

Lecture 2: Morphology, Classification

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Morphology of fungi:

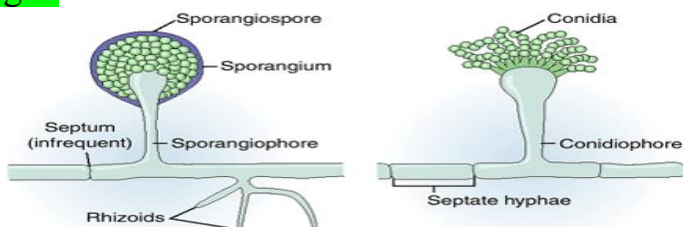
Fungi exist in two fundamental forms; the filamentous (hyphal) and single celled budding forms (yeast). But, for the classification sake they are studied as moulds, yeasts, yeast like and dimorphic fungi.

Moulds:

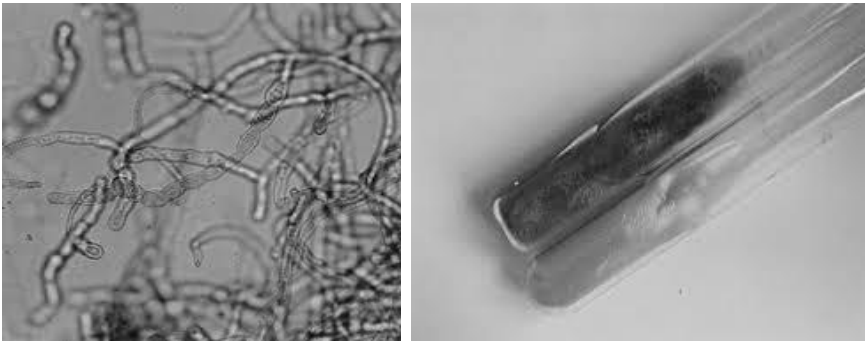
The thallus of mould is made of hyphae, which are cylindrical tube like structures that elongates by growth at tips. A mass of hyphae is known as mycelium. It is the hypha that is responsible for the filamentous nature of mould. The hyphae may be branched or unbranched. They may be septate or aseptate. 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 hyphae. Therefore all hyphal fungi tend to be coenocytic (multinucleate). 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 are those that penetrates the surface of the medium and absorbs 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.

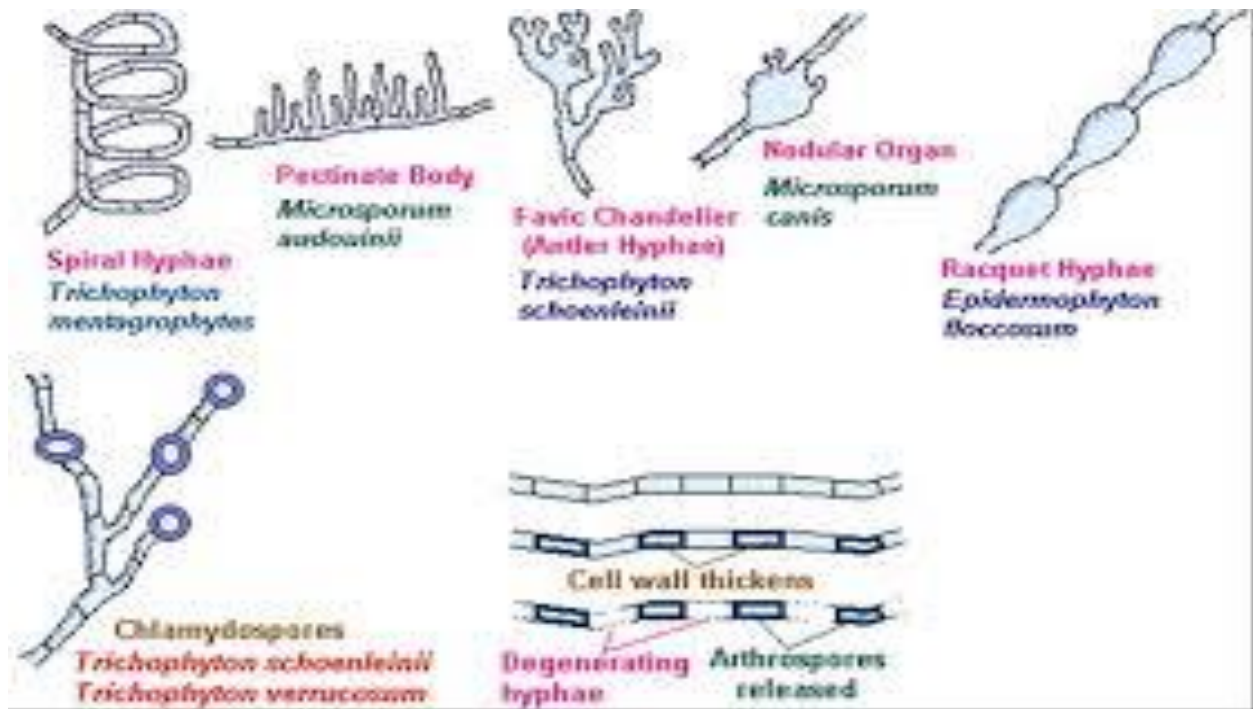


Since hypha is the structural unit of mould, the mycelium imparts colour, texture and topography to the colony. Those fungi that possess melanin pigments in their cell wall are called phaeoid or dematiaceous and their colonies are coloured grey, black or olive. Examples are species of *Bipolaris*, *Cladosporium*, *Exophiala*, *Fonsecaea*, *Phialophora* and *Wangiella*. Those hyphae that don't possess any pigment in their cell wall are called hyaline.



Hyphae may have some specialized structure or appearance that aid in identification. **Some of these are:**

- a) **Spiral hyphae**: These are spirally coiled hyphae commonly seen in *Trichophyton mentagrophytes*.
- b) **Pectinate body**: These are short, unilateral projections from the hyphae that resemble a broken comb. Commonly seen in *Microsporum audouinii*.
- c) **Favic chandelier**: These are the group of hyphal tips that collectively resemble a chandelier or the antlers (قرن الوعل) of the deer (**antler hyphae**). They occur in *Trichophyton schoenleinii* and *Trichophyton violaceum*.
- d) **Nodular organ**: This is an **enlargement** in the **mycelium** that consists of closely twisted (مجدول) **hyphae**. Often seen in *Trichophyton mentagrophytes* and *Microsporum canis*.
- e) **Racquet hyphae**: There is **regular enlargement** of one end of each segment with the opposing end remaining thin. Seen in *Epidermophyton floccosum*, *Trichophyton mentagrophytes*.
- f) **Rhizoides**: These are the **root like structures** seen in portions of **vegetative hyphae** in some members of **zygomycetes**.



Yeasts:

Yeasts: Yeasts are unicellular spherical to ellipsoid cells. They reproduce by budding, which result in blastospore (blastoconidia) formation. In some cases, as the cells buds 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 pseudohyphae at the point of budding, while the germ tube has no constriction.

Some yeast such as *Cryptococcus* and the yeast form of *Blastomyces dermatitidis* produce polysaccharide capsule. 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 such as *Phaeoannellomyces werneckii* and *Piedraia hortae* are dematiaceous, producing brown to olivaceous colonies. True yeasts such as *Saccharomyces cervisiae* don't produce pseudohyphae. Yeast-like fungi may be basidiomycetes, such as *Cryptococcus neoformans* or ascomycetes such as *Candida albicans*.

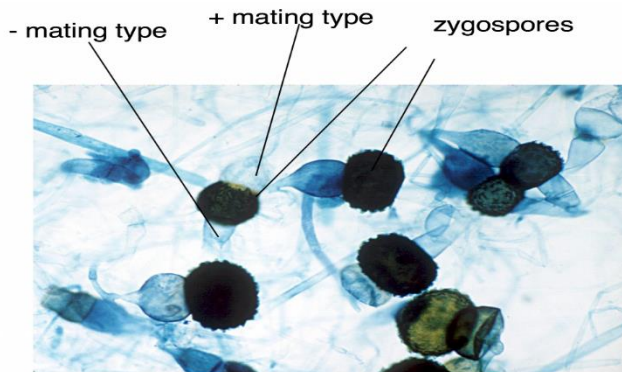
Classification of fungi:

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 Monera, Protista, Fungi, Plantae and Animalia. Traditionally the classification proceeds in this fashion:

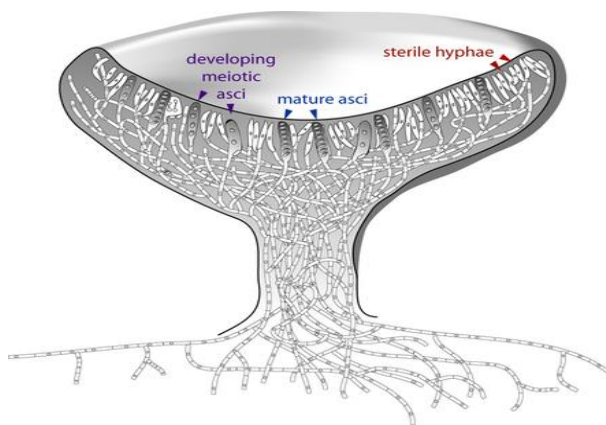
Kingdom - Subkingdom - Phyla/phylum - Subphyla - Class - Order - Family - Genus- Species .This classification is too complicated to be dealt here. There are alternate and more practical approaches, one based on sexual reproduction and the other based on morphology of the thallus (vegetative structure).

Based on Sexual reproduction:

1. **Zygomycetes**: which produce through production of **zygospores**.



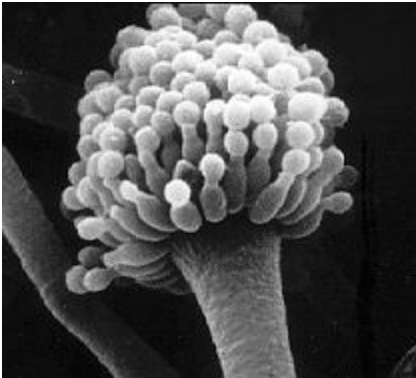
2. **Ascomycetes**: which produce **endogenous spores** called **ascospores** in cells called **asci**.



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**).

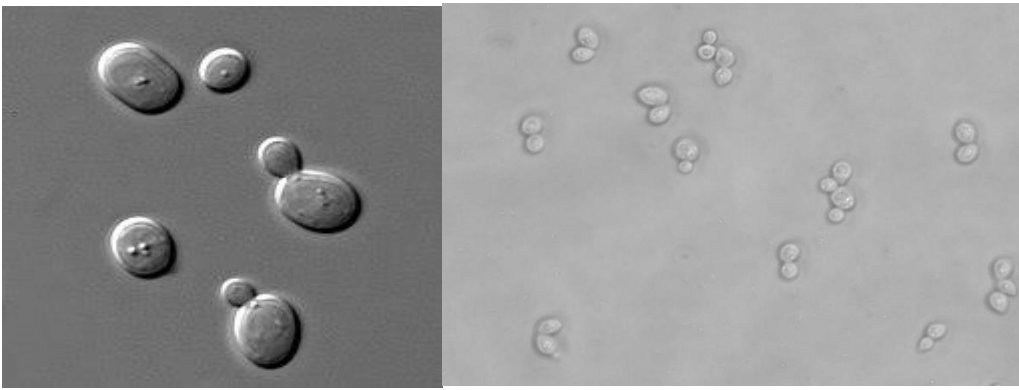


Based on Morphology:

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



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



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 37°C and as moulds in their natural habitat and in vitro at room temperature. Eg: *Histoplasma capsulatum*, *Blastomyces dermatidis*, *Paracoccidioides brasiliensis*, *Coccidioides immitis*. Some 200 "human pathogens" have been recognized from among an estimated 1.5 million species of fungi.

Biased 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. The form of

fungus undergoing asexual reproduction is known as 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 the forms is referred as holomorph.

importance of Spores:

A. Biological

- 1) Allows for dissemination (الانتشار)
- 2) Allows for reproduction
- 3) Allows the fungus to move to new food source.
- 4) Allows fungus to survive periods of adversity. (الشدائد)
- 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