

“FORMULATION AND EVALUATION OF ANTIFUNGAL AND ANTIMICROBIAL CREAM FROM EXTRACT OF CYPERUS ROTUNDUS LINN”: A Review

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ABSTRACT

Cyperus rotundus Linn. (family Cyperaceae), commonly known as nutgrass, is a medicinal plant widely used in traditional systems of medicine due to its diverse pharmacological properties. [3,4,13,14] The plant contains various bioactive constituents, including flavonoids, terpenoids, alkaloids, phenolic compounds, and essential oils, which contribute to its antimicrobial and antifungal activities. The increasing prevalence of microbial resistance and the demand for safe, natural therapeutic agents have encouraged the exploration of herbal formulations for topical applications. This review focuses on the formulation and evaluation of antifungal and antimicrobial cream containing *Cyperus rotundus* extract. The article discusses the phytochemical profile, mechanisms of antimicrobial action, formulation approaches, and quality control parameters of herbal creams. Furthermore, evaluation tests such as physical appearance, pH determination, viscosity, spreadability, stability studies, antimicrobial efficacy, and skin irritation assessment are reviewed. Available research findings indicate that *Cyperus rotundus*-based topical formulations exhibit promising inhibitory activity against various bacterial and fungal pathogens while maintaining acceptable physicochemical properties. The review highlights the potential of *Cyperus rotundus* as a natural alternative for the development of effective antimicrobial and antifungal topical preparations and emphasizes the need for further clinical investigations to establish its safety and therapeutic efficacy.

Keywords

Cyperus rotundus Linn., antifungal cream, antimicrobial activity, essential oil, α -cyperone, Clevenger hydro-distillation, herbal formulation.

1. INTRODUCTION

Skin infections caused by bacteria and fungi are among the most prevalent health problems worldwide, affecting individuals of all age groups. These infections range from mild superficial conditions to severe dermatological disorders and can significantly impact the quality of life. The increasing emergence of antimicrobial resistance, adverse effects associated with synthetic drugs, and the high cost of conventional therapies have created a growing interest in the development of alternative treatments derived from natural sources. Herbal medicines are gaining considerable attention due to their safety, efficacy, biocompatibility, and wide availability. [16,20]

Medicinal plants have been used for centuries in traditional healthcare systems for the prevention and treatment of various diseases. Among them, *Cyperus rotundus* Linn., commonly known as nut grass or purple nutsedge, belongs to the family Cyperaceae and is widely distributed in tropical and subtropical regions. The plant has been extensively utilized in Ayurveda, Traditional Chinese Medicine, and other indigenous systems of medicine for the treatment of fever, inflammation, gastrointestinal disorders, wounds, and skin diseases. Various parts of the plant, particularly the rhizomes and tubers, contain a diverse range of bioactive phytoconstituents, including flavonoids, alkaloids, tannins, phenolic compounds, glycosides, sesquiterpenes, and essential oils. [3,4,14]

Numerous pharmacological studies have demonstrated that *Cyperus rotundus* possesses antimicrobial, antifungal, antioxidant, anti-inflammatory, analgesic, and wound-healing properties. The antimicrobial and antifungal activities are mainly attributed to its phenolic compounds and essential oils, which inhibit the growth of pathogenic microorganisms by disrupting microbial cell membranes and metabolic pathways. Such biological activities make *Cyperus rotundus* a promising candidate for topical therapeutic formulations intended for the management of skin infections. [3,5,6,7,8,10,12,13]

Topical drug delivery systems, particularly creams, offer several advantages including ease of application, improved patient compliance, localized drug action, reduced systemic side effects, and enhanced therapeutic effectiveness. Herbal creams incorporating plant extracts have gained popularity because they combine the benefits of natural products with the convenience of modern pharmaceutical dosage forms. The formulation of creams containing *Cyperus rotundus* extract may provide an effective and safe alternative for the treatment of bacterial and fungal skin infections. [18,19]

The development of a stable and efficacious herbal cream requires careful selection of formulation components and thorough evaluation of physicochemical properties such as appearance, pH, viscosity, spreadability, homogeneity, stability, and microbial efficacy. Assessment of antimicrobial and antifungal activities against common pathogenic microorganisms is also essential for determining the therapeutic potential of the formulation. [15,18,19]

This review article aims to provide a comprehensive overview of the formulation and evaluation of antifungal and antimicrobial creams containing *Cyperus rotundus* Linn. extract. It discusses the botanical profile, phytochemical composition, pharmacological properties, formulation strategies, evaluation parameters, and recent advances related to the development of *Cyperus rotundus*-based topical preparations. Furthermore, the review highlights the potential of this medicinal plant as a natural source for the development of safe, effective, and economical antimicrobial and antifungal products. [3,13,15]

2. BOTANICAL PROFILE



Figure No.1: *Cyperus Rotundus* Linn

Cyperus rotundus Linn. is a perennial herb of the family Cyperaceae. It develops slender aerial leaves and underground rhizomes and tubers. The underground parts are particularly important in traditional medicine and phytochemical research. [3,4,14]

Table No.1: Botanical Profile

Classification	Details
Botanical Name	<i>Cyperus rotundus</i> Linn
Kingdom	Plantae
Class	Liliopsida
Family	Cyperaceae
Genus	<i>Cyperus</i>
Species	<i>Cyperus rotundus</i> Linn
Common Name	Nut Grass, Purple Nutsedge

3. MORPHOLOGY

- Slender, erect green stems.
- Narrow, grass-like leaves.
- Underground rhizomes.
- Small tubers or nut-like structures.
- Fibrous roots.
- Umbel-type inflorescence.
- Important medicinal portion → Rhizome/Tuber.
- Simple plant structure: Leaves → Stem → Underground rhizome → Tubers → Roots.

4. PHYTOCHEMICAL PROFILE

The chemical composition of *Cyperus rotundus* is complex. Xue et al. systematically collated 552 compounds from the plant and classified them into monoterpenoids, sesquiterpenoids, flavonoids, phenylpropanoids, phenolics and phenolic glycosides, triterpenoids, steroids, diterpenoids, quinonoids, alkaloids, saccharides and other compounds. [13]

Table No.2 : Phytochemical Profile

Constituent group	Examples/description	Potential relevance
Sesquiterpenes	Cyperene, α -cyperone and related volatile compounds	May contribute to antimicrobial activity
Monoterpenes	Volatile monoterpenoid fraction	May influence aroma and biological activity
Flavonoids	Polyphenolic secondary metabolites	Antioxidant and possible antimicrobial contribution
Phenolics	Phenolic acids and related compounds	Antioxidant and antimicrobial potential
Tannins	Polyphenolic compounds	May interact with microbial proteins

Alkaloids	Nitrogen-containing secondary metabolites	Potential biological activity
Saponins	Surface-active glycosides	May contribute to biological and formulation properties

4.1 Traditional and Medicinal Importance

Traditional literature describes *Cyperus rotundus* as a medicinal plant used for a variety of gastrointestinal, inflammatory, menstrual and other conditions. Reviews also describe reported antioxidant, anti-inflammatory, antibacterial, antifungal and other pharmacological activities. These traditional uses provide background for research but do not by themselves establish efficacy of a topical cream. [3,4,14]

5. PHARMACOLOGICAL ACTIVITIES

5.1 Antimicrobial Activity

Cyperus rotundus Linn. exhibits significant antimicrobial activity against a wide range of pathogenic bacteria, including *Staphylococcus aureus*, *Escherichia coli*, *Bacillus subtilis*, and *Pseudomonas aeruginosa*. [6,7,8,9,10,11] This activity is mainly attributed to the presence of flavonoids, phenolic compounds, tannins, terpenoids, and essential oils that inhibit microbial growth by disrupting cell membranes and interfering with metabolic processes. [6,7,8,9,10,11]

5.2 Antifungal Activity

Cyperus rotundus Linn. also possesses notable antifungal activity against various fungal pathogens such as *Candida albicans*, *Aspergillus niger*, and *Trichophyton rubrum*. [5,12] The antifungal effect is associated with its bioactive phytochemicals, which inhibit fungal growth by damaging fungal cell membranes, preventing spore germination, and suppressing hyphal development. These properties support its use in the treatment of fungal skin infections and in the formulation of herbal antifungal creams. [5,12]

5.3 Essential Oil Evidence

The essential oil of *Cyperus rotundus* rhizomes contains sesquiterpenes such as **cyperene**, **cyperol**, **α -cyperone**, and **cyperotundone**, which are responsible for its antimicrobial and antifungal properties. The oil has shown inhibitory activity against bacteria like *Staphylococcus aureus* and *Escherichia coli* and fungi such as *Candida albicans* and *Aspergillus niger*. These findings support the use of *Cyperus rotundus* essential oil in antimicrobial and antifungal cream formulations. [1,2,7,8,9,11]

6. GENERAL WORKFLOW

Plant authentication → collection of rhizomes/tubers → cleaning and drying → powdering → extraction → concentration and yield determination → preliminary phytochemical screening → standardization/chemical profiling where available → preparation of cream base → incorporation of extract → optimization of trial batches → physicochemical evaluation → antimicrobial assay → antifungal assay → stability testing → interpretation and documentation.

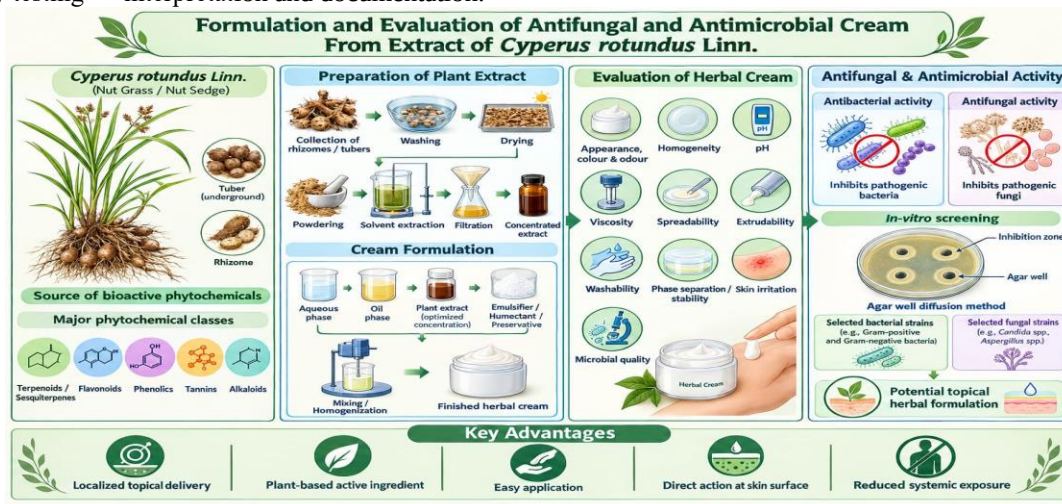


Figure No.2: General Workflow

7. INGREDIENT USE

Table No.3: Ingredient Use

Ingredient	Role
<i>Cyperus rotundus</i> oil	Active ingredient; provides antimicrobial, antifungal, anti-inflammatory, and antioxidant properties.
Stearic Acid	Emulsifying agent and thickener; helps form and stabilize the cream.
White Beeswax	Stiffenin agent and consistency enhancer; improves texture and stability.
Triethanolamine	Emulsifying agent; reacts with stearic acid to form a stable oil-in-water cream.
Almond Oil	Emollient; moisturizes and softens the skin.

Propylene Glycol	Humectant and penetration enhancer; retains moisture and improves drug absorption.
Methyl Paraben	Preservative; prevents microbial growth in the formulation.
Propyl Paraben	Preservative; enhances protection against fungi and bacteria.
Cetyl Alcohol	Thickening agent, emollient, and stabilizer; improves cream texture and spreadability.
Purified Water	Vehicle/Aqueous phase; dissolves water-soluble ingredients and forms the cream base.

8. EXTRACTION PROCEDURE

8.1 Collection and Authentication

Healthy rhizomes/tubers should be collected from a documented source and authenticated by an appropriately qualified botanist or pharmacognosist. A voucher specimen should be retained where possible. Proper authentication reduces the risk of substitution or adulteration. [3,14]

8.2 Drying and Powdering

Plant material should be cleaned to remove soil and foreign matter and dried under controlled conditions. Excessive heat should be avoided where volatile or heat-sensitive constituents are important. Dried material is powdered to increase surface area and improve extraction. [17]

8.3 Solvent Selection

Ethanol, hydroalcoholic mixtures, water and other solvents can extract different groups of constituents. The choice should be based on the target fraction and intended formulation. Essential oil is generally obtained by hydrodistillation or steam distillation, whereas a non-volatile extract may be prepared by maceration, percolation or Soxhlet extraction. [17]

9. FORMULATION PROCEDURE OF CYPERUS ROTUNDUS ANTIFUNGAL AND ANTIMICROBIAL CREAM

9.1 Oil Phase

- Stearic acid, cetyl alcohol, liquid paraffin and beeswax are taken in a suitable beaker.
- The ingredients are heated at 70–75°C until completely melted.
- The mixture is stirred properly to obtain a uniform oil phase.

9.2 Aqueous Phase

- Purified water, glycerin, methyl paraben, propyl paraben and triethanolamine are taken in another beaker.
- The aqueous phase is heated to approximately 70–75°C.
- It is stirred continuously until the ingredients are completely dissolved.

9.3 Emulsification

- The heated aqueous phase is slowly added to the oil phase with continuous stirring.
- Both phases are mixed thoroughly to form a uniform O/W emulsion.
- Stirring is continued until a smooth and homogeneous emulsion is obtained.

9.4 Final Cream Formation

- The emulsion is allowed to cool to approximately 40°C.
- Cyperus rotundus extract is added gradually and mixed uniformly.
- The final cream is homogenized, checked for smoothness and transferred into a suitable container.

10. EVALUATION PARAMETER

Table No.4: Evaluation Parameter

Parameter	Purpose
Appearance	Colour, odour, texture and visible uniformity.
Homogeneity	Checks uniformity and absence of lumps or separation.
pH	Assesses suitability for topical application.
Viscosity	Assesses consistency and flow characteristics.
Spreadability	Assesses ease of distribution over skin.
Extrudability	Assesses ease of removal from tube.
Washability	Assesses ease of removal with water.
Phase separation	Checks physical stability of the emulsion.
Centrifugation	May provide an accelerated physical stability screen.
Microbial quality	Assesses microbial contamination.
Skin irritation	Assesses dermal compatibility under approved procedures.
Stability	Monitors important properties during storage.

11. DISCUSSION

Cyperus rotundus is a medicinal plant with proven antimicrobial potential due to its diverse bioactive compounds. Studies have shown that rhizome essential oils containing sesquiterpenes such as α -cyperone and cyperene possess significant antibacterial activity, while solvent extracts also demonstrate antimicrobial effects that vary depending on the extraction method. These findings highlight the importance of formulation design, as creams prepared from ethanolic extracts may differ from essential-oil-based creams in terms of active constituents, drug release, skin penetration, and overall antimicrobial efficacy. Therefore, the selection of extract type and formulation components plays a crucial role in determining the therapeutic effectiveness of *C. rotundus* cream. [1,2,6,7,8,10,13]

12. RESEARCH GAP

Cyperus rotundus Linn is a medicinal plant that has been extensively studied for its antimicrobial and antifungal properties. Previous research has demonstrated that its rhizome extracts and essential oils possess significant inhibitory effects against various bacterial and fungal pathogens. Although a few studies have reported the preparation of herbal creams containing *C. rotundus* extracts or oils, most investigations have been limited to preliminary formulation and in vitro antimicrobial evaluation. [5,6,7,8,10,12,15]

However, there remains a lack of comprehensive studies focusing on the development of a standardized antifungal and antimicrobial cream of *Cyperus rotundus* Linn with optimized formulation parameters, physicochemical characterization, stability assessment, and safety evaluation. In addition, limited information is available regarding the comparative efficacy of such formulations against conventional antimicrobial products, their skin compatibility, and their effectiveness against resistant microbial strains. Therefore, further research is required to develop and evaluate a stable, safe, and effective *Cyperus rotundus*-based topical cream for the treatment of skin infections

13. CONCLUSION

Cyperus rotundus Linn. is a medicinal plant with a long history of traditional use and a broad range of reported biological activities. Its rhizomes and tubers contain essential oils, terpenoids, flavonoids, phenolic compounds and other phytochemicals. Scientific studies have reported antibacterial and antifungal activities of *C. rotundus* extracts and essential oils against several microorganisms. α -Cyperone has demonstrated antifungal activity in laboratory studies, while essential oils have shown activity against organisms including *S. aureus*, *E. coli*, *P. aeruginosa*, *C. albicans* and *Aspergillus* species. [3,4,13,14]

Incorporation of *C. rotundus* extract into a cream provides an interesting pharmaceutical approach for investigating a topical antimicrobial preparation. The formulation can be evaluated for appearance, homogeneity, pH, spreadability, viscosity, extrudability, washability, stability and antimicrobial activity. However, laboratory antimicrobial activity should not be interpreted as proof of clinical effectiveness. Standardization, formulation optimization, safety evaluation, stability studies and clinical research remain important. Overall, *C. rotundus* is a useful research candidate for development of plant-based topical antimicrobial formulations. [15,18,19]

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