**Dr. Shaimaa Nabhan**

**Dep. of Microbiology Mycology**

*The Fungi Kingdom*

The study of fungi is known as **mycology** and scientist who study fungi is known is a **mycologist.** A fungus is a member of a large group of eukaryotic organisms . Microorganisms such as yeasts and molds, as well as the more familiar mushrooms. Over 80,000 species of fungi are known .Fungi are important for the environment and can be opportunistic pathogens

**The Main Characteristics of Fungi:**

1) fungi are **eukaryotic :**they have a nuclei and their nuclei have nuclear membrane and chromatin network.

2) they are **heterotrophs :**they depend on other organisms for food

3) they are **multicellular** and cell may be uninucleate or multinucleate.

4) they are **sedentary** (they cannot move on their own).

5) they **have filamentous bodies.**

**6)** they **have cell walls made of chitin.**

**7)** they **have unusual reproductive modes.**

Fungi are found in wide variety of habitats. These habitats are water, soil, dead and decaying organic matter. Fungi are heterotrophic(they cannot synthesize their food). Therefore, they get their food from different sources. Fungi may be:

I. **Saprophytes:** These fungi get their food from dead organic matter. They secretes enzyme in their substratum. These enzymes break the organic matter into simple compounds. Then fungi absorb these substances.

2**.Parasites:** The live on their host and get their food from them. These fungi cause some serious diseases.

3.**Symbionts**: These fungi develop relation with other organisms.

**Structure of Fungi:**

* \_ Basic body “parts” are strands of cells, called **hyphae (are thread like tubular structure)** The hyphae may be septate or unseptate and has cell wall which consist of chitin .
* The mass of hyphae forming the fungus“body” is called the **mycelium**
* The mycelium is often mostly underground and can be very large butDiffuse.
* The visible fungus is usually the reproductive structure, or **fruiting body.**
* **Yeasts:**– unicellular - most reproduction is asexual and takes
* place by cell fission or budding, ferment carbohydrates - produce ethanol.

**Types of fungal spores**

**Spore** is a single celled reproductive body that grows into a new organism. it is produced by bacteria, fungi, algae, seedless plants and some protozoa. Spores can last a very long time in some nasty conditions.

**Spores differ from seeds in:**

1. They are generally smaller.
2. They are very resistant to climate.
3. They are haploid (only 1 set of chromosomes)

Spores are often formed through a process called **sporogenesis**, which just means the production of spores, and is accomplished through mitosis, or cellular reproduction.

**Importance of Fungi:** Fungi are important because they are:

* [agents of biodegradation and biodeterioration](http://www.fungionline.org.uk/1intro/5importance.html#import1)
* [responsible for the majority of plant diseases and several diseases of animals (including humans)](http://www.fungionline.org.uk/1intro/5importance.html#import2)
* [used in industrial fermentation processes](http://www.fungionline.org.uk/1intro/5importance.html#import3)
* [used in the commercial production of many biochemicals](http://www.fungionline.org.uk/1intro/5importance.html#import4)
* Penicillium (Antibiotic) , ripens cheese, adds flavor
* Yeast as food supplement, supplies vitamins
* Fruit juices (ethyl alcohol),Saccharomyces cerevisiae baker's yeast.
* Natural food supply for wild animals**.**

**Reproduction of fungi:**

Reproduction in fungi may be **vegetative, asexual or sexual**.

* **Vegetative reproduction**: A mall part of hyphae of fungi can produce complete mycelium. In some fungi fruiting bodies can form new mycelium. Sometimes, some parts of the fungi decompose. The remaining part develops new mycelium.
* **Asexual reproduction**

Fungi reproduce asexually by spore formation. Fungi produce a large number of spores in single cycle. Spores are produced during favourable conditions. The spores have thick wall. Unicellular fungi like yeasts reproduce by binary fission **or budding**. Following types of spores are produced in fungi:

* + **Conidia** - asexual fungal spores borne externally in various ways from a conidiophore; often referred to a macroconidia (multicellular) and microconidia (unicellular).
  + **Arthroconidium (Arthrospore**) - special type of asexual spore formed by disarticulation of the mycelium.
  + **Blastoconidia (Blastospore)** - asexual spore formed from a budding process along the mycelium or from another blastospore.
  + **Chlamydospore** - thick-walled asexual spore formed by direct differentiation of the mycelium (concentration of protoplasm and nutrients).
  + **Sporangiospore** - an asexual spore contained in a sporangium at the end of a sporangoiphore.
  + **Thallospore** - asexual spore produced on a thallus (hypha).
* **Sexual reproduction**

Sexual reproduction in fungi has three phases:

**(a)Plasmogamy:** Two gametes fuse and bring the two haploid nuclei in the same cell.

**(b)Karyogamy: The** two haploid nuclei fuse to form a single diploid or zygotic nucleus

**(c)Meiosis:** Reduction division occurs in zygotic nucleus.

**Nutrition of Fungi**

All fungi obtain their food by secreting digestive enzymes into their surroundings and then absorbing the organic molecules produced by this **external digestion.**

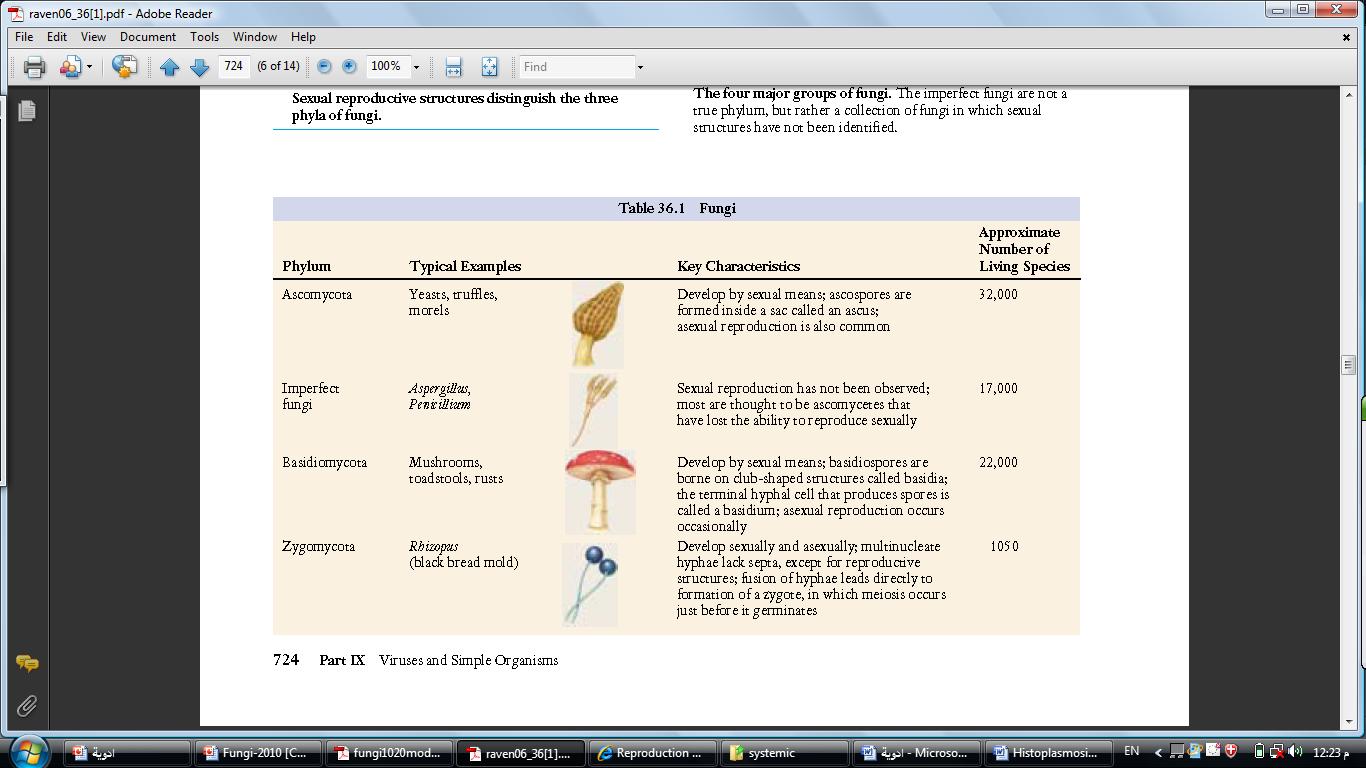
The extensive network of hyphae providing an enormous surface area for absorption. Many fungi are able to break down the cellulose in wood, or other substrate cleaving the linkages between glucose subunits and then absorbing the glucose molecules as food.

**Pathogenesis of the Fungi :**

* **Portal of entry** 
  + primary mycoses – respiratory portal; inhaled spores
  + subcutaneous - inoculated skin; trauma
  + cuotaneous and superficial – contamination of skin surface
* **Virulence factors** – thermal dimorphism, toxin production, capsules and adhesion factors, hydrolytic enzymes, inflammatory stimulants.
* **Classification of Fungi according to:**
* **The reproductive structures**

There are four groups of fungi:

* **phylum Zygomycota**, (zygospores) ex. ***Mucor,Rhizopus, Absidia (lower fungi).***
* **phylum Ascomycota**,( ascospores) ex. ***Histoplasma, Yeasts***
* **phylum Basidiomycota**, (basidiospores) ex. ***Mashroom, Cryptococcus***
* **Phylum Deuteromycota (Imperfect fungi**) **ex. *Candida, Aspergillus, Penicillium***

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**Another types of classification of fungi:**

* **Geographic grouping - where they exist.**
* **Epidemiologic grouping - how organism is transmitted.**
* **Taxonomy grouping - according to morphologic and cultural characteristics.**
* **Topographic Grouping -** type of mycosis produced**. (According to pathogenic fungi which is most often used)**

**1- Superficial** - Confined to the outermost layers of the skin and hair. No host cellular or inflammatory response due to organisms being remote from living tissue. Essentially no pathology .

**2- Cutaneous** - in the keratin of the skin, nails, and hair. These organisms prefer non-living cornified layers. The disease is called a **dermatophytosis or dermatomycosis.** Host response is patchy scaling or eczema eruptions. They are classified according to the area of the body that is involved.

**3- Subcutaneous -** Involve the deeper layers of skin and often muscle tissue. Infection may occur an accidentally following inoculation of fungal spores via some form of trauma. This type of infection is often identified by the presence of a characteristic tissue reaction or granule.

**4- Systemic -** Attack the deep tissues and organ systems; often creating symptoms that resemble other diseases. This type include:

* Those caused by **truly pathogenic fungi** with the ability to cause disease in the normal host when the inoculoum is of sufficient size (*Histoplasma farciminosum, Blastomyces dermatitidis*).
* Those caused by **opportunistic fungi**, low virulence organisms, which require the patient's defenses to be lowered before the infection is established (*Aspergillus spp. Candida albicans, Cryptococcus neoformans*).

**Cutaneous and Mucocutaneous Mycosis**

Associated with: Skin , Hair, Wool, Hooves, Horns, Eyes, Sinuses, Oropharynx and external ears….

**Ringworm –**disease called ‘herpes' by the Greeks, and by the Romans ‘tinea' (which means small insect larvae). The skin lesions characterized by red margins, scales and itching.

**Dermatophytosis and Dermatomycosis**

**Dermatophytosis** - "**ringworm"** disease of the skin & its appendeges like wool, hair, feather, horn and/or stratum corneum caused by group of fungi that called **dermatophytes.**

**Dermatophytes:** are keratinophilic "keratin Loving” because Keratin is a major protein found in horns, hooves, hair, and skin.

**Dermatophytes:**

General features:

* Molds producing keratinase.
* Saprophytes on skin and its appendages, inflammation below

Transmitted by contact with infected persons or animals .

* **Dermatomycosis:** more general name for any skin disease caused by a fungus. Caused by many different species and are generally named after the infected area rather than the species that causes it.
* Dermatomycosis are one of the most frequent sources of lesions on the skin.

**Causes of Dermatophytes:** Several genera of dermatophytic fungi

1. *Trichophyton Spp.*, an ascomycete
2. *Microsporum Spp.*, an ascomycete
3. *Epidermophyton Sp.*, a deuteromycete

**Infections by Dermatophytes:** Severity of ringworm disease depends on:

1. strains or species of fungus involved.
2. sensitivity of the host to a particular pathogenic fungus.

More severe reactions occur when a dermatophyte crosses non-host lines (e.g., from an animal species to man).Among dermatophytes there appears to be an evolutionary transition from a saprophytic to a parasitic lifestyle.

**Classification of Dermatophytes according to their habitat.**

**Geophilic species** - keratin-utilizing soil saprophytes (e.g., *M. gypseum*, *T. nanum).*

**Zoophilic species** - keratin-utilizing on hosts - living animals (e.g., *M. canis*, *T. verrucosum*).

**Anthropophilic species** -  keratin-utilizing on hosts - humans (e.g., *M. audounii*, *T. tonsurans).*

**Infection of skin.**

infection of skin by spors of any type of dermatophytes

1- Spors localized on skin. 2- start to germinate in radiated form Ringworm**.**

**Infection of hair.**

**Hair contaminated or infected by any type of spore of speceis T. or M. 1- Spore directed downward to reach the bulb of hair. 2- start to germinate to form hyphae.**  **3- Hyphae extend up word inside or inside and outside of hair.**  **4- then fragmented or break-down to form arthrospors(take mosiac &reguler form).**

**Endothrix or Ectothrix .**

**Diagnosis of dermatomycosis:** The diagnosis of dermatomycosis depend on:

* Clinical signs: 1- Roughness of skin 2- falling of hair

3- Itching.

* Wooden lamp examination.
* Isolation & Identification of the causative agent from skin and hair, this include:

Sample of skin: 1- skin scraping from edges of lesion.

2-collect sample in petridish or paper.

3-send to the lab.

In lab. The samples are divided into 2 parts: the first one for direct examination by rapid test with KOH 10-20%, while the second part for indirect examination by Inoculation on mycologycal media.