Chapter 5

Traditional Uses of Cyperaceae Members

Abstract

Being one of the wide spread group of plants across the globe, Cyperaceae members have extensive traditional applications in various sectors such as medicines, aroma, perfumery, cosmetics, food and art craft. The first writing paper was made from papyrus (*Cyperus papyrus* L.), a species of the Cyperaceae family in ancient Egypt. *Cyperus rotundus*, the most important Cyperaceae member, is one of the oldest known medicinal plants, widely used to treat stomach disorders, inflammatory diseases, dysmenorrheal and menstrual irregularities and, also for controlling thirst. *Cyperus rotundus* had also been used in perfumery and as a carbohydrate rich food in the period of scarcity. Literature review revealed that in addition to *Cyperus rotundus*, several other members from the family are also being used for various purposes traditionally.The chapter elaborates the traditional applications of Cyperaceae members across the globe.

Introduction

In spite of the developments in modern medicine, and the tremendous advances in synthetic drugs, nearly 80% of the world populations still rely on the use of traditional medicines, which are mainly derived from plant material. The fact is well recognized by the WHO, which has recently compiled an inventory of medicinal plants listing over 20,000 species.

Different Cyperaceae members across the globe has been used to treat various diseases and ailments such as indigestion, constipation, dysentery, abdominal distention, neurogenic gastralgia, chest pains, irregular as well as painful catamenia, skin diseases, furuncle infections, staphylococcal infections, leprosy, sprains and bruises, fever and stomach ache. Among the various Cyperaceae members, *Cyperus rotundus* is the widely used one across the globe. The major traditional applications of *Cyperus rotundus* were for the treatment of stomach disorders, inflammatory diseases, controlling thirst, and are also one of the oldest known medicinal plants used for the treatment of dysmenorrheal and menstrual irregularities. In addition to the documented traditional medicinal practices, various Cyperaceae members have been used world over in different folklore practices to treat

various ailments. In the Peruvian Amazon, reportedly there is a native species of *Cyperus* used widely by the tribal women as a natural contraceptive. This property has been attributed to a certain mold that grows on the root of the Amazonian species that has oxytoxic (abortive) properties similar to Ergot, a fungus that grows on rye.

In addition to the medicinal properties, the tubers of Cyperaceae members also have good nutritive values, and reputed as one of the earliest known edible plant products. The tubers and rhizomes are recognized as a food in scarcity. *Cyperus esculentus* is cultivated for its edible tubers, called earth almonds or tiger nuts. The tubers of *Cyperus rotundus* is recommended as famine food. Moreover, the seeds and tubers of Cyperaceae members are important food for many small birds and mammals. The rhizomes of various species such as *Cyperus rotundus* and *Cyperus scarious* are being used as source of aromatic products. In addition, the plants are being used as source of various artifacts and paper (**Figure 1)**. The first writing paper was made from papyrus (*Cyperus papyrus* L.), a species of the Cyperaceae family, and this highlight the importance of this plant group in human civilization. The chapter gives a glimpse of the diverse utilities of various Cyperaceae plants across the world.

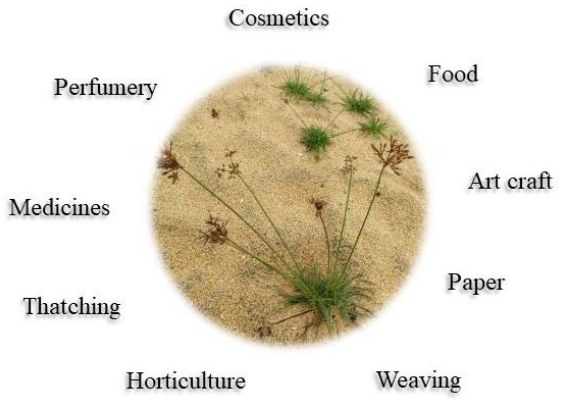

Figure 1. Traditional uses of Cyperaceae members

History of the traditional medicinal uses of Cyperaceae plants

Cyperaceae members had been used in different cultures across the globe for various curative purposes, the most widely used one being *Cyperus rotundus* (**Table 1**).The plant had been used since pre-historic times, as evidenced by the detection of characteristic compounds in archeological remaining dating back to Mesolithic or Middle Stone Age

period that extended from 15,000 BCE to 5,000 BCE (Buckley *et al*., 2014). The plant was used as both medicine and perfume by ancient Greek physicians Theophrastus (4th century BC), Pliny the Elder (1st century AD) and Dioscorides (1st century AD). The plant, known as 'xiang fu' is considered as a qi-regulating herb in traditional Chinese medicine, and well known for the gynecological applications. In West Asia, the roots are used for the treatment of leprosy, thirst, fever and blood ailments (Tsoy *et al*., 2011; Ito *et al*., 2012). Arabs in the Mediterranean region used the burned tubers of the plant to treat bruices, carbuncles and wounds. In Egyptian folk medicine, the tubers are used for stomach ache (Boulos and Hadidi, 1984). In Morocco, the plant is of traditional reputation in medicine and cosmetics (Siroua *et al*., 2022). *Cyperus rotundus* is used in Japanese 'Kampo' formulations. In the Island of Borneo (Kalimantan), *C. rotundus* have been used for decades as a medicine for the treatment of toothache, swollen gums and mouth ulcers, in the form of a mouth wash (Berniyanti *et al*., 2019).

In Ayurveda, the plant is considered as kashaya, tikta and kadu (Rasa), laghu and rooksha (guna), sheeta (virya), and katu (vipaka). As per ancient Ayurvedic concepts, the tubers are beneficial in the treatment of fever caused by aggravated pitta, anorexia, diarrhea, fatigue and thirst burning sensation (Raut and Gaikwad, 2006; Jeong *et al*., 2000). The plant has been mentioned in Charaka Samhita as *lekhaniya* (antiobesity), *trishnanigrahana* (thirst quenching), *sthanyashodhana* (breast milk cleansing) and *kandughna* (relieving itching). In *Sushruta Samhita*, the plant has been mentioned as *Vachadi* and *Mustadi*. The plant has also been mentioned in classical texts such as Ashtanga Hridaya, Bhavaprakasa Nighantu and Dhanvantari Nighantu. *Cyperus rotundus* tubers are incorporated in various types of Ayurvedic preparations such as arishta, kvatha, churna and lehyaas in the case ofMustakarishta, Mustakadikvatha, Mustakadichurna, Mustakadilehya, and also several Ayurvedic formulations such as Chyawanprash and Ashokarishtahave *Cyperus rotundus* as one of the ingredients (**Table 2**).

As per ancient Ayurvedic texts Amarkosha, Brihatrayees and Bhavaprakash Nighantu, different varieties of musta such as Nagarmusta, Bhadramusta, Kaivarta or Kshudramusta, Kuruvinda, Chudalamusta and Musta are mentioned. According to Kirtikar and Basu (1918), Nagarmusta is *Cyperus scariosus* Br., Bhadramusta is *Cyperus rotundus* L. and Kshudramusta is *Cyperus esculentus* L.

According to Bhaishajya Ratnavali, Musta is classified to 3 types of as per the habitat.

1) Anupadeshastha Musta (Marshy land)-Best quality

2) Mishrit Deshajanya Musta (Mixed type of lands)-Medium quality

3) Jangal Deshajanya Musta (Dry land)-Poor quality

Cyperaceae members in Hortus Malabaricus

Hortus Malabaricus is a treatise on the medicinal plant wealth of Malabar, Kerala, compiled by Hendrik Adriaan van Rheede, the Dutch Governor of Cochin, and published from Amsterdam during 1678-1693. The technical information contained in the book was mainly provided by Itty Achuthan, a Malayalee physician lived in Cherthala region of Kerala State. The work consists of 12 volumes, with 793 illustrations describing about 679 species of plants in 742 chapters. Hortus Malabaricus is a source of more than 2789 prescriptions for more than 210 diseases which were rampant in the 15^{th} to 17^{th} century (Manilal, 2003). The original text in Latin has plant names in Malayalam, Roman and Arabic scripts (**Figure 2)**. The treatise elaborates the following Cyperaceae members (the Malayalam name is in parenthesis);

1. *Cyperus exaltatus* (Wara pullu): against stomach pains
2. *Cyperus michelianus* (Pee muthanga): against itches
3. *Cyperus michelianus* sbsp. *pygmaeus* (Pee muthanga): against itches
4. *Cyperus pilosus* (Eera): against itches
5. *Cyperus malaccensis* (Pottapullu)
6. *Fimbristylis argentea* (Mullen pullu): against heat of the body
7. *Hypolytrum nemorum* (Beera kaida)
8. *Kyllinga nemoralis* (Muthenga): controls thirst, dry fever, cures diabetes, and hepatic disordres
9. *Mariscus javanicus* (Eera): leaves used against stomach pains, rouses menstruation
10. *Mariscus sumatrensis* (Kol pullu)
11. *Rikliella squarrosa* (Motta pullu): whole plant against hepatic disorders and vitiligine
12. *Scirpus articulates* (Chelli): root used ascathartic syrup
13. *Scleria lithosperma* (Kadan pullu): rootused as anti nephretus

14. *Scleria* sp. (Cholapullu): whole plant and leaves, rewarm contracted nerves, mitigates the pain of bones and fever
15. *Scleria terrestris* (Kaatucholam): fruit used to treat aphtha

Figure 2. Cyperaceae member*Cyperus exaltatus* as depicted in Hortus Malabaricus

In Siddha medicinal system, *Cyperus rotundus* is known as '*koraikkizhangu*', and used in several preparations such as Athimathuramathirai, Adathodaichooranam, Civataichooranam, Cukkutailam, KapadaIlakam, Sanjeevitheenir, Chandraprakasamathirai, Thathupushtikulikai, Parangichakkaichooranam, Milaguthailam, Kapacurakkudineer, Kabasutrakudineer and Nilavembukudineer (Sidha formulary 2011, Mattummal *et al*., 2018; Arasi *et al*., 2013; Vincent *et al*., 2020; Samraj *et al*., 2014).

In Unani medicinal system, the plant is known as 'Sa'ad ku'fi', and has been attributed with effects on gastric mucus, spasm, nausea and epilepsy. Sa'ad ku'fi is a major component in several Unani formulations such as *Anqaruya Sagheer, Jawarish Jalinoos* and *Dawa e Bawaseer* (Kabir and Abbasi, 2018).

Table 1. Ethnomedicinal applications of Cyperaceae members

Sl. No.	Cyperaceae member	Traditional medicinal use	Traditional medicinal formulation	Reference
1.	*Bulbostylis barbata*	Dysentery	Decoction of whole plant	Cheema *et al.*, 2017
2.	*Cyperus acuminatus*	Snake bite	Hot water extract of the rhizome	Juliana *et al*., 2017; Sulochana *et al.*, 2015; Otero *et al*., 2000
3.	*Cyperusalter nifolias*	Dysentery	Hot water extract of the plant	Wasuwat,1967
4.	*Cyperus angolensis*	Constipation in children	Hot water extract of the root	Gelfand, 1959
5.	*Cyperus articulatus*	Snake bite	Entire plant	Duke,1994
		Abortion Hemostatic Vulnerary	Hot water extract of the plant	
		Headache and migraine	Tubers	Shamkuwar *et al*., 2012
		Fever	Dried rhizome of the plant	Milliken and Albert, 1996
		Influenza Intestinal infection	Hot water extract of the plant	Duke, 1994
		Epilepsy	Decoction of the plant	Bum, *et al.*, 2001 Mongelli *et al*., 1995
		Malaria	Root of the plant	Etkin, 1997
6.	*Cyperus brevifolius*	Sore legs	Leaves with those of several other herbs	Holdsworth, 1990
7.	*Cyperus canescens*	Amenorrhea	Hot water extract	Saha *et al*., 1961
8.	*Cyperus compressus*	Wound	Dried rhizome of the plant	Dangol and Gurung, 1991
		Helminthiasis	Powdered roots	Soren *et al*., 2019
		Cuts and scabies	Powdered roots	Dangol and Gurung, 1991

9.	*Cyperus corymbosus*	Contraceptive	Whole plant	Amer, 1977
10.	*Cyperus cyperoides*	Tooth ache	Hot water extract of the plant	Altschul, 1973
11.	*Cyperus diffusus*	Head ache Fever	Hot water extract of the root	Duke, 1994
12.	*Cyperus erectus*	Foot swelling	Ground plant	Thornton-Barnett, 2013
13.	*Cyperus esculentus*	Cholic epilepsy Fever Cough Body ache Vomiting Stomach ache	Whole plant	Zamora, 1992 Dimayuga, 1998
		Depression	Root extracts	Guzmán Gutiérrez *et al.*, 2014
		Polymenorrhagia	Hot water extract of the root	Samuelsson, 1992
		Menstrual delay	The entire plant	Bryant, 1966
14.	*Cyprus exaltatus*	Swollen breast	Rhizome of the plant with *Saccharum officinarum*	Haerdi, 1964
15.	*Cyperus flavescens*	Depression	Roots	Guzmán Gutiérrez *et al.*, 2014
16.	*Cyperus incompletus*	Asthma Cough Ulcer	Dried leaf and stem	Dini *et al*., 1992 Haerdi, 1964
17.	*Cyperus iria*	Indigestion	Dried rhizome of the plant	Zagari, 1992
		Amenorrhea	Hot water extract of the plant	Dragendroff, 1898
		Stomach ache	Hot water extract of the plant	Uphof, 1968
18.	*Cyperus ixiocarpus*	Cold and Chest infection	Hot water extract of the plant	O'Connell and Barnett, 1983

19.	*Cyperus javanicus*	Fracture	Crushed wet leaves	Holdsworth, 1990
		Irregular menstrual	Leaves with those of several other herbs	Holdsworth *et al*., 1990
20.	*Cyperus kyllingia*	Tissue damage by snake bite	Hot water extract of the plant	Juliana *et al.*, 2017
		Oral thrush	*C. kyllinga* entire plant, *Aleurites moluccana* nut and ariel root of *Ficus prolixa*	Holdsworth, 1990
		Gonorrhoea	Decoction	Hafiz *et al*., 1982
21.	*Cyperus laevigatus*	Asthma	Water extract of the plant	Hope *et al.,* 1993
22.	*Cyperus latifolius*	Tuberculosis and related ailments	Extract made from the roots	Tabuti *et al.*, 2010
23.	*Cyperus longus*	Indigestion	Hot water extract of the plant	Zagari, 1992
		Tumour	Hot water extract of the plant	Tackholm *et al.*, 1941
24.	*Cyperus luzulae*	Diarrhoea Stomach ache	Hot water extract of rhizome	Duke, 1994
		Haemorrhage	Decoction of the whole plant	Barrett, 1994
		Ophthalmic infections	Hot water extract of root	Gupta *et al.*,1996
25.	*Cyperus maculatus*	Cattle worms	Tubers	Blench and Dendo, 2006
26.	*Cyperus monocephalus*	Dermatosis	Decoction of tuber and root	Holdsworth, 1990
		Ringworm	Decoction of tubers	Holdsworth, 1990
27.	*Cyperus mundii*	Evacuation of the placenta Tuberculosis Paludism	Whole plant extract	Razafindraibe *et al*., 2013

28.	*Cyperus natalensis*	Gynaecology and obstetrics complaints	Decoction of the roots	De Wet and Ngubane,2014
29.	*Cyperus nitidus*	Respiratory and digestive disorders	Rhizomes	Moteeteee*t al.*, 2019
30.	*Cyperus obtusatus*	Indigestion	Rhizome of the plant	Bandoni *et al.*, 2008
31.	*Cyperus officinalis*	Amenorrhea	Hot water extract of the plant	Dragendroff, 1898
32.	*Cyperus papyrus*	Female sterility	Decoction with leaf juice of *Mayenes senegalensis*	Haerdi, 1964
		Cancer	Hot water extract of the plant	Hamidi and Gengaihi 1975
		Ulcer Fistula Tumour Wounds	Hot water extract of the plant	Tackholm *et al.*, 1941
33.	*Cyperus pedunculatus*	Infections	Dried root of the plant	Taptiang *et al*., 1984
		Diarrhoea Kidney disease Fever Pain Inflammations	Stem and leaves	Rabelo *et al*., 2013
34.	*Cyperus prolifer*	Women sterility	Hot water extract of the plant	Rabelo, 1964
35.	*Cyperus rotundus*	Blood dysentery	Juice of the macerated flowers of *C. rotundus* with honey	Jahan *et al.,* 2011
		Bone fracture	Dried powder of *Cyperus rotundus, Cissus quadrangularis, Evolvulus nummularius* and ginger	Shahidullah *et al*., 2009
		Bronchitis	Fruits of *Pergularia daemia* with rhizomes of *Cyperus rotundus*and leaves of *Tinospora cordifolia*	Kumar *et al.*, 2011

		Cholera	Boiled rhizomes of *Cyperus rotundus* and *Mentha piperita*	Qureshi *et al.*, 2010
		Constipation	Juice obtained from macerated tubers	Jahan *et al.*, 2011
		Cough	Tubers of *Cyperus rotundus*	Holdsworth *et al.*, 1990
		Dermatitis	Rhizomes of *Cyperus rotundus*, stem bark of *Azadirachta indica* and leaves of *Trichosanthes anguina* in the form of paste	Das and Misra, 1988
		Diabetes	Dried powdered tuber	Zaman, 1989
		Dysentery	Mixture of the rhizomes of *Cyperus rotundus*, bark of *Holarrhena pubescens*, fruits and leaves of *Punica granatum*, dried young fruits of *Aegle marmelos* and flowers of *Woodfordia fruticose*	Bora *et al.*, 2012
		Dyspepsia	Dried rhizomes of *Cyperus rotundus*	Das and Misra, 1988
		Dyspnea	Dried rhizomes of *Cyperus rotundus*	Kirtikar and Basu, 1918 Jahan *et al.*, 2011
		Epilepsy	Decoction of *Cyperus rotundus* with honey	Kirtikar and Basu, 1918
		Eczema	*Lawsonia inermis* and *Azadirachta indica* leaves are macerated with *Cyperus rotundus* for topical application	Jahan *et al.*, 2011
		Gonorrhoea	Dried powdered leaves of *Cyperus rotundus*	Bhattacharya *et al.*, 1987

		Gynaecological disorder	Dried powder of rhizome of *Cyperus rotundus* and juice of *Citrus maxima* fruit	Bora *et al.*, 2012
		Headache	Dried leaves of *Cyperus rotundus*	Kirtikar and Basu, 1918
		Hyperacidity	Dried leaves of *Cyperus rotundus*	Ahmad, 2012
		Hypoglycemia	A mix of the seeds of *Syzygium cuminii* and *Momordica charantia*, and dried powder of *Cyperus rotundus* and *Rosa alba* leaves	Uddin *et al.*, 2006
		Reduced lactation	Paste of the roots	Qureshi *et al.*, 2010
		Intermittent fevers	Decoction prepared from *Cyperus rotundus* roots and fresh ginger	Dangwal*et al*., 2010 Das *et al.*, 1988
		Jaundice	A paste of fresh roots of *Cyperus rotundus* and fruits of *Phyllanthus emblica*	Suneetha *et al.*, 2013
		Kidney stone	Rhizome of *C rotundus*, roots of *Mimosa pudica* and flintstone for oral use	Nanda *et al.*, 2013
		Leukorrhea	*Cyperus rotundus* tubers with *Abutilon indicum* leaves and *Cuminum cyminum* seeds for oral use	Reddy *et al.*, 2010
		Loss of libido in men	Leaves of *Psidium guajava*, leaves of *Punica granatum*, and whole plants of *Cyperus rotundus*	Jahan *et al.*, 2011
		Malaria	Decoction of *C. rotundus* rhizomes and *Azadirachta indica* bark	Paul *et al.*, 2013

		Menstruation problem	Juice of *Citrus maxima* fruit and dried powder of *Cyperus rotundus*	Bora, 2016
		Pimples	Roots along with turmeric and curd are made into a paste	Qureshi *et al*., 2010
		Puerperal fever	Juice of *Cyperus rotundus* whole plant mixed with *Psidium guajava* and *Punica granatum* leaves	Jahan *et al*., 2011
		Rheumatic pain Bile problems Body ache	A mix of the rhizomes and roots of *Cyperus rotundus*, the stem bark of *Gmelina arborea*, root of *Asparagus racemosus*, leaves of *Adhatoda zeylanica*, *Aerva lanata*, honey and *Piper longum*	Das *et al*., 1988
		Skin eruptions	Decoction of the ash of leaves of *Ammannia baccifera* and *Cyperus rotundus* roots and fresh ginger in sesame oil	Dangwal *et al*., 2010
		Snake bite	Paste of rhizome of *C. rotundus*,leaf and root bark of *Albizia amara* and root bark of *Jasminum angustifolium* heated with neem oil for topical application	Ayyanar *et al*., 2005
		Stomach ache	Sun dried rhizomes of *Cyperus rotundus*, stem bark of *Holarrhena antidysenterica* and *Zingiber officinale* for oral administration, along with buttermilk	Rao *et al*., 2014

		Syphilis	Dried powdered leaves of *Cyperus rotundus*	Bhatnagar *et al.*, 2001
		Tonsillitis	The paste of *Cyperus rotundus* rhizome with turmeric powder is rubbed inwards of the tongue	Sharma and Gupta, 2011
		Urinary trouble Stone removal	Decoction of the whole plant	Lokendrajit, 2011; Kumar *et al.*, 2014
		Vaginal discharge	Tubers crushed with *Abutilon indicum* leaves and *Cuminum cyminum* seeds	Reddy *et al.*, 2010
		Vomiting Nausea Flatulence Diarrhoea Intestinal parasites Fever Renal and vesical calculi Urinary tenesmus Wounds Amenorrhoea Dysmenorrhoea Deficient lactation Loss of memory Insect bites Food poisoning Indigestion Infertility Cervical cancer	Dried rhizome	Kirtikarand Basu, 1918; Yeung Him-Che, 1985; Duke and Ayensu,1985; Bown, 1995; Chopra *et al.*, 1986
36.	*Cyperus scariosus*	Urinary infection	Hot water extract of the plant	Mukerjee, 1984
		Liver damage Diarrhoea Syphilis Epilepsy Gonorrhoea	Decoction of the plant	Gilani *et al.*, 1994
		Diabetes	Seeds of the plant	Rajurkar and Hande, 1997

37.	*Cyperus sexangularis*	Asthma Fatigue Fever Pneumonia TB	Rhizomes	Semenya *et al*., 2020
38.	*Cyperus tegetum*	Diabetes	Decoction of the plant	Selvanayahgam*et al*., 1994
39.	*Fimbristylis dichotoma*	Hair loss	Crushed leaves	Cheema *et al.*, 2017
40.	*Fimbristylis miliaceae*	Fever	Poultice	Roy *et al.*, 2022
			Decoction of leaves	Sen and Behera, 2018
41.	*Kyllinga brevifolia*	Diarrhoea Tumours Stomach and intestinal problems	Aerial parts of plant macerated in cold water	Cheema *et al.*, 2017
		External sores and swellings	Paste of rhizome	
42.	*Kyllinga nemoralis*	Malarial chills Pruritus of the skin Thirst due to fever Diabetes Snake bite	Leaves of the plant	Quisumbing *et al*., 1978 Manju *et al.*, 2010

Cyperus rotundus is an important candidate drug for several herbal formulations in Ayurveda, as mentioned in classical texts such as *Bhaishajya Ratnavali, Yoga Ratnakara, Ayurveda Sangraha* and *Ashtanga Hrudayam* (**Table 2**).

Table 2. Herbal formulations in Ayurveda containing *Cyperus rotundus*

Sl. No.	Herbal formulation	Traditional use	Herbal ingredients
1.	Musthadi Kwatha	Diabetes Stress Hyperlipidemia	*Cedrus deodara, Citrullus colocynthis, Curcuma longa, Cyperus rotundus, Emblica officinalis, Marsdenia tenecissima, Symplocos racemose, Terminalia bellerica, Terminalia chebula*
2.	Kutajashtaka Kwatha	Burning sensation Diarrhoea	*Aconitum heterophyllum, Cycleapeltata, Cyperus rotundus,*

		Colicky pain	*Holarrhena antidysenterica, Punica granatum, Santalum album, Symplocos racemose, Woodfordia fruticose*
3.	Darvyadi Kwatha Choorna	Excessive vaginal discharge	*Adathodavasica, Aegle marmelos, Berberis aristate, Cyperus rotundus, Nerium indicum, Semecarpus anacardium, Swertia chirata*
4.	Dhanyapanchaka Kwatha	Colicky pain Diarrhoea due to indigestion Tastelessness	*Aegle marmelos, Coriandrum sativum, Cyperus rotundus, Pavonia odorata, Zingiber officinale*
5.	Arimedadi Thailam	Oil pulling for oral health Diseases of mouth, tooth and noes	*Acacia catechu, Acacia leucophloea, Alhagi pseudalhagi, Berberis aristate, Caesalpinia sappan, Cinnamomum camphora, Cinnamomum tamala, Cinnamomum zeylanica, Coleus vettiveroides, Curcuma longa, Cyperus rotundus, Elettaria cardamomum, Ficus benghalensis, Glycyrrhiza glabra, Lacca laccifera, Mesua ferrea, Mimosa pudica, Myrica esculenta, Myristica fragrans, Nardostachys jatamansi, Nelumbo nucifera, Piper cubeba, Prunus avium, Prunus cerasoids, Pterocarpus santalinus, Rubia cordifolia, Santalum album, Sesame oil, Symplocosracemosa, Syzygium aromaticum, Vetiveria zizanoides, Woodfordia fruticosa*
6.	Mustaka Arishta	Improves appetite and digestion Dysentery Obesity Dyspepsia Digestive impairment Malabsorption	*Cuminum cyminum, Cyperus rotundus, Piper longum, Plumbago zeylanica, Syzygium aromaticum, Trachyspermum ammi, Trigonella foenumgraecum, Woodfordia fruticose, Zingiber officinale*

		syndrome Gastro-enteritis with piercing pain	
7.	Ashoka Arishta	Dysmenorrhoea Pain in female genital tract Leucorrhoea Fever Bleeding disorders Piles Dyspepsia Tastelessness Polyuria Inflammation	*Adhatoda vasica, Berberis aristate, Cuminum cyminum, Cyperus rotundus, Emblica officinalis, Mangifera indica, Nymphaea stellata, Santalum album, Saraca asoca, Terminalia bellerica, Terminalia chebula, Woodfordia fruticose, Zingiber officinale*
8.	Stanyashodhana Kashaya	Detoxing breast milk	*Cedrus deodara, Cyclea peltata, Cyperus rotundus, Hemidesmus indicus, Holarrhena antidysenterica, Marsdenia tenacissima, Picrorhiza kurroa, Swertia chirata, Tinospora cordifolia, Zingiber officinale*
9.	Gulmakatanala Rasa	Abdominal lump	*Achyranthes aspera, Acorus calamus,Cyclea peltate, Cyperus rotundus,Fumaria indica, Piper chaba, Piper longum, Sausserea lappa, Terminalia chebula, Zingiber officinale*
10.	Piyushvalli Rasa	Diarrhoea Fever Diarrhoea with bleeding Malabsorption syndrome Inflammation Intestinal colic due to indigestion Constipation Nausea Tastelessness Emesis	*Aconitum heterophyllum, Berberis aristate, Cinnamomum zeylanicum, Coriandrum sativum, Cuminum cyminum, Cyclea peltate, Cyprus rotundus, Datura metel, Eclipta alba, Holarrhena antidysenterica, Holoptelea integrifolia, Mimosa pudica, Myristica fragrans, Punica granatum, Santalum album, Saussurea lappa, Symplocos racemosa, Syzygium aromaticum, Woodfordia fruticose*

		Prolapse of the rectum Splenomegaly Abdominal lump Ascites Puerperal disease Menorrhagia Jaundice Anaemia Diabetes Urinary disorders	
11.	Mahalakshadi Taila	Fever Intermittent fever Cough Dyspnoea/Asthma Coryza Itching Pain in sacral region Backache	*Anethum sowa, Cedrus deodara, Curcuma longa, Cyperus rotundus, Glycyrrhiza glabra, Laccifer lacca, Marsdenia tenacissima, Picrorhiza kurroa, Santalum album, Saussurea lappa, Sesame oil, Vitex agnus, Withania somnifera*
12.	Shadanga Paneeya	Fever Thirst	*Cyperus rotundus, Fumaria indica, Pavonia odorata, Santalum album, Vetiver zizanioides, Zingiber officinale*
13.	Vatsakadi Kwatha Churna	Dysentery Diarrhoea Ulcerative colitis	*Aconitum heterophyllum, Aegle marmelos, Cyperus rotundus, Holarrhena antidysenterica, Pavonia odorata*
14.	Bahushala Guda	Haemorrhoids Abdominal lump Urinary disorders Anaemia Chlorosis Advanced stage of jaundice Ascites Chronic rhinitis Sinusitis Coryza Gout	*Amorphophallus campanulatus, Argyrea speciosa, Baliospermum montanum, Cinnamomum zeylanicum, Citrullus colocynthis, Cyperus rotundus, Elettaria cardamom, Embelia ribes, Hedychium spicatum, Operculina turpethum, Piper nigrum, Plumbago zeylanica, Scindapsus officinalis, Semicarpus anacardium, Teminalia chebula, Tribulus terrestris, Zanthoxylum alatum, Zanthoxylum armatum, Zingiber officinale*

15.	Chandraprabha Vati	Anaemia Bronchitis Cough Diabetes Digestive Diuretic General tonic Rasayana Haematinic Antimicrobial Jaundice Reducing weight Skin diseases Urinary tract disorders	*Aconitum heterophyllum, Baliosperumum montanum, Bamboo manna, Barberis aristate, Cedrus devadara, Cinnamomum tamala, Cinnamomum zeylanicum, Commiphora mukul, Coriandrum sativum, Curcuma longa, Elettaria cardmomum, Embelia ribes, Emblica officinalis, Hordeum vulgare, Operculina turpethum, Piper chaba, Piper longum, Piper nigrum, Plumbago zylanicum, Scindapsus officinalis, Terminalia bellirica, Terminalia chebula*
16.	Yogaraja Guggulu	Almost all joint disorders Rheumatism Nervous disorders For healthy digestion and metabolism	*Alpinia galanga, Apium graveolens, Cedrus deodar, Cinnamomum tamala, Cinnamomum zeylanicum, Commiphora mukul, Coriandrum sativum, Cuminum cyminum, Cyperus rotundus, Elettaria cardamomum, Embelia ribes, Emblica officinalis, Hordeum vulgare, Hyoscyamus niger, Nigella sativa, Pedalium murex, Piper chaba, Piper longum, Piper nigrum, Plumbago zeylanica, Saussurea lappa, Taxus baccata, Terminalia bellirica, Terminalia chebula, Vetiveria zizanioides, Zinziber officinale*
17.	Ardraka Khanda	Cough Respiratory disorders Allergic skin disorders	*Cinnamomum tamala, Cinnamomum zeylanicum, Curcuma zedoaria, Cyperus rotundus, Elettaria cardmomum, Apium graveolens, Embeliaribes, Mesua ferrea, Piper longum, Plumbago zeylanica, Zingiber officinale*

18.	Brahma Rasayana	Lassitude Fatigue Lethargy Tiredness without exertion Langour Mental weakness Senility Progeriasis Wrinkles in skin Graying of hair Impairment of memory	*Acorus calamus, Aegle marmelos, Aquilaria agallocha, Asparagus racemosus, Boerhavia diffusa, Centella asiatica, Cinnamomum zeylanicum, Clitoria ternatea, Curcuma longa, Cyperus rotundus, Desmodium gangeticum, Elettaria cardamomum, Embelia ribes, Emblica officinalis, Glycirrizha glabra, Gmelina arboera, Leptadenia reticulata, Litsea monopetala, Malaxis acuminata, Manikara hexandra, Mesua ferrea, Nyctanthusarbor-tristis, Oroxylum indicum, Oryza sativa, Phaseolus trilobus, Piper longum, Premna corymbose, Ricinus communis, Saccharum officinarum, Saccharum spontaneum, Santalum album, Serratophyllum submersom, Sesame oil, Sida cordifolia, Solanam xanthocarpum, Solanum indicum, Stereospermum suaveolens, Terminalia chebula, Uraria picta*

Cyperaceae members as source of food material

Plant resources remained as an integral part of human society throughout history to fulfil one of the basic needs, food. Plant parts like roots, leaves and fruits constitute their food. Various civilizations across the globe used Cyperaceae members as food. Among Cyperaceae members, *Cyperus, Carex, Scleria, Scirpus* and *Fimbristylis* species were the most common food sources. In Asia, the leaves of *Cyperus rotundus* were used as a food flavouring agent, while the rhizomes and tubers were widely used in curries, pickles and bakery products (Nima *et al.,* 2008). The rhizomes and tuberswere also used to purify water, and as a thirst quencher. It is a staple carbohydrate in tropical regions especially during the famine seasons. *Cyperus rotundus* and *Cyperus esculentus* can be eaten raw or processed in the form roasting, drying, baking and extract with milk (Oladele and Aina,

2007). The edible tubers of *Cyperus esculentus* are eaten as vegetables, made into sweets or used to produce horchata of the Valencia region. *Cyperus bulbosus* are eaten to a smaller extent. *Cyperus articulatus* is one of the traditional spices of the Amazon region used as food, and its reddish essential oil is used commercially as a flavouring for food. In Nigeria, *Cyperus articulatus* is mostly eaten raw as snacks. Other than Cyperus species, *Scirpus maritimus* inner rhizome portions are used as an occasional food source for ethnic group Maori in New Zealand, and *Scirpus paludosu* nutlets are found to be edible and used as a cooked vegetable (Jhonson 1989).

Several *Carex* species like *Carex coriacea, C. chlorosaccus, C. canescens, C. brevipes, C. brevior, C. bigelowii, C. bella, C. athrostachya, C. aquatilis, C. amplifolia, C. albonigra, C. demissa, C. divulsa, C. eleocharis* and *C. festivella* were grazed by animals and are important animal food. *Fimbristylis littoralis* is also used as animal food (Uranie *et al.*,1829*).* In wetlands, terrestrial birds such as francolin feed almost exclusively on some of *Cyperus* species. *Scleria ciliate* fruits are generally classed as desirable food for quail, doves and other birds.

***Horchata de chufa*- Popular natural drink from tiger nut tubers (*Cyperus esculentus*)**

Since ancient times the tuber of *Cyperus esculentus* has been considered a foodstuff, and was used in ancient Egypt according to the references of Theophrastus and Pliny (Negbi 1992; Serrallach, 1927). Its dry tubers have been found in tombs from pre-dynastic times (Serrallach, 1927). The chufa is a crop of early domestication which was added to those of the Nile Valley (Zohary, 1986). In Europe, chufa has been introduced during the middle ages by the Arabs after their expansion across the north of Africa. The small tuberous rhizomes were used both as food and medicine by the Native Americans. In the United States, chufa plots are favorite sites of food for the wild turkeys and also used as hog feed and pork feed to improve the taste of pork meat. Tubers of chufa have also been identified as valuable food for waterfowl, ducks and cranes in wetland fields.

There are written records from the 13th century about the consumption of a drink made from chufa in the Mediterranean areas of the present-day Valencian community in Spain. *Horchata*, a natural drink obtained from the yellow nutsedge, could be considered as developed from this drink. *Horchata* has a pleasant milky aspect and nutty flavor, along

with some health benefits such as gluten-free (Pascual *et al*., 2000). The popularity of this drink has recently extended to other countries such as France, Great Britain and Argentina. Horchata de chufa is considered as an effective remedy for diarrhea, according to popular traditional knowledge in Valencia, Spain.

The caramel from malted tubers of *Cyperus esculentus* can be used to add body, flavor and color to certain baked products, non-alcoholic malt beverages and dark beers, and in the production of condiments. The starch can be used in many starch-based foods as well as in the cosmetic industry, and for laundry, glazing and stiffening. The waste residue after oil extraction could be further modified producing syrups, flours or livestock feeds. The tubers of *C. esculentus* may be consumed raw, roasted, or ground. The tiger nuts are first fried, and then soaked in water, and the taste is similar to hazelnuts. The tubers contain protein, carbohydrates, sugars, oil and fiber. The chufa nut is good for human health, containing high levels of iron and potassium, and no sodium. Chufa tubers have a relatively high total antioxidant capacity as they contain considerable amounts of water-soluble flavonoid glycosides. Chufa is potentially a commercial source of oleic acid vegetable oil that could be exploited in the same way as olive oil. The oil may also be used as biodiesel fuel.

In parts of Africa, Europe and Asia, chufa is grown for its edible tubers. *Cyperus esculentus* is cultivated in Niger for export, and the revenues from this weed exceed those from the typical cash crops such as cowpea and groundnut. The African Nigeria and Ghana Togo Ivory Coast, export 2300 tons of tubers every year to Spain. The chufa is also a representative crop of the Spanish Mediterranean region, where tubers are used to make the beverage horchata or horchata de chufas.

Cyperaceae members in perfumery

In addition to the use in traditional medicinal systems, the tubers of various Cyperaceae members were used traditionally in perfume, cosmetic and spice applications in African, Arab and Asian countries for centuries, utilizing the floral-woody aroma of the rhizome (Sharma and Gupta, 2007). Numerous accounts of various Cyperaceae members for aromatic purposes from ancient Egypt, Mycenean Greece, Indian and elsewhere exist. *C. rotundus* had been mentioned by Hippocratic (5^{th} century BC), Theophrastus (3^{rd} century BC), Pliny and Dioscorides (1^{st} century AD), as a source of perfume (Negbi,1992).

The mystic kyphi of Egypt

Kyphi is the ancient perfume of Egypt, that had an important role as a sacred fragrance in many ceremonies.For ancient Egyptians, burning incense was a daily celebration of fragrance, and their favorite incense was Kyphi. On a daily basis, the ritualized burning of incense in ancient Egypt consisted of frankincense in the morning, myrrh during the day, and Kapet (Kyphi) in the evening. Dioscoridesmentions the use of *C. rotundus* tubers as an ingredient of kyphi, and the ingredients described by Dioscoridesis similar to one in the Ebers papyri, demonstrating its continuity over 1600 years. Kyphi, the scented preparation from ancient Egypt, was made from myrrh, sweet rush, Cyperus grass, wine, honey, raisins, resin and juniper. The incense has medicinal properties and also used to perfume goose or pork fat.

***Sugandha musthaka* of India**

Cyperus rotundus is known in Ayurveda as *sugandhamusthaka* (aromatic Cyperus) and also being suggested as substitute for *karpura* (*Cinnamomum camphora*) based on the concept of drug substitution (*Abhava Pratinidhi Dravya*) (Venkatasubramanian *et al.,* 2010). Ancient India had attained the highest proficiency in the manufacture of scents, perfumes and cosmetics.Varahamihira, the famous astrologer of the 6th Century AD, in his monumental work 'Brihat Samhita' devotes an entire chapter on perfumery under the title 'Gandhayukti'. He mentions that using just 16 ingredients, 1,74,720 varieties of scents and perfumes can be made, by mixing them in specified proportions, permutations and combinations. The fragrance of the perfume depended on the purpose for which it was used and accordingly the ingredients were selected. Musta (*Cyperus rotundus*) is one of the 16 aromatic ingredients mentioned by Varahamihira in Brihat Samhita.

Cyperus oil has the guanine sesquiterpene rotundone with a peppery note as one of the characteristic odoriferous compounds. Rotundone is an important component of agarwood scent and patchouli scent, and recently Cyperus oil with rotundone is emerging as an alternative to the costly agarwood and patchouli oils.The popular Australian Shiraz wines have the characteristic spicy black pepper aroma, and rotundone was identified as the major contributor to peppery characters in Shiraz grapes and wine, with an odor threshold of 8 ng/L in water and 16 ng/L in red wine.

The tubers of *Cyperus scariosus* is the source of the much acclaimed 'cypriol oil', widely used in the perfume industry. The tuber, commonly known as nagarmotha, nagarmustaka, or nut grass, has a long history of traditional use in both medicine and perfumery. The essential oil has a tenacious, woody-earthy smell with a spicy note. Priprioca (*Cyperus articulatus*) is one of the traditional spices of the Amazon region and its reddish essential oil is used commercially by the cosmetic industry, and also as a flavoring for food.

Cyperus papyrus and the history of paper

The term paper has its origin from the marshy sedge plant *Cyperus papyrus* belonging to the family Cyperaceae. The plant is commonly known as papyrus sedge, paper reed, Indian matting plant or Nile grass. The history of paper making can be traced back to around 3000 BC. The most extensive account of papyrus production occurs in the encyclopaedic work by Pliny the Elder (23-79 AD) in his 'Naturalis Historia', written around 77 AD (Lewis, 1974). The oldest evidence of papyrus was unearthed from the Hemaka tomb in Saqqara, Egypt, which is approximately 5,100 years old (Braidwood *et al.*, 1951). Papyrus made from *Cyperus papyrus* was mainly used for documenting information in ancient Egypt and then was adopted by the Greeks, and was used extensively in the Roman Empire (**Figure 3)**. The famous 'Ebers Papyrus' that dates back to around 1500 BC, and extends to 110 pages, gave vivid descriptions of 876 plant medicines of that period (Bryan, 1930). The papyrus stem pitch was cut into thin strips and pitch was softened in the river watersover days, and layered to form a thick mat. The true papyrus sedge of Ancient Egypt, *C. papyrus* subsp. *hadidii*, is very rare due to draining of its wetland habitat. Bausch *et al*. (2022) has investigated in detail on the papyrus making process and the constitution of ancient papyrus sheets through two-dimensional nuclear magnetic resonance spectroscopy, derivatization followed by reductive cleavage, and pyrolysis-gas chromatography-mass spectrometry along with microscopy and tests for surface pH and sodium content.

The plant is often cultivated as an ornamental plant. The flowering heads were made into garlands for the gods in gratitude. The pith of young shoots was eaten both cooked and raw. The highly buoyant stems can be made into reed boats. Further the fibrous plant was used for making baskets, mats, cloth, cordage and sandals.

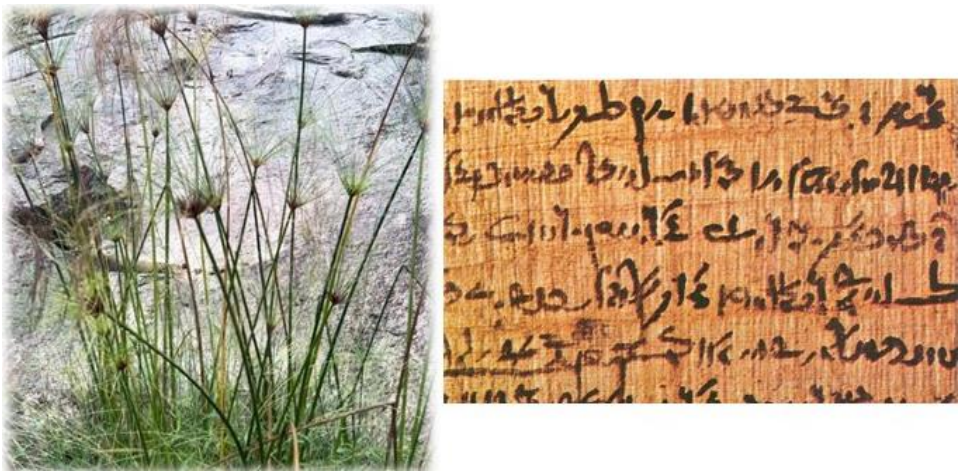

Figure 3.*Cyperus papyrus* and the ancient papyrus

Other uses of Cyperaceae members

In addition to the usage of Cyperaceae members in food and medicinal sector, many other traditional uses have been reported for the plant group. The plants in Cyperacea family are traditionally used for thatching, and for weaving household items such as mats, baskets, and other utensils.*Cyperus papyrus* is used in horticulture for water side planting. In the garden, sedges are generally used as 'architectural' plants, especially in wet places. The densely tangled rhizomes contribute to erosion control and water purification. The dense sedge beds in swampy regions provide food and shelter for birds, animals and other aquatic life, thus encouraging ecotourism.

Cyperus giganteus, locally known as cañita, is used by the Yokot'an Maya of Tabasco, Mexico, for weaving variety of mats. *Cyperus textilis* and *Cyperus pangorei* are traditionally used to produce the typical mats of Palakkad in India. The makaloa mats of Niihau were made from *Cyperus laevigatus*.

Conclusions

Review of the traditional uses of Cyperaceae members reveals wide applications for the plant group, and especially to the commonly used species such as *Cyperus rotundus, C. scariosus, C. papyrus, C. conglomeratus, C. esculentus, C. distans, C. iria, C. alternifolius, C. alopecuroides, C. articulates, C. longus, Scleria striatonux* and *Kyllinga nemoralis.* Traditional medicinal plants are widely accepted because of the time-tested efficacy and

safety, and Cyperaceae members have wide applications in traditional medicinal field. Validation of the therapeutic efficiency using modern pharmacological tools and the elucidation of the responsible constituents through phytochemicals analyses could lead to the development of value-added botanical products, with commercial potential. Being a notorious weed, the possibility of producing huge quantity of *Cyperus rotundus* or other Cyperaceae tubers in various geoclimatic conditions across the globe is high, and efforts should be directed to translate the traditional information to value-added products by the skilful application of modern science and technology tools.

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