Ethnobotany, phytochemistry, pharmacology and therapeutic potential of *Su'ad Kūfī* (*Cyperus rotundus* L.): An insight

ABSTRACT

Background:*Cyperus rotundus*, an important medicinal plant belonging tothe Cyperaceae family,is therapeutically used in many traditional systems of medicine, such as Unani medicine, Ayurveda, Siddha, Homeopathy, Chinese medicine, etc.
Aim: The prime goal of this review is to provide a scientific basis and classical references for clinical use and further scientific exploration of *Cyperus rotundus*.
Materials and methods: This meta-analysis was carried out after searching Unani classical and other ethnobotanical literature and published research work available at PubMed, SCOPUS, Science Direct, Google Scholar, Research Gate, etc.
Results:*Cyperus rotundus* L. is the accepted botanical name of *Su'ad Kūfī*, *Nagarmotha*, or Nutgrass as referred in Unani and other traditional medicines. It is grown in India, China, the Philippines, Thailand, Taiwan, Indonesia,Korea, Vietnam, Malaysia, the Pacific Islands, South America,Africa, the Middle East, North America, Mexico, Australia,New Zealand, andEurope. Usually, the rhizome of this important medicinal plant is therapeutically used for various ailments, including indigestion, constipation, dysentery, neurogenic gastralgia, skin diseases, mental weakness, cardiac weakness, nervine weakness,palpitation,weakness of stomach, flatulence, retention of urine, amenorrhea, dribbling of urine, etc. It contains many important secondary metabolites, including flavonoids, tannins, glycosides, monoterpenes, sesquiterpenes, sitosterol, alkaloids, saponins, terpenoids, essential oils, sugar, protein, amino acids, etc., which have been reported to possess antibacterial, anti-tumour, anticonvulsant, antidiabetic, anti-diarrhoeal, anti-inflammatory, antilipidemic, antimalarial, anti-obesity, antioxidant, hepatoprotective, cardioprotective, and neuroprotective pharmacological activities.
Conclusion: We concluded that abundant bioactive compounds identified and separated from *Cyperus rotundus* possess potential medicinal values on different systems of the body.

Keywords:*Su'ad Kūfī*, *Cyperus rotundus*, Nutgrass, Nagarmotha, Unani medicine

1. INTRODUCTION

Cyperus rotundus L., an important medicinal plant belonging to the Cyperaceae family, is extensively usedin various traditional systems of medicine for the treatment of several ailments [1,2].The Cyperaceae family describes nearly 5000 species. The genus name 'Cyperus' is derived from a Greek word, whereas the species name 'rotundus' is derived from a Latin word, which refers to the round shape of the tuber [3].*Cyperus rotundus* is a pestiferous perennial weed that is frequently available in agricultural land in temperate and subtropical regions. It is a smooth, erect, glabrous, grass like, fibrous rooted perennial herb that grows up to 15-60 cm of height and reproduces widely through rhizomes and tubers. The stems can reach a height of about 25 cm, with linear, dark green, leaves. The inflorescences

are modest, with 2-4 bracts and tiny flowers with a red-brown husk. The nut fruit is three-angled, oblong-ovate, yellow, and black color [4,5].This plant is the reservoir of industrially and medicinally epochal phytoconstituents. Many advanced techniques such as steam distillation, solvent extraction, pressured liquid extraction, etc. are being used to obtain extracts from this medicinal plant [6].Many studies have reported that *C. rotundus* yields several constituents, including diterpenoids, triterpenoids, steroids, quinonoids, alkaloids, saccharides, phenolics and phenolic glycosides, monoterpenoids, sesquiterpenoids, flavonoids, phenylpropanoids, etc [1,2,7].Its essential oil contains flavonoids, terpenoids, sesquiterpenes, α-cyperone, α-rotunol, β-rotunol, cyperotundone sitosterol, cyperene, cyperol, nootkatone, valencene, etc [8,9].The essential oil obtained from the rhizome of *C. rotundus* is extensively used in traditional systems of medicine to treat various disorders, such as stomach pain, wounds, boils, blisters, etc. In addition, essential oil is explored in the food industry as aromas and flavors, in the cosmetic industry as ingredients for fine fragrances and decorative cosmetics, in the pharmaceutical industry as medications and aromatics. Rhizomes of the plant are used as astringent, diaphoretic, diuretic, analgesic, antispasmodic, aromatic, carminative, antitussive, emmenagogue, lithotriptic, sedative, stimulant, stomachic, vermifuge, tonics, antibacterial, etc. Moreover, this plant has also been reported to have numerous pharmacological activities, such as anti-fungal, anti-inflammatory, antidiabetic, anti-diarrheal, cytoprotective, antimutagenic, antimicrobial, antioxidant, cytotoxic, apoptotic, anti-pyretic, and analgesic effects [10].The plant has also been explored to treat bronchitis, infertility, amenorrhea, dysmenorrhea, memory loss, renal and vesical calculi, urinary tenesmus, skin diseases, wounds, insufficient lactation, foodpoisoning, dysuria, vomiting, colic, flatulence, dysentery, intestinal parasites, malaria, etc [11]. Hence, the current review has been carried out to comprehensively summarize the information, including taxonomy, morphology, geographical distribution, traditional uses, phytochemistry, and pharmacological activities of *C.rotundus*.

2. METHODOLOGY

This study was conducted by exploring all forms of accessible written, electronic, and internet literature. Both modern and Unani classical literature were explored for its description, identification, temperament, pharmacological actions, and therapeutic uses. Additionally, in-depth literature was collected by reconnoitering the key words *Cyperus rotundus*, *Nagarmotha*, Nutgrass, and *Su'ad Kūfī*in conjugation with itstaxonomy, medicinal uses and pharmacological activities via various renowned search engines, viz., PubMed, Google Scholar, Science Direct, Scopus, Research Gate and other databases. A valid

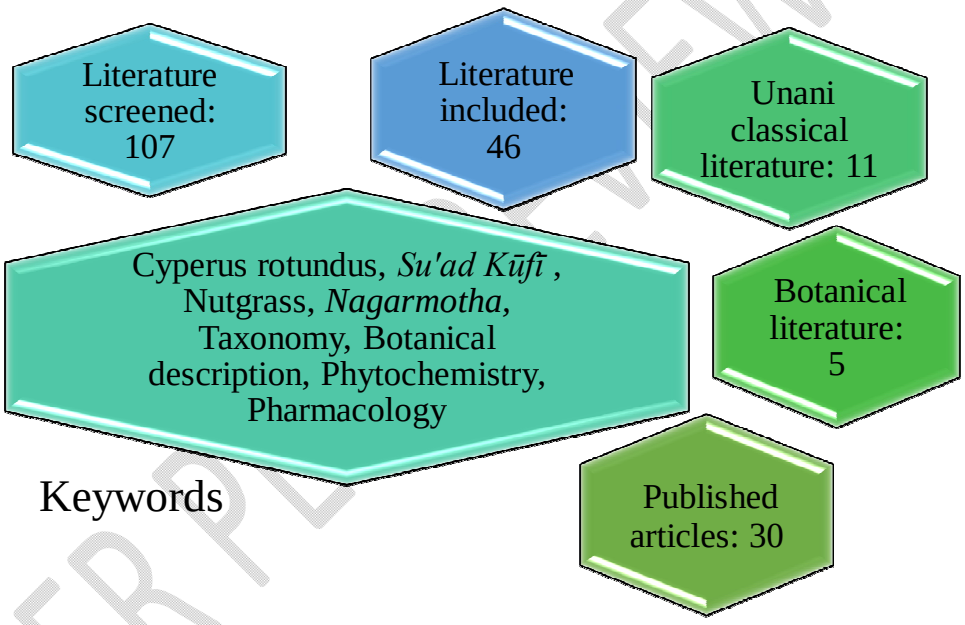
binomial with author citation was verified using the standard database "World Flora" [12] (http://www.worldfloraonline.org). The Unani terminologies were written as per the Standard Unani Medical Terminology published by the Central Council for Research in Unani Medicine in association with the World Health Organization.

Table 1: List of reviewed literature

Type of literature	Title/ Source	Author
Classical Unani literature Keywords: Botanical description, Temperament, Pharmacological properties, Therapeutic uses, Dose, Compound formulations (n = 11)	Muhīt-i-A'zam, Vol. III	Mohammed Azam Khan (1722-1807 AD)
	The Unani Pharmacopoeia of India. P-I, Vol-V	Anonymous (Published by Dept. of Ayush, Ministry of H & FW, Govt. of India)
	Makhzan al-Mufridat (Kitab-ul-Advia), 3rd Ed.	Mohammad Kabiruddin (1889-1976 AD)
	Khazā'in al-Adwiya, Vol. IV	Najmul Ghani Khan (b. 1859 AD)
	Al-Jami al-Mufridat al-Adviawa al-Aghzia, Vol. III	Ibn al-Betar (1197-1248 AD)
	Makhzan al-MufridatwaMurakkabat	Mohammad Ghulam Nabi
	Hamdard Pharmacopoeia of Eastern Medicine	Mohammad Said (1920-1998 AD)
	National Formulary of Unani Medicine. P-II, Vol-I	Anonymous (Published by Dept. of Ayush, Ministry of H & FW, Govt. of India)
	National Formulary of Unani Medicine, P-VI	Anonymous (Published by Dept. of Ayush, Ministry of H & FW, Govt. of India)
	National Formulary of Unani Medicine, P-V	Anonymous (Published by Dept. of Ayush, Ministry of H & FW, Govt. of India)
	Bayan al-Adwiya	Ram Lubhaya
Botanical Literature Keywords: Taxonomy, Botanical description, Geographical distribution, Ethnobotany, Ethnopharmacological uses, Habitat	The weed flora of Egypt. Cairo	Boulos L and El-Hadidi MN
	Indian Medicinal Plants: An Illustrated Dictionary, 1st Ed.	C. P. Khare
	Indian Medicinal Plants, 2nd Ed. Vol. IV	K. R. Kirtikar and B. D. Basu

(n = 5)	Medicinal Plants	E. E. Jarald and S. E. Jarald
	Phytochemicals Methods	J. B. Harborne
Published articles **Keywords:** Botanical description, Morphology, Pharmacognosy, Bioactive compounds, Pharmacological activities (n = 30)	PubMed, Science Direct, SCOPUS, Research Gate and Google Scholar	

Figure 1: Search strategy used for a systematic review of *Cyperus rotundus*L.



3. RESULTS AND DISCUSSION

*Cyperus rotundus*L. is the accepted botanical name of *Su'ad Kūfī*or Nutgrass. Its synonyms are *Chlorocyperusrotundus* (L.) Palla, *Pycreusrotundus* (L.) Hayek, *Cyperus agrestis*Willd. ex Spreng. & Link,*Cyperus bicolor Vahl*, *Schoenus tuberosus*Burm.f., *Cyperus comosus* Sm., *Cyperus rudioi* var. minor Boeckeler, *Cyperus stoloniferus* var. pallidus Boeckeler[13] (http://www.worldfloraonline.org).

3.1 Taxonomy

Kingdom	:Plantae
Subkingdom	:Tracheobionta
Super-division	:Spermatophyta
Division	:Magnoliophyta
Class	:Liliopsida
Subclass	:Commelinidae

Order	:Cyperales
Family	:Cyperaceae
Genus	:*Cyperus*
Species	:*rotundus* [3]

3.2 Vernacular names

Arabic	:*QrāhulJaml*[14]*Su'ad*[15,16]*Su'ad Kūfi*[17,18]
Ayurveda	:*Musta, Mustaka, Ambhoda, Jaldhara*[19]
Bengali	:*Motha*[20]
Chinese	:*HiangFouTse*[20]
English	:Nutgrass[19,21]
Hindi	:*Motha*[15], *Nagar Motha*[16]
Persian	:*MushakkakZīr-i-Zamīn*[14,16,17],*MushkZamīn*,*Mushakkak*[15,18]
Sanskrit	:*Mustra*, *Mustaka*[21]
Suryani	:*S'adā* and *Farja*[14]
Unani	:*Fīnāras, Aqarqūn*[14,17]
Urdu	:*Su'dKūfi*[22]

3.3 Botanical description

3.3.1 Macroscopic

Leaves of the plant are simple, alternate, tristichous with parallel veins and truant ligule. Flower bisexual, light yellow with truant perianth. Inflorescence sessile, spikelet in the shape of terminal umbel-like arrays. The bracts are green, erect, sheath less, and resemble like the leaves in an alternating tristichous pattern. The dry, single-seeded fruit of the nutgrass is widely obovoid, trigonous, and grayish black (Figure 2). Fruiting is most notably apparent during the rainy season [3]. The stem appeared as aerial shoots, subterranean rhizomes or tubers, solid glaucous or glabrous, without the distinction of nodes and internodes. The rhizome has several wiry, stiff, slender roots that are bluntly conical, with the exterior dark brown or black in colour, while the interior is light brownthat emits a fragrant aroma and a mildly pungent flavour. The coarse and fine powders of the same have a coffee-brown hue with a fragrant aroma and mildly pungent flavour [4,22].

Figure 2: Vegetative and reproductive stage (a & b),flowering and fruiting of *Cyperus rotundus*L. (c, d & e)

3.3.2 Microscopic

Rhizome exhibits a single layer of epidermis followed by 2 to 6 layers of suberisedsclerenchymatous cells packed with a dark brown substance. The ground tissue of the cortex is comprised of circular to oval, thin-walled parenchymatous cells with minute intercellular spaces. The wide central zonebeneath the endodermis is composed of round to oval, thin-walled parenchymatous cells with intercellular spaces havingseveral collaterals and closedvascular bundles. Xylem vessels are narrow with an oblique poreand have simple reticulate and scalariform thickening. This region is also loaded with simple round to oval starch grains measuring 6-28 u in diameter and a considerable number of pigmented cells filled with reddish-brown content [22].

3.4 Geographical distribution

*Cyperus rotundus*L. is a cosmopolitan weed that thrives on the continents of India, China, the Philippines, Thailand, Taiwan, Indonesia,Korea, Vietnam, Malaysia, the Pacific Islands, South America,Africa, the Middle East, North America, Mexico, Australia,New Zealand,andEurope in tropical, subtropical, and temperate climates(Figure 3). It is native to India and grows at an altitude of 1800 m, being abundant in the sandy, moist soil of Punjab, Oudh, and Bengal. It is an invasive species, and because of their abundance and growing frequency, itis referred as the "World's Worst Weed". The 40,000 kg/hectare of underground plant material produced by *Cyperus* weed fills the soil with its tangled rhizomes and roots [1,10,17].

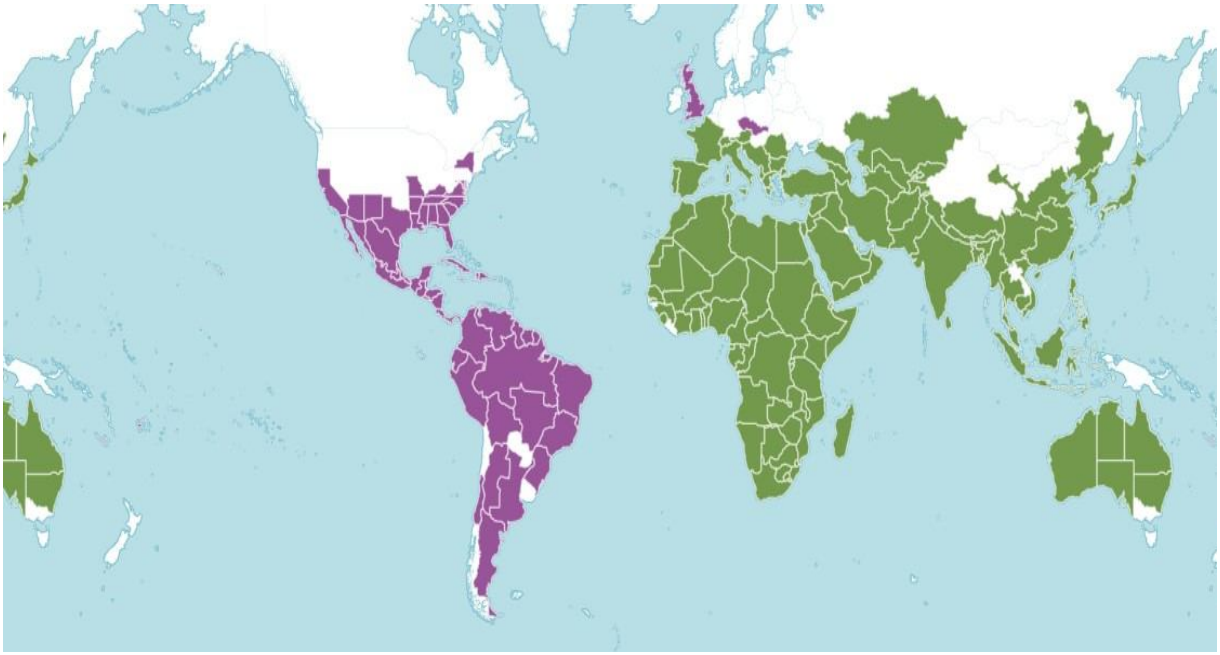


Figure 3: Geographical distribution of *Cyperus rotundus*L. (world map from: https://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:305797-1 in the world (The green surface symbol map shows native to that area and violet represent to the Introduced in area of *C. rotundus*L.)

3.5 Ethnobotany

Tribal people in India's central and southern regions are exploring *Cyperus* weed's medicinal properties from lifelong and have exploited the same to cure conditions like digestive problems, joint pain, and wound healing [1]. According to ethnobotanical and pharmacological research,*C. rotundus* is explored traditionally for treating pain [23], fever, inflammation, diarrhoea[24] and diuresis [25]. In Indian traditional medicine, the rhizomes are used to treat blood disorders, inflammation, diarrhoea, palpitation, bronchitis, amenorrhea and dysmenorrhea [14]. In traditional Chinese medicine (TCM), the rhizomes are commonly deployed to treat irregular menstruation, dysmenorrhea, stomach pain, breast soreness, and liver disease [9]. The roots are used in traditional medicine in West Asia to cure blood disorders, thirst, fever, and leprosy [5]. The tubers in Egyptian traditional medicine are exploited as an aphrodisiac, diuretic, sedative, carminative, stimulant, tonic, and for the treatment of renal colic and stomachaches [26].This plant is a commonly quoted species in ethnobotanical and pharmacological studies on the Brazilian medicinal flora [27].

3.6 Parts used

Roots and rhizomes are used for various therapeutic purposes [14,15,21].

3.7 Therapeutic uses in Unani medicine

In Unani medicine, it is therapeutically used for the treatment of mental weakness, cardiac weakness, nervine weakness,palpitation,weakness of stomach, flatulence, retention of urine, amenorrhoea, dribbling of urine, etc [14,17,18,28].

3.8 Compound formulations

In Unani medicine, several compound formulations are prepared by adding *C. rotundus* as ingredient (Table 2).

Table 2: Compound preparations containing *C. rotundus*

S.No.	Compound formulation	Dose	Actions and therapeutic uses	Reference
1.	*'Arq Ambar*	60 ml	General tonic, helps in weakness of heart, brain and liver	[29]
2.	*'Arq Hara Bhara*	125 ml along with 25 ml *Sharbat Ejaz*	It is useful in tuberculosis, liver and lung diseases	[30]
3.	*Halwa-i-Supari Pak*	12-25 g in morning along with 250 ml of milk	Kidney and gall bladder diseases, male sexual dysfunctions	[30]
4.	*Jawārish-i-Kāfūr*	5-10 g	Stomachic, carminative, helps in perverted digestion, dyspepsia and flatulence	[31]
5.	*LabūbKabīrKhās*	6 g along with 60 ml *Mā' al-LaḥmKhās* or milk once a day	Aphrodisiac, nervine tonic, tonic for vital organs, kidney and vesical, weakness of kidney, vesical and vital organs	[32]
6.	*Labub-i-Kabir*	5 g before breakfast along with 250 ml of milk	Brain andnervine tonic, semenagogue, aphrodisiac, liver and general tonic	[30]
7.	*Ma'jūnAzaraqi*	3 g twice a day after meal	Useful in facial paralysis and paralysis	[30]
8.	*Ma'jūnBawāsīr*	5-10 g	Haemostyptic, astringent, helps in diarrhoea and haemorrhoids	[31]
9.	*Ma'jūnChobChīni*	5 g before breakfast along with 250 ml of	Nervine tonic, antirheumatic, antiarthritic,	[30]

		milk	antispasmodic, depurative.	
10.	*Ma'jūnFanjanosh*	5 g	Useful in piles and digestive system disorders	[30]
11.	*Ma'jūnJalinusLulu'ī*	5 g in the morning along with 250 ml of milk	Aphrodisiac, nervine tonic, general tonic, depurative, complexion brightener	[30]
12.	*Ma'jūnKalkalanj*	5 g followed by 125 ml of *ArqBrinjasif*	It is effective in dropsy, diuretic and analgesic for colicky pain	[30]
13.	*Ma'jūn Khadar*	5 g	Numbness	[30]
14.	*Ma'jūnKhubs al-Hadīd*	3-5 g	Styptic for bleeding piles, stomachic, liver tonic, digestive, appetizer	[30]
15.	Ma'jūnKundur	5 g twice a day preferably along with *KushtaKhubs-ul-Hadid* or *Kushta Baiza Murg* one tablet for quick effect	Kidney and gall bladder tonic, prevent incontinence of urine	[30]
16.	*Ma'jūnLūluvī*	5 g	Aphrodisiac, nervine tonic, helps in weakness of nerve and sexual debility	[31]
17.	*Ma'jūnMasīhi*	5-10 g	Analgesic, helps in lumber pain.	[31]
18.	*Ma'jūnMuqawwīwaMumsik*	1-1/2 g before requirement along with 250 ml of milk	Male sexual dysfunctions	[30]
19.	*Ma'jūnMurawweh-ul-Arwāh*	1 g along with *Ma-ul-Laham Do Atisha* (60 ml) or 250 ml of milk	Enhances heat of the body, aphrodisiac, brain tonic, cardiac stimulant, liver and stomach tonic	[30]
20.	*Ma'jūnNisyān*	5 g	Cure amnesia, brain tonic for stunted children, enhances memorizing power	[30,31]
21.	*Ma'jūnNisyān*	5 g	Brain tonic, helps in amnesia	[31]
22.	*Ma'jūnRegmāhī*	5-10 g	Aphrodisiac, helps in sexual debility	[29]

23.	*Ma'jūnZanjabīl*	10 g	Stomachic, helps in weakness of stomach, polymenorrhoea and metritis	[30]
24.	*Naushdaru-i-Lūlū'ī*	5 g	Cardiac stimulant, cephalic tonic, stomachic and liver tonic, antidysentery	[30]
25.	*Naushdāru-i-Sāda*	10 g	Stomachic, bowel tonic, curative for dysentery	[32]
26.	*Ravghan Ahmar Jadīd*	Q.S. for external use only	Analgesic, nervine tonic, helps in arthritis, weakness of nerve and infantile tuberculosis	[29]
27.	*SanūnMuqawwīDandān*	Applied on the teeth and gum at bed time	Strengthening of tooth and gum	[32]
28.	*Shabābī*	6 g	Aphrodisiac, spermatogenic, general and nervine tonic	[32]
29.	*Sharbat-i-Faulād*	Adult - 20 ml twice a day Children - 10 ml twice a day	Haematopoietic, stomachic, liver tonic	[30]
30.	*Sufūf-i-Ḥabis*	5 g	Heavy menstrual bleeding	[30]

3.9 Phytochemical constituents

Cyperus rotundus is the reservoir of several phytoconstituents, including fat, gum resins, carbohydrates, essential oils, flavonoids, saponins, terpenoids, sesquiterpenes, fibers, etc. The plant is the pool of essential oils, 1,8 cineole, 4a, 5 α-oxidoeudesm-1 l-en-3a-ol, alkaloids, α-cyperone, β-cyperone, α-pinene, β-pinene, β-rotunol, α-Selinene, β-selinene, camphene, cyprotene, acopaene, cyperene, aselinene, rotundene, valencene, cyperol, gurjunene, trans-calamenene, dcadinene, gcalacorene, cadalene, amuurolene, gmuurolene, cyperotundone, mustakone, isocyperol, acyperone, 4,11-selinnadien-3-one and 1,8-cineole, valerenal, myrtenol and sesquiterpene hydrocarbons (Caryophyllene). It also contains γ-cymene, isocyperol, isokobusone, kobusone, linoleic acid, linolenic acid, p-cymol,mustakone, a novel saponin, oleanolic acid, oleic acid, oleanolic acid-3-O-neohesperidoside, and pectin. Among the substances found in the plant are polyphenols, rotundene, rolundenol, rotundone, selinatriene, sitosterol, stearic acid, sugeonol, and sugetriol [1,3].

3.10 Pharmacological activities

3.10.1 Antioxidant activity

The current study reveals that both aqueous and ethanolic extracts of *Cyperus rotundus* rhizomes have antioxidant and free radical scavenging property, with the ethanolic extract being more obvious. These discrepancies in activity could be attributed to variances in the phytoconstituents contained in each extract. According to the findings of this investigation, both aqueous and ethanolic extracts have high antioxidant activity against free radicals such as reactive oxygen species and reactive nitrogen species [33].

3.10.2 Anti-obesity activity

In this study, it was observed that the*Cyperus rotundus* extract standardized for 5% total Stilbenoids (Piceatannol, Scirpusin A, and Scirpusin B) has anti-obesity activity. The extract proved beneficial in lowering body weight and BMI in obese people. *Cyperus rotundus* rhizome extract (CRE) inhibited adipogenic activity in differentiated 3T3 L1 adipocytes *in vitro* and could minimize body weight gain in obese mice. Although stilbenes have been demonstrated to have anti-obesity activity in *in vitro* and *in vivo*models.This is the first time, an extract comprising Piceatannol and dimeric Stilbenoids, particularly Scirpusin A and Scirpusin B, has been observed to be active. According to the findings, an herbal composition derived from the rhizomes of *C. rotundus* including Piceatannol, Scirpusin A, and Scirpusin B could be a strong and safe health adjuvant for the treatment of hypercholesterolemia and obesity in humans. As a result, *Cyperus rotundus* extract is safe for human ingestion and effective in the treatment of obesity and hypercholesterolemia [34].

3.10.3 Antimicrobial activity

Many studies revealed that*Cyperus rotundus* extracts possesses potential antimicrobial activities against various strains, including *Bacillus cereus, Staphylococcus epidermidis*, and*Escherichia coli*[35].

3.10.4 Neuroprotective activity

The protective effects of N-acetyl-L-cysteine (NAC) was investigated against 3, 4-methylenedioxymethamphetamine (MDMA)-induced neurotoxicity in rats. The rats' brains were taken at the end of the study, and the levels of Bcl-2, Bax, and caspase-3 expression in the hippocampi were assessed. NAC pretreatment reduced MDMA-induced hyperthermia substantially. NAC significantly reduced the MDMA-induced increase in distance travelled in the Morris water maze (MWM); however, the observed increase in escape latency was not

significant. The decrease in time spent in the target quadrant was significantly reduced in MDMA animals. NAC protected against MDMA-induced cell death and increased the expression of Bax and Caspase-3, while decreasing the expression of Bcl-2. This research suggested that NAC may be useful in the treatment of neurotoxicity in MDMA users [36].

3.10.5 Anti-inflammatory activity

The present study confirms the anti-inflammatory effect of the methanolic extract of *Cyperus rotundus* rhizome in an animal model of carrageenan-induced paw oedema. *Cyperus rotundus* exhibited anti-inflammatory characteristics similar to non-steroidal anti-inflammatory medications such as Indomethacin. It is also suggested that the mechanism of action of *Cyperus rotundus* is related to the suppression of histamine, serotonin, and prostaglandin formation. The results showed that methanolic extract greatly reduced oedema when compared to the reference standard, Indomethacin. The findings of this study provide rationale for the use of this plant in the treatment of inflammatory diseases [37].

3.10.6 Anti-diarrhoeal activity

The methanol extract of *Cyperus rotundus* rhizome, administered orally at 250 and 500 mg/kg b.w., demonstrated considerable antidiarrheal action in mice with castor oil-induced diarrhoea. The petroleum ether fraction (PEF) and residual methanol fraction (RMF) were found to preserve activity when evaluated at 250 mg/kg, with the latter being more active than the control. The ethyl acetate fraction (EAF) lacked antidiarrheal efficacy [38]. Another study, Daswani et al. (2011) investigated the anti-diarrheal effect of *C. rotundus* tubers on enteropathogenic *Escherichia coli,* and *Shigella flexneri*. The anti-diarrheal activity was determined by assessing the adhesion of these pathogens to HEP-2 cells. The decoction inhibited bacterial adhesion and invasion of HEP-2 cells. The decoction also influenced cholera toxin synthesis and heat labile toxin activity. Because *C. rotundus* decoction did not have significant anti-microbial activity, the anti-diarrheal action was discovered to be exerted via mechanisms other than direct killing of germs [39].

3.10.7 Anti-nociceptive activity

The antinociceptive activity of hydro-methanol extract of *C. rotundus* was examined at three distinct dosages (50, 100, and 200 mg/kg; p.o.) in thermally induced (hot plate and tail immersion) and chemically induced (formalin) nociception models in mice. As reference analgesics, morphine sulphate (5 mg/kg, i.p.) and diclofenac sodium (10 mg/kg, i.p.) were utilized. The present study found that all the dose levels of the test drug had a substantial central and peripheral antinociceptive impact. The effect is immediate, long-lasting, and statistically significant, especially at dosages of 100 and 200 mg/kg.Considering these

observations, it appears that *C. rotundus* includes elements with promising antinociceptive effect. This study supports the plant's traditional use in the treatment of painful ailments [40].

3.10.8 Anti-diabetic activity

The purpose of this study was to assess the hypoglycemic activity of ethanolic extract of *C. rotundus* (EECR) in streptozotocin (STZ) induced diabetic mice. The biomarker enzymes SGOT and SGPT rise due to metabolic alterations in the liver, which results in enzyme leakage from tissues to the blood. The administration of EECR and glibenclamide reduced enzyme activity in STZ-treated rats. The results showed that EECR can lower the levels of marker enzymes and confirmed the possibility that the ethanolic extract can improve liver function. In comparison to the normal control group, the ethanolic extract (250 and 500 mg/kg body weight) and standard glibenclamide (10 mg/kg body weight) significantly reduced the raised blood glucose levels at 0 min, 30 min, 60 min, and 120 min. The ethanolic extract at dose levels of 250 and 500 mg/kg body weight shown considerable antidiabetic activity, improvement in body weight, and reduction in elevated biochemical markers such as SGPT, SGOT, cholesterol, and triglyceride levels, suggesting that it could be useful in the treatment of diabetes [41].

3.10.9 Antiplatelet activity

In the *in vitro* platelet aggregation investigation, *Cyperus rotundus*EtOH extract (CRE) inhibited collagen, thrombin, and/or AA-induced platelet aggregation significantly and concentration-dependently. The most effective inhibitor of its eight constituents on collagen, thrombin, and AA-induced platelet aggregation was discovered to be (+)-nootkatone. Furthermore, mice given CRE and (+)-nootkatone had noticeably longer bleeding periods. Additionally, (+)-nootkatone significantly inhibited the ex vivo platelet aggregation of rats. This study shows that CRE and its main ingredient (+)-nootkatone have antiplatelet properties, and it raises the possibility that using these drugs therapeutically could help prevent cardiovascular disorders linked to platelets [42].

3.10.10 Anti-ulcer activity

The ethanol induced method was used to analyse two dosages of *Cyperus rotundus* chloroform extract, 200 and 400 mg/kg, using Ranitidine (50mg/kg) as standard. The standard and test medications were given orally for 14 days using an ethanol-induced method. *Cyperus rotundus* extract contains alkaloids, flavonoids, terpenoids, and glycosides, according to early phytochemical investigation. The inclusion of flavonoids, terpenoids, alkaloids, and saponin glycoside could explain the considerable increase in antiulcer efficacy of *Cyperus rotundus* extract. Flavonoids are among the cytoprotective materials whose

antiulcerogenic activity has been thoroughly demonstrated. It is hypothesized that these active chemicals can increase mucus, bicarbonate, and prostaglandin secretion while also counteracting the degrading effects of reactive oxidants in the gastrointestinal lumen. As a result, the antiulcer action of *Cyperus rotundus* extract could be related to its flavonoid concentration. The present results show that the chloroform extract of *Cyperus rotundus* may be useful in the treatment of gastric lesions [43].

3.10.11 Anticonvulsant activity

The anticonvulsant activity of *Cyperus rotundus* rhizomes against maximum electroshock (MES) and pentylenetetrazole (PTZ) produced tonic seizures in albino rats was investigated. The extract's anticonvulsant action was determined by monitoring (in seconds) the length of tonic flexion, tonic extensor, clonus, stupor, and recovery phase in rats.The presence of flavonoids, vitamins, and carbohydrates was discovered during a phytochemical analysis of an ethanol extract. The ethanol extract (100 mg / kg, p.o.) considerably reduced hind limb extension and convulsion duration, which was comparable to the conventional drugs phenytoin (25 mg / kg, i.p.) and diazepam (4 mg /kg, i.p.).The ethanol extract of *Cyperus rotundus* rhizomes is promising for the development of a potent phytoconstituent for the treatment of epilepsy, and the flavonoids found in the extract may be responsible for anticonvulsant property [44].

3.10.12 Antimalarial activity

Cyperus rotundus aqueous crude extract (CRE) possesses strong antimalarial properties. In the 4-day suppressive test, the maximum parasitemia inhibition was seen at 400 mg/kg. The plasmodium berghei ANKA-infected mouse model responded better to chemotherapeutic treatment when CRE and dihydro-artemisinin (DHA) were combined at dosages of ED50/2.Additionally, CRE and DHA together have been shown to prolong mean survival time (MST) and inhibit packed cell volume (PCV) reduction, body weight loss, and hypothermia induced on by malaria infection. These results also back up the conventional wisdom that C. rotundus can treat malaria. To isolate and identify the active ingredients and to clarify the mechanism of action for the antimalarial activity of this extract, more research should be done [45].

3.10.13 Ovicidal and Larvicidal activity

The effectiveness of essential oils derived from the tubers of *Cyperus rotundus*and *Cyperus giganteus* on the eggs and fourth-instar larvae of Aedes albopictus (Skuse) was investigated. The eggs and larvae were observed for 24 hours after being subjected to a series of oil concentrations ranging from 5-150 ppm. Indicated by EC50 values of <5 ppm and LC50 and

LC90 values of <20 ppm, respectively, both oils demonstrated remarkable ovicidal and larvicidal effects. The findings point to a possible source of natural mosquitocidal agents in the essential oils of certain Cyperus species [46].

4. Conclusion

After going through many Unani classical and other published literature, it is concluded that*Cyperus rotundus* is extensively used for various therapeutic purposes. Several published literatures revealed that different extracts prepared with the rhizome of *Cyperus rotundus* exhibited various pharmacological activities like antioxidant, anti-obesity, anti-microbial, anti-inflammatory, analgesic, antimalarial, larvicidal, anti-convulsant, anti-ulcer, anti-platelet, anti-diarrhoeal, neuroprotective, etc. which might be due to the presence ofnumerous secondary metabolites.

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