I. Ecology

Fungi occur in every environment on Earth and play very important roles in most ecosystems. 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. As decomposers, they play an essential role in nutrient cycling, especially as saprotrophs and symbionts, 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 in the case of commensal fungi are of no apparent benefit or detriment to the host.

i. With plants

Mycorrhizal symbiosis between plants and fungi is one of the most wellknown plant-fungus associations and is of significant importance for plant growth and persistence in many ecosystems. It often increases the plant's uptake of inorganic compounds, such as nitrate and phosphate from soils having low concentrations of these key plant nutrients. Some fungal species inhabit the tissues inside roots, stems, and leaves, in which case they are called **endophytic symbiosis**. Similar to mycorrhiza, endophytic

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

ii. 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, and are prominent in some extreme environments, including polar, alpine, and semiarid desert regions. Lichens are able to grow on inhospitable surfaces, including bare soil, rocks, tree bark, wood, and leaves. As in mycorrhizas, the photobiont provides sugars and other carbohydrates via photosynthesis to the fungus, while the fungus provides minerals and water to the photobiont.

iii. As pathogens and parasites

Many fungi are parasites on plants, animals (including humans), and other fungi. Serious pathogens 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.

II. Mycotoxins

o 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.

o 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.

III. Classification of fungi

i. Based on the morphology, fungi are grouped into four

morphological classes.

1. Moulds (Molds)

2. Yeasts

3. Dimorphic fungi

4. Yeast-like fungi (dimorphic)

ii. Based on the sexual/asexual reproduction and characteristics of sexual spores.

Fungi classified into kingdom, divisions, subdivisions, classes, subclasses, orders, families, genera and species. 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***

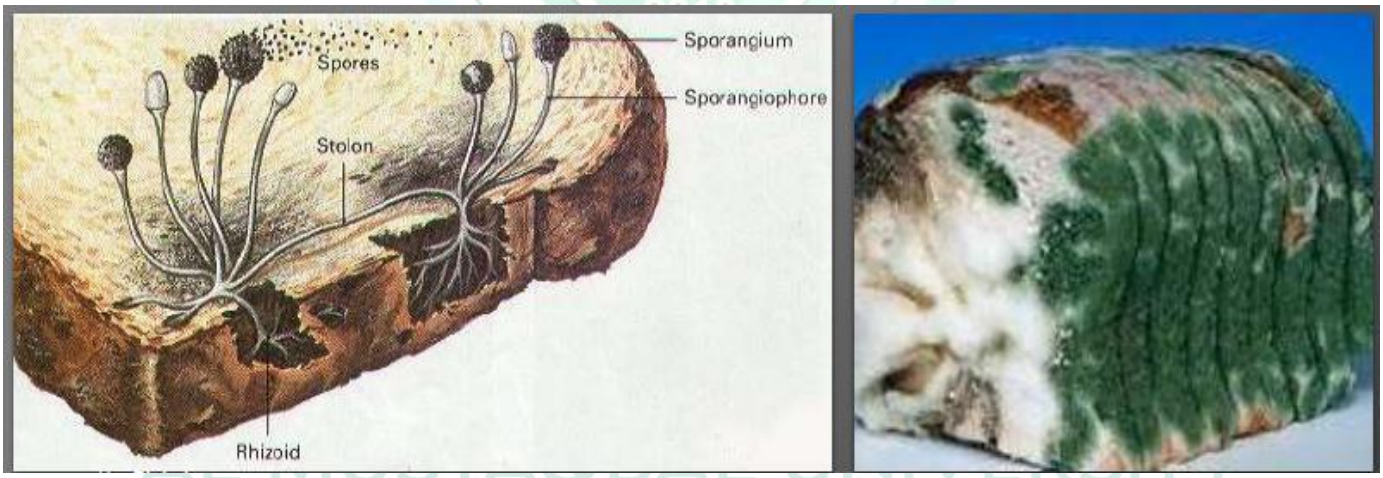
6. Family names end in:- ***aceae***

7. Genus and species names do not follow any order.

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).

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 true mycelium/ 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.

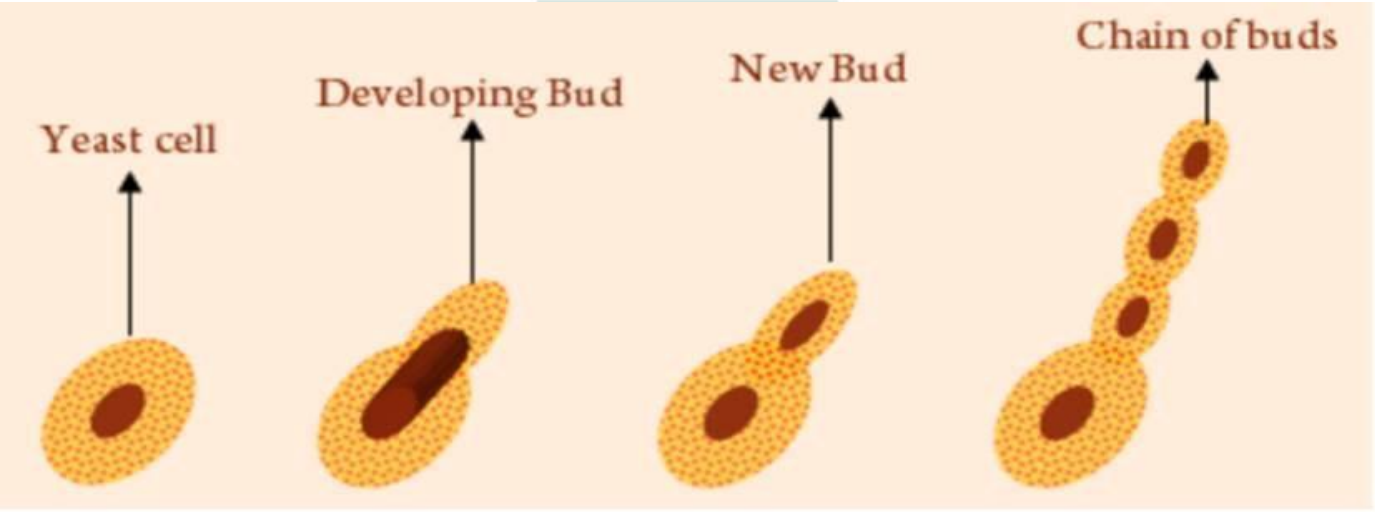


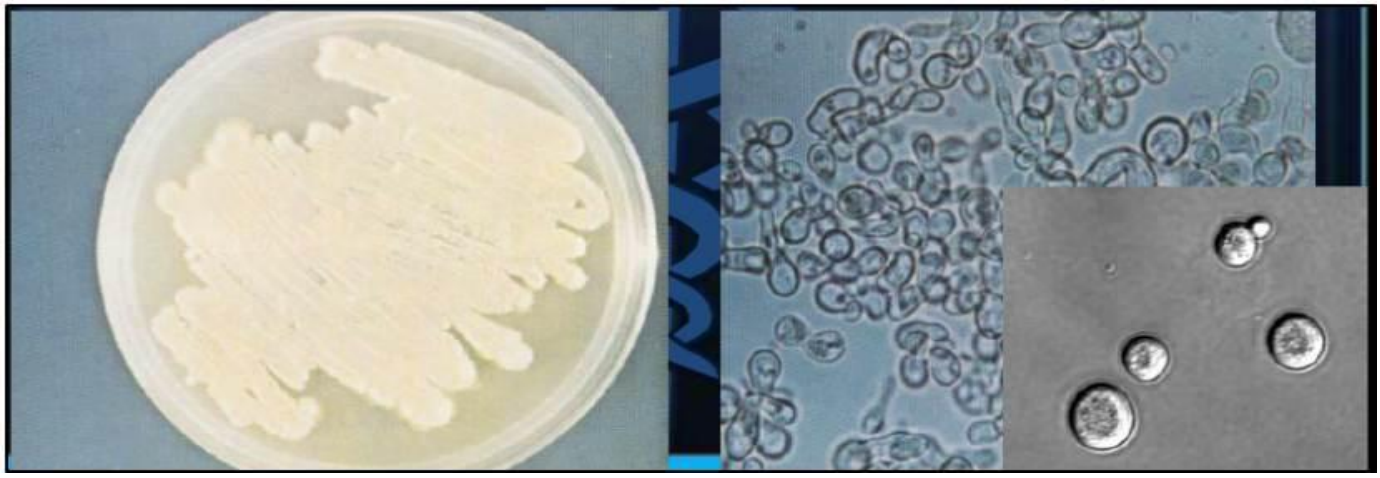
3. Dimorphic Fungi

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 37ºC in the human). Examples (*Blastomyces, Histoplasma,, Coccodioides*).

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 myciliate form at 37°C.





The Growth Curve in batch culture

A. Growth is an increase in cell constituents B. For most microbes, growth in 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

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 that previous one and thus new enzymes may be needed for growth

(c) Cells may be injured and need time to recover

The growth curve

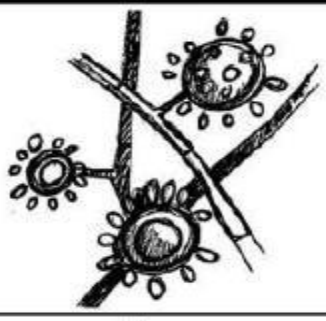
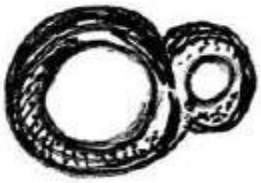
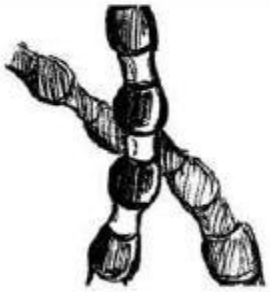
The logarithm of the number of viable cells versus the incubation time.

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) 5

Dimorphic fungi	Yeast 37°C	Mold 25°C
Histoplasma capsulatum • Growth on cycloheximide media • Fluffy white to buff-brown colonies	 3-5 µm	
Blastomyces dermatitidis • Fluffy white to buff-brown colonies	 8-15 µm	
Coccidioides immitis • Rapidly growing, highly infectious • Can appear on standard blood agar	 10-100+ µm	

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