Correct speling: Mycelium not ~~mycellium~~

Phylum Ascomycota

Introduction to Ascomycetes

Ascomycota and Basidiomycota share a number of characters, including;

1. compartmentalized mycellium
2. a dikaryotic stage in the life cycle.
3. Plectenchymatous structures associated with spore production, conidia, and sometimes, complex dispersal system. There is ever-increasing evidence that the two phyla have diverged from a common ancestor.

Morphological character that distinguishes members of ascomycota from all other fungi is the ascus (Pl. asci, Gr. askos = goat skin, sac), a saclike structure containing ascospores cleaved from within from by free cell formation after karyogamy and meiosis. Eight ascospores are formed within the ascus, but this number may varry from one to over a thousand according to the species. Mycellial ascomycetes are characterized further by a compartmentalized mycellium with distinctive walls, a septa having simple pores, and presence of woronin bodies. A few of true yeasts (Sacchromycetales) also have been reported to have simple septal pores and woronin bodies but this is uncertain. coenocytic bodies are present in lichen-forming ascomycetes

occurance and importance

Ascomycetes rival other groups of eukaryotic organisms in their ability to occupy a broad range of habitats. According to their habitats or the substrates on which these grow, they are devided into following denotions.

1. **Coprophilous**:- Having dung habitats.
2. **Corticolous**:- Live in bark ~~[illegible]~~
3. **Folicolous**:- Live in ~~[illegible]~~ leaves.
4. **Lignicolous**:- Live in ~~leaves~~ wood.
5. **Lichen**:- Live with green algae or cynobacteria (blue green algae)

Ascomycetes live in fresh water and marine water. Ascomycetes are important in following ways.

1- cellulotic ascomycetes i.e. Chaetomium and Trichoderma are responsible for destruction of cellulosic fabrics.

2- Ascomycetes causing several diseases in plants, like, apple scab, powdery mildews, brown rot of stone fruits, foot rot of cereals

3- Athlete's foot disease, caused by ascomycetes

A- Beauveria, Metarrhizium, and Fusarium are used for the biological control of insect-pest.

4- Role in baking and brewing industry.

5- Toxic alkaloids and toxic cyclopeptides, coumarins, phenolics, terpenoids, polysacchrides, and glycoproteins are also produced from ascomycetes.

6- Produce growth regulators in green plants. For example, gibberellin is produced in rice plants by Gibberella fujikuroi causing folish seedling disease.

7. These have the natural mushrooms i.e Truffles and Morels - Truffles are hypogeous while morels are epigeous.

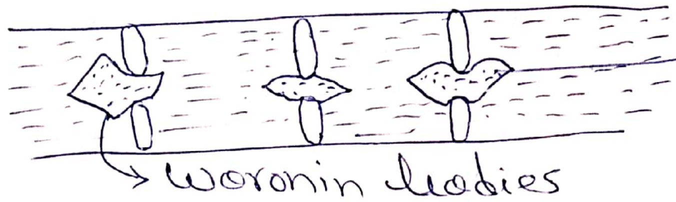
8- Neurospora crassa, serve as biological model organism, belong to ascomycetes.

General characters

Asexual fungi known as deuteromycetes, are basically asexual ascomycetes.

Somatic structures

The somatic stages of ascomycetes may be single celled, mycelial or dimorphic. A large proportion of the cell walls of filamentous ascomycetes is chitin. Hyphae of ascomycetes are septated, with the septum, spherical, hexagonal or reactangular membrane bound structures with a crystalline matrix that usually are associated with a septum. These woronin bodies frequently plug the septal pores of hyphae and serve to separate aging or damaged from the rest of the mycellium. woronin bodies give



rise to septal pore organelles. Ascomycetes have haustoria, appressoria, and thick walled hyphopodia (specialized form of appressorium) Hyphopodia are associated with the production of ascocarp and sticking of hypha with the tissues. Some of most important fungi of ascomycetes have traps, nooses, coils, and sticky pegs that trap nematodes. Ascomycetes mycelium may be organised into fungal tissues (Plectenchyma). If similar structure is loosely woven, these are called prosenchyma. If, however, the hyphae have lost their individuality and the cells are more or less isodiametric, closely resembling the parenchyma of plants, it is known as pseudoparanchyma.

Asexual reproduction :-

Asexual reproduction in ascomycetes may be carried out by fission, fragmentation, or formation of chlaymadospores or conidia according to species and environmental conditions. Fission and budding are methods of propogation present in yeasts and dimorphic ascomycetes. Because all portions of thallus are potentially capable of growth, fragmentation and may result in as many as individuals as there are fragments. Many lichens produce vegetative propagules called soredia, that are composed of algal cells enveloped by hyphae of fungi. Resistant/thick walled structures are formed, which may also serve as reproductive unit. These include; sclerotium, stromata and chlamydospore.

Sexual Reproduction:-

In sexual reproduction in ascomycetes two compatible nuclei are brought together in the same cell by one of several methods

1- Two morphologically similar gametangia touch at their tips or coil around each other and fuse. The fusion cell develops into the ascus. No long-lived dikaryotic phase is developed in most species because karyogamy takes place shorter after plasmogamy. In yeasts, which are mostly unicellular, the somatic cells themselves act as gametangia with the zygot transformed directly into ascus.

2- Some species produce morphologically differentiated uninucleate or multinucleate gametangia i.e. antheridia and ascogonia (sing. ascogonium; Gr. askos = sac + gennao = I give birth). Asci develop from outgrowths of the ascogonium, which is designated the female gametangium. The male nucleus passes from the antheridium into the ascogonium, at point of fusion

between the gametangia. The ascogonium bears
a specialzed hypha, the trichogyne (Gr. thrix=
hair+ gyne= woman, female that receives the
male nucleus. While, spermatization involves
a single detached male cell that becomes
attached to the female receptive organ- whether
a trichogyne or somatic hypha- and empties
its nucleus into the receptive cell. The func-
-tional male gamete may be a spermatium,
microconidium or conidium. spermatia are formed
on the ~~spem~~ spermagonia (sing. spermagonium).
spermatia do not form the germ tube. micro-
conidia serve as spermatia but they can
produce germ tube. conidia also may function
as spermatia by attaching themselves to
the receptive organs and emptying nuclei
into them. A fourth method is somatogamy
and involves the fusion of unspecialized
somatic hyphae of two compatible
~~nuclei~~ mycelia with the nuclei migra-
ting to the ascogonia through the septal
perforations. First two cytoplasm ~~nuclei~~ fuse with
each other (plasmogamy), then two nuclei
(karyogamy), karyogamy takes place in the
young ascus. Meiosis in the diploid nucleus
occurs sooner and form haploid four
nuclei. After that, mitosis occurs that
form the eight nucelei in the ascus.

Incompatibility systems:-

The capacity of cells to fuse
with each ~~each~~ other is controlled by complex
genetic systems. Inability of genetically
similar individuals to fuse, is referred
as homogenic incomplibility. It is the
process that promotes outcrossing in sexual
fusions and is controlled by mating type gens.

incomplitability systems:-

The capacity of cells to fuse is controlled by complex genetic systems in both ascomycetes and basidiomycetes. Fusions may occur between cells during plasmogamy or between somatic structures not associated with sexual reproduction. Inability of genetically similar individuals to fuse is called "Homogenic incompatibility". It is a process that promotes outcrossing in sexual fusions and is controlled by mating-type genes. The outcrossing individuals are said to be heterothallic and phenomenon is called heterogenic compatibility. The sexual reproduction in heterothallic ascomycetes requires the participation of genetically different strains. The mating system is controlled by single genetic locus(MAT) that specifies one of two alternative mating types and is termed as unifactorial or bipolar. The mating types of two individuals i.e. complible haploid, can be designated as MAT1-1 and MAT1-2 or MATA and MATa.

Plasmogamy requires that a given isolate recognize and respond to an individual of the opposite mating type. once complible strains have fused, they are incapable of fusion with any other partners and the mated individual is committed to sexual reproduction. The nuclei of the resulting heterokaryotic cell will fuse immediately (in yeast) or at some latter time to form a diploid nucleus that is capable of undergoing meiosis. The analysis of mating genes has made it clear that, not only is fusion under their control, but they also lie at the heart of the entire sexual reproductive process.

Each mating type signals its presence to a cell of the opposite mating type by producing peptide Pheromones.

The MATa cells secrete "a" factor, which is recog-
nized by a receptor protein in "α" cells, and conversely
"α" cells produce "α" factor, which binds to a receptor
in a-type cells. The binding of both pheromones
to the respective receptors results in a transient
arrest of the cell cycle and induces the production
of cell surface molecules that facilitate conjug-
ation and fusion of the two cells. The diploid
cells produce through this fusion, are capable
of indefinit asexual reproduction by budding, but
they are no longer responsive to pheromones.

In the ascomycetes that have been studied
the genes at the MAT loci are completely dissimilar
and can not be regarded as homologous alleles.
Such alternative forms of a locus that does
not have homology sequence is termed as "idiomo-
rph".

Several other interesting points should be made
about ascomycete mating loci. Sometimes, mating type
switching occurs between individuals of unrelated
yeasts. This happens, when opposite mating type
genes are silient on the loci of opposite indivi-
dual. Some ascomycetes do not outcross and do
not require a second genetically distinct nucleus
to initiate sexual reproduction. These self fertile
ascomycetes are known as homothallic. Another
condition is known as secondary homothallism
has been recognized in a number of ascomycetes
that have binucleate ascospores. If each of
the two nuclei contains a different mating
gene, then the spore is capable of germinating
to form a self-fertile mycelium. However,
such a fungus is, infact, actually heterothallic
as there are two mating types present.

Vegetative or somatic incompatibility in
ascomycetes prevents the fusion of genetically
different mycelia (heterogenic incompatibility) and
is usually under multigenic control by a
series of

bi-or multiallelic genes at vegetative incompatibility (het) loci. Studies of this phenomenon have helped to modify previous notions of the widespread occurance of fusions of related fungi to form heterokaryons. In nature this is not the case, and closely related individuals are much more likely to be isolated from each other. This situation is evident from the patterns of zone lines that delimit the pieces of a three dimensional jigsaw puzzle with each piece representing the domain of a genetically discrete individual known as a ~~greal~~ "genet".

When two mycelia in different vegetative compatibility (VC) groups meeting tate that may interact with varying degrees of antagonism, as would be expected under multigenic control. In some cases "barrage reactions" may be recognized by a clear zone between the two mycelial fronts due to lysis of the interacting cells. Sometimes incomplete interactions occur at the margins and unstable dikaryons may exist for a short time. In some cases pigments or enhanced conidium production indicates the meeting of the two mycelia. of a phenotype

Pathogencity has been correlated with VC groups. Ascomycetes rely on vegetative incompatibility to maintain their integrity of genetics, in addition, vegetative incompatibility functions to eliminate the possibility of transmittal of deleterious Cytoplasmic factors including viruses.

Parasexuality:-

According to this, recombination may take place
within the mycellium without the occurance of sexual
reproduction. This phenomenon occurs rarely in natural
population of ascomycetes. Parasexuality has importance
only for asexual ascomycetes i.e. Deuteromycetes.
Parasexuality occurs when mycellium contains two
types of nuclei (heterokaryon). Presence of two
nuclei in the mycelium may be due to mutation
or fusion of two hyphae. Establishment of
heterokaryon in nature is not possible, because
of vegetative incompatibility, while in labo-
ratory conditions mutant strains can be used
to create heterokaryon. These heterokaryons may
be stable or unstable. Heterokaryons in the petri-
dishes can be observed by the differentiated
regions of the mycelium containing differe-
-nt populations of ~~nucl~~ nuclei, these regions are
called sectors. Once a heterokaryon is established
there is possibility for parasexual recombination to
occur. The events for parasexuality require followi-
ng processes to occur;

1- Fusion of two different nuclei to produce a
diploid nucleus.

2- Crossing over at mitosis in the diploid
nucleus.

3- Haploidization, apparently by aneuploidy
the gradual loss of chromosomes, until the
normal haploid complement is restored.

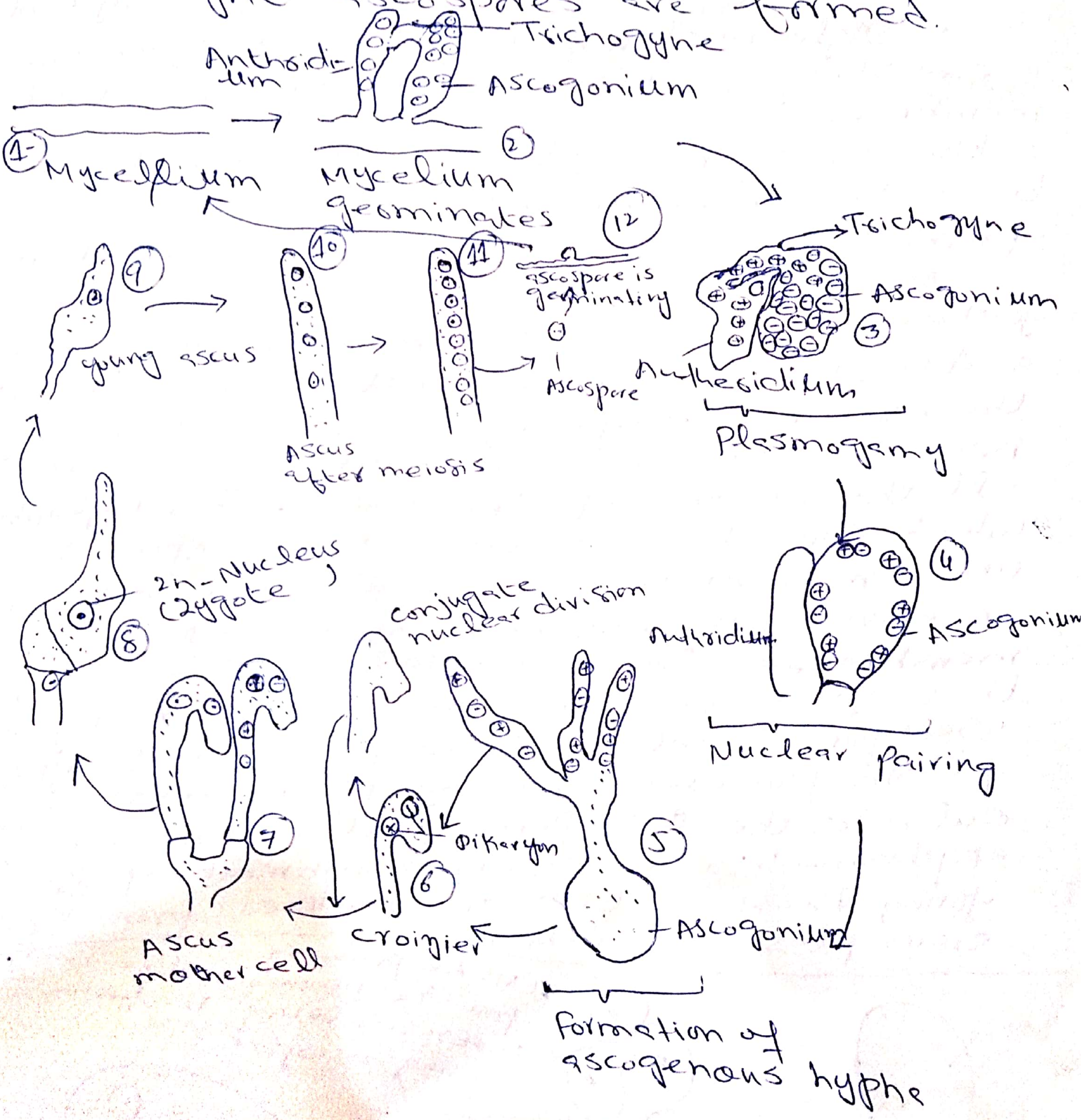
Recovery of non-parental types provides
evidence that recombination has occured in
laboratory, strains i.e. mutant strains, differing
in colour, antibiotic resistance, nutritional
requirements, and conidium characters may
be used to distinguish the recombinants
from the parental nuclei.

It is also possible to treat cultures with chemicals that will induce mitotic crossing over and haploidization. However, outside the laboratory these processes are impossible to perform.

Life cycle pattern:-

Mycelium germinates and form the ascognium and anthridium hyphae. These two hyphae unit together (plasmogamy) via four processes mentioned previously in the sexual reproduction. After plasmogamy, ascogonium produces papilla and transfere two nuclei into it. Pipilla elongate and form the ascogenous hyphae. Nuclei in the ascogenous hyphae soon undergo simultaneous mitosis known as conjugate division. Primary septa are formed between daughter nuclei in such a way that the tip cell of ascogenous hypha is uninucleate and is followed by a series of binucleate cells ~~of the ascogenous~~ that contain pairs of nonsister nuclei. Binucleate cells contain ascogonial and antheridial cells.

Binucleate cells elongate and bends over to form a hook, or crozier. crozier contain two nuclei and is delimited by a septum. The binucleate crook cell is young ascus. Karyogamy takes place in the young ascus and form diploid zygote. In zygote meiosis occurs which form the ascospores. Afterwards, mitosis occurs and eight ascospores are formed.



life cycle pattern

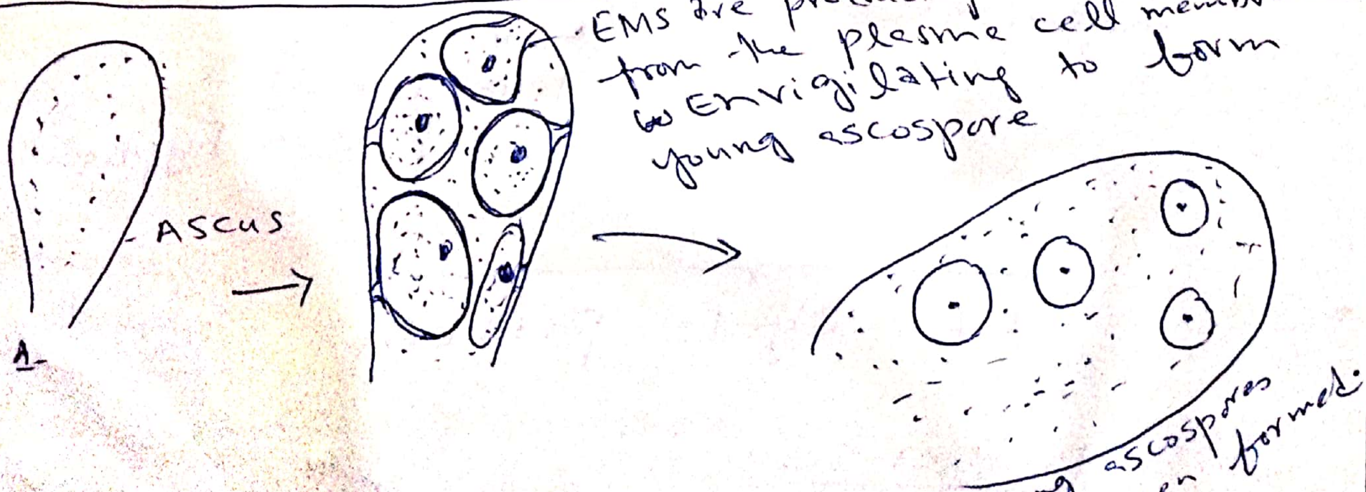
Ascosporogensis :-

Are formed within the ascus through free-cell formation. The free cell formation has two mechanisms;

1- Portions of cytoplasm, each typically containing a single nucleus, are delimited by an envelop consisting of two closely appressed unit membranes.

2- the ascospore wall is deposited between these two membranes to separate them from one another as the spore mature.

In most of the filamentous ascomycetes, these envelops initially are part of a discontinous cylinder that forms around the extreme periphery of the ascus very near the plasma membrane and surrounds all the nuclei of the ascus. This cylinder, which consists of two closely spaced unit membranes, known as ascus vehsicles or enveloping membrane system (EMS). These membranes cleared out in such a way, that young ascospores are formed. Young ascospores contain single nuclei and cytoplasm. However, some cytoplasm remain outside the ascospores which is known as epiplasm — this is used for the nurishment of the young ascospores. EMS are produced from the ascus plasma membrane.



Ascosporogenesis

Asci

Ascus shape varies i.e., spherical to elongated with cylinderical, ovoid, or globose form. spherical asci are produced by some yeasts, and may be produced directly on hypha. Asci are stalked or sessile; may arise at various levels or from single point in the ascocarp. Elongated asci are present in the form of hymenium (a definit layer in which asci are arranged within ascocarp or whether naked or in simple words, it is layer of asci). On the basis of morphology, asci are devided into three categories: protunicate, unitunicate and bitunicate. The protunicate asci have a thin, delicate wall and release thier spores by deliquescing. The wall in both unitunicate and bitunicate ascus is said to consist of two layers i.e. exotunics and endotunics. In unitunicate asci both layers are merged with each other while in bitunicate these layers can be seen separately. Ascospores are released from terminal pore slit or higed cap (operculum). Bitunicate ascus is also known as Jack-in-the-box or fissitunicate ascus.

Release, Dispersal, and Geomination of Ascospores

Ascospores are released forcibly or passively from the asci and are dispersed by wind, water, rainsplashes, animals and humanbeings.

The ascocarp

Except filementous ascomycetes,

best of ascomycetes produce their asci in the ascocarp (Gr. askos = sac, karpos = fruit). These are of five types.

1- Naked asci. These do not produce in the ascocarp.

2- cleistothecium: (Gr. kleistos = closed + theke = case). Ascocarp is completely closed.

3- Perithecium: (Gr. peri = around + theke = case) It is of pitcher shaped and have pore at the tip. This pore is called ostiole.

4- Apothecium: (Gr. apotheke = storehouse) Those that produce their asci in the open ascocarp.

5- Pseudothecium: They produce their asci in a cavity (locule) within a stroma. Stroma forms the wall of ~~of~~ the ascocarp and is linked to the cushion of closely woven hyphae.

In addition to asci, sterile structures are also present in the ascocarp. An ascocarp having asci and sterile hyphae is called centrum. sterile structures are of two types mainly;

1- Paraphyses :- Are elongated, cylinderical or club-shaped hyphae originating at the base of the ascocarp.

2- Periphyses :- A short, unbranched hyphae in the ostiolar canal of an ascocarp.

Role of paraphyses is, ~~in the~~ to absorb water, and aiding in the release of ascospores. Periphyses align the ascospores, so that, they released easily from the ostiole.

The End