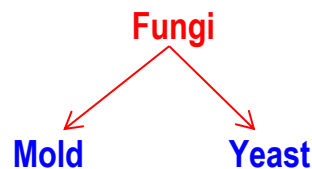


Introduction to Medical Mycology

Definition

Medical mycology is the study of fungi that are able to initiate diseases in humans and animals. Fungi are eukaryotic organisms that usually grow in a filamentous (mold) or yeast form or both.



Disadvantage Advantage

Fungi have been known long time ago and over 400,000 species and many are waiting to be discovered. About 150 species are known to cause primary disease in human and animals, range from localized cutaneous, subcutaneous or mucosal to sever systemic fatal disease. Also as the number of immune compromised patients increase other non-pathogenic species have been emerged to cause disease in these groups of patients such fungi known as opportunistic mycoses.

Fungi also harmful to human in other ways such as the food spoilage, major cause of plant diseases, destroy timber, textile and synthetic materials. However fungi play important role in the decay of complex plants and animals remain in soil with other bacteria (Streptomyces) breaking those to simple molecules to be absorbed by future generation of plants. Fungi also play important role in the production of antibiotics, organic acids, alcoholic beverage, soya sauce, bread-making (CO₂), cheese and as a scientific model to study genetic, biochemical processes and parasitic-host relationships.

Habitat

Fungi are free living with only few in the normal flora of humans, for that reason fungi do not need to colonize or infect tissue of human or animals to preserve the

species. With only two exceptions all fungal infection originated from exogenous sources by traumatic implantation or inhalation.

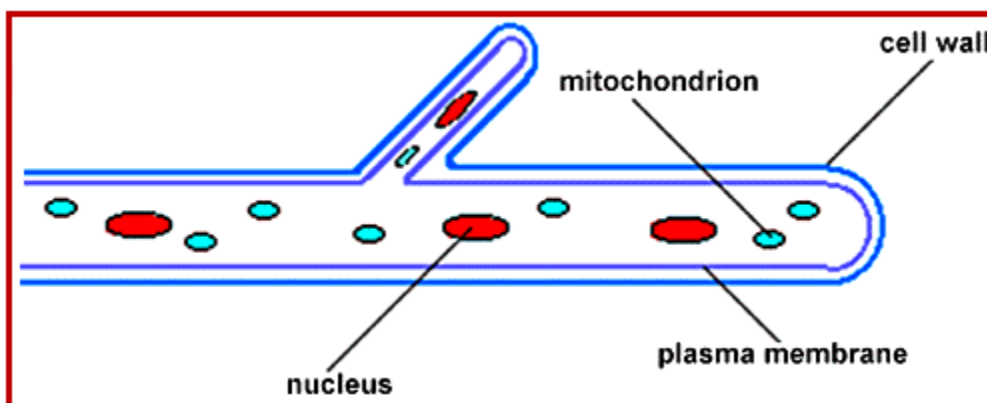
Fungi do not contain chlorophyll and cannot synthesize macromolecules from CO₂ and energy derived from light rays, for this reason fungus lead a heterotrophic existing in nature as saprobes, symbionts, commensal or parasites. However there are a bunch of fungi which can cause a disease in human have developed the ability to adapt to host tissue such as:

- a. Fungi that colonize cutaneous layer of epidermis, invade hair and nail can metabolize keratin such as agents of Dermatophytes.
- b. Fungi cause systemic disease such as *Histoplasma capsulatum* grow at 37C° (host temperature) rather than 25C° (environment), and can survive at low oxidation reduction state found in damaged host tissue.
- c. Some fungi have capsule such as *Cryptococcus neoformans*.

Structure of fungi

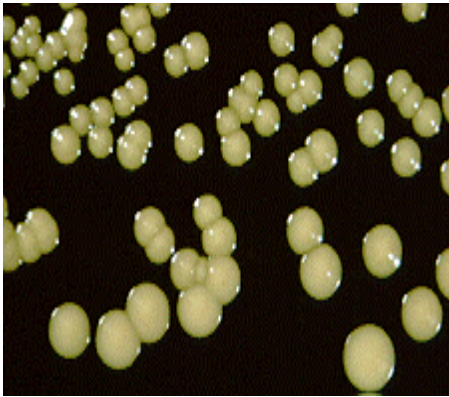
Fungi like any other eukaryotic cell composed of the following:

1. Cell wall which contain chitin and glucan.
2. Plasma membrane most important contain ergosterol.
3. Nucleus is rich in RNA and has double membranes with pores.
4. Cytoplasm contain mitochondria, vacuoles and so on.

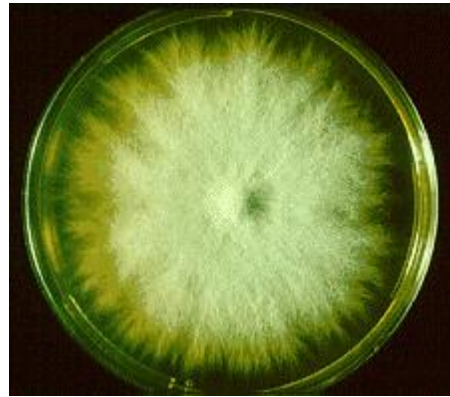


Morphology of fungi

Fungi as eukaryotic, non-motile organisms reproduce by means of spores (sexual) or (asexual) to form morphologically such diverse forms as molds or yeast depending on fungal species and growth condition.



Yeast colony



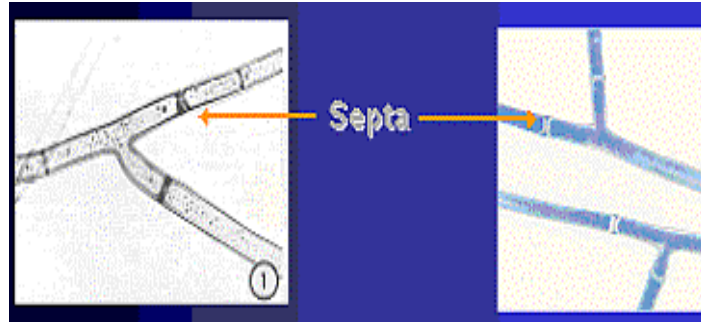
Mold colony

Mold form

Spore germinate to produce filament (**hyphae**) which divided in cells by **septa**, the cells may be **uninucleated** or **multinucleated**. Some fungi such as those belong to **Zygomycota** produce hyphae without septa called **Coenocytic hyphae**.



Coenocytic hyphae



Septate hyphae

A mass of hyphae called **mycelium** and have fuzzy appearance on macroscopic examination. Mycelium grows on (above) or into substrate is called **aerial** and **submerged** mycelium respectively.

Septa may be **simple** (solid plate without pores) or with single pores or several pores have **sieve-like** appearance, such as in the member of **Ascomycota** and

Deuteromycota. **Woronin body** may plug septa with single pores. In the more complex form such as members of **Basidiomycota** septa have barrel shaped apparatus called **dolipore**. Hyphae with dolipore produce hook-like bridge between cells called **clamp-connection**.

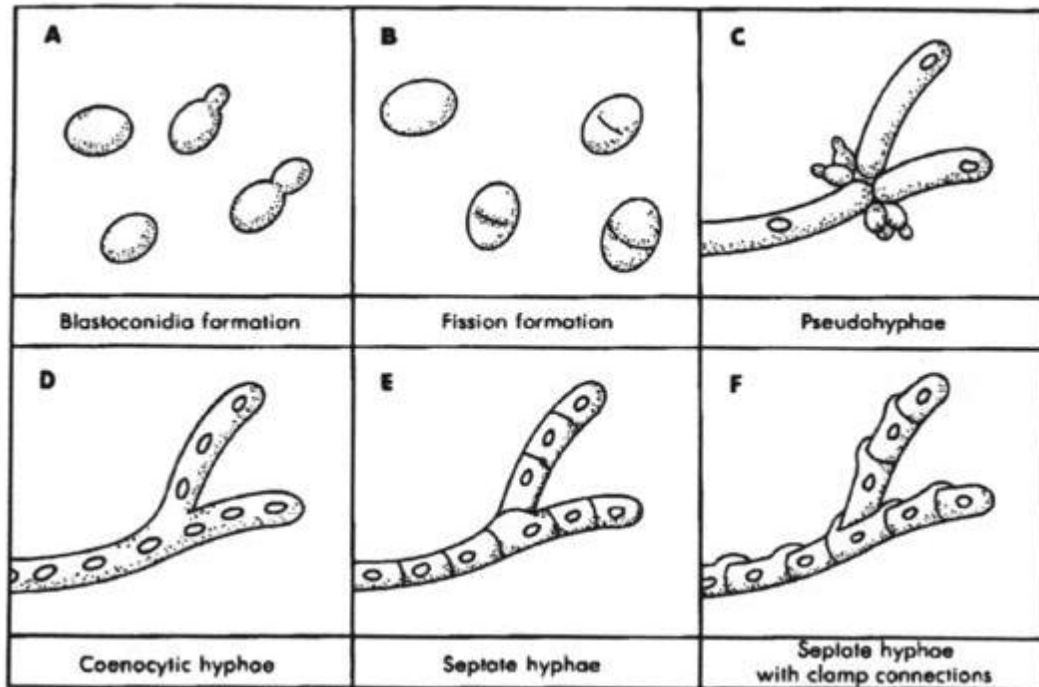


Clamp-connection

Mycelium of some fungi forms complex tissue in which individual hyphae lose their individuality. The tissue may take the form of column, rope, ball and other forms. *Aspergillus flavus* produce somatic round irregular hard macroscopic shaped called **sclerotium**.

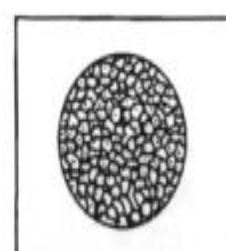
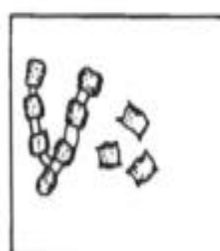
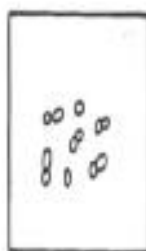
Yeast form

Spore germinate to produce oval, round or elongated single cell reproduce by budding and some by fission to form moist or mucoid colonies. Sometimes bud remain attach to parent cells and continuous budding without separation to form chain of elongated cells called **Pseudohyphae** which are differ from true hyphae. *Candida* species produce both pseudo and true hyphae depending on growth condition and species while other such as *Cryptococcus neoformans* produce only yeast form.



Dimorphic fungi

Some important mycotic agent such as *Histoplasma capsulatum*, *Sporothrix schenckii* have yeast form in host tissue (37 C°) or in vivo using enriched medium (37C°) and mycelium form in the environment or (25C°). Not all dimorphic fungi have yeast form in host tissue, for example *Coccidioides immitis* grow in the form of spherules with endospores.



Histoplasma capsulatum

Coccidioides immitis

Agent of **chromoblastomycosis** produces sclerotia bodies divided by internal septation and *Emmonisa parva* produce tick conidia called a diaspore never reproduce inside host tissue.



Sclerotia bodies

Growth

Mycelium produces circular colony (**solid medium**) or globose colony (**liquid medium**) owing to its tendency to grow equally in all direction from central point. Most fungi grow at 25C° and few are thermos tolerant such as *Aspergillus fumigatus*, *Cladosporium trichoides*, which capable of growth at 37-50C°. Fungi prefer acid pH (6.6-6.8), and light may suppress sporulation.

Nutritional requirements

As **heterotrophic organisms** fungi require organic nutrients and they are absorb rather than ingest their food. Most important medical fungi are facultative parasites and a few are obligate parasites such as *Rhinosporidium seeberi* and *Loboa lobo*. Many fungi grow on simple medium containing carbohydrates and organic or inorganic sources of nitrogen and minerals. **Glucose** is the best source of carbon and **organic nitrogen** or **ammonium compounds** are best source for nitrogen. Some fungi require vitamins such as **thiamin** and **biotin** (anthropophilic Dermatophytes).