

## Medical Mycology

### Lecture 3

#### Ecology

Fungi occur in every environment on Earth and play very important roles in most ecosystems.

1- Along with bacteria, **fungi are the major decomposers** in most terrestrial (and some aquatic) ecosystems, and therefore play a **critical role in biogeochemical cycles and in many food webs.**

2- **As decomposers**, they play an essential **role in nutrient cycling**, especially as saprotrophs and symbionts,

3 - **Degrading organic matter to inorganic molecules**, which can then re-enter **anabolic-metabolic** pathways in plants or other organisms.

#### Symbiosis

Many fungi have important symbiotic relationships with organisms from most if not all Kingdoms.

These interactions can be:

- **Mutualistic**
- or **antagonistic** in nature,
- or of **no apparent benefit or detriment to the host.**, in case of commensal fungi.

### Mutualistic relationship with plants:

-Symbiosis between plants and fungi is of significant importance for plant growth. It often increases the plant's uptake of inorganic compounds, **such as nitrate and phosphate from soils.**

- Some fungal species inhabit the tissues inside roots, stems, and leaves, in which case they are called **endophytic symbiosis.**

The endophytic colonization by fungi **benefit both symbionts**; for example, **endophytes of grasses** help their host **by increased resistance to herbivores and other environmental stresses** and receive **food and shelter from the plant in return.**

### The photobiont with algae and cyanobacteria:

#### With algae and cyanobacteria Lichens:

Are a symbiotic relationship between fungi and photosynthetic algae or cyanobacteria. The photosynthetic partner in the relationship is referred to in lichen terminology as a "**photobiont**".

**Lichens** occur in every ecosystem on all continents, play a key role in soil formation and the initiation of biological succession.

They are prominent in **extreme environments**, including polar, alpine and desert regions. Lichens are able to grow on inhospitable surfaces, including bare soil,

`rocks, tree bark, wood, and leaves.

**The photobiont provides sugars and other carbohydrates via photosynthesis to the fungus, while the fungus provides minerals and water to the photobiont.**

**Antagonistic relationship: As pathogens and parasites:**

Many fungi are parasites on plants, animals, and humans

- Serious of many cultivated plants causing extensive **damage and losses to agriculture and forestry** include the rice blast fungus.
  - **Some fungi can cause serious diseases in humans**, several of which may be fatal if untreated.
  - **Mycotoxins** of Many fungi produce biologically active compounds, several of which are toxic to animals or plants and are therefore called mycotoxins.
  - **Of particular relevance to humans are mycotoxins produced by moulds causing food spoilage, and poisonous mushrooms.**
- Mycotoxins** are secondary metabolites (or natural products)
- Mycotoxins** may provide fitness benefits in terms of physiological adaptation, **competition with other microbes and fungi**, and protection from consumption.

## Classification of fungi:

### A- Based on the morphology:

Fungi are grouped into four morphological classes.

1. **Moulds (Molds)**
2. **Yeasts**
3. **Dimorphic fungi**
4. **Yeast-like fungi (dimorphic)**

### B. Based on Sexual reproduction:

The sexual/asexual reproduction and characteristics of sexual spores.

#### 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).

### C. The Nomenclature and Taxonomy of fungi is based on the recommendations of the committee on international rules of Botanical Nomenclature.

1. **Division (Phylum) names** end in:- mycota
2. **Sub-division names** end in:- mycotina
3. **Class names** end in:- mycetes

4. **Sub- class** names end in:- mycetidae

5. **Order** names end in:- ales

6. **Family** names end in:- aceae

**D. In 1969 R.H Whittaker classified all living organisms into five kingdoms namely:**

1. Monera,(Bacteria)

2. Protista, (Protozoa)

3. Fungi, (Fungi)

4. Plantae (Plants)

5. Animalia.( Animals)

**Fungi morphology:**

1. **Moulds (filamentous fungi):**

The thallus (pl. thalli) of mould is made of hyphae, which are cylindrical tube like structures that elongate by growth at tips. A mass of hyphae is known as mycelium (pl. mycelia).

2. **Yeast:**

Predominate unicellular. They are **commonly oval, but some are elongated and some spherical**. Yeasts have no flagella or other organelles seen in bacteria. Reproduce asexually by budding. Some species produce buds that characteristically fail to detach and become elongated; continuation of the budding process then produces a chain of elongated yeast cells called pseudomycelium or pseudohyphae. **Yeast colonies are usually soft, opaque,**

**1–3 mm in size, and creamcolored**. Primarily identified by the ability to ferment sugar and assimilation of carbon and

nitrogen compounds. Examples include **Cryptococcus**, **Saccharomyces** etc. Because the colonies and microscopic morphology of many yeasts are quite similar, yeast species are **identified on the basis of physiologic tests and a few key morphologic differences.**

### 3. **Dimorphic Fungi:**

The dimorphic fungi are the thermally dimorphic pathogenic fungi that exist in the hyphal form when cool (e.g., in the environment) and as yeast when warm (e.g., at 37°C in the human). Examples (Blastomyces, Histoplasma,, Coccidioides).

### 4. **Yeast-Like Fungi (Dimorphic):**

These are fungi that are partly yeasts and partly mould (pseudohyphae/ pseudomycelia). An example: Candida albicans does grow as yeast form at room temperature and myceliate form at 37°C.

## The Growth Curve in batch culture

- A. Growth is an increase in cell constituents
- B. For most microbes, growth is indicated by an increase in cell # because cell division accompanies growth
- C. Batch culture = cultivation of organisms in 1 batch of liquid medium
- D. Growth curve 6 Phases of growth of a population of cells

### a). **Lag phase**

(1) No increase in cell # when cells are introduced into fresh media

(2) Reasons

(a) Cells may be depleted of a variety of factors that may need to be Resynthesized

(b) Medium may be different than previous one and thus new enzymes may be needed for growth

(c) Cells may be injured and need time to recover The growth curve The logarithm of the number of viable cells versus the incubation time.

#### **b) Exponential phase**

(1) Microbes are growing at maximal rate possible for the particular conditions

(2) Growth rate is constant

(3) Growth is exponential – cell growth doubles every x min (generation time) 5c)

#### **c) Stationary phase**

1) No net increase in cell

2) Mostly due to cessation of cell division.

3) depletion of nutrients

4) accumulation of waste

5) Also due to balance between cell death and cell division

#### **d) Death phase**

(1) Decrease in viable cell

(2) Causes are extended nutrient deprivation and accumulation of toxic waste