

# MYCOLOGY: Is the study of fungi and their multiple functions in nature.

## Introduction

- *Mykes* (Greek word) : Mushroom
- Fungi are eukaryotic protista; differ from bacteria and other prokaryotes.
  1. Cell walls containing chitin (rigidity & support), mannan & other polysaccharides .
  2. Cytoplasmic membrane contains ergosterols .
  3. Possess true nuclei with nuclear membrane & paired chromosomes.
  4. Divide asexually, sexually or by both.
  5. Unicellular or multicellular.

## Taxonomy

Kingdom	Characteristic		Examples
Monera	Prokaryocyte	Bacteria	E. Coli
Protista	Eukaryocyte	Protozoa	E.Histolytica
<b>Fungi</b>	<b>Eukaryocyte</b>	<b>Fungi</b>	Mushroom , Candida sp.
Plants	Eukaryocyte	Plants	Moss
Animals	Eukaryocyte	Arthropods	Arthropods Mammals <b>Man</b>

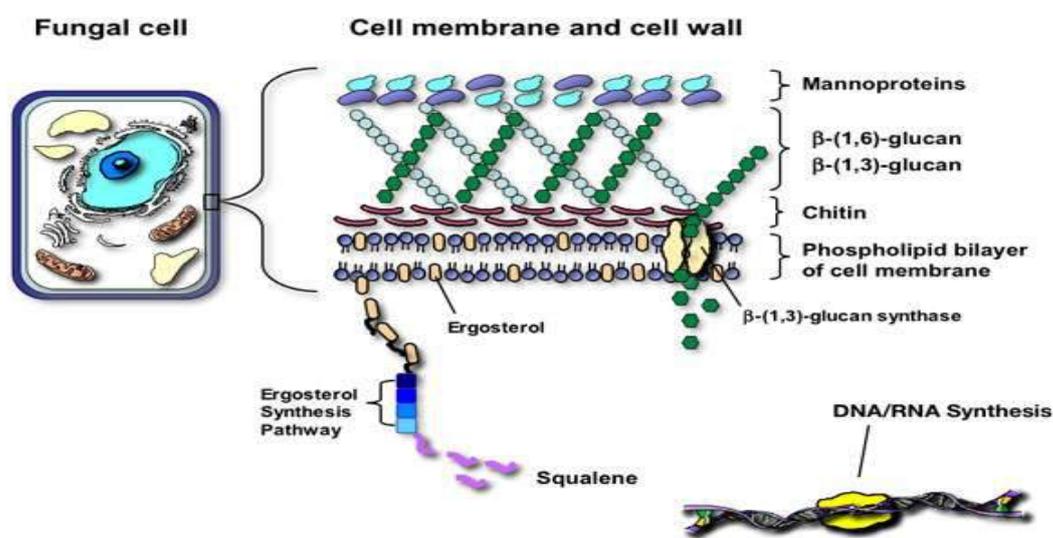
## WHAT ARE FUNGI?

Fungi are not plants. Fungi form a separate group of higher organisms, distinct from both plants and animals, which differ from other groups of organisms in **several major respects** :-

**First:** fungal cells are encased within a rigid cell wall, mostly composed of chitin and glucan. These features contrast with animals, which have no cell walls, and plants, which have cellulose as the major cell wall component.

**Chitin** :Is a long-chain polymer of a N-acetylglucosamine, a derivative of glucose, and is found in many places throughout the natural world.

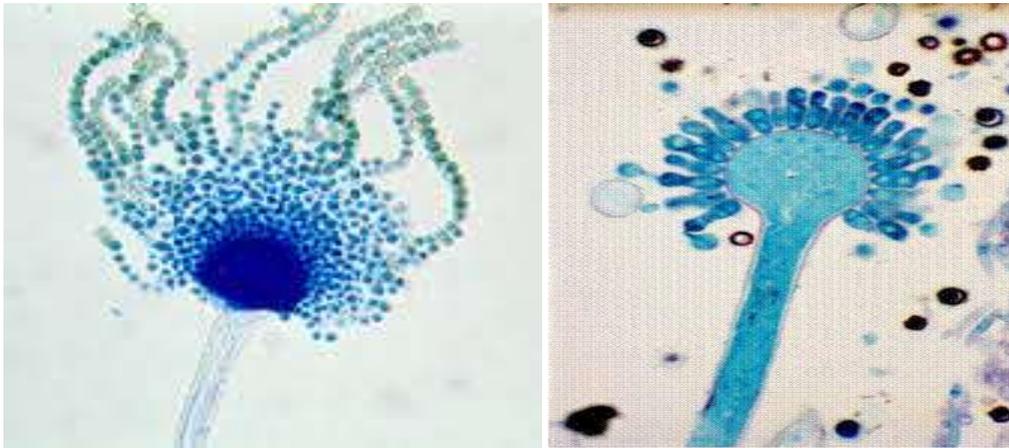
**glucan molecule**:-Is a polysaccharide of D-glucose monomers, linked by glycosidic bonds. Many beta-glucans are medically important. They represent a drug target for antifungal medications .



**Second:** fungi are heterotrophic. This means that they are lacking in chlorophyll and cannot make their organic food as plants can, through photosynthesis. Fungi live embedded in a food source or medium, and obtain their nourishment by secreting enzymes for external digestion and by absorbing the nutrients that are released from the medium.

**Third:** fungi are simpler in structure than plants or animals. There is no division of cells into organs or tissues. The basic structural unit of fungi is either a chain of tubular, filament-like cells, termed a hypha or hyphae (plural) or an independent single cell.

**Fourth:** fungi reproduce by means of microscopic propagules called *spores*. Many fungi produce spores that result from an asexual process. Many fungi are also capable of sexual reproduction. Some species are homothallic and able to form sexual structures within individual colonies.



- **Simplest fungus** :- Unicellular budding yeast
- **Hypha** :- Elongation of apical cell produces a tubular, thread like structure called hypha
- **Mycelium** :- Tangled mass of hyphae is called mycelium. Fungi producing mycelia are called molds or filamentous fungi.
- Hyphae may be septate or non-septate



### **General properties of fungi:**

1. They are eukaryotic; cells contain membrane bound cell organelles including nuclei, mitochondria, golgi apparatus, endoplasmic reticulum, lysosomes etc. They also exhibit mitosis.
2. Have ergosterols in their membranes and possesses 80S ribosomes.

3. Have a rigid cell wall and are therefore non-motile, a feature that separates them from animals. All fungi possess cell wall made of chitin.
4. Are chemoheterotrophs (require organic compounds for both carbon and energy sources) and fungi lack chlorophyll and are therefore not autotrophic.
5. Fungi are osmotrophic; they obtain their nutrients by absorption.
6. They obtain nutrients as saprophytes (live off of decaying matter) or as parasites (live off of living matter).
7. All fungi require water and oxygen and there are no obligate anaerobes.
8. Typically reproduce asexually and/or sexually by producing spores.
9. They grow either reproductively by budding or non-reproductively by hyphal tip elongation.
10. Food storage is generally in the form of lipids and glycogen.

Many fungal pathogens of humans and animals change their growth form **during the process of tissue invasion**. These *dimorphic* pathogens usually change from a **multicellular hyphal** form in the natural environment to a **budding, single-celled** form in tissue. In most multicellular fungi the vegetative stage consists of a mass of branching hyphae, termed a mycelium. Each individual hypha has a rigid cell wall and increases in length as a result of apical growth. In the more primitive fungi, the hyphae remain aseptate (without cross-walls). In the more advanced groups, however, the hyphae are septate



## Beneficial Effects of Fungi:

- 1. Decomposition (تحلل) - nutrient and carbon recycling.
- 2. Biosynthetic factories. The fermentation property is used for the industrial production of alcohols, fats, citric, oxalic and gluconic acids.
- 3. Important sources of antibiotics, such as Penicillin.
- 4. Model organisms for biochemical and genetic studies. Eg: *Neurospora crassa*
- 5. *Saccharomyces cerviciae* is extensively used in recombinant DNA technology, which includes the Hepatitis B Vaccine.
- 6. Some fungi are edible (صالح للاكل) (mushrooms).
- 7. Yeasts provide nutritional supplements such as vitamins and cofactors.
- 8. Penicillium is used to flavor Roquefort (نوع من الاجبان) and Camembert cheeses.
- 9. Ergot (مرض يصيب الحبوب) produced by *Claviceps purpurea* contains medically important alkaloids that help in inducing uterine contractions, controlling bleeding and treating migraine.
- 10. Fungi (*Leptolegnia caudate* and *Aphanomyces laevis*) are used to trap mosquito larvae in paddy (الشلب) fields and thus help in malaria control.

## Harmful Effects of Fungi:

- 1. Destruction of food, lumber (الاشخاب), paper, and cloth.
- 2. Animal and human diseases, including allergies.
- 3. Toxins produced by poisonous mushrooms and within food (Mycetism and Mycotoxicosis).
- 4. Plant diseases.
- 5. Spoilage (تلف) of agriculture produce such as vegetables and cereals (حبوب) in the godown (مخازن الحبوب).
- 6. Damage the products such as magnetic tapes and disks, glass lenses, marble statues (تمائيل المرمر), bones and wax.

## **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). This is a heterogeneous group of fungi where no sexual reproduction has yet been demonstrated.

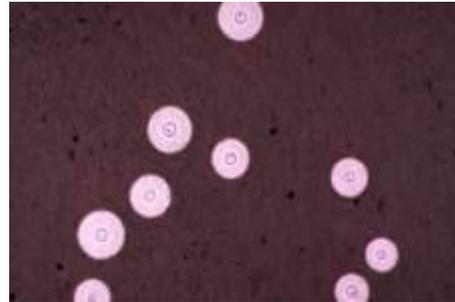
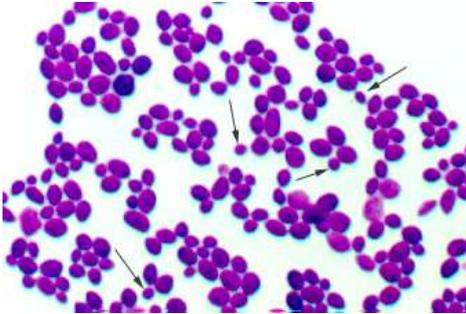
### **Based on Morphology:**

1. Moulds (Molds): Filamentous fungi Eg: *Aspergillus sps*, *Trichophyton rubrum*
2. Yeasts: Single celled cells that buds Eg: *Cryptococcus neoformans*, *Saccharomyces cerviciae*
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 37C° and as moulds in their natural habitat and in vitro at room temperature. Eg: *Histoplasma capsulatum*, *Blastomyces dermatidis*, *Paracoccidioides brasiliensis*, *Coccidioides immitis*.

## 1. Yeasts

- Unicellular fungi which reproduce by budding
  - On culture - produce smooth, creamy colonies
- e. g. *Cryptococcus neoformans* (capsulated yeast)



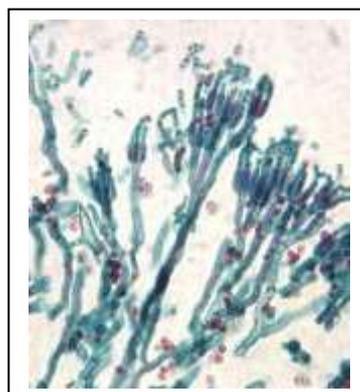
## 2. Yeast like fungi

- Grow partly as yeasts and partly as elongated cells resembling hyphae which are called pseudohyphae. e.g. *Candida albicans*



## 3. Molds/ Filamentous fungi

- Form true mycelia & reproduce by formation of different types of spores.
  - Vegetative/ aerial hyphae
- e.g. *Rhizopus*, *Mucor*



## 4. Dimorphic fungi

- Occur in 2 forms

Molds (Filaments) – 25°C (soil)

Yeasts – 37°C (in host tissue)

Most fungi causing systemic infections are dimorphic:

- *Histoplasma capsulatum*
- *Blastomyces dermatidis*
- *Paracoccidioides brasiliensis*
- *Coccidioides immitis*
- *Penicillium marneffe*
- *Sporothrix schenkii*

## CLINICAL CLASSIFICATION OF THE MYCOSES

- a. Superficial mycoses  
(Cutaneous mycoses )
- b. Subcutaneous mycoses
- c. Systemic mycoses
- d. Opportunistic mycoses