Structure of Fungal Cell :

Subcellular structure of a fungal cell is discussed below:

1. The Cell Wall:

Except slime molds (Myxomycetes), the fungal cell consists of a rigid cell wall and cell organelles. However, composition of cell wall of different fungal groups differs. Chemical analysis of cell wall reveals that it contains 80-90% polysaccharides, and remaining proteins and lipids.

Chitin (a polymer of N-acetyl glucosamine), cellulose (a polymer of D-glucose) or other glucans are present in cell walls in the form of fibrils forming layers. In most of the fungi the cell wall lacks cellulose (except Oomycetes) usually chitin and cellulose are found together e.g. Ceratocystis and Rhizidiomyces contain a form of chitin called fungus cellulose. It is similar to the chitin of insects. Structural formulae of repeating units of cellulose and chitin are given in Fig. 4.36.

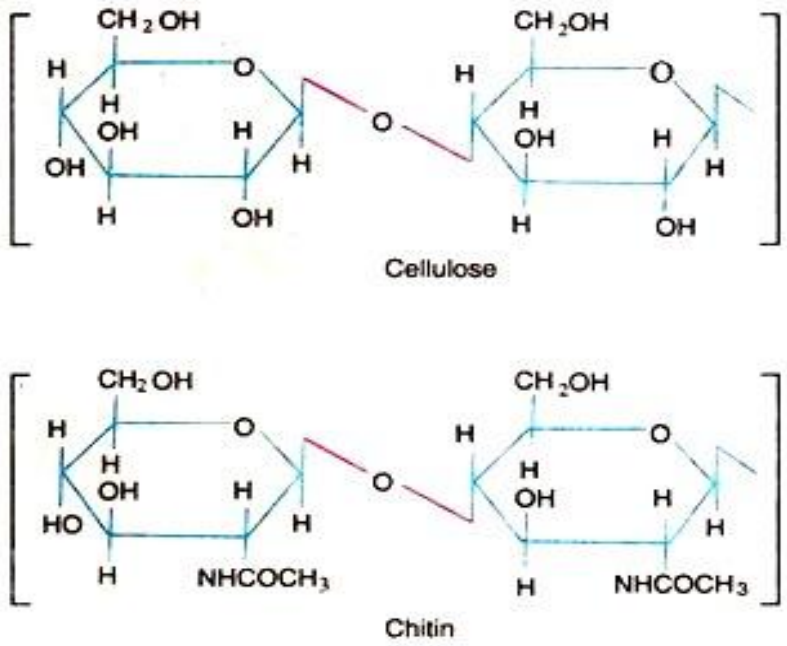


Fig. 4.36 : Structural formula representing the units of cellulose and chitin.

The micro-fibril layers run parallel to the surface. Several non-fibril materials are also associated with micro-fibrils. Though chitin is the most usual

component yet cellulose is present in cell walls of Oomycetes along with glucans. An amino acid and hydroxy-protein are present in the cell wall of Oomycetes along with cellulose.

Several other substances have also been found to be associated together in cell walls and cell wall components such as proteins enzymes, etc. In Peronospora and Saprolegnia true cellulose is present, but in Phytophthora and Pythium cellulose is totally absent and glucans predominates in their walls. In the cell wall of some fungi the presence of chitin has been reported.

The basic constituents of cell walls of Zygomycetes, Ascomycetes and Basidiomycetes are chitin. But in yeasts and some Hemiascomycetidae chitin is absent. Micro-fibrils of mannans and β-glucan constitute their cell wall. Various chemical substances found in cell walls seem to be correlated with fungal taxonomy (Table 4.5).

Table 4.5 : Taxonomy of fungal cell walls.

Categories	*Taxonomic groups*	*Features*
Cellulose-glycogen	Acrasiales	Pseudoplasmodia
Cellulose-glucan	Oomycetes	Biflagellate zoospores
Cellulose-chitin	Hypochytridiomycetes	Anteriorly uniflagellate zoospores
Chitosan-chitin	Zygomycetes	Zygospores
Chitin-glucan	Chytridiomycetes	Posteriorly unitlagallate zoospore
	Ascomycetes	Septate hyphae, ascospores
	Basidiomycetes	Septate hyphae, basidiospores
	Deuteromycetes	Septate hyphae
Mannan-glucan	Saccharomycetaceae	Yeast cells, ascospore
	Cryptococcaceae	Yeast cells
Mannan- chitin	Sporobolomycetaceae	Yeast cells, ballistospores
	Rhodotorulaceae	Yeast (carotenoid pigment)
Polygalacturosamine-galactan	Trichomycetes	Heterogenous group

2. Plasma Membrane (Plasma lemma, Cell Membrane):

In fungi too the cell wall is followed by plasma membrane that encloses the cytoplasm. It is semipermeable and, in structure and function, it is similar to that of prokaryotes. However, specialized organelles have been reported at the surface of plasma membrane in the region where the fusion of secretory

vesicles of cytoplasm occurs. The plasma lemma invaginates and forms a pouch like structure enclosing the granular or vesicular materials.

Moore and McAlear (1962) named it lomasomes. It has been defined as "membranous vesicular material embedded in the wall external to the line of plasma lemma: Lomasomes are formed by plasmalemmasomes which are various membrane configurations external to the plasma lemma, often pockets projecting into the cytoplasm and less obviously embedded into wall materials".

However, plasmalemmasomes are produced when the balance between wall plasticity and turgor pressure is distributed is such a way that more plasma-lemma is produced than is needed to line the cell wall.

3. Cytoplasm:

Cytoplasm is colourless in which sap-filled vacuoles are found. Except chloroplasts many of the familiar organelles and inclusions, characteristic of eukaryotes, are found in fungal cytoplasm.

The cytoplasmic inclusions are dead, non-functional and unimportant for fungal survival for example stored food (glycogen and oil drops), pigments and the secretory granules. The cell organelles are endoplasmic reticulum, mitochondria, ribosomes, golgi bodies and vacuoles (Fig. 4.37A). Lomasomes are also present between plasma membrane and cell wall.

The organelles are described below:

(i) Endoplasmic Reticulum:

Presence of endoplasmic reticulum in fungal cytoplasm is observed through electron microscope. It is made up of a system of microtubules beset with small granules. In most of the fungi it is highly vesicular. It is loose and irregular as compared with cells of green plants. In multinucleate hyphae the nuclei may be connected by endoplasmic reticulum.

(ii) Mitochondria:

Numerous small and spherical to elongated bodies known as mitochondria are dispersed in cytoplasm. Mitochondria are covered by an outer double membrane; the inner infoldings form parallel flat plates of irregular tubules called cristae. There is no difference between mitochondria of fungi and green plants.

Generally, these are called the power house of the cell. Mitochondria consist of its genetic material (mt-DNA) as circular double helical molecules devoid of histones and very similar to prokaryotic DNA (molecular weight 1 × 107 Dalton). Mitochondria has its own machinery for transcription and translation of organelle specific DNA.

(iii) Golgi Apparatus or Dictyosomes:

Except in Oomycetes (e.g. Pythium) and non-fungal eukaryotic cells, Golgi apparatus is of rare occurrence in fungal cells. In Oomycetes and non-fungal eukaryotes, Golgi apparatus consists of stacks of folded membranes functioning in secretion. In the cells of Saccharomyces a Golgi apparatus consisting of three flattened sacs can be observed.

(iv) Vacuoles:

Vacuoles are found in the old cells of hyphae. The end of hyphal tip of young hyphae lacks vacuole. With the age, the vacuoles coalesce. Vacuoles are surrounded by a membrane known as tonoplast.

(v) Septum:

Basically three types of septa are found in fungal cells:

(a) Complete septa which lack a pore and rare in vegetative hyphae (Fig.4.37B),

(b) Perforated septa containing a pore through which cytoplasmic organelles such as mitochondria and nuclei can pass freely, for example septa found in members of Ascomycetes and Deuteromycotes .(C), and (c) dolipore (dolium

means a large Jar) septa which are found in Basidiomycetes and are rather more complex.

The central pore of the septum is surrounded by a curved flange of wall material which is often thickened to form a barrel shaped cylindrical structure.

(D). These septa are often overlaid by the perforated endoplasmic reticulum. The central pore cap is known as parthenosome.

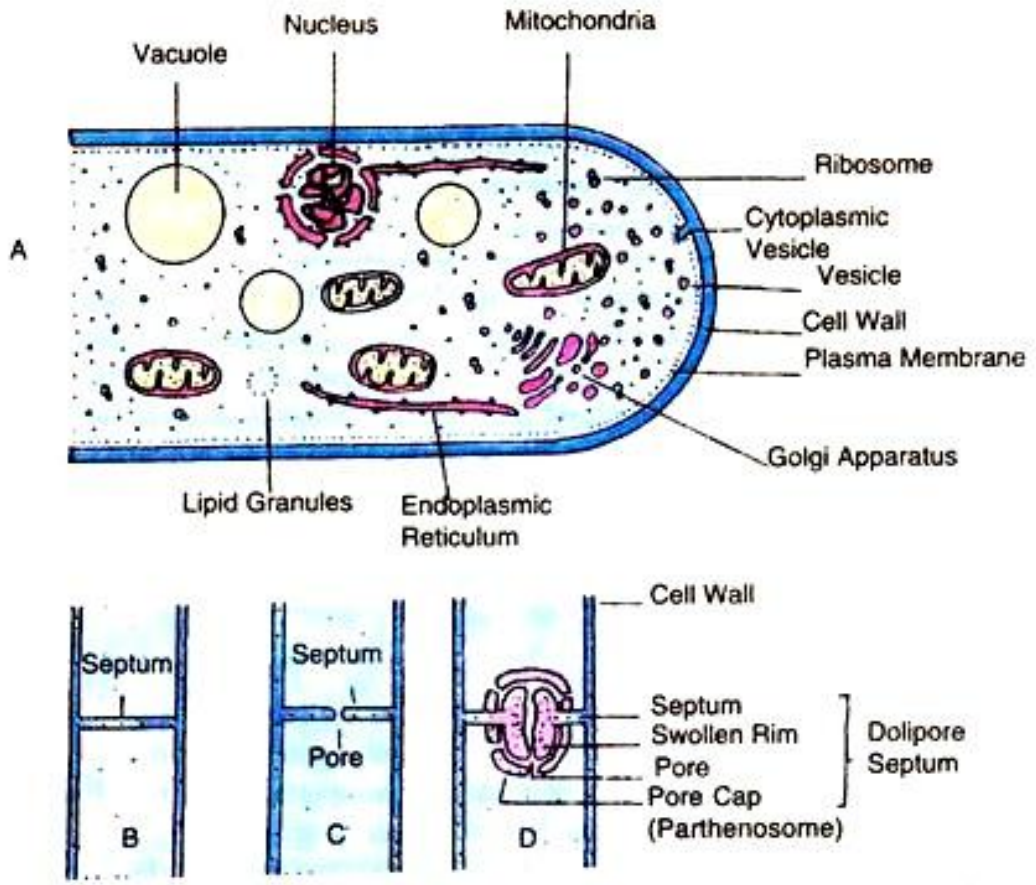
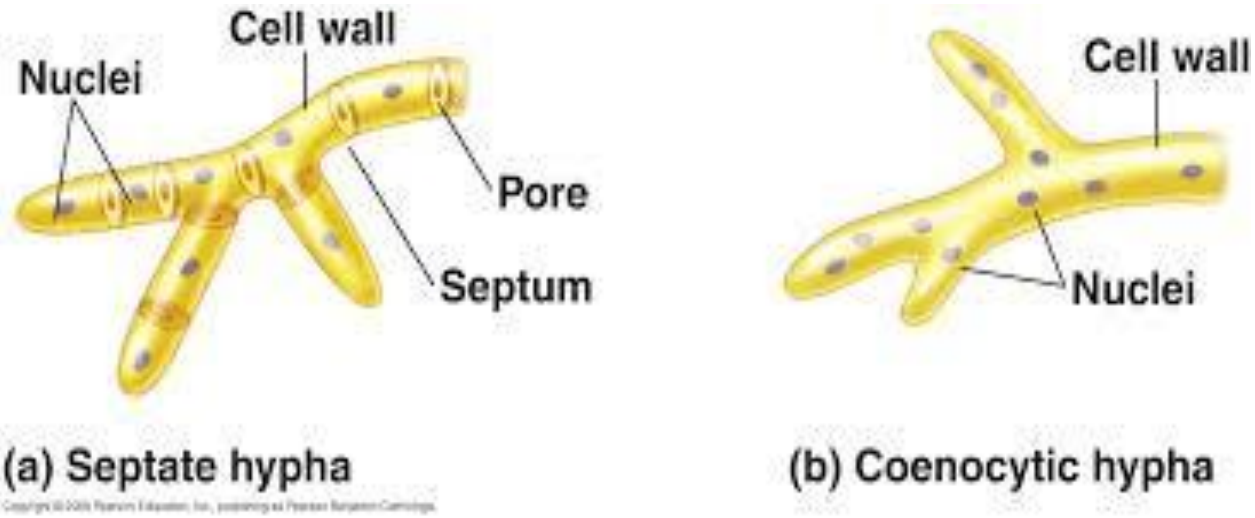


Fig. 4.37 : Different cell organelles of the hyphal apex of *Pythium ultimum (A)*, and different types of septa: complete (B), porus (C) and dolipore (D) septa.



(vi) Cytoplasmic Inclusions:

The cytoplasm consists of various inclusions such as lipid droplets, and glycogen (a typical fungal storage product), the carbohydrate trehalose, proteinaceous material and volutin. The vacuoles contain glycogen. Several metabolites (enzyme, organic acids, etc.) are secreted by the cytoplasm. In mature cells, hpids and glycogens are abundantly present.

(vii) Nucleus:

The cytoplasm contains one, two or more globose or spherical nuclei of about 1-3 p.m diameter. A nucleus consists of a bilayered porous nuclear envelope that encloses the chromosomes and nucleolus.

The chromosome consists of DNA and a few basic proteins called histones. The DNA material remains in changing stage with cell growth. The nuclear pores permit to interchange the materials between the cytoplasm and nucleus.