Subject - Botany

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content for UG course

- Paper -Plant Life and Utilization -I

Module- Fungi

Credit II

Chap-4

Fungi

Plant Life and Utilization –I

Paper -I, Sem- I

FYBSc

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Learning Objectives

- **4.1.Introduction**
- **4.2.Generl Character**
- **4.3.Classific ation of Fungi (Ainsworth, 1973)**
- **4.4.Life cycle of Mushroom: *Agaricus bisporus***
- 4.4.1Habit and Habitat,
- 4.4.2.Structure of thallus,
- 4.4.3Structure of Sporocarp,
- 4.4.4.Structure of Gill
- 4.4.5.Reproduction- Asexual and Sexual,
- 4.4.6.Systamatic position
- **4.5 Utilization of Fungi**

Summary

4.1 Introduction

- The fungi (sing. Fungus; L., a mashroom) are heterotrophic organisms of very diverse form, size, physiology and mode of reproduction.
- Defination- Fungi are achlorophyllous, heterotrophic, eukaryotic and spore bearing organism whose cell wall is made up of chitin or cellulose or both, which reproduce by asexual and sexual spores.
- The study of fungi is known as Mycology (Gr. mykes, a mushroom and logoes, discourse)
- There are about 5100 genra and 250000 species of fungi.

4.2 General Character

Thallus-Plant body of fungi is called as thallus because it is not differentiated in root, stem and leaves.

- Plant body is Unicellular (e.g. Yeast) or multicellular,
- **Eucarpic thallus** -Thallus is differentiated into two part: Vegetative and Reproductive, vegetative part absorb nutrient and reproductive part forms reproductive structure, such thalli is called as Eucarpic thalli.
- **Holocarpic thallus:-**After a phage of vegetative growth, whole vegetative cell is convrted into reproductive unit, such thalli is called as holocarpic thalli.

- Monokaryotic mycellium (Uninucleate)- Mycellium contains single nucleus that usually forms part of haplophase in the life cycle of fungi.
- Dikaryotic mycellium(Binucleate) :- Mycellium contains pair of nuclei (dikaryon), which denotes the diplophase in the life cycle of fungi.

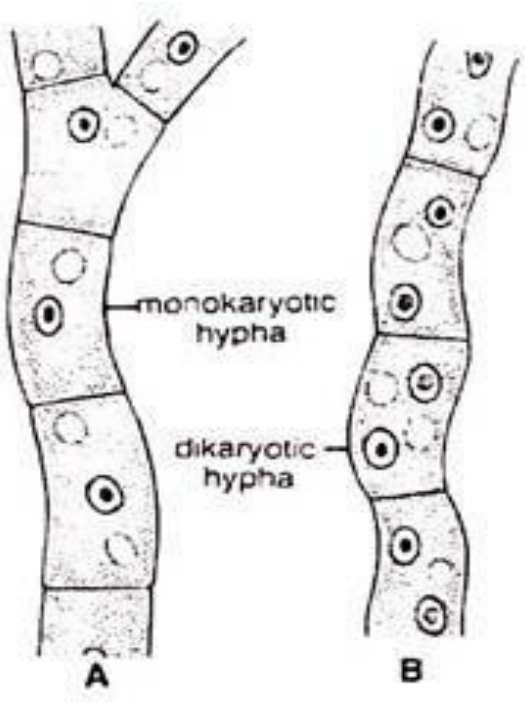


Fig. 1 (A, B). *Agaricus* mycelium. (A) Monokaryotic, (B) Dikaryotic

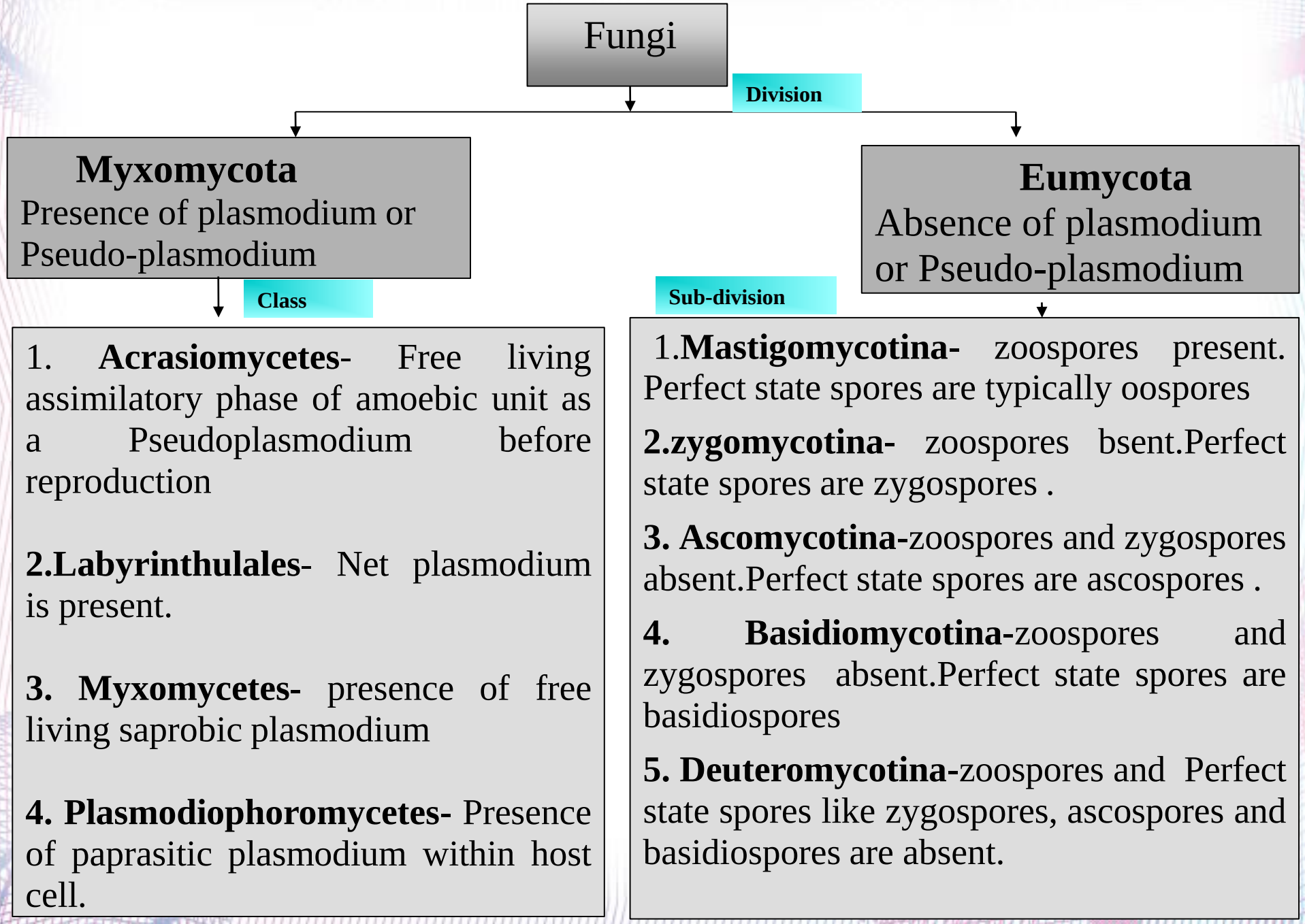
- Chlorophyll is absent so can't prepair their own food through photosynthesis.
- Mode of nutrition is heterotrophic-Heterotrophy - 'other food'
- Saprophytes or saprobes - feed on dead tissues or organic waste (decomposers)
- Symbiont s - mutually beneficial relationship between a fungus and another organism
- Parasites - feeding on living tissue of a host.
- Parasites that cause disease are called pathogens.

- Stored food material is glycogen, sugar alcohol and lipids.
- Reproduction :-Usually there are two broadly recognizable types of reproduction; asexual and sexual
- **Asexual Reproduction-** By means of asexual spore , flagellated spore are called as zoospores and nonflagellated spores are called as sporangiospore and cinidia.
- **Sexual reproduction** – process of Sexual reproduction is completed in three distinct phase

1. Plasomogamy- Fusion of cytoplasm 2. Karyogamy-fusion of nucleus
3. Meoisis- reduction division

- In deuteromycetes sexual reproduction is absent so these fungi is called as imperfect fungi
- Common examples are yeast, *Penicillium notatum*, *Agaricua*, *Albugo* etc

4.3 Classification of Fungi (Ainsworth, 1973)



Division - Eumycota

Sub-division	Class	Character
1.Mastigomycotina	1.Chytridiomycetes	Zoospore with whiplash type of flagella
	2.Hypochytridiomycetes	Zoospore with tinsel type of flagella
	3. Oomycetes	Zoospore with biflagellate
2.Zygomycotina	1. Zygomycetes	Mostly Saprobic
	2. Trichomycetes	Attached to the cuticle or digestive track of Arthropodos.
3.Ascomycotina	1.Hemi-ascomycetes	Ascogenous hyphae and ascocarp are absent
	2. Loculoascomycetes	Ascogenous hyphae and ascocarp are present
	3.Pictomycetes	Ascospores aseptate
	4. Laboulbeniomycetes	Ascocarp of perithecium type
	5. Pyrenomycetes`	Ascocarp typically perithecium
	6. Discomycetes	Ascocarp apothecium

Sub-division	Class	Character
4. Basidiomycotina	1.Teliomycetes	Basidiocarp absent, parasitic on vascular plant
	2.Hymenomycetes	Mostly saprophytic, Basidiocarp present
	3. Gasteromycetes	Mostly saprophytic, Basidiocarp angiocarpus
5.Deuteromycotina	1.Blastomycetes	True mycellium is poorly develop or absent
	2. Hypomycetes	True mycellium is well developed
	3.Coelomycetes	Budding cell are absent. Spores develop in acervuli or Pycnidia

4.4 Life cycle of Mushroom- *Agaricus bisporus*

4.4.1 Habit and Habitat of Agaricus

(a) An edible species of these fungi are called as mushroom

(b) These are saprophytic fungi

(c) Vegitatve part of Plant body is the mycellium composed of septate branched hyphae which grow sporophytically in soil rich in organic matter,in or on dead wood in or on rotting logs or stumps.

(d) Some of edible agaricus are: *Agaricus campestris,A. bisporus*

(e) Some poisonous are:*Amanita muscaria, A. Uerna*

(f) Cosmopolitan distribution

(g) About 17 species of Agaricus reported in India

4.4.2 Structure of thallus

- It can be studied in two parts:

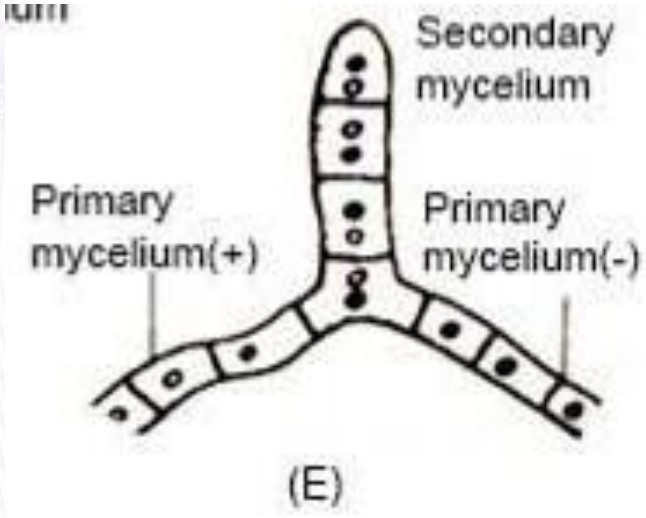
(a) Vegetative mycelium (living inside the soil)

(b) Fruiting body or basidiocarp (present above the soil and edible in young stage)

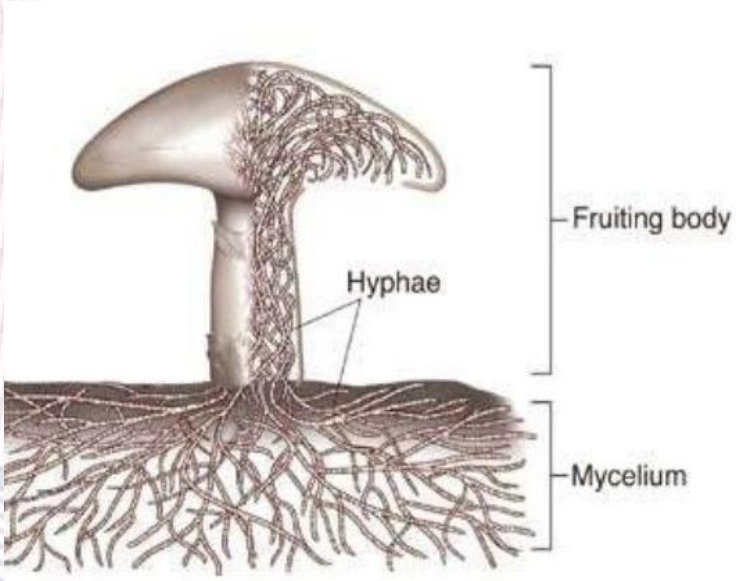
- (a) Vegetative Structure:Vegetative mycelium is of three type
- **Primary Mycelium:**

It originates by the germination of uninucleate basidiospores carrying either '+' or '-' strain. The cells are uninucleate i.e., monokaryotic. It is short lived and becomes bi-nucleate by fusing of two compatible hyphae (Fig. 1 A).

- **Secondary Mycelium:**
- It originates from primary mycelium. After fusion of the hyphae of two opposite strains, the nucleus from one hypha migrates to the other and later gives rise to the bi-nucleate secondary mycelium i.e., dikaryotic. It is long lived and abundant (Fig. 1 B).



(E)



Tertiary Mycelium:

The secondary mycelium grows extensively under the soil and becomes organised into special tissue to form the fruiting body or basidiocarp. The fruiting body appears like umbrella above ground. It is made up of dikaryotic hyphae. These hyphae are called tertiary mycelium. The mycelium is subterranean. The hyphae are septate and branched. The cells communicate with one another by means of a central pore in the septum. It is a typical dolipore septum.

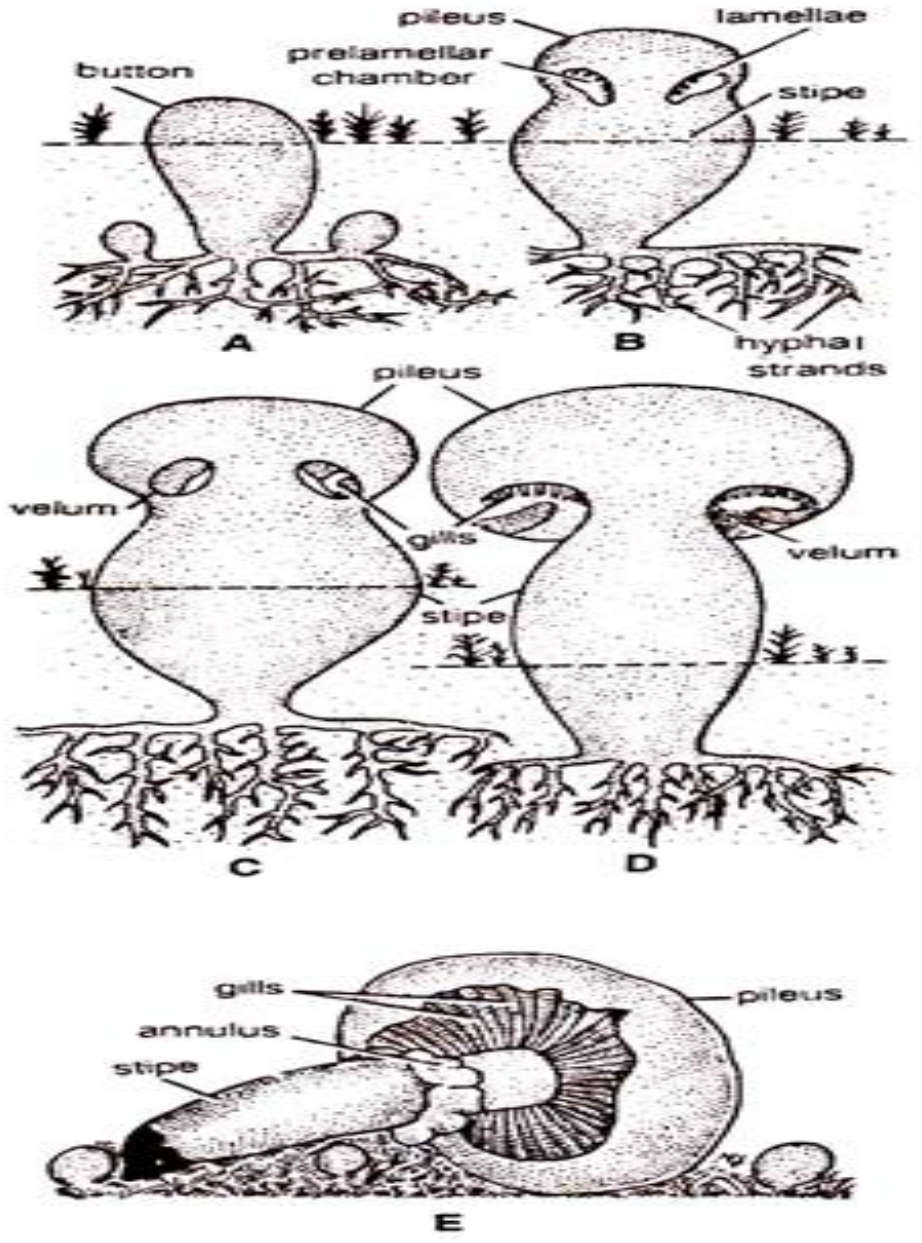


Fig. 3 (A–E). *Agaricus* : Development of basidiocarp; (A–D) Vertical sections of developing basidiocarp showing various stages of development; (E) A mature basidicarp

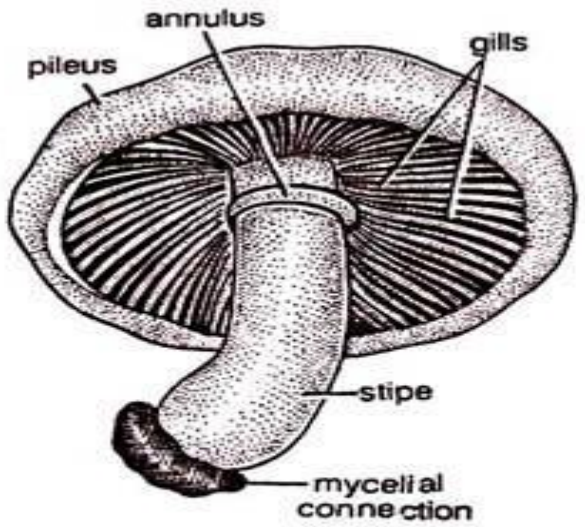


Fig. 5. *Agaricus* : A mature basidiocarp

The mature fruiting body can be differentiated into three parts i.e., stipe, pileus and annulus

4.4.4 Structure of Gill

- A cross section of gill showes that the bulk of tissue is composed of compact hyphae. Gill or lamellae are of three types i.e. Long gills, half length gill, quarter length gill.T.S. Of gill showing 3 part:
- **Trama:-** Central tissue of the gill is called trama, This region is made up of loosely arranged interwoven mass of plectenchymatous tissue of long, slender hyphae. These hyphae run, more or less, longitudinally.
- **Sub-Hymenium or Hypothecium:** Towards the free surface, the cells of the diverging hyphae are shorter and more closely packed, forming the Sub-Hymenium
- **Hymenium or Thecium:-** Next to the Sub-Hymenium, Hymenium is present which is composed of the terminal cells of same hyphae constituting the trama and Sub-Hymenium. The Hymenium layer is composed of palisade-like club-shaped cells rich in protoplasm. A few of them are selender than rest and remain streile, they are known as Paraphyses (sing. Paraphysis).

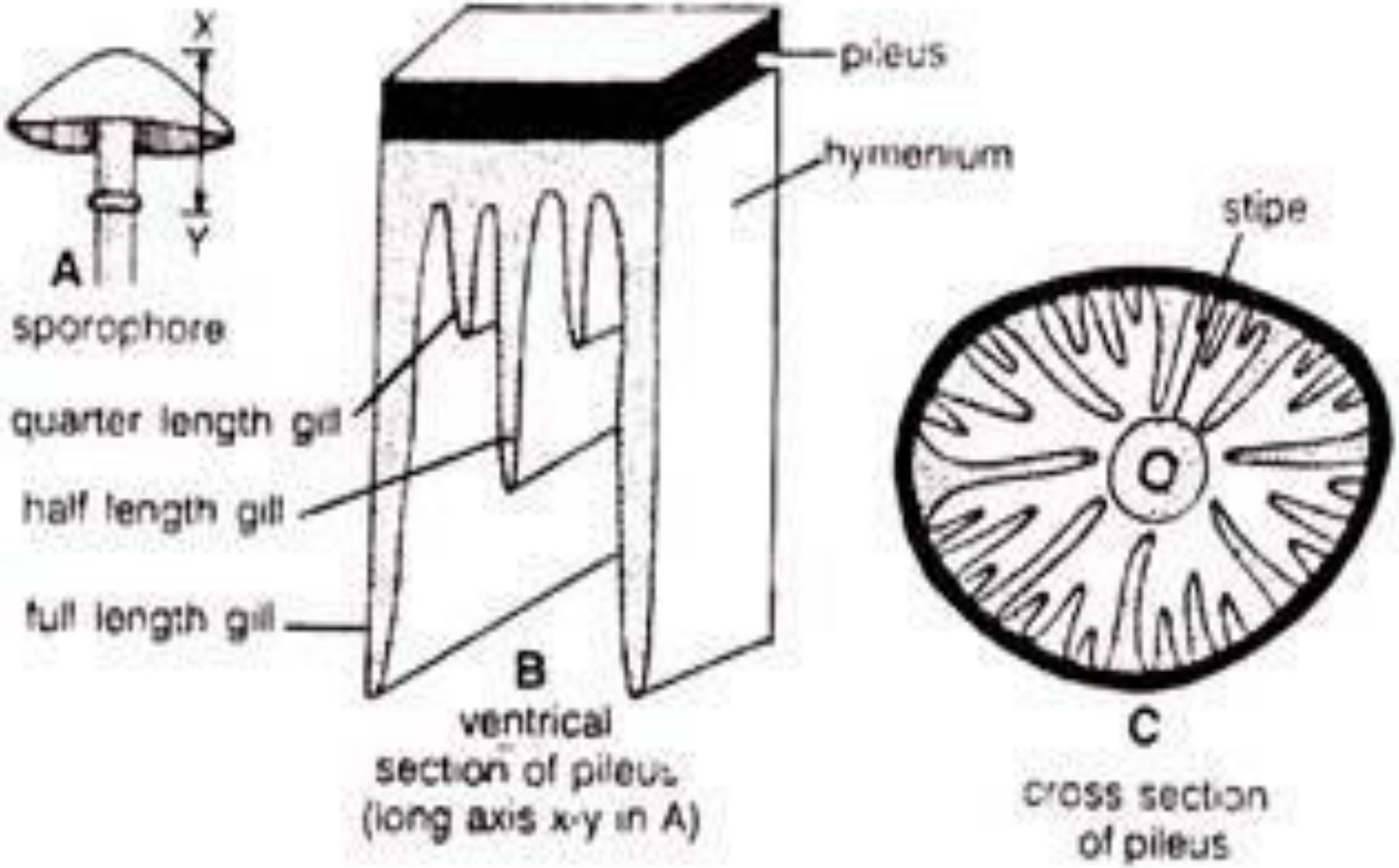
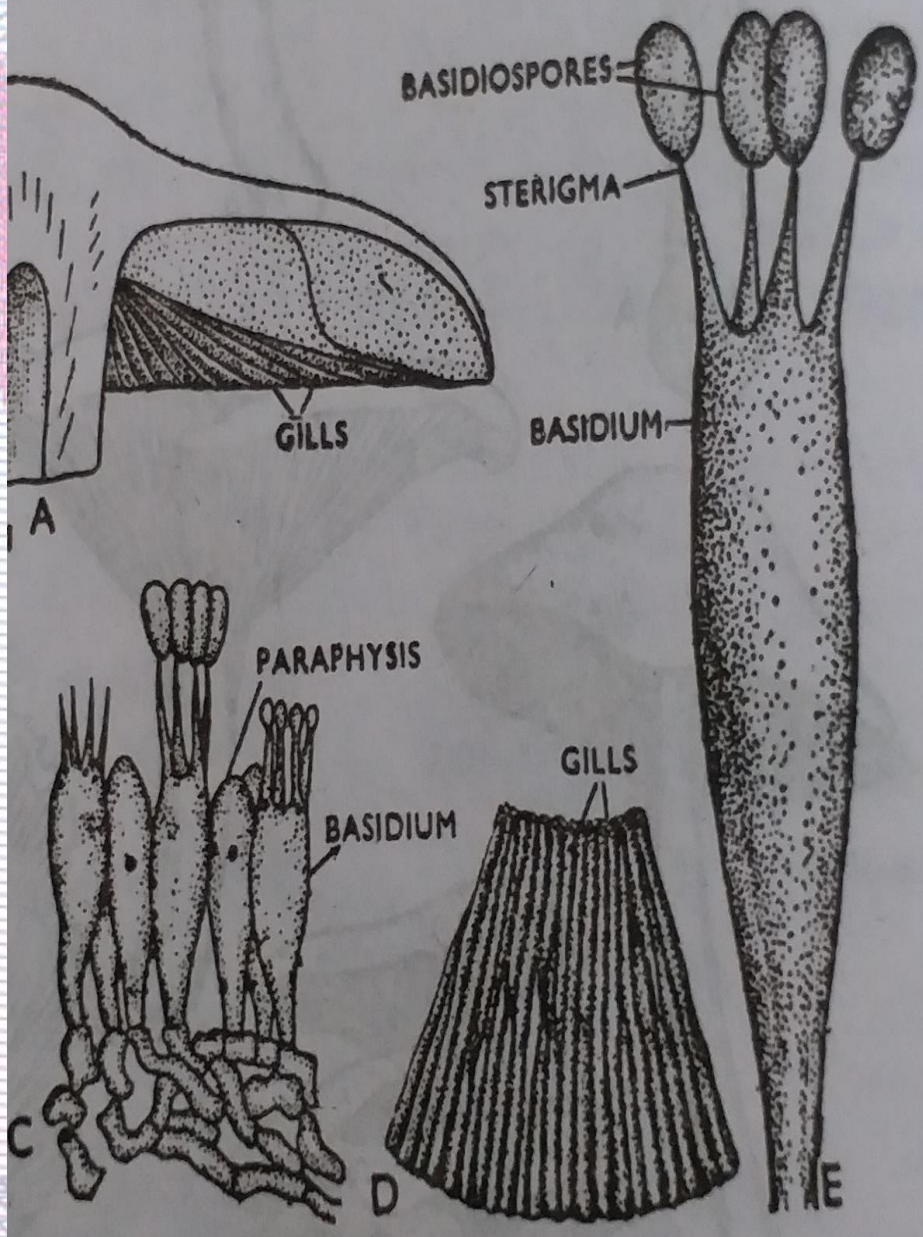


Fig. 4 (A–C). *Agaricus* : Pileus. (A, B). Vertical section of pileus; (C) Cross section of pileus

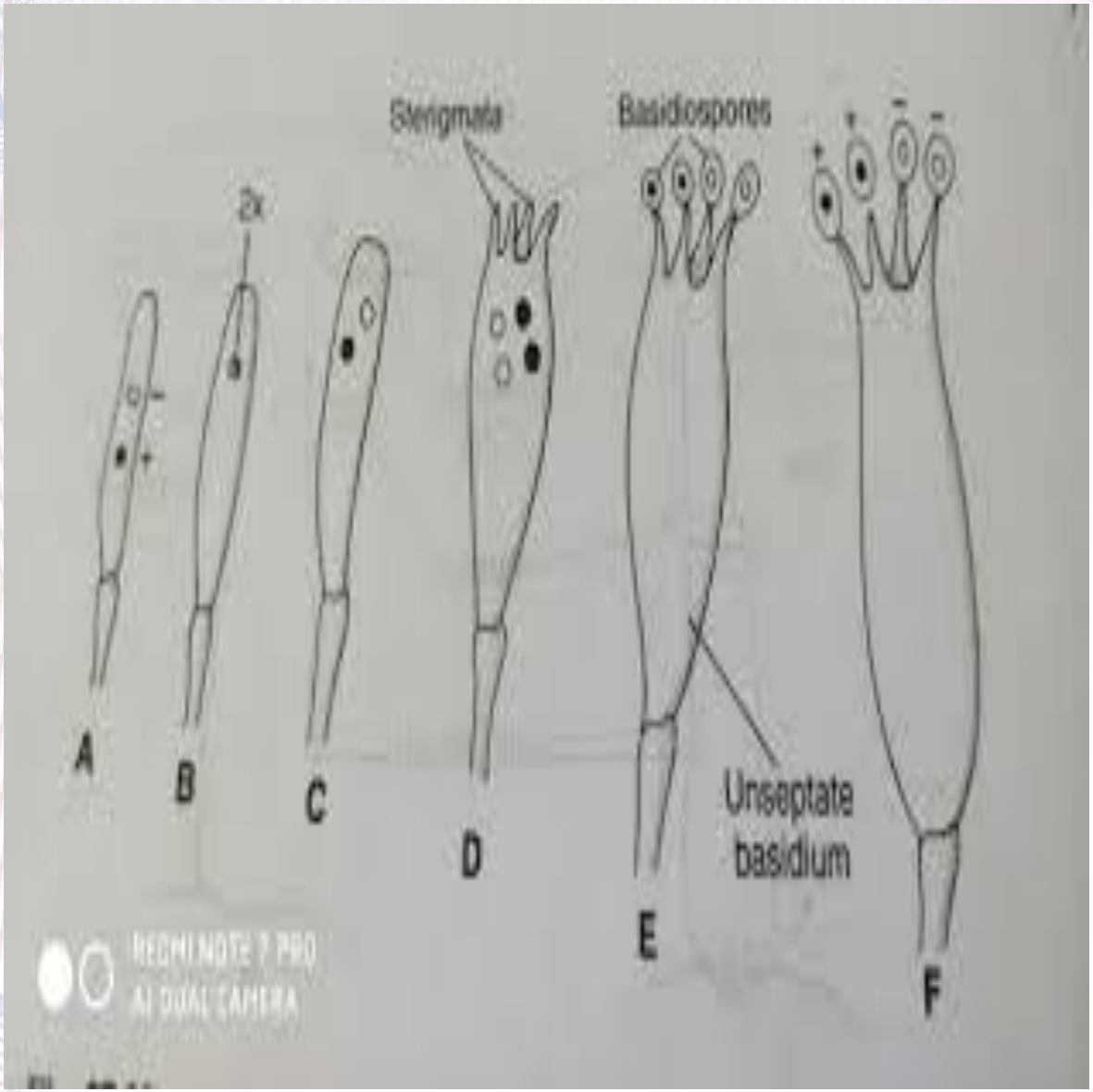
ndibuliform) with a pit or small depression at the nob protruding from the centre (**umbonate**); with the edge (**stristulate** or **striate**); and split at the scaly (**squamose** or **squamulose**). The pileus may



us of *Agaricus* sp. A. Sectional view of the gills. B. Structural . D. Gills in surface view. E. Basidium with sterigmata and basidiospores.

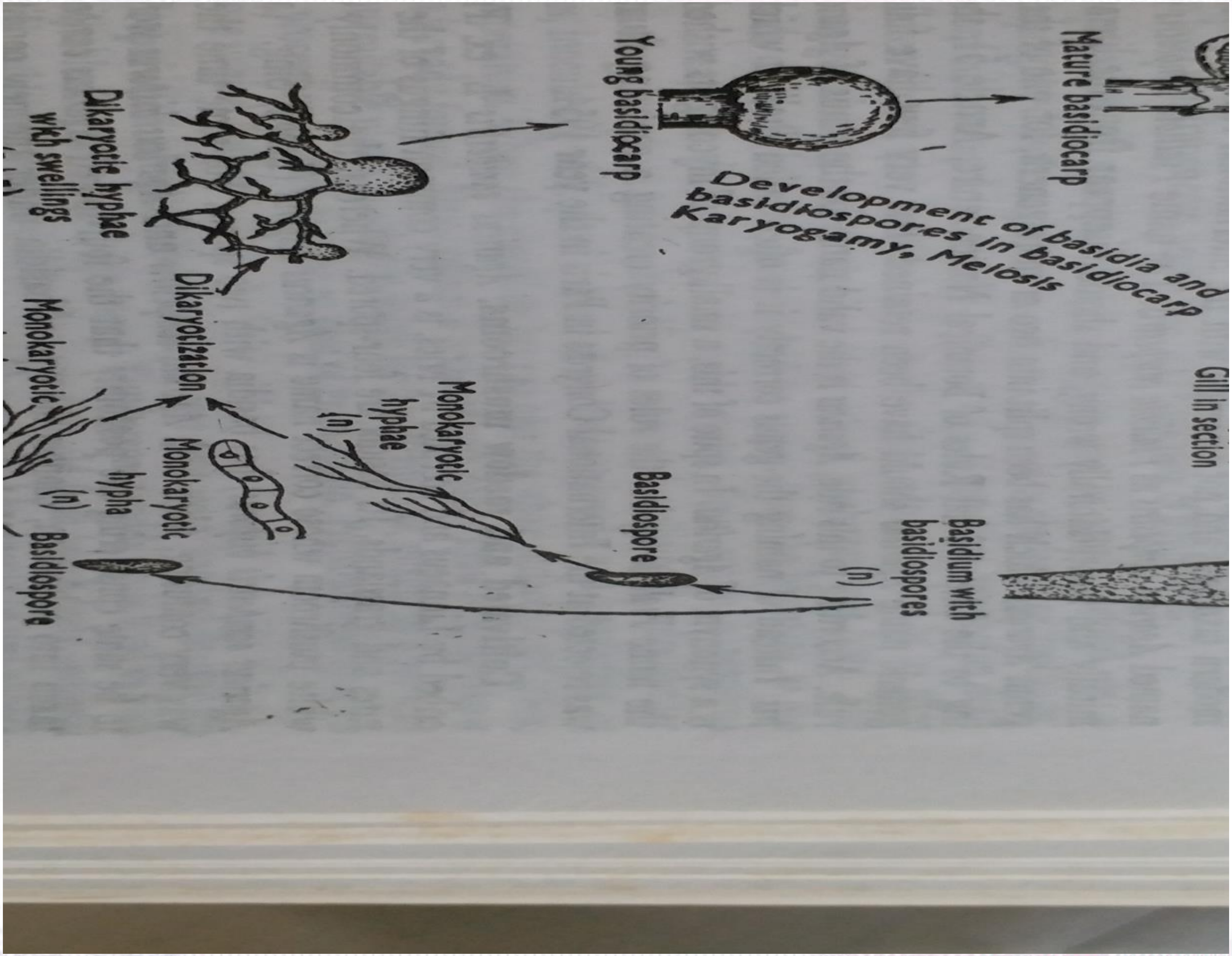
Development of Basidium

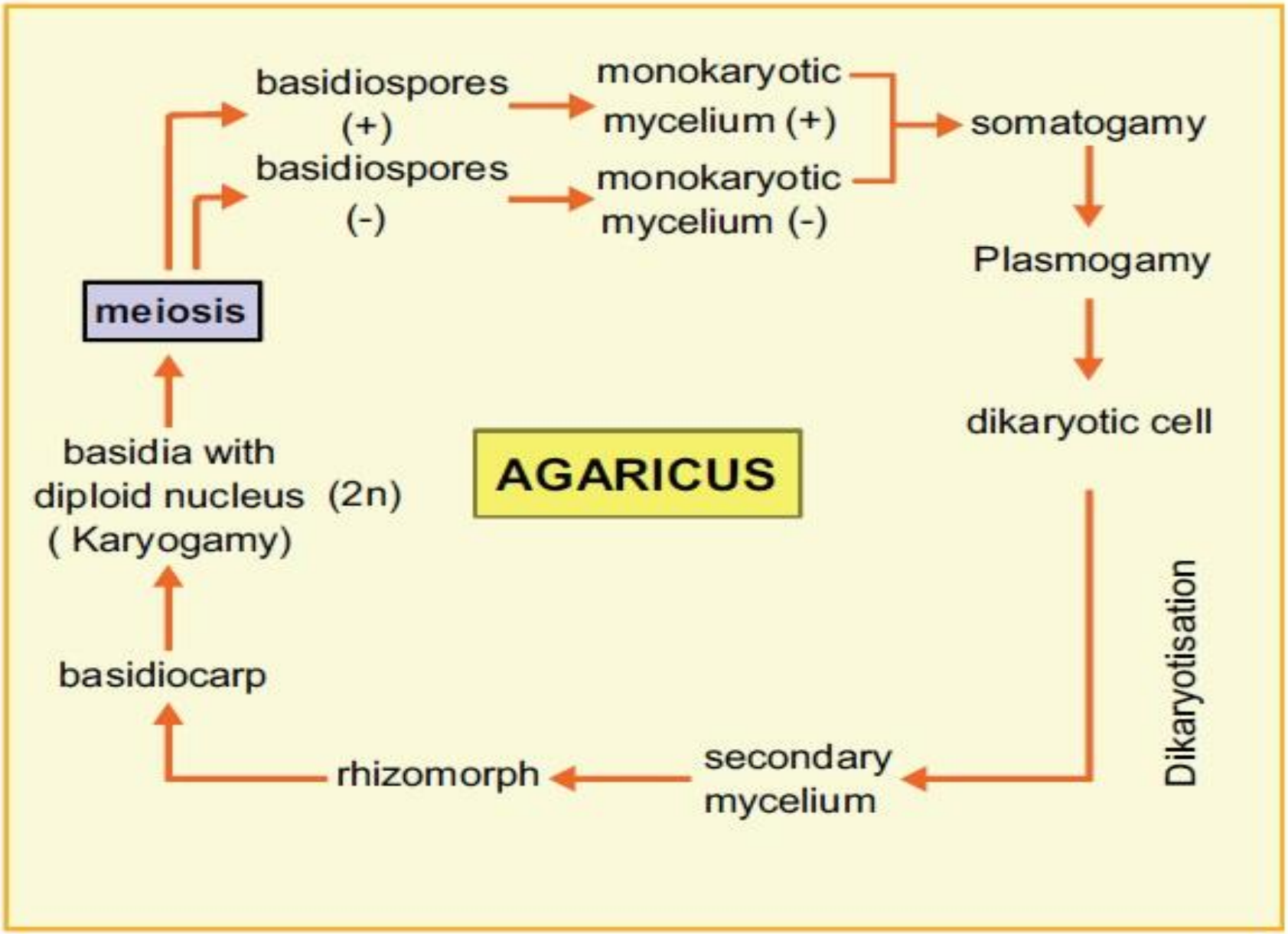
- The basidia are spore producing bodies. The young basidia arise from the terminal, bi-nucleate cells of the sub-hymenium layer (Fig. 7 B 1). As the basidium grows, the two nuclei of the dikaryon fuse to form the synkaryon (karyogamy, Fig. 7 B 2). The diploid nucleus soon undergoes meiosis to form four haploid nuclei (Fig. 7 B 3).
- Simultaneously, four narrow tube-like structures develop at the top of the basidium. These are called sterigmata (sing, sterigma). The sterigmata swell at their tips and each forms a small, single basidiospore by budding.
- A large vacuole develops in the basdium due to which the cytoplasm and nucleus (one in each) migrate into the budding basidiospore (Fig. 7 B 4-5). Thus, four haploid basidiospores are formed in a basidium. Out of the four basidiospores, two are of '+' strain and two are of '-' strain.



- The young basidiospore is un-pigmented but it develops brown or black pigments at maturity.In A. Bisporus two basidiospores are produced. The mature basidiospore is attached obliquely at the top of the sterigmata. It has minute projection at one side of its attachment called hilum or hilar appendix (Fig. 7B 6).

Life cycle of Agaricus




basidiospores (+)
basidiospores (-)
monokaryotic mycelium (+)
monokaryotic mycelium (-)
somatogamy
Plasmogamy
dikaryotic cell
Dikaryotisation
secondary mycelium
rhizomorph
basidiocarp
basidia with diploid nucleus (2n) (Karyogamy)
meiosis
AGARICUS

4.4.5 Reproduction in *Agaricus*

- **1. Vegetative Reproduction:**

It reproduces vegetatively by its perennating mycelium.

- **2. Asexual Reproduction:**

(a) Chlamydospores are produced which are lateral or intercalary in position. On germination, it gives rise to hyphae.

(b) Oidia may also be formed under certain conditions which are also known to have sexual function in the diplodisation.

- **3. Sexual Reproduction**:

The sexual reproduction is mainly somatogamous or pseudogamous. The sex organs are completely absent and their function has been taken over by the somatic hyphae which are heterothallic. However, a few species of Agaricus, like A. campestris and A. bisporus, are homothallic

- **(a) Plasmogamy:**

It is the first step in the sexual reproduction of Agaricus. The vegetative hyphae with uninucleate haploid cells from mycelia of opposite strains (heterothallic) or from the same mycelium (homothallic) come into contact and fuse. Each of such fusion results into a bi-nucleate (dikaryotic) cell. The dikaryotic cell, by successive divisions, gives rise to the bi-nucleate or dikaryotic mycelium. This dikaryotic mycelium is perennial and produces the characteristic fruiting body of the mushroom year after year.

- **(b) Karyogamy:**

This is the second step in sexual reproduction. This step is considerably delayed and takes place in the young basidium. In it the fusion of the two nuclei of dikaryon takes place.

- **(c) Meiosis:**

It is the third and last step in sexual reproduction. It takes place in basidium prior to basidiospores formation. Karyogamy is immediately followed by meiosis. Thus, the basidiospores, formed after meiosis, are haploid.

4.5 Utilization of Fungi

- 4.5.1 Industry
- 4.5.2 Agriculture
- 4.5.3 Pharmaceuticles

4.5.1 Utilization of Fungi in Industry:-

- Alcohol production
- Bread and Cake Production
- Chesse production
- Enzyme and Organic acid Production

4.5.2 Utilization of Fungi in Agriculture:-

- Soil fertility
- Plant Nutrition
- As insecticide

- Production of Plant hormone
- Biological control
- Benefits of Mycorrhizae
- Direct use as food

4.5.3 Utilization of Fungi as Pharmaceuticals

- Preparation of Medicine
- Antibiotics
- Vitamins
- Steroids
- Alkaloids
- Biological research
- Test Organism

- It reproduces vegetatively by its perennating mycelium.
- Chlamydospores and Oidia are asexual spores.
- The sexual reproduction is mainly somatogamous or pseudogamous.
- The mature fruiting body can be differentiated into three parts i.e., stipe, pileus and annulus.
- Stipe is basal part of the basidiocarp and the stipe at the top supports a broad umbrella shaped cap called pileus.
- Utilization of Fungi in Industry for Alcohol production,Bread and Cake Production,Chesse production and in Enzyme and Organic acid Production.
- Utilization of Fungi in Agriculture to increase Soil fertility, as Plant Nutrition, used as insecticide, in production of Plant hormone, as biological control,benefits of Mycorrhizaeand direct use as food.
- Utilization of Fungi in Pharmaceuticals for preparation of Medicine,Antibiotics,Vitamins,Steroids,Alkaloids, in biological research and used as test Organism

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