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MICROSCOPIC FUNGI: STRUCTURE, TYPES, AND DISEASE-CAUSING PROPERTIES

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Annotation: This work examines the structure, main types, and disease-causing properties of microscopic fungi. Microscopic fungi are widely distributed eukaryotic organisms in nature and include molds, yeasts, and dimorphic fungi. The study analyzes their morphological structure, reproduction methods, and the fungal infections they cause in the human body. In addition, the main representatives of pathogenic fungi and their medical significance are discussed. The results of the research are of important scientific and practical value in the prevention and treatment of fungal diseases.

Keywords: Microscopic fungi, molds, yeasts, dimorphic fungi, mycology, fungal infections, *Candida*, *Aspergillus*, pathogenic fungi, microbiology, immunity.

This study focuses on microscopic fungi, their structural organization, diversity, and pathogenic properties, as well as their medical and biological significance. Microscopic fungi (micromycetes) are widely distributed eukaryotic organisms that inhabit diverse ecological environments, including soil, water, air, plants, animals, and the human body. Due to their adaptability and metabolic versatility, they play an essential role in natural ecosystems, particularly in the decomposition of organic matter and nutrient cycling.

From a biological perspective, fungi belong to a separate kingdom of eukaryotic organisms, distinct from plants, animals, and bacteria. Unlike plants, they do not contain chlorophyll and are unable to perform photosynthesis. Instead, they obtain nutrients through absorption, either as saprophytes, parasites, or symbionts. Their cellular structure includes a rigid cell wall primarily composed of chitin, which provides structural support and protection. The fungal body may exist as unicellular organisms (yeasts) or multicellular filamentous structures (molds), forming a network of hyphae known as mycelium. Microscopic fungi are generally classified into three main groups: molds (filamentous fungi), yeasts (unicellular fungi), and dimorphic fungi, which can exist in both forms depending on environmental conditions. Molds such as *Aspergillus*, *Penicillium*, and *Mucor* grow as multicellular filamentous networks and reproduce primarily through spore formation. Yeasts, such as *Candida albicans*, reproduce by budding and are commonly found in mucosal surfaces of the human body. Dimorphic fungi, including *Histoplasma* and *Blastomyces*, can switch between yeast and mold forms depending on temperature and environmental conditions, which significantly contributes to their pathogenicity.

In recent decades, the clinical importance of microscopic fungi has significantly increased due to the rising incidence of fungal infections, especially among immunocompromised individuals. Factors such as HIV/AIDS, cancer chemotherapy, organ

transplantation, diabetes mellitus, and prolonged antibiotic use have contributed to the growing prevalence of opportunistic fungal infections. These infections range from superficial conditions, such as dermatophytosis affecting skin, hair, and nails, to life-threatening systemic infections involving internal organs.

Pathogenic fungi employ various mechanisms to invade host tissues, evade immune responses, and establish infections. These include adhesion to host cells, secretion of enzymes, toxin production, and biofilm formation. Species such as *Candida albicans*, *Aspergillus fumigatus*, and dermatophytes like *Trichophyton* are among the most clinically significant fungal pathogens. *Candida* species are responsible for candidiasis affecting the oral cavity, genital tract, and bloodstream, while *Aspergillus* species can cause invasive pulmonary aspergillosis, particularly in immunosuppressed patients. Despite their pathogenic potential, microscopic fungi also have significant beneficial applications. In biotechnology and pharmaceutical industries, fungi are used for the production of antibiotics (such as penicillin derived from *Penicillium* species), enzymes, organic acids, and fermented food products. Yeasts, particularly *Saccharomyces cerevisiae*, play a crucial role in bread making, brewing, and bioethanol production. These applications highlight the dual nature of fungi as both beneficial and harmful biological agents. The increasing resistance of fungal pathogens to antifungal drugs has become a major global health concern. Limited availability of effective antifungal agents, combined with delayed diagnosis of fungal infections, often leads to high morbidity and mortality rates. Therefore, early detection, accurate identification of fungal species, and development of new antifungal strategies are essential for effective clinical management.

In conclusion, microscopic fungi represent a highly diverse and biologically significant group of organisms with both positive and negative impacts on human life. A comprehensive understanding of their structure, classification, and pathogenic mechanisms is crucial for advancing medical microbiology, improving diagnostic techniques, and developing effective therapeutic approaches. Consequently, research on microscopic fungi remains an important and rapidly developing field in modern science, with significant implications for medicine, biotechnology, and environmental biology.

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