

THE FUNDAMENTALS OF FUNGI



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ORGANISM CLASIFICATION

1. Plantae:

Seed plants, “paku-pakuan”, moss

2. Animalia:

vertebrata & invertebrata

3. Protista (procaryotic):

ricketsia, bacteria, virus

(eucaryotic):

algae, fungi, protozoa

Algae : chlorophyl +
autotrophic

- Fungi : chlorophyl -
heterotrophic
parasite, saprophyte

Mycology → Mycetes

myces = fungi

FUNGI / MUSHROOM

*MACROFUNGI/ MACROMYCETES

- mushroom

*MICROFUNGI/ MICROMYCETES

- yeast

- mould

Growth & developed on skin, hair, nail, mucous membrane, tissue → animal + human

As an agent of caused to infection → mycosis

It was produced of toxic metabolite →

Mycotoxicosis → Poison symptomatically

Purpose of classifications

FUNGI

A. Schizomycetes

- a. Actinomyces (anaerobe)
- b. Nocardia (aerobe)

} Pseudomycetes
(false fungi)

B. Mycomycetes (mucous fungus)

C. Eumycetes (true fungi)

1. Phycomycetes (Zygomycetes & Oomycetes)

hyphae non septate

*2. Ascomycetes

*3. Basidiomycetes

*4. Deuteromycetes (fungi imperfecti)

asexual spore, sexual spore ?

Pathogenic generally

* hyphae septate

MORPHOLOGY :

Difference with plant :

- chlorophyll –
- the composition of the cell wall was different (chitin, glucan, cellulose, mannan)
- developed by spore
- trunk, branch, root, & leaves –
- function sharing of each part –

Fungi micro organism chemoheterotroph

Nutrition Sources :

- Carbon from organic materials
- Nitrogen - organic (pepton)
 - an organic (ammonium & nitrate)
- Mineral (P, K, Mg) → macro element
 - Fe, Zn, Cu, Mn, Mo → micro elementfrom substrate
- Vitamin synthesis on their bioactivities / not → from substrate
 - ex/ thiamine & biotin
- Water

Physical / Area Condition

1. Aeration :

Kapang → aerob

Khamir → aerob & facult. anaerobe

anaerobe → lab

CO₂ → inhibit of growth

some fungi dimorphic → morphogenesis and performing :

macroconidia → Trichophyton

blastoconidia → Histoplasma capsulatum

2. Light

as a chemoheterotroph →

without light still growth

- influence Spore perform
(asexual & sexual)

3. Temperature

optimum 25-30°C

psicrophilic mesophilic thermophilic

4. pH

“Kapang” was optimum developed on acid pH →
pH 6-6,8 ; approximately at ranging : pH 2-8,5

Khamir was developed at pH 4-4,5

5. water activity (a_w)

Kapang < khamir < bacteria

The Fungi was distinction on 2 groups :

KHAMIR

- Mono/ unicellular
- Pseudohyphae / not
- Aerob / anaerobe
- The colony was pasta performed

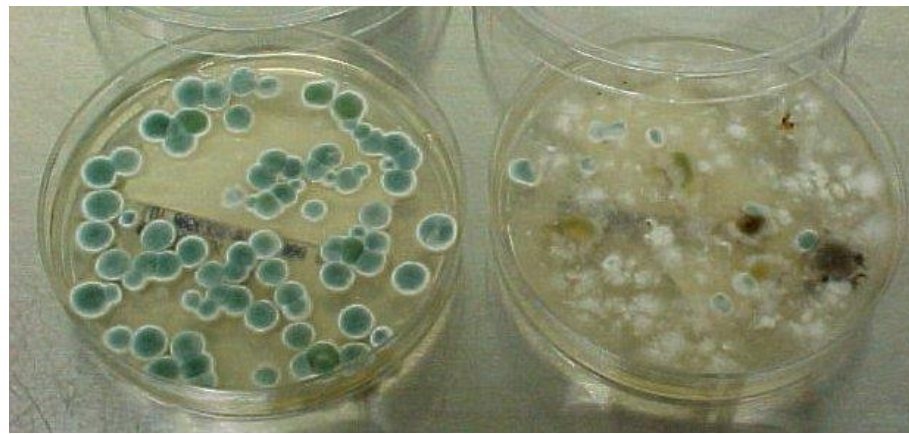
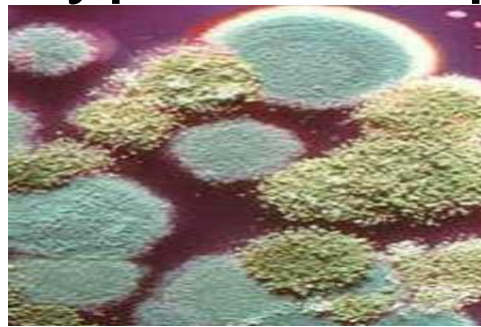
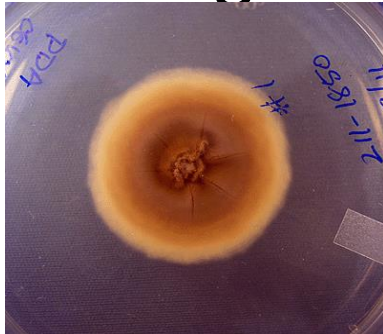
KAPANG

- Multicellular
- Hyphae septate / not
- Aerob
- Cotton form / fibre
- Rhizoid / not
place of rhizoid

KAPANG

MORPHOLOGY

Micellium + → easy to be seen
the growing white (at first) → color
according to the types of Kapang



REPRODUCTION SYSTEM

Asexual/vegetative : fission, budding,
production of spore

Sexual/generative : fusion of 2 nucleic

SPORE

ASEXUAL

- Sporangiospore
- conidiospore
- Arthrospore/oidospore
- Klamidospore

SEXUAL

- Ascospore
- Basidiospore
- Zygospor
- Oospore

PHYSIOLOGY

- Water necessity (a_w) to grow:
kapang < khamir < bacteria
- Temperature: mesophilic → optimum 25°C - 30°C
- Oxygen necessity & pH
aerobic, pH 2,0 – 8,5 → good acid pH
- Nutrition: simple to complex
amylase, pectinase, proteinase, & lipase
enzyme production
- Component inhibit: antibiotic
Its to be slowest to growth, but already fast to growth if the inhibit component not active

The lucky “KAPANG”

- *Aspergillus oryzae*: tape, soy sauce, tauco
- *Aspergillus niger*: cytric acid, gluconat acid, amylase enzyme
- *Aspergillus wentii*: pectinase enzyme
- *Auricularia polytricha*: kuping mushroom
- *Mucor rouxii*: saccarification process → pati
- *Neurospora sitophila*: red oncom
- *Penicillium notatum*: penicillin
- *P. camemberti*, *P. roqueforti*: cheese fragrant
- *Rhizopus oryzae*, *R. oligosporus*: tempe, black oncom
- *Volvariella volvacea*: merang mushroom

The unfortunately of KAPANG

- *Actinomyces israelii*: Actinomycosis (teeth & tonsil)
- *Aspergillus niger*: Otomycosis (tr. ear)
 - *A. flavus*: Aflatoxin
 - *A. fumigatus*: Aspergillosis (human & animal lung)
- *Blastomyces dermatitidis*, *B. brasiliensis*: Blastomycosis
- *Candida albicans*: Candidiasis (tr. Respiratorius,
• tr. digestivus, tractus genitalia)
- *Coccidioides immitis*: Coccidioidomycosis
- *Cryptococcus neoformans*: Cryptococcosis
- *Histoplasma capsulatum*: Histoplasmosis
- *Mucor mucedo*: Food damaging
- *Nocardia asteroides*: Nocardiosis (human lung)
- *Trichopyton mentagrophytus*: Tinea pedis (foot jaro)

MICOTOXIN

- *Aflatoxin (*A.flavus*): peas, corn, cereal
- *Emlanditoxin (*Penicillium islandicum*): rice
- *Patulin (*A.clavatus*): apple & apple products
- *Sterigmatosistin (*A.versicolor, A.flavus*):
milk, grain, coffee, cheese
- *Tricotesen (*Fusarium tricinchum*): corn, cereal

Toxin → Symptom illness

sometimes - fatal

- carcinogenic

- hallucinogenic

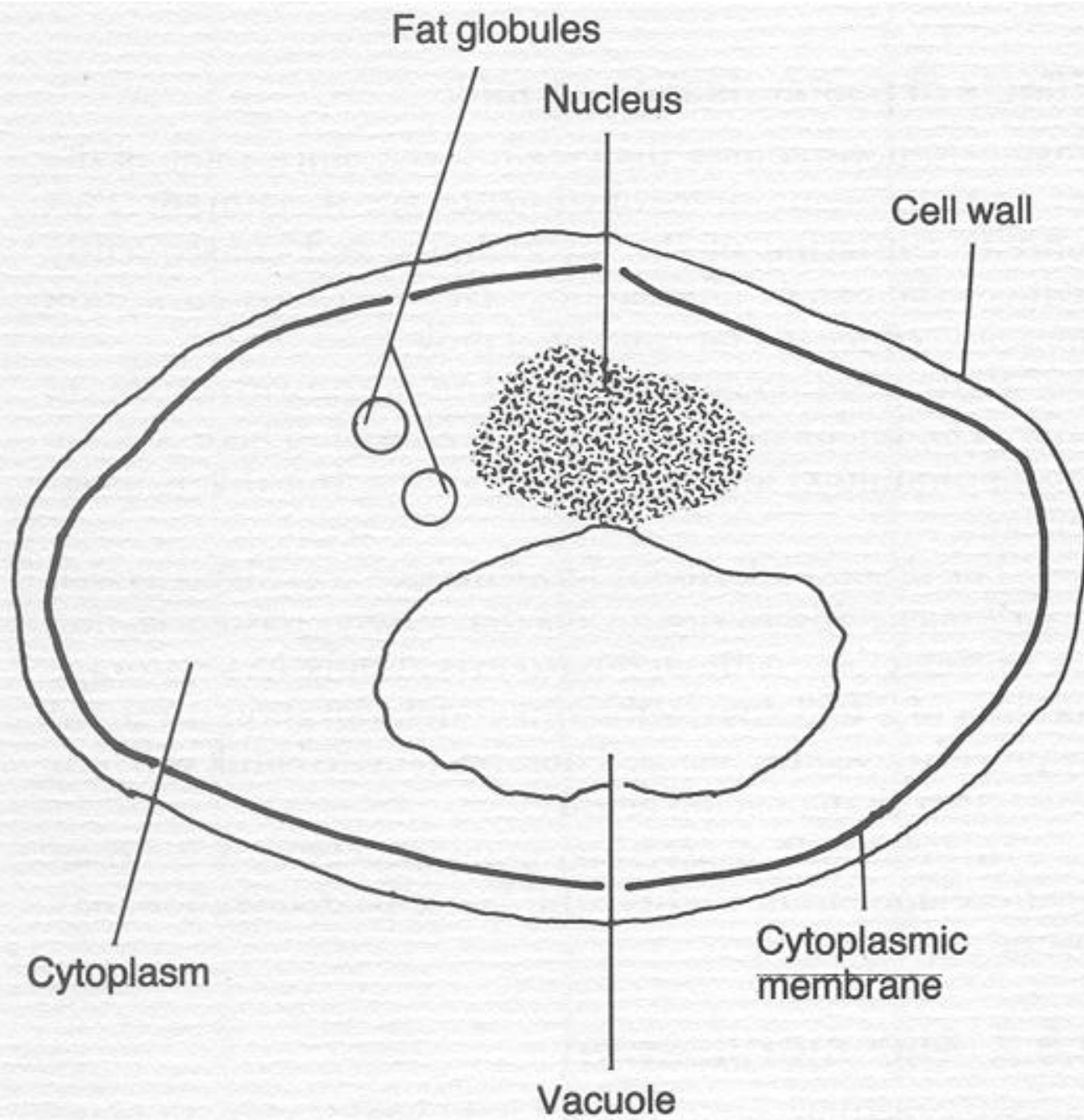
KHAMIR

MORPHOLOGY

- Macroscopic: like-bacteria colony
- Size at ranging : length 1-5 μm \rightarrow to 20-50 μm
wide 1-10 μm
- Types of perform: circle, oval, cylinder, triangular, bottle, lemon, pseudohiphae, etc.
- Cell formation: pseudohiphae/not

CYTOLOGY

Microstructure consists of capsule, cell wall bane, cytoplasm membrane, nucleus, vacuole, mitochondria, globule lipid, volutin/poliphosphat & cytoplasm



1. CAPSULE

- Had by several khamir
- Extra cellular component, mucous, cover up the outer part of cell wall bane
- Polysaccharide and heteropolysacharide
- Hydrophobic

2. CELL WALL BANE

Thin layer at immature cell → at mature cell to be thicker
generation time 1-6 hours

- glucan/Cellulose 3-35%
- mannan 0-30%
- protein 6-8%
- variated chitin 0-2%
- lipid < 8-13,5%

3. CITOPLASMA MEMBRANE

- \pm 8 μm thick
- Consists of protein, ribonucleic acid & lipid
- Nutrition transport & dismissal of metabolism product to outside

4. NUCLEUS

- Surround by nucleus membrane (porous)
- At fission/budding \rightarrow chromosome divided to 2

5. VACUOLA

- Pocket contains translucent & aqueous fluid
- \geq 1, size various

6. MITOCHONDRIA

- P 0,4-0,6 um diameter 0,2-0,3 um
- Respiration process

7. GLOBULA LIPID

- Amount and various size

8. SITOPLASMA

- Contains glycogen
- Ribonucleic acid & protein (esp. in ribosome)

REPRODUCTION SYSTEM

Some ways : 1. budding

2. fission

3. bud fission

4. sporulation →

- asexual spore

- sexual spore called generative

reproduction

} vegetative reproduction

1. Cell budding

duct formed from vacuole near nucleus → cell wall bane.

cell wall bane thinning → protoplasm protruding goes out, and bigger (component is nucleus + cytoplasm) → growth forming with new cells

if size is almost = with the host → goes separated or stay sticking & forming new bud

Categories of budding:

- Multilateral: bud appear surround the tip of the cell at cylinder & oval formed cell
- At all cell surface → circle formed cell
- Polar: just at one tip & Bipolar: at two tips lemon formed cell
- Trigonopsis: bud at three tips of the cell (triangular form)
- Pseudomicelium: if the bud don't liberated from its mother and continue budding

2. Cell fission

firstly, '*bengkak/memanjang*' → nucleus separated into 2 → septa formed (2 layer) → separated or formed into chain like mycelium

3. bud fission

firstly, bud formed (where it sticks >) → septa is formed → separated

4. Production of asexual spore:

arthrospore, blastospore, and klamidospore

5. Production of sexual spore:

basidiospore and ascospore

PHYSIOLOGY CHARACTERISTICS

- Grow well in enough water condition
- Grow in medium with intense sugar or salt
- a_w 0,88-0,94 (osmophylic 0,62-0,65)
 A_w rice & cereal < 14%
- Optimal temperature 25°C – 30°C, max. temperature 35°C – 47°C some can grow at 0°C
- pH 4,0 – 4,5

CLASSIFICATION & IDENTIFICATION

- a. Morphology characteristics
 1. vegetative reproduction
 2. vegetative cell form, size, colour
- b. Culture characteristics:
growing characteristics in liquid media, dense media
- c. Physiology characteristics
- d. Sexual reproduction

Khamir differ to 3 main classes:

- Ascomycetes class: spore grow inside ascus
- Basidiomycetes class: spore formed inside basidium
- Deuteromycetes class: not produce sexual spore → called **Fungi Imperfecti**

THE USAGE OF KHAMIR IN INDUSTRY

Sacharomyces, Hansenula, Candida on making tape, brem

Sach. Cerevisiae on making bread, beer, and wine

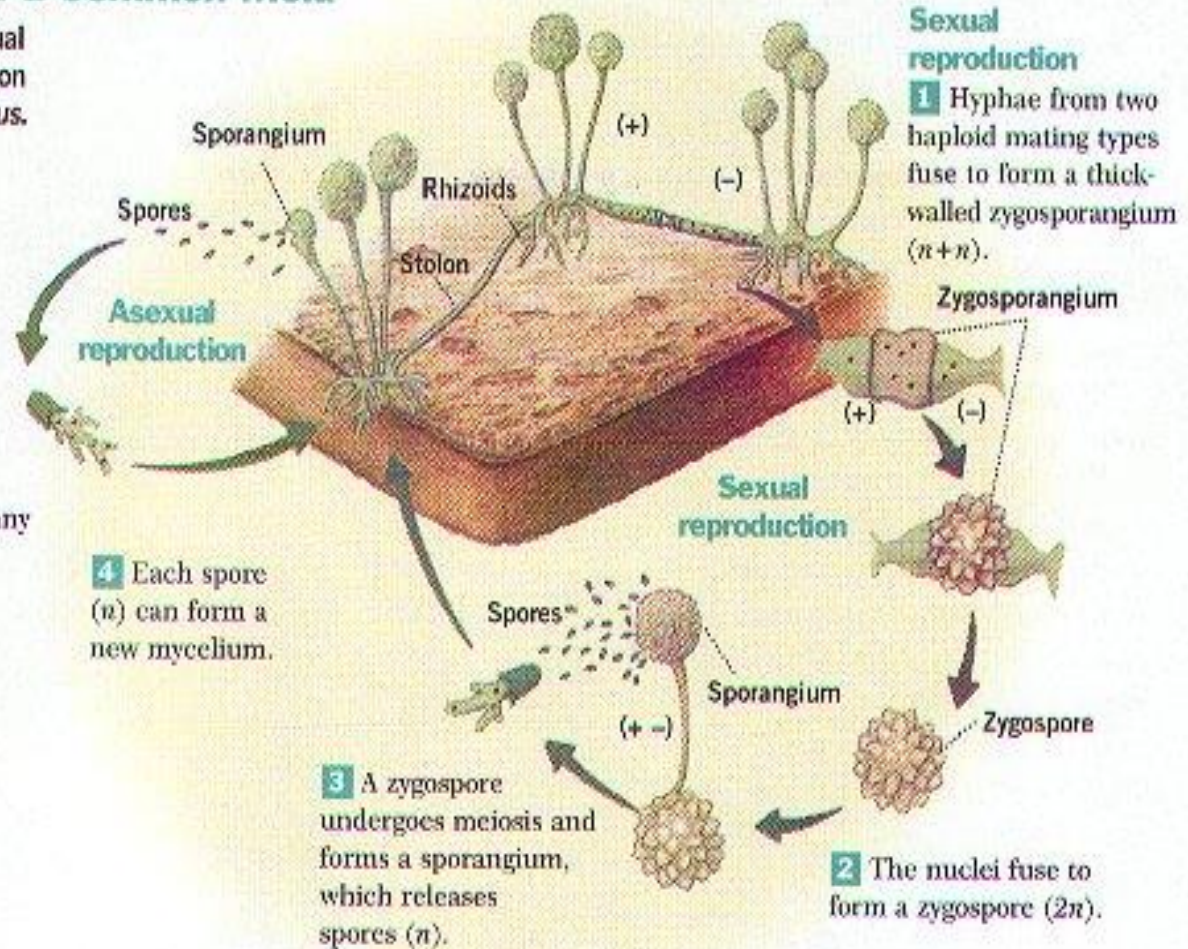
- Dimorphic Fungi:
fungi which has 2 phase that seen if grown
at different temperature
 - a. khamir phase at 37°C
 - b. kapang phase at 24-28°Cex/ *Sporothrix schenckii*
Histoplasma capsulatum
Blastomyces dermatitidis
Coccidioides immitis

The Life Cycle of a Common Mold

Compare sexual and asexual reproduction in the common bread mold called *Rhizopus*. How do they differ?

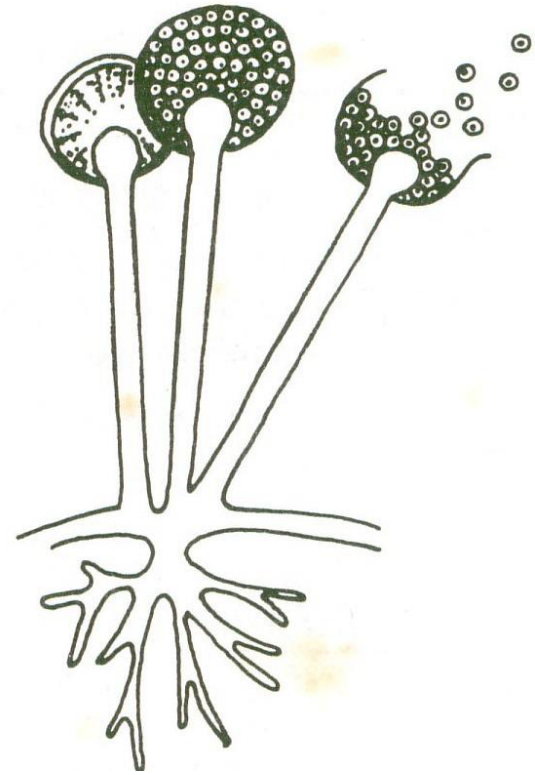
Haploid (n)
Diploid ($2n$)

Asexual reproduction
Upright hyphae develop sporangia, from which many spores (n) are dispersed.



1. Sporangiospore

- Spore formed because cell protoplasm divide itself, formed small groups in sporangium pocket that placed on the tip of sporangiophore on hyphae has non septate.
- Ex/ *Rhizopus sp.*
Mucor sp.

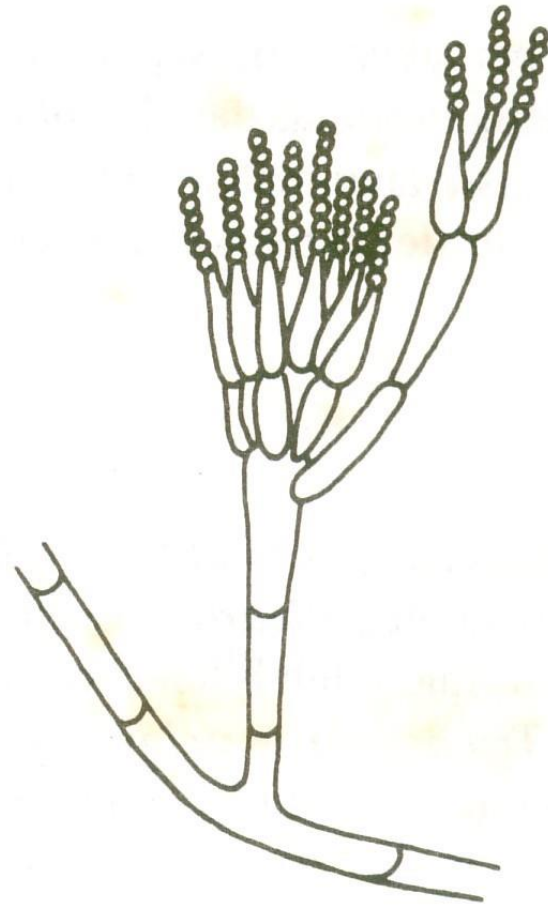


2. CONIDIOSPORE

- Spore formed because the tips of hyphae split.
- Conidia formed at the tip of hyphae.
- Pillar hyphae called Conidiophore.

Ex/ *Penicillium* sp.

Aspergillus sp.



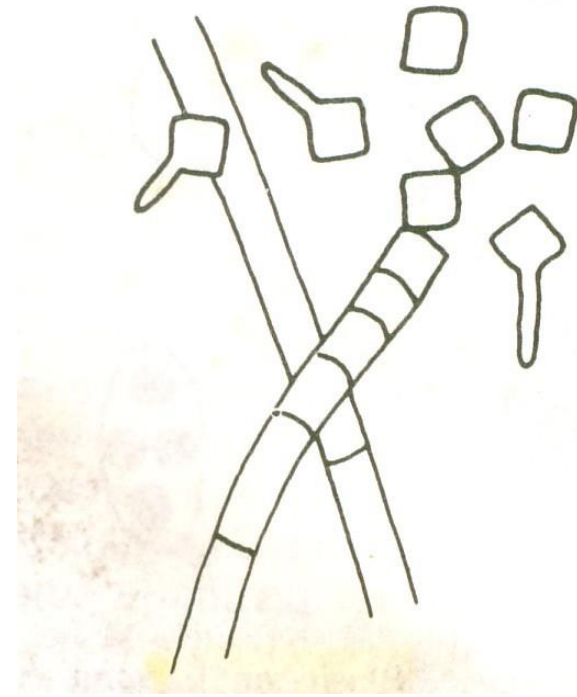
3. ARTHROSPORE

- Spore formed because a part of hyphae is broken & the wall thicken but not expand.

ex/ *Geotrichum*

Coccidioides

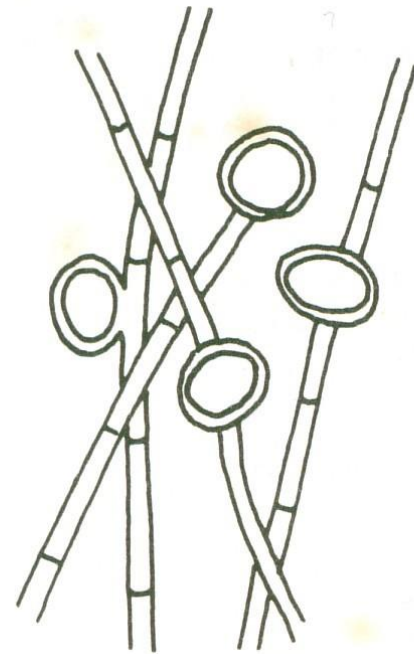
Trichosporon



4. CLAMIDOSPORE

- Spore formed because part of hyphae expand & create thick wall.
- Rest phase
- Many found at old hyphae.

ex/ *Candida albicans*
Epidermophyton

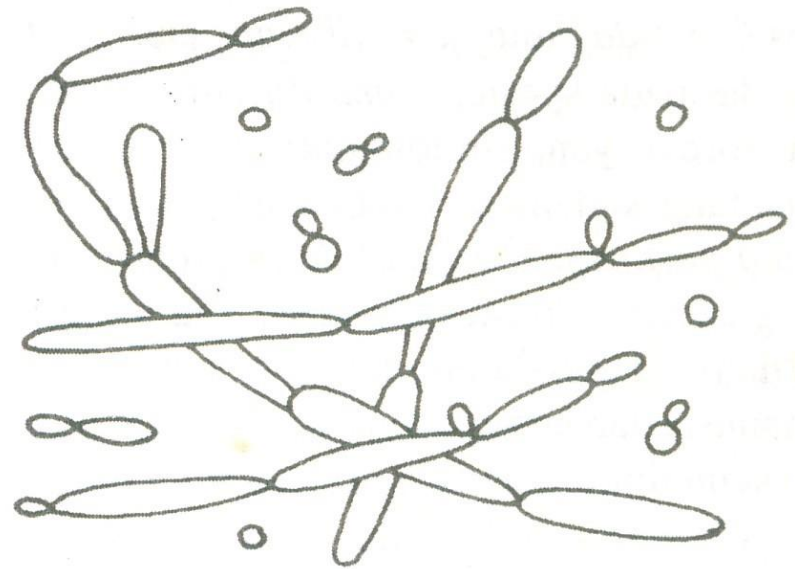


5. BLASTOSPORE

- Spore which created from budding on yeast cell & the bud not liberated from its mother

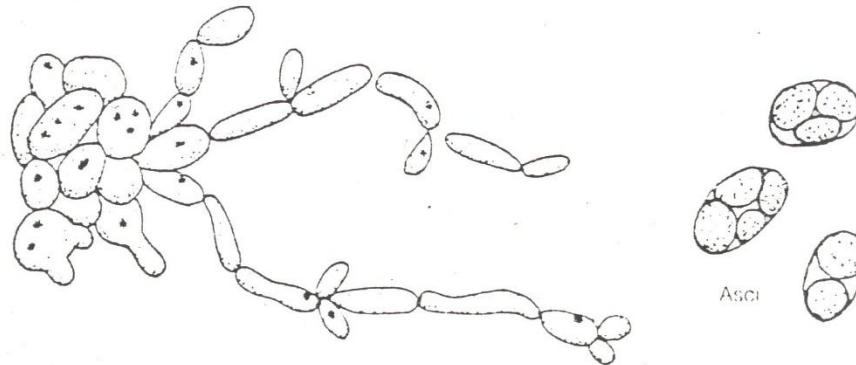
ex/ *Rhodotorula* sp.

Blastomyces dermatitidis



1. ASCOSPORE

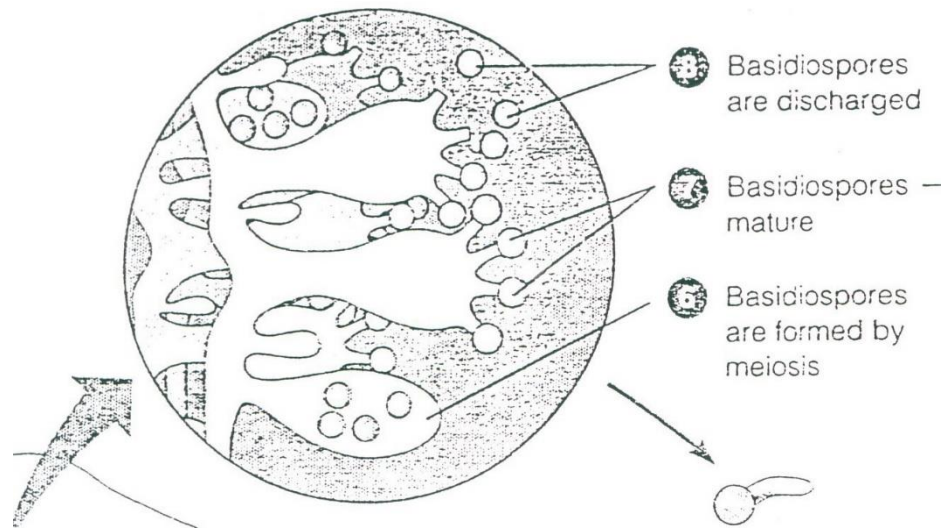
- One-cell spore formed inside a pocket called ascus
ex/ Saccharomyces



2. BASIDIOSPORE

- Spore produced by basidia. Basidium exist on the tip of hyphae expanding that formed like vase/club

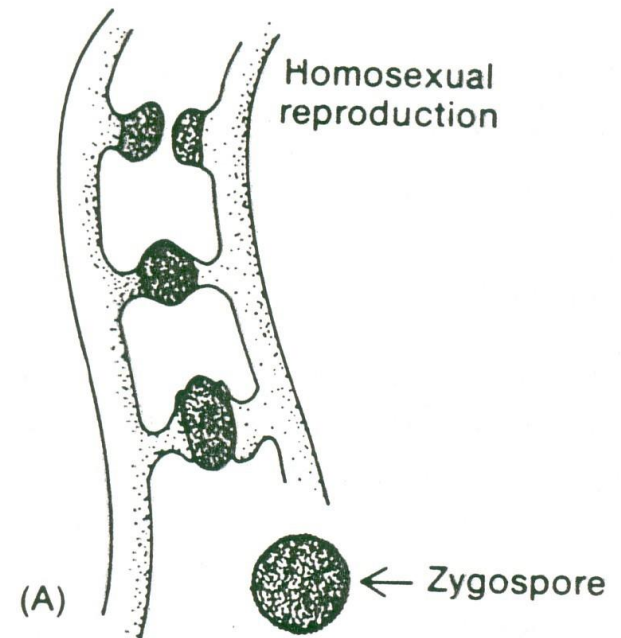
ex/ Cryptococcus neoformans



3. ZYGOSPORE

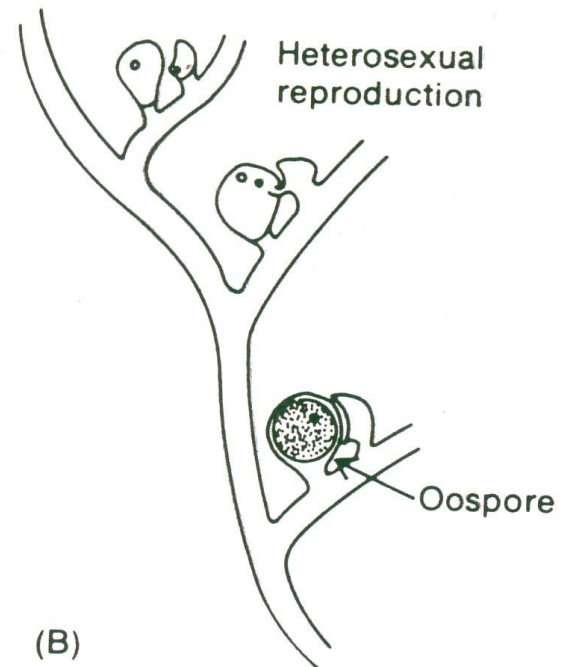
- Big thick-walled spore that formed if the tip of two swollen hyphae (gametangia) fuse (merged)

ex/ Rhizopus
Mucor



4. OOSPORE

- Spore that formed inside oogonium because female gamet (oospher) fertilized by male gamet (antheredium) → oospore
- Inside each oogonium exist ≥ 1 oospher



**GOODLUCK TO
LEARN**

**SUCCESSFUL
HOPEFULLY**