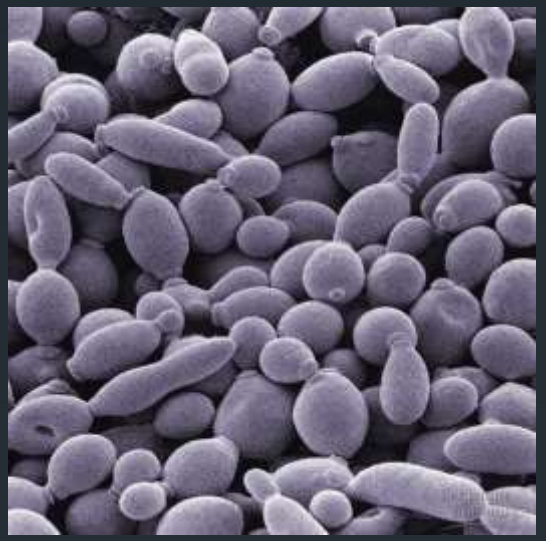
FUNGI



Introduction

- Fungi is the plural of fungus.
- A member of a large group of eukaryotic organisms.
- Familiar as mushrooms.
- These organisms are classified as a kingdom, Fungi, which is separate from plants, animals, protists and bacteria.
- One major difference is that fungal cells have cell walls that contain chitin, unlike the cell walls of plants and some protists, which contain cellulose, and unlike the cell walls of bacteria.
- The study of fungi is known as MYCOLOGY.
- Genetic studies have shown that fungi are more closely related to animals than to plants.

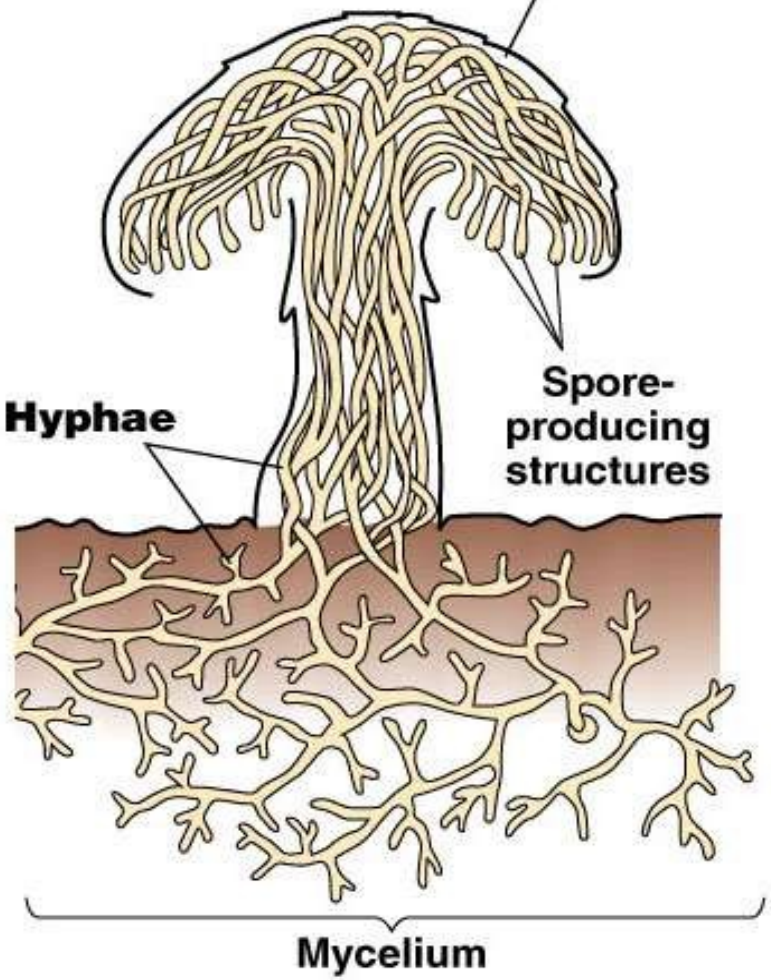
Intro... Contd.

- However, little is known of the true biodiversity of Kingdom Fungi, which has been estimated at 1.5 million to 5 million species, with about 5% of these having been formally classified.

- Taxonomical works of Carl Linnaeus, fungi have been classified according to their morphology or physiology.

Morphological Characteristics of Fungi

- Non-motile eukaryotic organisms which exists as saprophytes, parasites.
- Posses differentiated nuclei surrounded by a nuclear membrane.
- Reproduce either by budding or by forming spores.
- Nonphotosynthetic (heterotrophic).
- Morphologically may be either simple oval cells or long tubular septate hyphae showing true lateral branching.
- Most fungi grow as thread-like filamentous microscopic structures called **hyphae** (which are microscopic filaments between 2–10 μm in diameter and up to several centimeters in length) and which collectively form the **mycelium** (aggregates of hyphae).
- Hyphae can be **septate**, i.e., divided into compartments separated by a septum, each compartment containing one or more nucle.
- May be unicellular or multicellular.
- Most are microscopic molds or yeasts.



Classification of fungi

- Depending on cell morphology, fungi can be divided into 4 classes:

  I. Moulds
  II. Yeasts
  III. Yeast like fungi and
  IV. Dimorphic fungi

- Based on their sexual spore formation fungi are divided into 4 classes:

  I. Phycomycetes
  II. Ascomycetes
  III. Basidiomycetes
  IV. Deuteromycetes

1. Moulds

- Fungi which form mycelia are called moulds or filamentous fungi.
- Filaments of fungi are called hyphae.
- Diameter is 2-10μm .
- The cell walls contain chitin.
- Some hyphae may divided by cross sections called septa
- Two types of hyphae: Septate and Non-septate

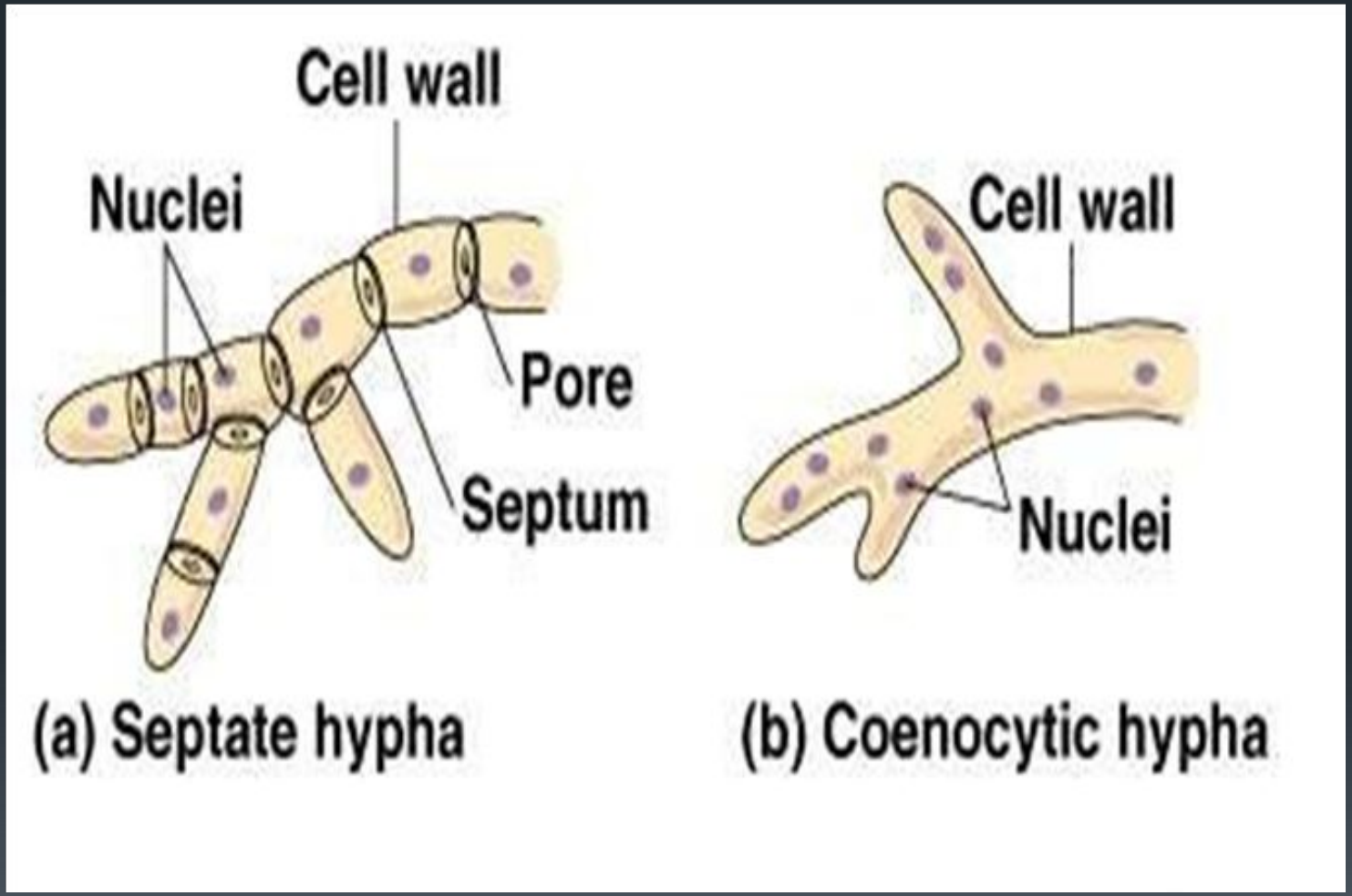
I. **Septate**: septa divide the hyphae into distinct, uninucleate or mulitnucleate cell-like units.

II. **Nonseptate**: does not contain septa and appear as long, continuous cells with many nuclei.

- Example: *Aspergillus fumigatus, Aspergillus niger, Penicillium notatum*

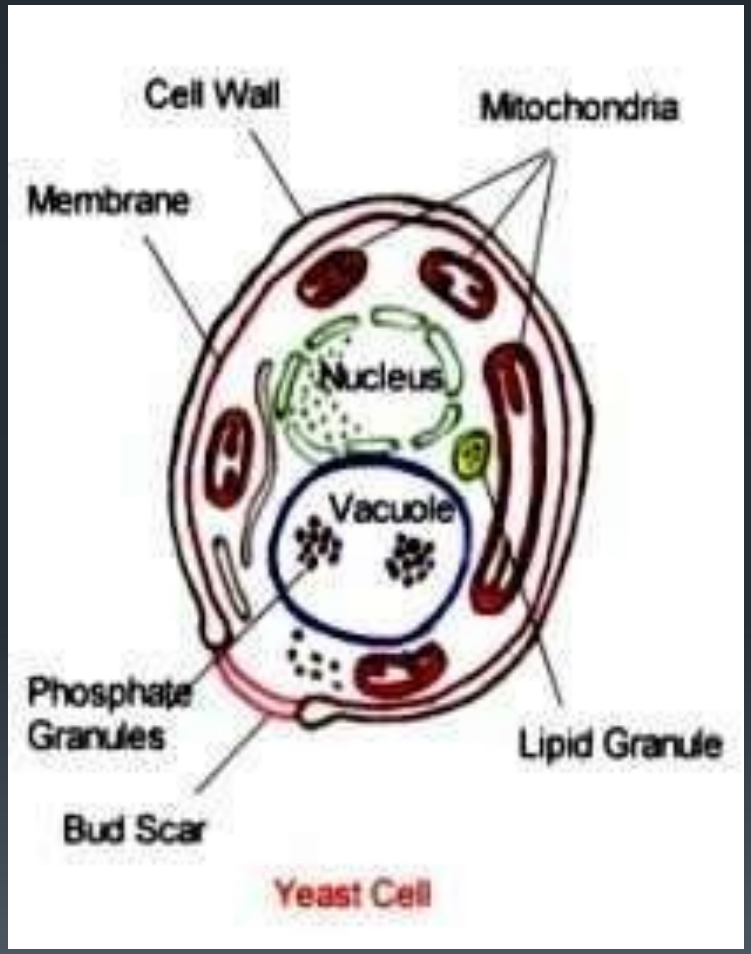
Septated

Nonseptated -coenocytic


Cell wall
Nuclei
Pore
Septum
(a) Septate hypha
Cell wall
Nuclei
(b) Coenocytic hypha

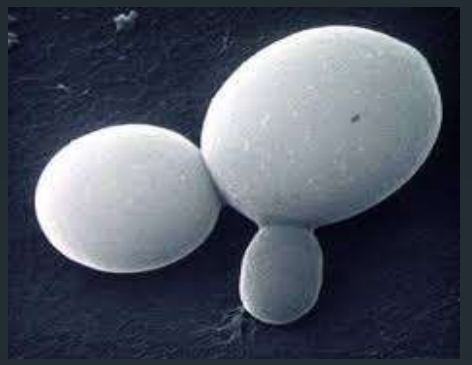
2. Yeasts

- Round, oval or elongated, unicellular fungi
- Reproduce by an asexual process called budding in which the cell develops a protuberance which enlarges and eventually separates from the parent cell
- On culture they form smooth, creamy colonies
- Example: *Saccharomyces cerevisae*, *Cryptococcus neoformans*



3. Yeast like fungi

- The bud remains attached to the mother cell and elongates, followed by repeated budding, forming chains of elongated chains known as pseudohyphae.
- Example: *Candida albicans*



4. Dimorphic fungi

- Mainly pathogenic species exhibit dimorphism i.e. 2 forms of growth
- Fungi can grow either as a mould or as a yeast
- Mouldlike forms produce vegetative and aerial mycellium and Yeast like forms reproduce by budding
- Dimorphism is temperature and CO_2 dependant.
- At 37ºC, the fungus grows yeastlike and at 25ºC it shows mould like growth
- Example: *Mucor rouxii, Histoplasma capsulatum*

1. Phycomycetes

- Fungi having non-septate hyphae, forms endogenous asexual spores (sporangiospores) contained within a sac like structures called sporangia.
- Also produce sexual spores known as oospores and zygospores.
- Example: *Mucor, Rhizopus*.

2. Ascomycetes

- Form sexual spores within a sac and are called ascospores.
- The sac is called as ascus.
- They form septate hyphae.
- Include both yeasts and filamentous fungi e.g. *Histoplasm, Candida* etc.

3. Basidiomycetes

- Reproduce sexually and form septate hyphae.
- These basidiospores are borne at the tip of the basidium
- Example: *Cryptococcus neoformans*

4. Deuteromycetes

- Consist of group of fungi whose sexual phases have not been identified and they form septate hyphae and asexual conidia.
- Majority of the pathogenic moulds, yeasts, yeasts like fungi and dimorphic fungi.
- Example: *Trichophyton, Epidermophyton*

Reproduction

- Most fungi reproduce both sexually and asexually.
- When environmental conditions are favorable, asexual reproduction occurs rapidly.
- When unfavorable conditions stress the organism, sexual reproduction occurs and the offspring have an increased likehood that they will be better suited for the environment.

Asexual Reproduction

- Production of various types of spores
  - ✔ Sporangiophores
    - Upright stalk with an enclosed sac (bread mold)
  - ✔ Conidia
    - Upright stalk with no enclosed sac (penicillin)
  - ✔ Fragmentation
    - Hyphae dry out and shatter releasing individual cells that act like spores
  - ✔ Budding
    - Small offspring

Sexual Reproduction

- “Plus and minus” mating types
- Hyphae of different mating types fuse and give rise to a specialized structure that produces spores (diploid)
- Most fungi are haploid throughout most of their life cycle

CULTIVATION OF FUNGI

- Sabouraud's dextrose agar (SDA) with chloramphenicol which inhibits contaminating bacteria & cycloheximide which suppress contaminating fungi.
- Potato flake agar or combination of SDA with brain heart infusion agar is recommended for isolation of dimorphic fungi.
- Czepak' agar can be used for cultivation of aspergillus species.
- SDA medium was developed by French dermatologist Raymond sabouraud.
- Sabouraud agar medium is a selective medium that is allow growth of fungi and inhibits the growth of bacteria.
- Glucose present in high concentration 4% to assist in fermentation and subsequent acid production by any bacteria. High acid concentration serve to inhibit all bacterial growth.

Composition

Peptone – 10 gm
Dexrtrose -40 gm
Agar -15 gms
Distilled water -1000 ml

Each sample is cultivated in two set of culture medium and incubated at different temperature at 30° C and at 35° C. All fungal cultures are incubated for a minimum of 30 days.

The identification of colonies is done by the characteristics colony morphology. Microscopy is performed from fungal colony to study the morphology of hyphae, spores and other structure.