

Mycology

Lecture 1: introduction

lect. Dr. Ahmed Yaseen Abed

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

- Mykes (Greek word) : Mushroom ,logy (science)
 - **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.

kingdom	Characteristic		Examples
Monera	Prokaryote	Bacteria	E .coli
Protista	Eukaryote	Protozoa	E .histolytica
Fungi	Eukaryote	Fungi	Mushroom ,candida sp.
Plants	Eukaryote	Plants	Moss
Animals	Eukaryote	Arthropods	Arthropods .mammals, Man



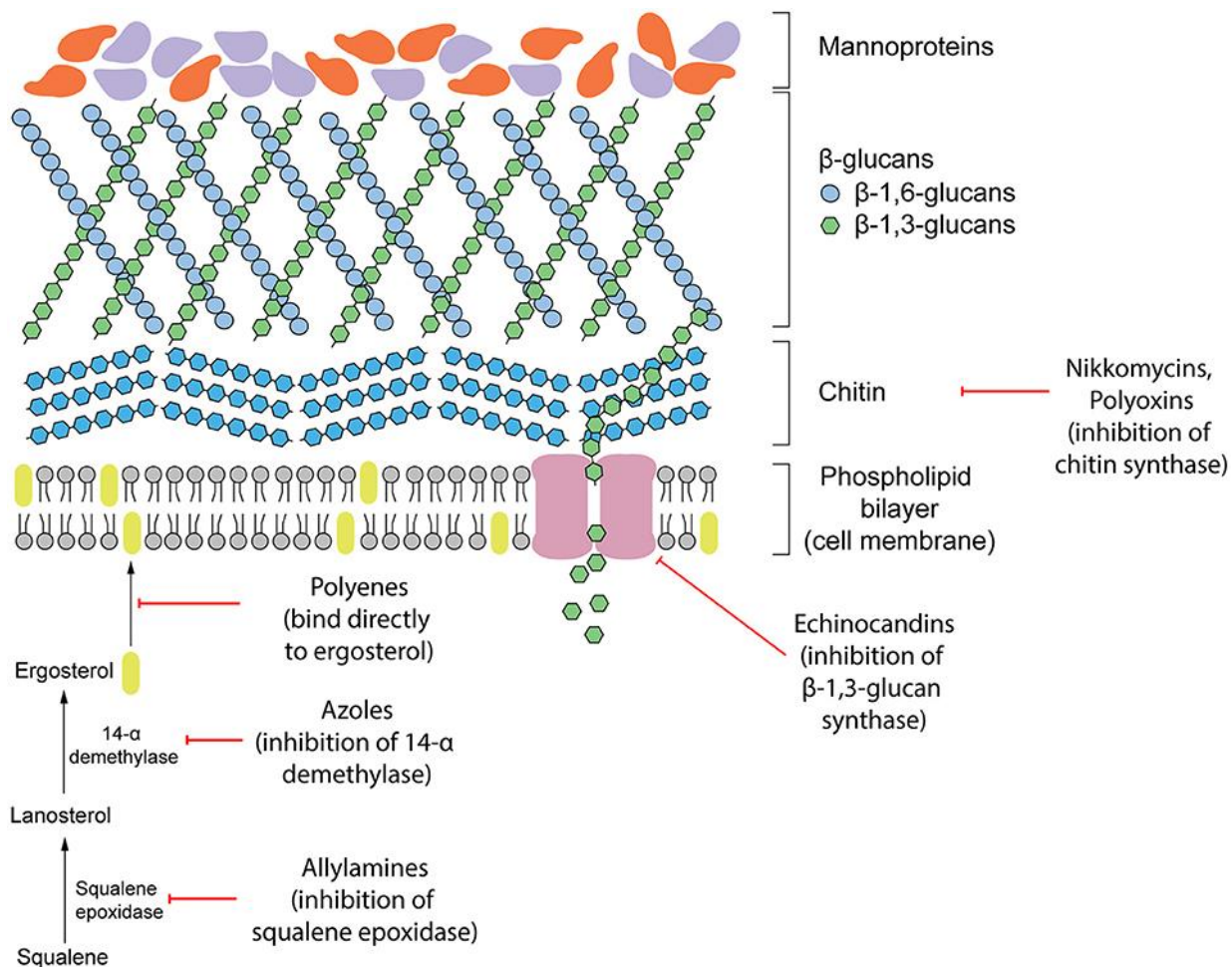
WHAT ARE FUNGI?

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- acetyl glucosamine, 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 .

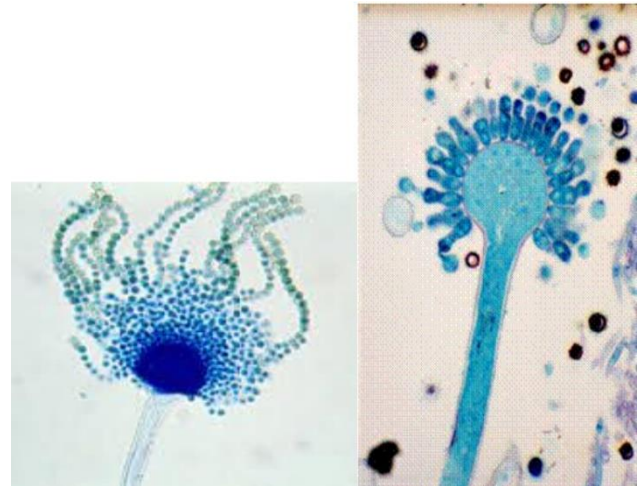


Second: fungi are heterotrophic. This means that they are **lacking** in **chlorophyll** and **cannot** make their **organic food** as plants can, through **photosynthesis**. Fungi live embedded in a food source or medium, and obtain their **nourishment** by **secreting enzymes** for **external digestion**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

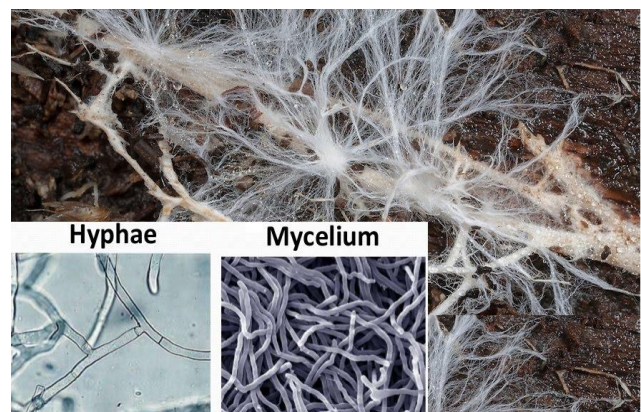
Third: fungi are simpler in structure than plants or animals. There is no division of **cells** into **organs** or **tissues**. The **basic** structural unit of fungi is either a **chain** of **tubular, filament-like cells**, termed a **hypha** or **hyphae** (plural) **or an independent single cell**.

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**, Hyphae may be **septate** or **non-septate**

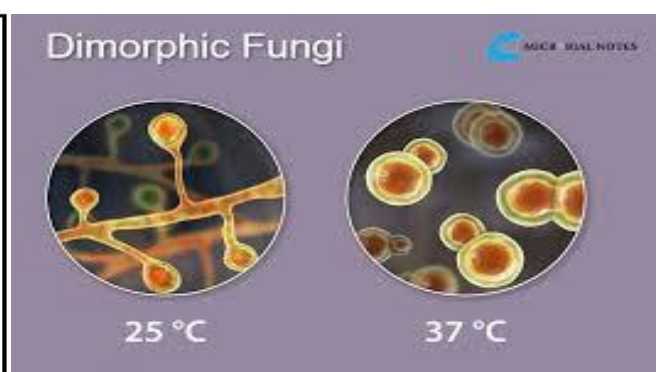
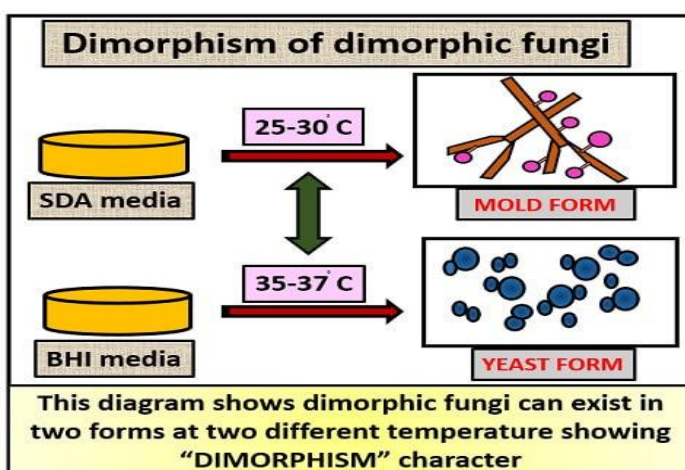


Mycelium :- Tangled mass of hyphae is called **mycelium**. Fungi producing mycelia are called **molds** or **filamentous fungi**.

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, singlecelled** 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 – (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 cerevisiae* 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 (الخشاب), 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 مخازن الحبوب (the godown).
6. Damage the products such as magnetic tapes and disks, glass lenses, marble statues (تماثيل المرمر), bones and wax.

The differences between bacteria and fungi:

1. Fungi are eukaryotes while bacteria are prokaryotes.
2. Bacteria are single celled whereas most fungi are multicellular except for yeast.
3. The compositions within their cell walls are different.
4. Fungi are heterotrophs while Bacteria can be autotrophs or heterotrophs.
5. Bacteria have 3 distinct shapes while fungi have various shapes.
6. Bacteria reproduce asexually via binary fission whereas fungi are capable of reproducing both sexually or asexually.

EPIDEMIOLOGY OF MYCOLOGY

Fungi are ubiquitous in nature and human beings are constantly exposed to them.

-Most mycotic agents → soil saprophytes

-mycotic diseases → not communicable from person-to-person (exceptions: Candida and some dermatophytes).

-mycotic infection usually depends on size of the inoculum and resistance of host.

-severity of disease depend mostly on the immunologic status of the host.

Fungemia → fungi found in blood.

-transient fungemia → transitory dissemination of fungi through blood stream without disease

-Fungal infection of human beings is called as → mycosis

-treatment of systemic fungal infections requires the aggressive use of drugs with various degrees of toxicity.

-to diagnose mycotic diseases physician must be able to elicit a complete history from the patient including → occupation, avocation and travel history