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Antifungal Mechanism of Foeniculum Vulgare

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Abstract: *The escalating prevalence of drug-resistant fungal infections has intensified the need for alternative treatments. This study describes the development and evaluation of a novel herbal antifungal cream utilizing Foeniculum vulgare (fennel) seed extract as the primary active ingredient. The cream, which incorporates natural ingredients such as aloe vera gel, coconut oil, and beeswax, is designed for topical application to treat superficial fungal infections. Comprehensive evaluations included physical characteristics, pH, spreadability, homogeneity, viscosity, and antifungal efficacy against Candida albicans. The cream exhibited a smooth texture, a pH of 5.8 suitable for skin application, excellent spreadability, and significant antifungal activity without causing skin irritation. These findings suggest that the Foeniculum vulgare-based cream is a promising, safe, and effective alternative to synthetic antifungal agents*

Keywords: Foeniculum vulgare, herbal antifungal cream, fennel seed extract, natural antifungal, topical treatment, skin infections, antifungal efficacy, herbal medicine, cream evaluation

I. INTRODUCTION

Fungal infections, ranging from superficial conditions like ringworm and athlete's foot to severe systemic diseases, pose significant public health challenges, particularly due to the emergence of resistant fungal strains. Conventional antifungal drugs, while effective, often cause adverse effects such as skin irritation, nausea, or renal toxicity, prompting exploration into natural alternatives. Foeniculum vulgare, commonly known as fennel, is a widely recognized herb from the Apiaceae family with documented antimicrobial and antifungal properties, attributed to bioactive compounds like trans-anethole. This study aims to formulate a herbal antifungal cream using fennel seed extract and evaluate its physicochemical properties and efficacy against Candida albicans, a common fungal pathogen.

Foeniculum vulgare, commonly known as fennel, is a perennial herb belonging to the Apiaceae family, celebrated not only for its culinary uses but also for its significant medicinal properties. With a history dating back to ancient civilizations, fennel has been utilized in traditional medicine for centuries, primarily for its digestive and antimicrobial benefits.

Fungi:

"Fungi are a kingdom of usually multicellular eukaryotic organisms that are heterotrophs and have an important role in nutrient cycling in an ecosystem".

Types of Fungi:

Chytridiomycota:

Chytrids, the organisms found in Chytridiomycota, are usually asexual, and produce spores that no around using flagella, small tail-like appendages.

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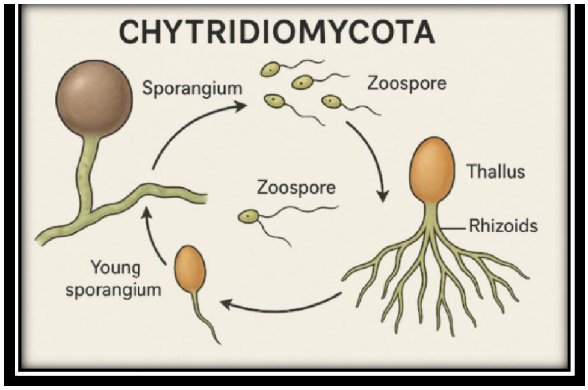

Fig.1. Chytridiomycota.

Zygomycota:

These are mainly terrestrial. They cause problems by growing on humans few sources.
Ex: Rhizopus stolonifer, a bread mold.

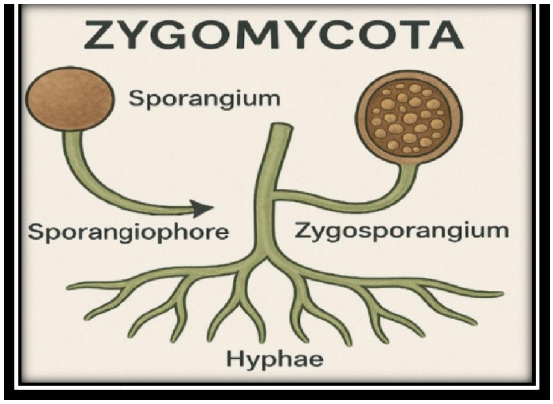

Fig.2. Zygomycota.

Pharmacognostic Account:

Aloe vera gel:

Biological Name: *Aloe barbadensis*

Biological Source: Mucilaginous gel from the parenchymatous cells of *Aloe vera* (L.) Burm.f. (Family: Asphodelaceae)

Chemical Constituents:

Polysaccharides (acemannan, glucomannan)
Anthraquinones (aloin, emodin)

Coconut oil:

Biological Name: *Cocos nucifera*

Biological Source: Fixed oil obtained from dried endosperm (copra) of Cocos nucifera L. (Family: Arecaceae)

Chemical Constituents:

Saturated fatty acids (lauric acid, myristic acid, palmitic acid)
Glycerides, tocopherols.

Beeswax:

Biological Name: *Cera alba*

Biological Source: Wax secreted by *Apis mellifera* (Family: Apidae)

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Chemical Constituents:
Esters of fatty acids and long-chain alcohols
Hydrocarbons, free acids, propolis

Citric acid:
Biological Name: *2-hydroxypropane-1,2,3-tricarboxylic acid*
Biological Source: Naturally found in citrus fruits (e.g., Citrus limon); industrially produced by Aspergillus niger fermentation.
Chemical Constituents:
Citric acid ($C_6H_8O_7$)

Bentonite clay:
Biological Nmae: *Hydrated aluminum silicate*
Biological Source: Naturally occurring colloidal hydrated aluminum silicate formed from volcanic ash
Chemical Constituents:
Montmorillonite (hydrated aluminum silicate)
Minerals: magnesium, calcium, sodium, iron

Guar gum:
Biological Name: *Cyamopsis tetragonoloba*
Biological Source: Endosperm of seeds of *Cyamopsis tetragonoloba* (Family: Fabaceae)
Chemical Constituents:
Galactomannan polysaccharide

Lavender oil:
Biological name: *Lavandula angustifolia*
Biological Source: Essential oil from flowers of Lavandula angustifolia Mill. (Family: Lamiaceae)
Chemical Constituents:
Linalool, linalyl acetate
Camphor, cineole, geraniol

Fennel extract:
Synonym: Saunf
Biological Source: Extract from fruits (seeds) of *Foeniculum vulgare* Mill. (Family: Apiaceae)
Chemical Constituents:
Anethole, fenchone, estragole

MATERIAL AND METHODS:

Method of Preparation:
In Beaker A:
Aqueous Phase Preparation: Aloe Vera Gel + Portion of Distilled Water

↓
Stir the mixture
↓
Slowly Add Guar Gum (while stirring)
↓
Add Citric Acid (pH adjustment)
↓
Add Fennel Extract
↓
Add Saffron Solution

In Beaker B:
Oil Phase Preparation: Beeswax + Coconut Oil

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↓

Melt Together at 60–70°C

↓

Add Lavender Oil

Emulsification:

Aqueous Phase + Oil Phase (add slowly with continuous stirring)

↓

Gradually Add Bentonite Clay

↓

Mix Well to Form Uniform Cream

Final Adjustment:

Adjust Volume with Distilled Water (to make up 25 g)

↓

Continue Stirring Until the Cream Cools and Thickens

↓

Transfer to Sterilized Containers

PHYTOCHEMICAL SCREENING:

Preliminary phytochemical tests revealed the presence of key compounds in the extract. **Proteins** were confirmed by a violet color in the Biuret test. **Terpenoids** showed a reddish-brown color in Salkowski's test. **Flavonoids** were indicated by a yellow color that disappeared with HCl. **Alkaloids** gave a creamy white precipitate with Mayer's reagent, and **phenols** produced a deep blue/green color with ferric chloride.

Evaluation:

pH Determination:

The cream (2.5g in 25ml distilled water) showed a pH of **5.80**, suitable for skin application.

Patch Test:

No signs of irritation or inflammation were observed after 24–48 hours, indicating **good skin compatibility**.

Spreadability Test:

The cream showed **good spreadability**, ensuring uniform coverage and easy application.

Homogeneity: The formulation was **uniformly distributed**, indicating proper mixing and consistent application.

Viscosity:

Measured viscosity was **21802 mPa·s**, indicating good consistency and stability.

RESULT AND DISCUSSION:

The formulated antifungal cream was **pale golden green**, smooth, semi-solid, and had a **characteristic odor**. It showed **a skin-friendly pH (5.80)**, was **homogenous**, and demonstrated **good spreadability** and **viscosity (21802 mPa·s).** Preliminary phytochemical tests confirmed the presence of **terpenoids, flavonoids, and phenols,** with **proteins and alkaloids absent.** The **patch test showed no irritation,** and **microbial testing confirmed antifungal activity**. Overall, the cream was **stable, effective, and safe** for topical treatment of fungal infections.

II. CONCLUSION

Herbal antifungal creams offer a safe, effective, and eco-friendly alternative to synthetic drugs. Their plant-based ingredients are generally well-tolerated and supported by both traditional use and modern research. As environmental awareness grows, these natural formulations are gaining prominence in healthcare, with future developments focusing on sustainability, safety, and proven efficacy.

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