

MYCOLOGY

The term “**Mycology**” is derived from Greek word “**mykes**” meaning mushroom. There for the mycology is study of fungi. In 1910 Raymond Sabouraud published his book *Les Teignes*, which was a comprehensive study of dermatophytic fungi. He is also regarded as father of medical mycology.

Mycology: - mycology is a branch of microbiology in which fungus are studied. The morphology, nutrition, reproduction, cultivation in the laboratory and the method of identification of fungi are studied in mycology. The diseases caused by fungi in man and animals are also studied in mycology.

Classification: - fungi are eukaryotic (higher) organisms compared to bacteria which are prokaryotic (lower). Fungi belong to plant kingdom

Kingdom -----Plant.

Phylum -----Thallophyta

Division -----Eumycetes

Class -----
1. Phycomycetes
2. Ascomycetes
3. Basidiomycetes
4. Deuteromycetes/Fungi Imperfecti

Fungi: They are nucleated, spore bearing, achlorophyllous organism which reproduce sexually and asexually and whose filamentous branched somatic structures are surrounded by cell walls containing cellulose or chitin.

1. Have true nucleus
2. They reproduce by spores
3. They reproduce sexually
4. They have thread like structures which branch.
5. The cell walls contain cellulose or chitin

Advantages:

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1. Responsible for degradation of organic matter and so useful for recycling process in nature.
2. Fungi are responsible of wine and beer, preparation of bread, cheese and commercial preparation of organic solids and alcohol.
3. Synthesis of antibiotic (penicillin).
4. Model organism for biochemical and genetic studies e.g. *Neurospora crassa*

5. *Saccharomyces cerviciae* is extensively used in recombinant DNA technology
6. Synthesis of vitamins and cofactors.
7. Mushroom which is a fungus is a very highly proteinous food.
8. Ergot produced by *Claviceps purpurea* contains medically important alkaloids that help in inducing uterine contractions, controlling bleeding and treating migraine.
9. Fungi (*Leptolegnia caudate* and *Aphanomyces laevis*) are used to trap mosquito larvae in paddy field thus help in malaria control.

Disadvantages: -

1. Fungi cause the majority of plant diseases.
2. Fungi also causes few diseases of man and animals.
3. Cause spoilage of leather and clothes.
4. Cause spoilage of food grain.
5. Produce toxins in food stuffs vis. Aflatoxin in cake and other grains.
6. Certain varieties of mushroom are toxic and produce a toxin which are harmful.
7. Laboratory contamination in bacteriological media and in tissue culture.
8. Damage the product such as magnetic tapes and disks, glass lenses, marble statues, bones and wax.

General properties of fungi:

- They are eukaryotic; cells contain membrane bound cell organelles including nuclei, mitochondria, Golgi apparatus, endoplasmic reticulum, lysosomes etc.
- Have ergosterols in their membranes and possesses 80S ribosomes.
- Have a rigid cell wall and non-motile, a featured that separate from animal cell. All fungi possess cell wall made of chitin.
- Are chemoheterotrophs (require organic compounds for both carbon and energy source) and fungi lack chlorophyll and are therefore not autotrophic.
- Fungi are osmotrophic; they obtain their nutrients by absorption.
- They obtain nutrients as saprophytes
- All fungi require water and oxygen and there are no obligate anaerobes.
- Typically reproduce asexually and/or sexually by producing spores.
- They grow either reproductively by budding or non-reproductively by hyphal tip elongation.
- Food storage is generally in the form of lipids and glycogen.

Association of fungi with other living and non-living: - The majority of fungi live on dead organic matter while some are parasitic on other living organism (plants and animals). Almost all pathogenic fungi of plant are obligate parasites while all animal fungi (except *Rhinosporidium seeberi*) grow as saprophytes.

1. **Obligate saprophytes:** - Fungi which live on dead organic matter and incapable of infecting living organism.

2. **Facultative parasites:** - Lives on dead matter as well as on living organisms.
3. **Obligate parasites:** - Those fungi which can live only on other living organisms (plant and animals).

Morphological structures of fungi: -

The two most important structures of fungi are spore and hypha. The spore is basic structure and it is responsible for reproduction of fungi. In suitable environment spores germinate, enlarge in size and produce microscopic, thread like structures called "hypha". The hypha is thin, transparent, tubular structure and contains protoplasm. The hypha is of two types

- 1). Non-septate hypha in which there are no cross partitions and
- 2) Septate hypha in which protoplasm is divided at irregular intervals with septa.

Mycelium: - The hypha branch, rebranch and produce a network or meshwork and it is known as mycelium. The mycelium is of two types.

Vegetative mycelium: - It is that portion of mycelium which burrows inside the medium or which is in contact with the medium. The function of the vegetative mycelium is to absorb the food from the medium for growth and reproduction.

Aerial or reproductive mycelium: - It is that part of mycelium which produce from vegetative part into air its function is to produce the spores.

Growth of hypha: - fungal hypha is capable of indefinite growth & multiplication under favourable condition and the mycelium grow equally in all directions from a central point and in this way spherical colony is formed on media.

Morphology of Fungi:

Fungi exist in two fundamentals form; the **filamentous (hyphal) and single celled budding forms (yeast)**. But, for the classification they are studied as mould, yeast, yeast like and dimorphic fungi.

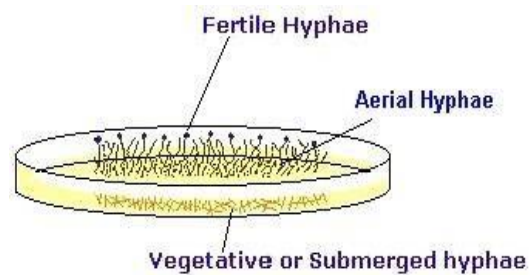
All fungi having typical eukaryotic morphology. They have rigid cell wall composed of chitin, which may be layered with mannans, glucans and other polysaccharides in association with polypeptide. Some lower fungi possess cellulose in their cell wall. Some fungi such as Cryptococcus and yeast form of *Histoplasma capsulatum* possess polysaccharide capsule that help them to evade phagocytosis. Inner to the cell wall is the plasma membrane that is typical bi-layered membrane in addition to the presence of sterol. Fungal membrane possesses ergosterol in contrast to cholesterol found in mammalian cells. The cytoplasm consists of various organelles such as mitochondria, Golgi apparatus, ribosome, endoplasmic reticulum, lysosomes, microtubules and a membrane enclosed nucleus. A unique property of the nuclear membrane is that it persists throughout the metaphase of mitosis unlike in plant and animal cell where it dissolves and re-forms. The nucleus possesses paired chromosome.

Mould:

The thallus of mould is made of 'Hyphae', which are cylindrical tube-like structures that elongated by growth as a tip. 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 non-septate. Hyphae usually having cross walls that divide them into numerous cells. These cross walls, called septa having small pores through which cytoplasm is continuous throughout the hyphae. Therefore, all hyphal fungi tend to be coenocytic (Multinucleated) with exception of Zygomycetes (Rhizopus, Mucor), all mould is septate. Non-septate hyphae are considered to more primitive because if a hyphal strand is damage, the entire strand will die. When a septate hyphae strand is damage, the pores between adjacent compartments can be plugged, thus preventing death of the whole hyphal strand.

Mycelium are of three kinds:

1. **Vegetative mycelium:** They are those that penetrates the surface of the medium and absorbs nutrient.
2. **Aerial mycelium:** they are those that grows above agar surface
3. **Fertile mycelium/reproductive form:** They are aerial hyphae that bear reproductive structures such as conidia or sporangia.



Yeast:

Yeast is unicellular spherical to ellipsoid cells. They reproduce by budding, which result in Blastospores (Blastoconidia) formation. In some cases, as the cells 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.

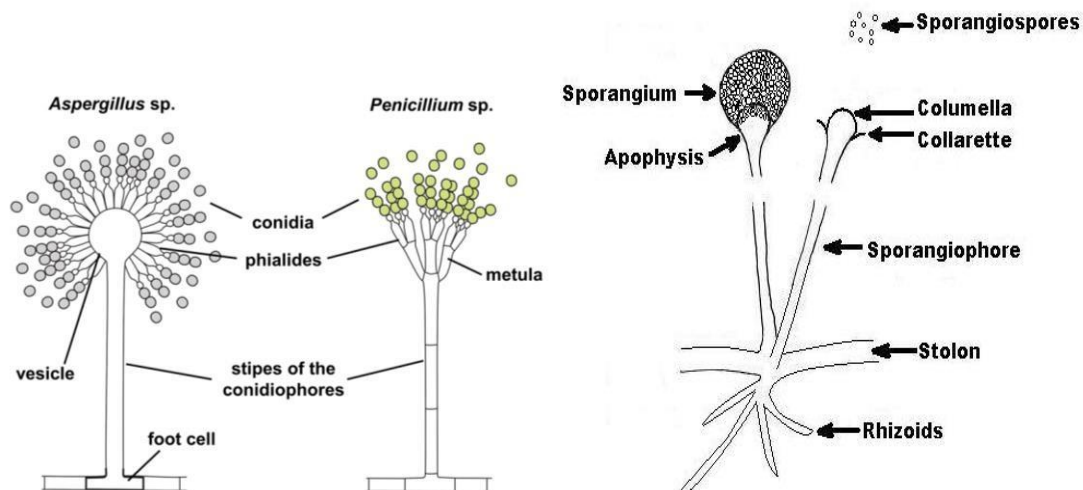
Some yeast such as *Cryptococcus spp.* produce polysaccharide capsule. Capsule can be demonstrated by negative staining method using Indian ink or Nigrosin. The capsule itself can be stained by Meyer Mucicarmine stain. Some yeasts are pigmented like *Rhodotorula spp.* produces pink colonies.

Spores: Different fungi produce different types of spores and it is useful in identification of fungi.

1. The spores grow on specialized hyphae or spore bearing structure of hyphae and it is known as 'sporophore' i.e. (spore producing structure). The spores are enclosed in a sac like structure known as sporangium. When one spores become mature, the sporangium ruptures and spores are set free. Example: mucor.

- The spores are free i.e., not enclosed within the sac. Such spores are called conidiophores or conidia. Example: aspergillus and penicillium.

In aspergillus, the hyphae are septate and from a 'foot cell' conidiophore arises which is an enlarged cell of the vegetative mycelium. The terminal part of conidiophores is swollen and known as vesicle. From the vesicle flask shaped sterigmata arises and spores or conidia are produced by these sterigmata.



In penicillium, the structures are similar to aspergillus but there are 3 differences:

- (1) Conidiophore is branched and these branched give a 'brush like' appearance.
 - (2) Vesicle is absent.
 - (3) Hyphae is septate but foot cell is absent.
- The conidia are of two types- macroconidia and microconidia, and both type of conidia is produced by hyphae.
Example: the fungi which cause the disease of ringworm produce such conidia viz., microsporium, trichophyton and Epidermophyton.

Microsporium: The macroconidia are large spindle shaped. And end is pointed. It is thick walled and has 8 septa.

Trichophyton: The macroconidia are small and club shaped. The free end is round. It is thin walled.

Epidermophyton: The microconidia are pear shaped. There is no stalk and narrow end is attached directly to conidiophores.

- Spores are formed on hyphae itself and modification of cell wall of hyphae spores are produced. Such spores have thick walls and spores remain intact and viable even if hypha is dead or disintegrated.

Produces in **Asexual Reproduction**

Chlamydo spores: Chlamydo spores are thick-walled spherical structures which are reproduced on hypha. Example: *Candida albicans* produce chlamydo spores.

Arthrospores: There is segmentation of hypha and hyphal cells become rectangular and thick walled and, in this way, 'arthrospores' are formed. E.g., coccidioides.

Blastospores: In candida buds originate from the hypha to produce blastospores.

Conidiospores: Multiple (chains) or single spores formed at the end of an aerial hypha. Not enclosed within sac E.g., Aspergillus and penicillin spp.

Sporangiospores: Hundreds formed within a sac (sporangium) at the end of an aerial hypha e.g., Rhizopus spp.

