

Eumycetes (True fungi)**Classified by method of reproduction**

- 1. Zygomycetes 2. Basidiomycetes 3. Ascomycetes 4. Deuteromycetes**

ZYGOMYCETES

Commonly known as bread moulds, these are fast growing, terrestrial, largely saprophytic fungi. Hyphae are coenocytic and mostly aseptate. Asexual spores include chlamydoconidia, conidia and sporangiospores. Sporangiohores may be simple or branched. Sexual reproduction involves producing a thick-walled sexual resting spore called a zygospore. Medically important orders and genera include:

1. Entomophthorales: *Conidiobolus* and *Basidiobolus* are involved in subcutaneous zygomycosis
2. Mucorales: *Rhizopus*, *Mucor*, *Rhizomucor*, *Absidia* are involved in subcutaneous and systemic zygomycosis (formerly called Mucormycosis)

BASIDIOMYCETES

They exist as saprobes and parasites of plants. Hyphae are dikaryotic and can often be distinguished by the presence of clamp connections over the septa. Sexual reproduction is by the formation of exogenous basidiospores, typically four, on a basidium. Occasional species produce conidia but most are sterile. Genera of medical importance include:

Cryptococcus neoformans, Mushroom poisoning by *Amanita*

ASCOMYCETES

They exist as saprophytes and parasites of plants. Hyphae are septate with simple septal pores. Asexual reproduction is by conidia. Sexual reproduction is by the formation of endogenous ascospores, typically eight, in an ascus. Examples of sac-fungi are morels, truffles, cup fungi and powdery mildews. Example: *Aspergillus*, *Claviceps*, *Neurospora*.

DEUTEROMYCETES

Deuteromycetes are also known as Fungi Imperfecti because of absence of sexually reproducing forms (teleomorph or perfect stage). As their teleomorph continue to be discovered, they would be classified among the previous categories, until then this remains an artificial and heterogeneous group. There are three subclasses of Fungi Imperfecti.

1. Blastomycetidae: These include asexual budding forms of *Cryptococcus*, *Candida*,. Depending on the presence of melanin in their cell walls, they may be non-dematiaceous or dematiaceous.
2. Hyphomycetidae: A class of mycelial moulds which reproduce asexually by conidia on hyphae. Hyphae are septate.
- 3-coelomycetidae: reproduce asexually by conidia. Hyphae are septate.

Classification of Zygomycetes

General characteristics of the Zygomycetes:

- a. The majority of the members are saprobe- Some occur on dung, showing coprophilous nature, and some members attack other fungi- A few Zygomycetes are weak parasites, attacking plants and animals.
- b. Most Zygomycetes produce a well-developed and branched mycelium, consisting of coarse, grey or white, coenocytic hyphae. A few members, however, contain a highly reduced mycelium, having septa at definite intervals.
- c. Cells contain all typical cellular organelles including mitochondria, nuclei, ribosomes, lipid granules and endoplasmic reticulum.
- d. Cell wall is mainly composed of chitosan-chitin.

- e. Centrioles are absent.
- f. Motile cells or zoospores are absent.
- g. Asexual reproduction takes place by non-motile sporangiospores, called aplanospores. They produce in very large number within the sporangia.
- h. Some reproduce by chlamydospores and a few by oidia.
- i. Many Zygomycetes reproduce by 'modified sporangial units functioning as conidia or by true conidia'.
- j. In mucorales appendaged sporangiospores are also formed. Sporangiospores and appendaged sporangiospores develop in sporangia, merosporangia, and sporangiola or also as one-spored sporangia or conidia in Mucorales.
- k. Sexual reproduction takes place by gametangial fusion. Two fusing gametangia may arise from the same mycelium or from different mycelia.
- l. Gametangial fusion results the production of a thick-walled resting spore, called zygospore. The zygospore develops within a zygosporangium.
- m. Zygospore remains surrounded by a very thick wall, which is highly resistant to desiccation and other unfavorable factors. This wall pigmented and sculptured in many species.
- n. The time of germination of the zygospore a hypha emerges and bears a terminal sporangium. It is believed that the meiosis occurs during germination.
- o. Regarding the primitive Mucorales require nutrition in Zygomycetes, no vitamins or growth factors. Only inorganic nitrogen with minerals and sugars are required. Higher forms like *Pilobolus* require growth factors such as ferrichrome (Coprogen). Entomophthorales require complex nutrition medium.

Classification:

The classification of Zygomycetes is not been settled yet. However, the majority of the workers divide Zygomycetes into three orders:

- (i) Mucorales
- (ii) Entomophthorales and
- (iii) Zoopagales

However, Heseltine and Ellis (1973) also mentioned that 'possibly a fourth order,

Endogonales, should also recognize, but Benjamin (1979) divided Zygomycetes into following

seven orders, and Alexopoulos and Mims (1979) have also followed the same classification,

except in the order Harpellales:

- a. Mucorales
- b. Dimargaritales
- c. Kickxellales
- d. Endogonales
- e. Entomophthorales
- f. Zoopagles
- g. Harpellales

Recently Webster (1980) mentioned that Zygomycetes comprise only two Orders:

- i. Mucorales
- ii. Entomophthorales

Mucoraceae is the largest family of 'the order, containing 20 genera, its common genera is *Mucor*, *Rhizopus*, *Absidia*, *Phycomyces*, *Adnomvcor* and *Circadian*.

Order: Mucorales; often called the bread moulds; saprotrophic, weakly parasitic on plants, or parasitic on humans and then causing mucormycosis (a pulmonary infection); asexual reproduction by sporangiospores, 1-spored sporangiola (a small deciduous sporangium), or conidia; in the genus *Pilobolus* the heavily cutinized sporangium is forcibly discharged; about 360 species, example genera: *Mucor*, *Parasitella*, *Phycomyces*, *Pilobolus*, *Rhizopus*.

The genus *Pilobolus* produces sporangia that are attached to the constriction above the vesicle along a circumscissile zone. The sporangium, which has a black, cutinized wall is forcibly shot from the sporangiospore. The sporophore which is generally simple arises from a trophocyst. Zygospores are formed in the substrate and they have apposed suspensors. These fungi are obligate coprophiles.



Table 4.5 : The difference between *Rhizopus* and *Mucor*

<i>Rhizopus</i>	<i>Mucor</i>
1. Commonly grows on bread.	1. Commonly grows on dung.
2. Vegetative mycelium is differentiated into stolon and rhizoidal hyphae.	2. Vegetative mycelium is not differentiated and has only one kind of hypha.
3. Nutrition is being absorbed by the rhizoidal mycelium.	3. Nutrition is being absorbed by the mycelial surface.
4. Sporangioophore develops in clusters above the nodes.	4. Sporangioophore develops singly at different places on the mycelium.
5. Gametangia are unequal or equal in size.	5. Gametangia are equal in size.
6. Reduction division occurs at the time of zygosporangium germination after rest.	6. Reduction division occurs just after karyogamy before rest of a zygosporangium.

Order: Entomophthorales; insect parasites or saprotrophs, some implicated in animal or human diseases; asexual reproduction by modified sporangia functioning as conidia, forcibly discharged. About 150 species; example genera: *Entomophthora*, *Ballocephala*, *Conidiobolus*, *Entomophaga*.

Order: Zoopagales; parasitic on amoebas, rotifers, nematodes, or other small animals, which they trap by various specialised mechanisms; asexual reproduction by conidia borne singly or in chains, not forcibly discharged. About 60 species; example genera: *Cochlonema*, *Rhopalomyces*, *Piptocephalis*, *Sigmoideomyces*, *Syncephalis*, *Zoopage*.

