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Unit1: Introduction to Protozoa, Fungi, Algae and Viruses

Module name: Fungi – Discovery, Nature, Definition and General Properties

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Fungi – Discovery, Nature , Definition and General Properties

Introduction

Fungi are referred to as Eumycota (Greek eu – True and Mykes – Fungus). The study of fungi is called Mycology and scientists who study fungi are called Mycologist. The study of fungal toxin is called Mycotoxicology.

Discovery

Heinrich Anton de Bary (26 January 1831 – 19 January 1888) was a German surgeon , botanist, microbiologist, and mycologist (fungal systematics and physiology). He is considered a founding father of modern mycology.

Definition

The term 'Fungus' describes eukaryotic organisms that are spore – bearing, have absorptive mode of nutrition, lack chlorophyll, and reproduce both sexually and asexually.

Nature of Fungi

Fungi are heterotrophs and obtain their food from non living organic matter as saprophytes or by feeding as parasites on living host. They are Eukaryotic, Chemoorganotrophic organisms. They do not possess chlorophyll. The bodies are usually thread-like, filamentous and commonly branched. Fungi are a group of Eukaryotic spore bearing protists that lack chlorophyll. They reproduce both sexually and asexually.

General characteristics

The general characteristics include the distribution, morphology, classification, and reproduction (both asexual and sexual).

Distribution

Fungi occur- in all possible habitats i.e. aquatic, terrestrial (which grow in soil, on dead and decaying material). Some grow on plants and animals. Fungi are also present in the air. Chlorophyll are absent in fungi and so they depend on others for food. That is why fungi may be saprophytes, parasite or symbionts.

Morphology

Yeasts cells are unicellular generally larger than most of the bacteria. The size of yeast ranges from 1 to 5µm in width and from 5 to 30 µm in length. They are commonly egg-shaped, but some are elongated and some spherical. Flagella or other organelles of locomotion are absent in yeast. The cell wall constituents of fungi are mainly chitin and glucans. Multicellular fungi are composed of networks of long filamentous branched structure called hyphae. The hyphae often aggregate in a thread-like dense network known as mycelium. The hyphae may be: without crosswalls (as in the case of lower fungi) or maybe divided into compartment by formation of septa (as in the higher fungi). Hyphae occur- in three forms: Coenocytic or non-septate, such hyphae have no septa, septate with uninucleate cells, or septate with multinucleate cells.

The mycelia form- tissue-like aggregates called the plectenchyma, -at certain stages of their life cycle, often during transition to the sexual or asexual reproduction phase.

Classification of fungi

Classification of fungi are based on the characteristics of sexual spores and fruiting bodies present during the sexual stages of their life.

Following are the eight fungal subdivisions:-

1) Chytridiomycetes
2) Zygomycota
3) Ascomycota
4) Basidiomycota
5) Glomeromycota
6) Microsporidia
7) Cryptomycota

1) **Chytridiomycetes**

- The simplest and most primitive fungi.
- They are unique among fungi in the production of zoospore with a single, posterior, whiplash flagellum (primitive features).
- Free living members of this taxon are found in plants and animals matter.
- Parasitic forms infect aquatic plants and animals including insects.
- They display sexual and asexual type of reproduction in their life cycle.
- Members of this group are microscopic, single cell, a small multinucleated.
- Sexual reproduction is by release of sporangiospores from sporangia at the surface.
- Many are capable of degrading cellulose and keratin.
- Eg:-*Allomyces macrogynus*

2) Zygomycota

- The Zygomycota contain fungi called Zygomycetes.
- Most live on decaying plants and animals matter in the soil, few are parasites of plants, insects, animals and humans.
- The hyphae are coenocytic-, with many haploid nucei.
- Asexual spores, usually wind dispersed and develop in sporangia at the tip of aerial hyphae.
- Sexual reproduction produces tough, thick –walled zygotes called zygospores that can remain dormant when environment is harsh for growth of fungus.
- Eg: - Bread Mold (*Rhizopus stolonifer*), *Mucor*

3) Ascomycota

- They are called as ascomycetes, commonly known as sac fungi.
- They are ecologically important in freshwater, marine and terrestrial habitat.
- They degrade many chemically stable organic compounds such as lignin, cellulose and collagen.
- The ascomycetes are named for their characteristic reproductive structure, the sac-like ascus.
- Some Ascomycetes are yeast while others have a life cycle that alternates between yeast and filamentous forms.
- Sexual reproduction involves meiosis of a diploid nucleus in an ascus, giving rise to haploid ascospores.
- Most also undergo asexual reproduction with the formation of conidiospores from specialized aerial hyphae called conidiophores .

- It includes saprophytic and parasitic form of fungi.
- Example : *Candida albicans, Aspergillus niger*

4) Basidiomycota

- Fungi in Basidiomycota are commonly known as basidiomycetes or club fungi.
- Most are saprophytes that decompose plant debris, especially cellulose and lignin.
- The class Basidiomycetes includes those members that produce basidia and basidiospores on or in a basidiocarp.
- Basidiomycetes are named for their characteristic structure, the basidium, which is involved in sexual reproduction
- Basidiomycetes, known as Urediniomycetes and Ustilaginomycetes include plant pathogens causing “rusts” and “smuts,” respectively, that destroy millions of dollars worth of crops annually.
- Example: Mushroom

5) Glomeromycota

- Glomeromycetes are of critical ecological importance as they are mycorrhizal symbionts of vascular plants.
- Mycorrhizal fungi form important associations with the roots of almost all herbaceous plants and tropical trees.
- Mycorrhizal Association are of 2 types :-
    - Ectomycorrhizae
    - arbuscular mycorrhiza
- Glomeromycetes have aseptate hyphae.

- Only asexual reproduction is known to occur by fragmentation of filaments
- Glomeromycetes have evolved specialized flat hyphae called appressoria (s., appressorium) to penetrate their host plants.
- Example: *Mycorrhizae*

6) Microsporidia

- Microsporidia morphology is unique among eukaryotes. It is distinct in the possession of an organelle called the polar tube, that is essential for host invasion.
- spores may be spherical, rodlike, or egg-shaped shaped.
- Spore germination occurs only in the host.
- Microsporidia are important obligate intracellular parasites that infect insects, fish, and humans. They are particularly problematic for immunocompromised individuals, especially those with HIV/AIDS.
- Example :*Enterocytozoon bieneusi*

7) Cryptomycota

- 3-5 µm spherical cells, flagellated, osmotrophic.
- Cell wall does not posses chitin .
- Broadly distributed in soil, freshwater and aquatic sediments.
- Example : *Rozella*

Reproduction

Asexual reproduction

Asexual reproduction is accomplished by:

(1) Fission of somatic cells yielding two similar daughter cells

(2) Budding of somatic cells or spores with each bud, being a small outgrowth of the parental cell and further developing into a new individual

(3) Fragmentation or disjointing of the hyphal cells and each fragment developing into a new organism

(4) Spore formation

Function of asexual spores is to disseminate the species.

There are different kinds of asexual spores: -

1) Sporangiospores: Single celled spores formed in sacs called 'Sporangia' at the end of special hyphae called 'sporangiophores'.

Apalanospores: Non Motile Sporangiospores

Zoospores: Motile Sporangiospores, motility is due to the presence of flagella.

2) Conidiospores

Conidia are formed at the tip or side of a hypha, called conidiophore.

Small single celled spores are called – microconidia.

Large, multinucleated conidia are called – macroconidia.

3) Oidia (singular –Oidium) or arthospores

It is a single celled spore. Formed by disjointing of hyphal cells.

4) Chlamydospores

Thick walled, single celled spores formed from cells of the vegetative hypha. These spores are highly resistant to adverse condition.

5) Blastospores

These are spores formed by budding.

Sexual Reproduction

- Involves fusion of compatible Nuclei of two parent cells.
- Sex organs of fungi are called Gametangia.

Male Gametangium – Antheridium. Female Gametangium – Oogonium.

- The various methods of sexual reproduction in fungi are :-

1) Gametic Copulation – fusion of naked gametes.

2) Gamete –Gametangial copulation – two gametes come in contact but do not fuse, the male gamete migrates through fertilization tube into female gametangium.

3) Gametangial copulation – two gametangia fuse and give rise to a zygote that develops into a resting spore.

4) Somatic copulation – fusion of somatic cells.

5) Spermatization – union of a special male structure called a spermatium, with a female receptive structure.

There are several types of sexual spore :-

1) Ascospores – Single celled spores produced in ascus.

- Usually each ascus contain 8 ascospores.

2) Basidiospores – single celled spores are borne on a club shaped structure called

Basidium.

3) Zygospores – large, thick walled spores formed when the tips of sexually compatible hyphae fuse together

4) Oospores – formed within special female structure called oogonium.

Importance of Fungi

- Fungi, are saprophytic that help in breaking dead organic matter into simpler substances.
- Mycorrhizae is important for the good growth of the plants.
- Fungi especially yeast are important in many industrial fermentation process.
- Fungi are also important research tool in the study of biological processes.