

Course content :

- Morphologie et structure des mycètes microscopiques
- Classification
- Reproduction

Course Objectives

By the end of this course, the student will be able to:

- Know the types of morphologies and structures in microscopic fungi ;
- Identify the different classes of fungi ;
- Understand the concept of reproduction in fungi.

1. Introduction to fungi

Mycology is the study of fungi or fungi. There are three major groups of fungi: molds (filamentous fungi), yeasts (unicellular) and macroscopic fungi.

Fungi are saprophytic eukaryotes, usually commensal (some can be parasitic and highly pathogenic to humans, animals, and plants).¹² They are characterized by a high production of degradation enzymes. Fungi are generally strictly **aerobic** (optional in the case of yeasts), mesophilic (optimal growth temperature between 25 and 35°C), tolerate **pH values wider** than those of bacteria, and can grow in environments with **relatively low water activity**. They are **chemoheterotrophic**.

2. Morphology and cell structure of microscopic fungi

The cellular organization of fungi is called the **thallus**. In microscopic fungi, the thallus can be unicellular (yeasts) or filamentous (molds). The plasma membrane, rich in ergosterol, is protected by a rigid and thick wall consisting mainly of polysaccharides (usually chitin).

2.1. Yeast

Yeasts are **single-celled** fungi that are typically between 10 and 50 µm in size. Their shape can be spherical, ovoid, elongated or cylindrical. Their thallus is said to be **levuriform**.

The cytoplasm contains organelles (endoplasmic reticulum, Golgi apparatus, mitochondria, vacuoles and ribosomes) and a true nucleus that contains chromosomes (16 in *Saccharomyces cerevisiae*).

2.2. Mold

Moulds are **multicellular**: the thallus is made up of filaments, more or less **branched**, which are called **hyphae**. All the hyphae make up the **mycelium** (this is the vegetative part). Depending on the organization of their fronds, a distinction is made between:

- ❖ **Septomyceta**, which have a septate thallus. In this case, perforations ensure communication between the cells;
- ❖ **Phycomyceta** have thalli that are not **separated** by transverse septa: the thallus is said to be coenocytic (or "siphonate").

3. Reproduction of microscopic fungi

3.1. In yeasts

¹ Saprophytes feed on decaying organic matter

² Commensalism: a type of biological interaction between two individuals in which the host provides part of its food to the commensal that does not harm it (as opposed to parasitism) but does not provide any counterpart (unlike symbiosis).

Most yeasts reproduce by budding (after mitosis, the daughter cell, smaller than the parent cell, detaches), but a few species are able to divide by binary fission (*Schizosaccharomyces*) while in other species (*Saccharomyces*) reproduction occurs sexually.

3.2. In moulds

❖ Vegetative (asexual) reproduction

The colonization of environments by fungi is ensured by the production of dissemination spores that differentiate from vegetative cells. Spores can come in different forms:

- Blastospores: formed by budding vegetative mother cells;
- Chlamydospores, thick-walled resistance structures;
- Sporangiospores, formed inside a differentiated vegetative cell, the sporangium, and released by bursting this "sac" when it is mature;
- Conidiospores (or conidia), produced at the end of a conidiophore by fruiting bodies.

In many molds, the fragmentation of the hyphae can give rise to new individuals. The isolation of cells by cleavage of the cell wall allows the formation of arthrospora (spores born from the disarticulation of a filament at the level of the septa) or thallospores (formed from a region of a thallus).

❖ Sexual reproduction

Sexual reproduction involves the fusion of two haploid cells (cells with n chromosomes) that act as gametes, and results in the formation of a diploid zygote (cells with 2n chromosomes). Some species are self-fertilizing and produce sexually compatible gametes on the same mycelium. In other species, interbreeding between different individuals is necessary.

4. Classification of mould

Yeasts and molds belong to the kingdom of the *Fungi*. The classification of this kingdom is constantly changing and is based on **morphology, reproductive mode and genetics** (Table 1).

Table 1. The main taxonomic groups of the current classification of the kingdom *Fungi*.

Group	Partitioning	Reproduction	Examples
Basidiomyceta	Yes	sexuée (basidiospores)	<i>Agaricus campestris</i> (macroscopic fungus), <i>Tremella fuciformis</i> (mold), <i>Malassezia globosa</i> (yeast)
Ascomyceta	Yes	asexuée (conidiospores) sexuée (ascospores)	<i>Saccharomyces</i> (yeast), <i>Aspergillus</i> (mold)
Zygomyceta	No	asexuée sexuée (zygospores)	Mucorales: <i>Mucor</i> , <i>Rhizopus</i> , <i>Absidia</i>
Glomeromyceta	No	Asexuée	<i>Glomus</i> , <i>Acaulospora</i> (molds)
Blastocladiomyceta	No	asexuée (zoospores) sexuée	<i>Allomyces</i> , <i>Blastocladiella</i> (molds)
Chytridiomyceta	Thalls/Spheroids	asexuée (zoospores) sexuée	<i>Synchytrium</i> , <i>Obelidium</i>
Neocallimastigomyceta	Thalls/Spheroids	asexuée (zoospores)	<i>Anaeromyces</i> , <i>Piromyces</i>