

# School of Basic and Applied Sciences

Course Code : BSDB2003

Course Name: Fundamentals of Microbiology



**Fungi**

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Biomedical Science Sem III

Program Name: B.Sc. (H) Biochemistry/ Biological Science/

# Introduction

- Fungus is a Latin word - Mushroom
- Mycology and Mycologist
- 1.5 million
- 80 000 to 120 000
- Least-explored biodiversity resources of our planet.
- Some are single celled yeasts, but many are large multicellular organisms including molds and mushrooms.
- In contrast to algae, which derive energy from sunlight, fungi gain their energy from organic materials.
- Interestingly, fungi are found wherever organic materials are present.
- Unlike algae, which live primarily in water, fungi live mostly on land.
- A large number of fungi cause disease in plants.
- Fortunately, only a few species cause disease in animals and humans.

# Famous mycologists

- ✓ International Fame- Pliny, Clausius, Tournefort Joseph, Dillenius, Pier Antonio Micheli, Needham, Kasper Bauhin, Anton de Bary, Muller, Buller, Alexopoulos, Mims, Anisworth, Martin, etc.
- ✓ Name fungi given by- Kasper Bauhin
- ✓ Pier Antonio Micheli- **Father of mycology**. Accurate description and illustrations of fungi in his book 'Nova Plantarum Genera'.
- ✓ Anton de Bary- Father of Mordern Mycology and plant pathology.
- ✓ **National Fame**
- ✓ **E.J. Butler (1920)**- Started studies on fungi and disease caused by them in Pusa institute (Bihar). **Father of Indian mycology and plant pathology**.
- ✓ Dastur, Mundkar, **Prof. K.C. Mehta** (annual recurrence of wheat rust in India), Thind, Srinivasan, K.G. Mukherji, Chaudhary and Sadasivan.

# General features

- ✓ **Nutrition.** Heterotrophic.
- ✓ **Vegetative state.** typically as a non-motile mycelium of hyphae **Cell wall.** based on glucans and **chitin**, rarely on glucans and **cellulose** (Oomycota).
- ✓ **Nuclear status.** Eukaryotic, uni- or multinucleate, the thallus being homo- or heterokaryotic, haploid, dikaryotic or diploid
- ✓ **Life cycle.** Simple or, more usually, complex.
- ✓ **Propagules.** These are typically microscopically small spores produced in high numbers. Motile spores are confined to certain group (**Chytridiomycota and Blastocladiomycota**)
- ✓ **Habitat.** Ubiquitous in terrestrial and freshwater habitats, less so in the marine environment
- ✓ **Ecology.** Important ecological roles as saprotrophs, mutualistic symbionts, parasites, or hyperparasites
- ✓ **Distribution.** Cosmopolitan.
- ✓ **Reproduction.** The following reproductive events may occur: sexual (i.e. nuclear fusion and meiosis) and/or asexual (i.e. purely mitotic nuclear division).
- O<sub>2</sub> requirement- Most aerobic or facultatively anaerobic. Only a few fungi are anaerobic.

# Taxonomy of fungi

- Zoospores.
- Sporangiospores (aplanospores); Chlamydospores; Zygosporangia
- Ascospores; Conidia (conidiospores)
- Basidiospores
- Anamorphs and teleomorphs

# Fungal Classification(Webster and Weber, 2007)

Group and Representative Member	Usual Habitat	Some Distinguishing Characteristics	Asexual Reproduction	Sexual Reproduction
Zygomycetes <i>Rhizopus stolonifer</i> (black bread mold)	Terrestrial  (Club)	Multicellular, coenocytic mycelia (with many haploid nuclei)	Asexual spores develop in sporangia on the tips of aerial hyphae	Sexual spores known as zygospores can remain dormant in adverse environment
Basidiomycetes <i>Agaricus campestris</i> (meadow mushroom) <i>Filobasidiella neoformans</i>	Terrestrial  (Sac)	Multicellular, uninucleated mycelia. Group includes mushrooms, smuts, rusts that affect the food supply	Commonly absent	Produce basidiophores that are borne on club-shaped structures at the tips of the hyphae
Ascomycetes <i>Neurospora, Saccharomyces cerevisiae</i> (baker's yeast)	Terrestrial, on fruit and other organic materials	Unicellular and multicellular with septated mycelia	Is common by budding; conidiospores	Involves the formation of an ascus (sac) on specialized hyphae

**Chytridiomycota**  
Rhizophlyctis rosea  
Synchytrium endobioticum,  
Batrachochytrium dendrobatidis,

**Mostly aquatic**

**Mostly unicellular**

**Zoospores, developed in sporangia or zoosporangia**

**Fusion of gametes (haploid dominant; isomorphic alternation of generations)**

# Example of the hierarchy of taxonomic terms

Kingdom Fungi

Subkingdom Eumycota

Phylum Basidiomycota

Class Urediniomycetes

Order Uredinales

Family Pucciniaceae

Genus *Puccinia*

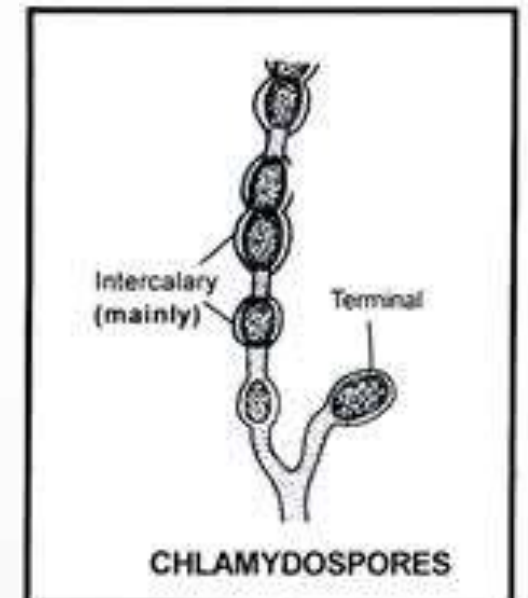
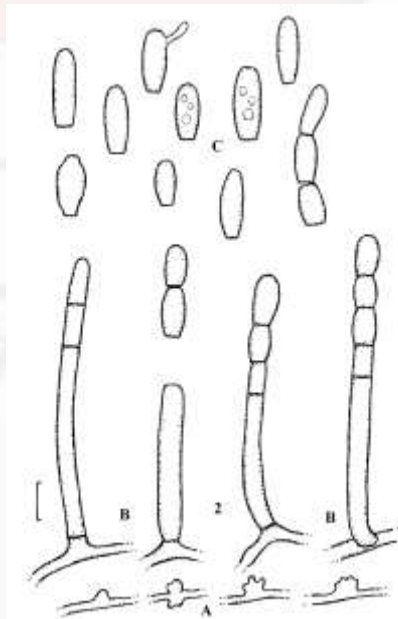
Species *Puccinia graminis*

Race *Puccinia graminis*

f. sp. *tritici*

# Modes of vegetative reproduction

- Fragmentation
- Fission
- Budding
- Oidium formation- The hypha breaks up into component cells/ small pieces and develop into spores. Oidia cannot survive in unfavourable conditions.
- Chlamydo spores- Thick walled large resting spore formed by vegetative cells.
- Sclerotia- Hard and dark resting body consisting of a mass of hyphal threads, capable of remaining dormant for long.





# Modes of asexual and sexual reproduction

- Zoospores.
- Sporangiospores (aplanospores); Zygosporangia
- Conidia (conidiospores); Ascospores
- Uredo-teleutospores- binucleate spores;  
Basidiospores
- Anamorphs (asexual stage) and teleomorphs (sexual stage)
- The basidium produced 4 basidiospores whereas ascus produced 8 ascospores.
- The basidiospores are produced exogenously whereas ascospores are produced endogenously.

# Sexual reproduction

- 3 phases- Plasmogamy, karyogamy and meiosis.
- Types- 1. Planogametic copulation (Isogamy-primitive, morphologically similar but physiologically differ, Anisogamy-morph-physiologically different and Oogamy- egg nonmotile and male gamete motile).
- 2. Gametangial contact- Gametangia come in contact, dissolution of common wall, entire content of male migrate into female.
- 3. Gametangial copulation. Complete fusion occur.

# Physiology

- Heterotrophic
- pH-5-6
- Temp- 28
- Withstand certain extreme conditions eg. Concentration of sugar and thermophilic
- Aw (water activity)
- Yeasts are facultative but molds are strictly aerobic.

# List of some important plant diseases

Name of the disease	Pathogen
1. Club root of Crucifers	<i>Plasmodiophora brassicae</i>
2. Wart disease of potato	<i>Synchytrium endobioticum</i>
3. Stem Rot of Papaya	<i>Pythium aphanidermatum</i>
4. Damping off of seedlings	<i>Pythium sp.</i>
5. Late blight of potato	<i>Phytophthora infestans</i>
6. White rust of crucifers	<i>Albugo candida</i>
7. Downy mildew of peas	<i>Peronospora pisi</i>
8. Green ear disease of Bajra	<i>Sclerospora graminicola</i>
9. Powdery mildew of peas	<i>Erysiphe polygoni</i>
10. Powdery mildew of wheat	<i>Erysiphe graminis</i>
11. Leaf curl of peaches	<i>Taphrina deformans</i>
12. Stem gall of coriander	<i>Protomyces macrosporus</i>
13. Ergot disease of rye	<i>Claviceps purpurea</i>
14. Rust of wheat	<i>Puccinia graminis</i>
15. Rust of pea	<i>Uromyces pisi</i>
16. Rust of gram	<i>Uromyces ciceris-arieteni</i>
17. Rust of Linseed	<i>Melampsora lini</i>
18. Covered smut of barley	<i>Ustilago hordei</i>
19. Loose smut of wheat	<i>Ustilago nuda</i>
20. Bajra smut	<i>Tolyposporium penicillariae</i>
21. Grain smut of Jowar	<i>Sphacelotheca sorghi</i>
22. Bunt of wheat	<i>Tilletia tritici</i>
23. Early blight of potato	<i>Alternaria solani</i>
24. Wilt of pigeon pea	<i>Fusarium oxysporum</i>
25. Red rot of sugarcane	<i>Colletotrichum falcatum</i>
26. Tikka disease of groundnuts	<i>Cercospora personata</i>
27. Stripe disease of barley	<i>Helminthosporium graminieum</i>

# List of some important animal diseases

## List of some animal diseases caused by fungi.

Name of the disease	Pathogen
Penicillosis	Spp. of <i>Penicillium</i>
Aspergillosis	Spp. of <i>Aspergillus</i>
Athelete foot	<i>Tinea rubrum</i>
Ringworm	<i>Trichophyton, Microsporum</i>
Mucomycosis	<i>Mucor, Rhizopus</i>

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# Symbiotic association

- Lichens
- Mycorrhizae



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# Application of fungi

- Food e.g. mushrooms (*Agaricus*), *Morchella*, *Lycoperdon*, *Clavatia*, etc- edible fungi. Yeast- Vit. B and D. *Saccharomyces*, *Endomyces*, *Torulopsis* rich in protein.
- Medicine eg. antibiotics-penicillin, ergotine, cyclosporine, etc.
- Industries-
  - Alcoholic eg. yeast- zymase- glucose to ethyl alcohol and CO<sub>2</sub>
  - Baking- dough raising
  - Enzymes- invertase, amylase, zymase etc
  - Cheese- *P. roqueforti* and *P. camemberii*
  - Organic acid eg. Citric acid, gluconic acid, kojic acid, fumaric acid
  - Proteins- yeast cake.

# Application of fungi

- Genetics and other biological studies- Neurospora, yeast and Ascobolus for genetical and biochemical studies.
- As trace organism- Aspergillus niger detect element like Cu, Zn, Mo, Mn, Cd, Pb, etc.
- Agriculture- soil fertility, biocontrol, predacious fungi, mycorrhiza, insecticide, in soil aggregation.
- Growth hormone
- Pigments
- Amino acids
- Mycotoxin
- Secondary metabolites
- Biodegradation



# Harmful activities

- Mycotoxin
- Spoilage
- Disease
- Poison
- Hallucinogenic eg. LSD (Lysergic acid diethylamide)

The logo of Galgotias University is a circular emblem with a spiral design. The spiral starts from the center and moves outwards, with colors transitioning from light blue to yellow, then to orange, and finally to red. The text "GALGOTIAS UNIVERSITY" is written in a serif font below the logo.

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## References

- Alexopoulos, CJ, Mims, CW and Blackwell, MB, Introductory Mycology. 4<sup>th</sup> ed., John Wiley and Sons, New York, 1996.
- Webster, J and Weber, R, Introduction to fungi. 3<sup>rd</sup> ed., Cambridge University Press, USA, 2007.

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