Bawl* (dysuria) [25,26,20, 27,21,19,1].

Tarkīb Iste'māl (Method of Administration)

***Amrāḍ-i-Mi'da* (Diseases of the Stomach)**

Taking one spoon of the powdered root of So'd Kūfī is useful for vomiting [25].

Powdered root/Infusion of tubers is useful in diarrhoea, dysentery, dyspepsia, cholera, and fevers [27].

Ingestion of So'd Kūfī is helpful in halitosis that is caused due to Gastric ailments [18].

***Amrāḍ-i-Dimāgh wa A'sāb* (Diseases of Brain and Nerves)**

Consuming a decoction of 10g root or powered roots mixed with honey is beneficial in Laqwa (bell's palsy), and Fālij (paralysis) [25].

***Amrāḍ-i-Qalb* (Diseases of the heart):** 5g of powder of shade-dried root/decoction of So'd Kūfī are useful in cardiac weakness and palpitation [25].

***Amrāḍ-i-Zanāna* (Diseases of the female reproductive system):** Fresh tubers are applied to the Breast in the form of paste or warm plaster as a galactagogue [21].

Decoction of *So'd Kūfī* while taking daily is very effective in *Iḥtibās-i-Ṭamth* (amenorrhea) [25].

Poisonous Bite: Paste/ingestion of *So'd Kūfī* is helpful in scorpion stings [21]

Maḍarrat (Toxicity, side effects and adverse effects): It is harmful to the throat, and lungs. Overuse can cause *Ḥummā-i-Diq* (tuberculosis) [18]

Musleh (Correctives): Anīsūn (*Pimpinella anisum*), or Sugar, Sirka Sandal or liquid extract of Kahu/Khīrā with Sharbat-i-Dīnār or Sandal are used as correctives for adverse effects [18]

Badal (Substitutes): Bālchar (*Nardostachys jatamansi*) in equal quantity, ½ Mur Makki (*Commiphora myrrha*) and ¼ Dārchīnī (*Cinnamomum zeylanicum*) [Tables 1,2] [18,24].

Compound Formulations

S. No.	Unani Formulations	Part Used	Dose and Method of Administration	Action and Uses
1	*Arq-i-Jazar*	Root	90 g/oral	Aphrodisiac
2	*Arq Ambar*	Root	22.5 g/oral	Cardiac tonic, Brain tonic, can be used in syncope, it is helpful in certain conditions like illnesses in males due to bleeding piles and in females due to menorrhagia
3	*Ma'jūn Regmahi*	Root	12g/oral	Aphrodisiac, oligospermia.
4	*Ma'jūn Safarjal*	Root	7 g/oral	Stomachic, helps in digestion.
5	*Ma'jūn Jālīnūs*	Root	Oral	Used in Phlegmatic and Sanguineous diseases of the brain, and is helpful in obstructive liver diseases also.
6	*Ma'jūn Mufarriḥ*	Root	2.5 g/Oral	Used in Palpitation caused due to some cold factors.
7	*Ma'jūn Nisyān*	Root	35g/Oral	Dementia/amnesia
8	*Ḥabb-ul-Misk*	Root	7g/oral/lozenge	Halitosis
9	*Hubb-i-Jadwar Kalan*	Root	13.5 g/Oral	Cold, diarrhoea, intestinal weakness.
10	Jawārish-i-Jālīnūs	Root	7 g/Oral	General-tonic, aphrodisiac, used in bad breath, headache, cough, piles, gout, ringworm, helpful in urolithiasis.

Table 1: Unani formulations having '*So'd Kūfī*' as one of the ingredients with their dose, method of administration, action and uses: [28].

Chemical Constituents

S. No.	Class	Compound	Reference
1	Sesquiterpene	Patchoulane; Rotundine; Eudesmane;Guaiane; Cadinane; Caryophyllene	
2	Flavonoids	Visnagin; Khellin; Ammiol; Isorhamnetin; Tricin	
3	Phenolic acids	Salicylic acid; Protocatechuic acid; Caffeic acid; p coumaric acid	
4	Steroids	Steroidal glycoside; Sitosteryl-(6'-hentriacontanoy)-β-D-galactopyranoside	
5	Essential oil (Sesquiterpenes, monoterpenes and terpenoids)	Oxo-α-ylangene; α-cyperene; Trans-pinocarveol; cyperene; α-pinene; Cyclopentene-3-ethylidene-1-methyl; Sabinene; β-pinene; p-cymene; 1-limonene; 8-cineole; Trans-pinocarveol; Terpinen-4-ol; Citronellol; 4, 4- dimethyl-tricyclo-(3, 2, 1)octan-6-on; p-cyman-8-ol; 1-α-terpineol; Cis-dihydrocarvone; Myrtenol; Verbenone; 1-β-4,4-trimethyl-bicyclo(3, 2)hept-6-en-2-ol; Trans-carveol; Carvone; Carvenone; α-cubebene; Dihydro-carvylacetate; α-copaene; Isolongifoline; Cyperene; Trans-caryophyllene; Dihydrooromadendrene; Aromodendrene-epoxide; Naphthalene, 1,6-dimethyl-4-(1-methyl ethyl); α-silenene- Ciscalamenene; Trans-calamenene; Elema-1, 3, 11(13)-trien-12-ol; Caryophyllene-oxide; Cis-12-caryophyll-5- en-2-one; Caryophylla-2(12), 6(13) dien-5-one; Cyclohexane, 1, 1, 2-trimethyl-3, 5 bis-1-methyl ethyl; Cyclo-hexanone, 2, 3, 3-trimethyl (3-methyl-butadienyl); Isopropyl,4αβ, 8αβ-dimethyl; Longiver benone; 10-epi-α-cyperene; Caryophyllenol; Vulgarol A and B; Vellerdiol; Aristolone; Ledenoxide; Dimethyl-7- isopropenyl-bicyclo-dec-1-en-3-one; Longifolinaldehyde; Longipynocarvone; Cyperene; Caryophyllene oxide; α-longipinone; β-salinene.	[17,29,30,31,32]
6	Others	Quinones; Saponins; Alkaloids; Coumarins	
7	Minerals	Cu, Fe, Mg, Ni., Starch; Carbohydrates; albuminous matters, fibres; Protein and Amino acid	

Pharmacological Studies

Anti-inflammatory activity: C. *rotundus* alcohol extract (70%) has been shown to effectively cure formaldehyde-induced arthritis in albino rats and shows anti-inflammatory efficacy against carrageenan-induced oedema. When albino rats were exposed to carrageenan-induced oedema, a triterpenoid extracted using chromatographic separation from the rhizome's ethyl acetate extract showed anti-inflammatory properties. C. *rotundus* is also used as a preventative measure against inflammatory bowel diseases. Additionally, the extract decreased the production of free radicals. Combining these results, it was determined that C. *rotundus* rhizome methanol extract may now be utilised to produce a novel anti-inflammatory medication for treating inflammatory diseases brought on by free radicals [33,34].

Antiulceractivity: C.*rotundus* rhizome powder demonstrated ulcer-preventive qualities. For the experiment, two different animal models were employed. In guinea pigs, histamine (50 mg base i.p.) was used to induce stomach ulcers; in albino rats, aspirin (500 mg/kg orally) was used to induce the same. The powdered root of C. rotundus was taken orally 45 minutes before the histamine and an hour before the aspirin. C. rotundus produced outcomes comparable to those of the reference medication ranitidine in both scenarios, greatly lowering the ulcer index. C. *rotundus* has antiulcer effects due to its significant antioxidant activity [35].

Anti-Obesity activity: The efficacy of C. rotundus's aqueous tuber extract in preventing obesity was evaluated in obese albino rats given a high-fat restaurant diet. Six groups of rats were used: group I was the normal control group, group II was the disease control group, group III, group IV, and group V were the test groups, receiving doses of 100, 200, and 300 mg/kg body weight of the aqueous extract of C. *rotundus* in addition to a high-fat cafeteria diet, and group VI was the standard group. Orlistat (50 mg/kg) was used as the standard. The high-fat cafeteria cuisine that the experimental groups were fed for forty days was the cause of their obesity. However the application of aqueous extract treatment led to a significant reduction in weight [36].

Wound Healing activity: For wound healing activities, three different rat models-the excision, incision, and dead space wound models-were used to compare an ethanolic extract

of C. rotundus to a standard medication, nitro furazone ointment (0.2% w/w). An ointment form was applied using C. rotundus ethanolic extract. After 18 days, 100% wound closure was observed with 2% of the weight of the ethanolic extract of C. *rotundus.* Wound contractibility, wound closure time, and tensile strength were used to monitor the healing process of wounds. In comparison to regular nitrofurazone, it was found to have relatively higher wound-healing activity [37].

Hepatoprotective activity: Ethyl acetate extract of C. *rotundus rhizome* was tested for its hepatoprotective qualities against carbon tetrachloride-induced liver injury in rats. Measurements were made of total bilirubin, alanine transaminase (ALT), aspartate transaminase (AST), and alkaline phosphatases (ALP). Significant protection was shown with an oral dose of 100 mg/kg. Additionally, the test was supported by histopathological investigation [38].

Antidiarrheal activity: Using castor oil-induced diarrhoea in mice models, Uddin et al. examined the anti-diarrheal properties of Cyperus rotundus. The results of the study showed that oral administration of methanolic extract at 250 and 500 mg/kg b.w. exhibited potent anti-diarrheal effects. The antibacterial qualities of Cyperus rotundus were studied by Jabier et al. A few bacterial species, both gram-positive and gram-negative, are used by them. Cyperus rotundus oil, for instance, demonstrated the strongest inhibitory effects on gram-positive bacteria relative to gram-negative bacteria [39].

Anticonvulsant activity: The way anticonvulsants work in pre-treated mice with an ethanolic C. rotundus extract demonstrated a robust protective effect against leptazol and strychnine-induced convulsions. Phenytoin (25 mg/kg, i.p.; Indian Pharmacopoeia) and diazepam (4 mg/kg, i.p.; Indian Pharmacopoeia) are standard drugs that are equivalent to the rhizome ethanol extract (100 mg/kg, p.o. (pour on animals)) in terms of reducing the length of the convulsion and hind limb extension ($p<0.001$). According to these results, the ethanol extract from the rhizome is valuable for making a potent phytoconstituent that can be used to treat epilepsy, and its anticonvulsant qualities may be attributed to its flavonoids [40].

Antibacterial activity: Using the inhibitory zone method (Aromatogram), the antibacterial activity of Cyperus oil was investigated for a variety of pathogens, including *S. aureus, Klebsiella pneumoniae, Proteus vulgaris, Streptococcus pyogenes, E. coli, and P. aeruginosa.* For every microorganism, estimates of its MIC and MBC were made. The oil derived from C. rotundus exhibited impressive efficacy against Gram-positive bacteria. However, it exhibited negligible antibacterial action against Gram-negative bacteria and no discernible activity against *P. aeruginosa* and *P. vulgaris* [41].

Conclusion

According to Unani Medicine, C rotundus has numerous medicinal properties. Research indicates that this plant has promise for anti-inflammatory, hepatoprotective, antibacterial, anticonvulsant, antidiarrheal, wound healing, antiobesity and antiulcer properties. The plant's therapeutic potential stem from bioactive compounds present in its tubers /roots. Compound formulations of Nagarmotha are used in Unani Medicine to treat gastrointestinal problems, nephrolithiasis, urolithiasis, wound and ulcers, Paralysis, and Memory related problems. Additional research is needed to uncover the plant's unique features and possible therapeutic applications in various health conditions.

Consent and Ethical Approval

It is not applicable.

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Competing Interests

The authors have declared that no competing interests exist.

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