

Medical Mycology

Second Lecture

Morphology, Classification and Reproduction of fungi:

Morphology of fungi:

Fungi exist in two fundamental forms; **the filamentous (hyphal) and single celled budding forms (yeast).**

But, for the classification sake they are studied as

1. moulds,
2. yeasts,
3. yeast like
4. dimorphic fungi.

Moulds:

- The thallus of mold is made of **hyphae**, which are cylindrical tube like structures that elongates by growth at tips.
- A mass of hyphae is known as **mycelium**.
- The hypha is responsible for the filamentous nature of mold.
- The hyphae may be **branched or unbranched**.
- They may be **septate or aseptate**.
- Hyphae usually have cross walls that divide them into numerous cells.
- These cross walls, called septa have small pores through which cytoplasm is continuous throughout the hypha, therefore all hyphal fungi tend to be

coenocytic (multinucleated). With exception of zygomycetes (Rhizopus, Mucor), **all moulds are septate**.

- **Non-septate hyphae** are considered to be more primitive because if a hyphal strand is damaged **the entire strand dies**.

- **When a septate hyphal strand** is damaged, the pores between adjacent compartments can be plugged, thus **preventing death** of the whole hyphal strand.

Mycelium are of three kinds:

1. **Vegetative mycelium** those which penetrate the surface of the medium and absorb nutrients.
2. **Aerial mycelium** are those that grow above the agar surface
3. **Fertile mycelium** are aerial hyphae that bear reproductive structures such as **conidia or sporangia**.

- Since hypha is the structural unit of mold, the **mycelium** imparts colour, texture and topography to the colony.

Those fungi that possess melanin pigments in their cell wall are called **phaeoid** their colonies are coloured **grey, black or olive**. Examples are species of **Bipolaris**.

Those hyphae that don't possess any pigment in their cell wall are called **hyaline**. Hyphae may have some specialized structure or appearance that aids in identification.

Yeasts:

Yeasts are unicellular spherical to ellipsoid cells. They reproduce by budding, which results in blastospore (blastoconidia) formation.

-In some cases, as the cells bud, the **buds fail to detach and elongate** thus forming a chain of elongated hyphae like filament **called pseudohyphae**. This property is seen in **Candida albicans**.

- The same species also have the ability to produce **true hypha**, which is seen as germ tube. The difference between the two is that there is a **constriction in psueudohyphae** at the point of budding, **while the germ tube has no constriction**.

- Some yeast such as **Cryptococcus** and the **Blastomyces dermatatidis** produce polysaccharide capsule. Yeast form of capsules can be demonstrated by negative staining methods using India ink or Nigrosin. The capsule itself can be stained by Meyer Mucicarmine stain.

- Some yeasts are pigmented. Rhodotorula sps produces pink colonies due to carotenoid pigments while some yeasts produce brown to olivaceous colonies.

- True yeasts such as Saccharomyces cerviciae don't produce pseudohyphae. Yeast-like fungi may be **basidiomycetes**, such as Cryptococcus neoformans or **ascomycetes** such as Candida albicans.

Classification of fungi:

Fungi were initially classified with plants and were a subject of interest for botanists; hence the influence of botany can be seen on their classification. In 1969 R.H Whittaker classified all living organisms into five kingdoms namely:

- 1. Monera,**
- 2. Protista,**
- 3. Fungi,**
- 4. Plantae**
- 5. Animalia.**

Traditionally the classification proceeds in this fashion: Kingdom - Subkingdom - Phyla/phylum - Subphyla - Class - Order - Family - Genus - Species .

This classification is too complicated to be dealt here. There are alternate and more practical approaches, **one based on sexual reproduction** and the other **based on morphology of the thallus** (vegetative structure).

A. Based on Sexual reproduction:

1. Zygomycetes:

which produce through production of zygospores.

2. Ascomycetes:

which produce endogenous spores called ascospores in cells called asci.

3. Basidiomycetes: which produce exogenous spores called basidiospores in cells called basidia.

4. Deuteromycetes (Fungi imperfecti): fungi that are not known to produce any sexual spores (ascospores or basidiospores).

B. Based on Morphology:

1. Moulds (Molds): Filamentous fungi Eg: *Aspergillus* sps, *Trichophyton rubrum*

2. Yeasts: Single celled cells that buds Eg: *Cryptococcus neoformans*, *Saccharomyces cerviciae*

3. Yeast like: Similar to yeasts but produce pseudohyphae Eg: *Candida albicans*

4. **Dimorphic:** Fungi existing in two different morphological forms at two different environmental conditions. They exist **as yeasts** in tissue and in vitro at 37C° and **as molds** in their natural habitat and in vitro at room temperature. Eg: Histoplasma capsulatum, Coccidioides immitis

Some 200 "human pathogens" have been recognized from among an estimated 1.5 million species of fungi.

C. Based on the site of infection (Clinical Classification) :-

- 1- Superficial infection.
- 2- Cutaneous infection
- 3- Subcutaneous infection.
- 4- Systemic infection.
- 5- Opportunistic infection.

Reproduction in fungi:

Fungi reproduce by asexual, sexual and parasexual means.

- Fungi can reproduce **asexually** by fragmentation, budding, or producing spores,
- Or **sexually** with homothallic or heterothallic mycelia.
- Asexual reproduction is the commonest mode in most fungi with fungi participating in sexual mode only under certain circumstances.

Asexual reproduction is called **anamorph (or imperfect stage)** and when the same fungus is undergoing sexual reproduction, the form is said to be **teleomorph (or perfect stage)**. The whole fungus, including both forms is referred as **holomorph**.

Importance of Spores:

A. Biological

- 1) Allows for dissemination.
- 2) Allows for reproduction.
- 3) Allows the fungus to move to new food source.
- 4) Allows fungus to survive periods of adversity.
- 5) Means of introducing new genetic combinations into a population.

B. Practical

- 1) Rapid identification (also helps with classification).
- 2) Source of inocula for human infection.
- 3) Source of inocula for contamination.