AZERBAIJAN MEDICAL UNIVERSITY
DEPARTMENT OF MEDICAL MICROBIOLOGY and IMMUNOLOGY

Lesson 6.

Classification, morphology and ultrastructure of fungi

FACULTY: General Medicine
SUBJECT: Medical microbiology - 1

DISCUSSED QUESTIONS:

- Structural features of eukaryotic cells.

- Classification of fungi
- Primitive and higher fungi
- Perfect and imperfect fungi
- Morphology, ultrastructure of fungi.
- Mycelial, yeast, yeast-like, dimorphic fungi.
- Reproductive characteristics of fungi: sexual and asexual reproduction.
- Pathogenic fungi of the types *Zygomycota, Ascomycota, Basidiomycota* and *Deuteromycota*.
- The examination methods of fungi morphology.

PURPOSE OF THE LESSON:

- To inform students about fungi that are eukaryotic microorganisms, to acquaint them with the classification, morphology and structural features of fungi.

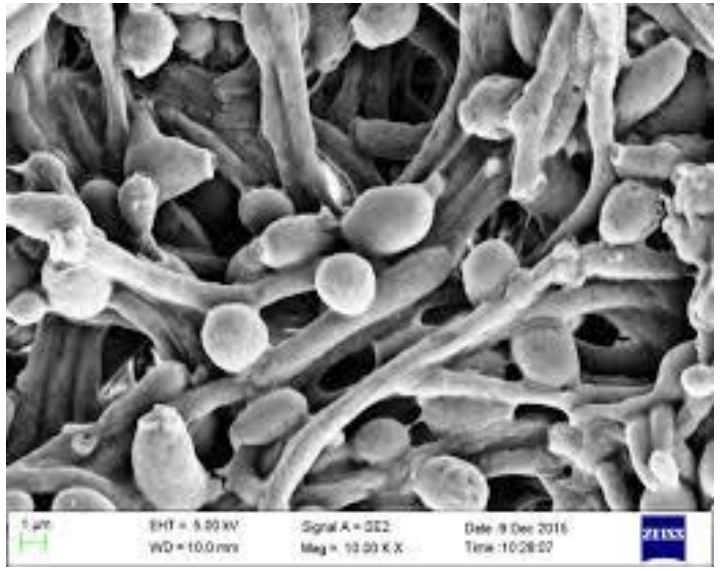
Fungi (Fungi, Mycetes, Mycota) **are plant-based, chlorophyll-free, single- or multi-celled eukaryotic organisms**

The branch of microbiology that studies fungi is called mycology

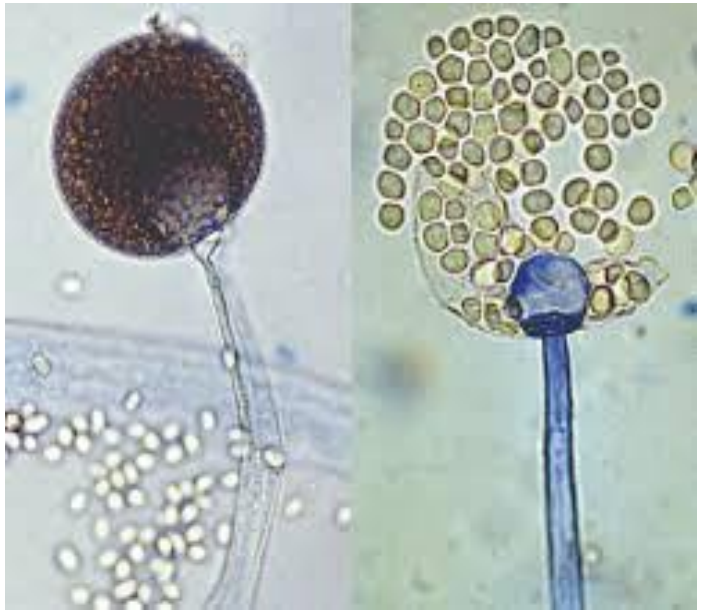
There are pathogenic and non-pathogenic types of fungi

MORPHOLOGY OF FUNGI

- Mycelial or filamentous fungi
- Yeasts and yeast-like fungi



Candida species



Mucor (mycelial)

Mycelial or filamentous fungi

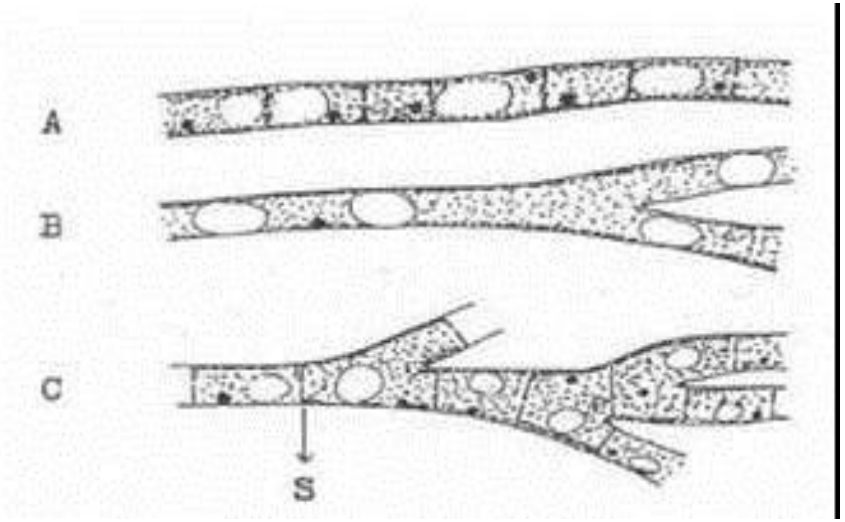
They are composed from long filamentous cells of hyphae.

Hyphae branch out to form mycelium.

Mycelium may be septate or aseptate.

In primitive fungi, mycelium is aseptate.

In most fungi, hyphae are divided into cells by internal cross-walls called "septa“

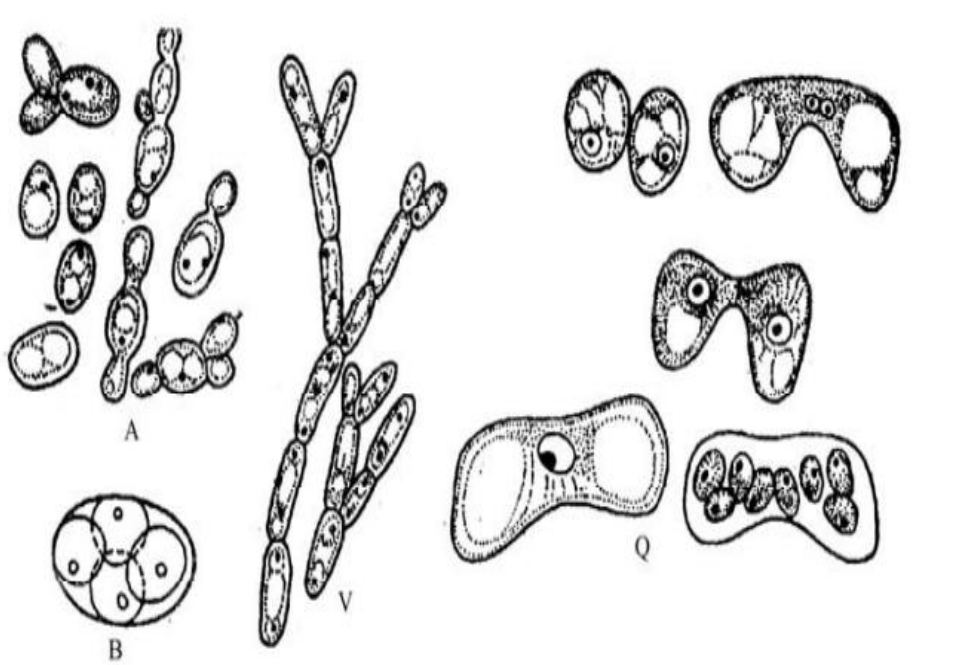


Substrate or vegetative mycelium that grows on and into the culture medium and, as the colony matures

The portion of mycelium that grows upward or outward from the surface of the substrate is called the aerial mycelium or the reproductive mycelium

Yeasts fungi (Saccharomycetes)

- True yeasts are round, oval or rod-shaped single-celled fungi. Fungi reproduce both sexually and asexually
- Asexual reproduction occurs through budding.
- Yeast fungi also reproduce by forming ascospores. At this time, 2,4,8 ascospores, etc. are formed inside the sac that called the ascus
- An ascospore is a spore contained in an ascus or that was produced inside an ascus
- Yeast fungi are widely used in baking, dairy production, etc.



***Şəkil 31. Maya göbələkləri**: A – tumurcuqlanan hüceyrələr; B– Saccharomyces cerevisiae kisəsi; V – psevdomitseli; Q – S. octosporada cinsi proses.*

YEAST-LIKE FUNGI

- They are morphologically similar to real yeasts.
- They are single-celled, round or oval-shaped fungi reproduce through budding
- Sometimes the buds grow longitudinally without leaving the mother cell and form derivatives called pseudomycelium. For example, Candida fungi.

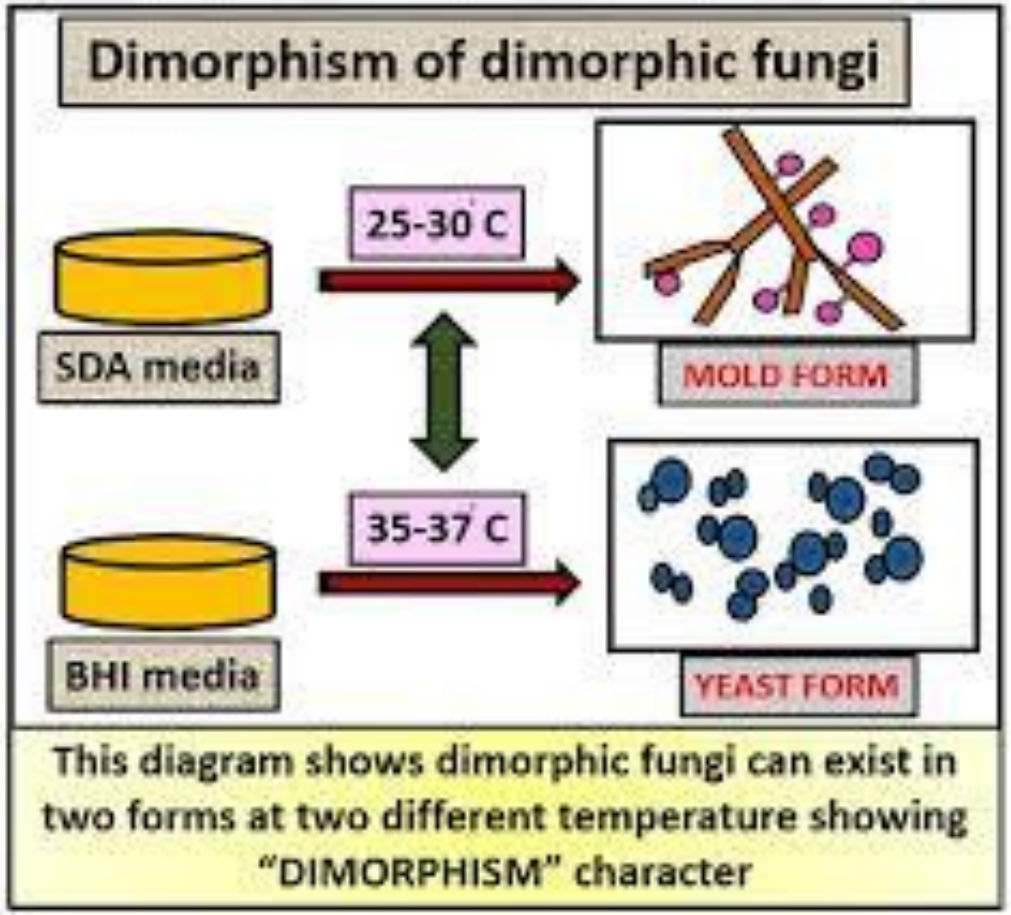
Candida cinsli göbələklər

DIMORPHISM OF FUNGI

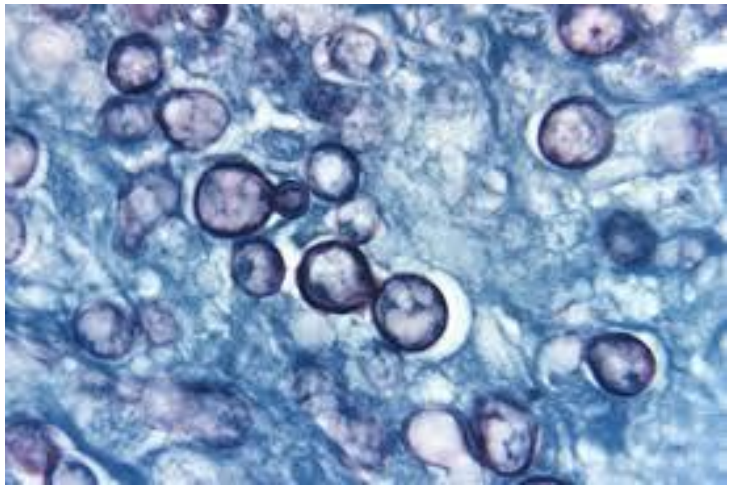
Dimorphic fungi are fungi that have a yeast (or yeast-like) phase and a mold (filamentous) phase

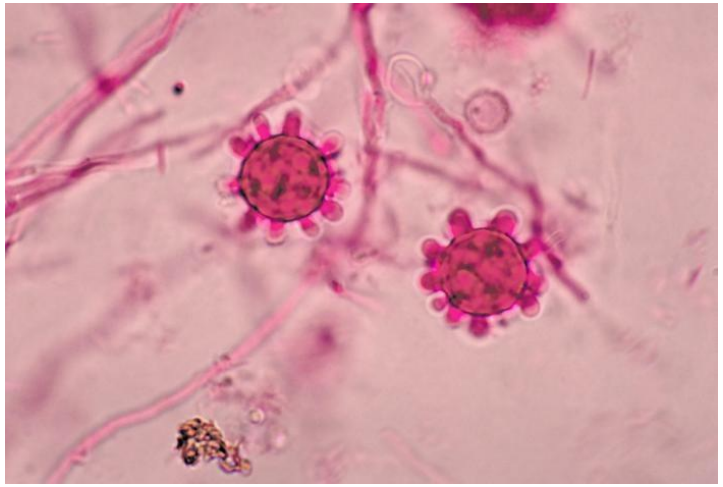
Mold form typically exist in the environment and nutrient media and yeast-like form in the human body

Most causative agents of subcutaneous and systemic mycoses have dimorphism

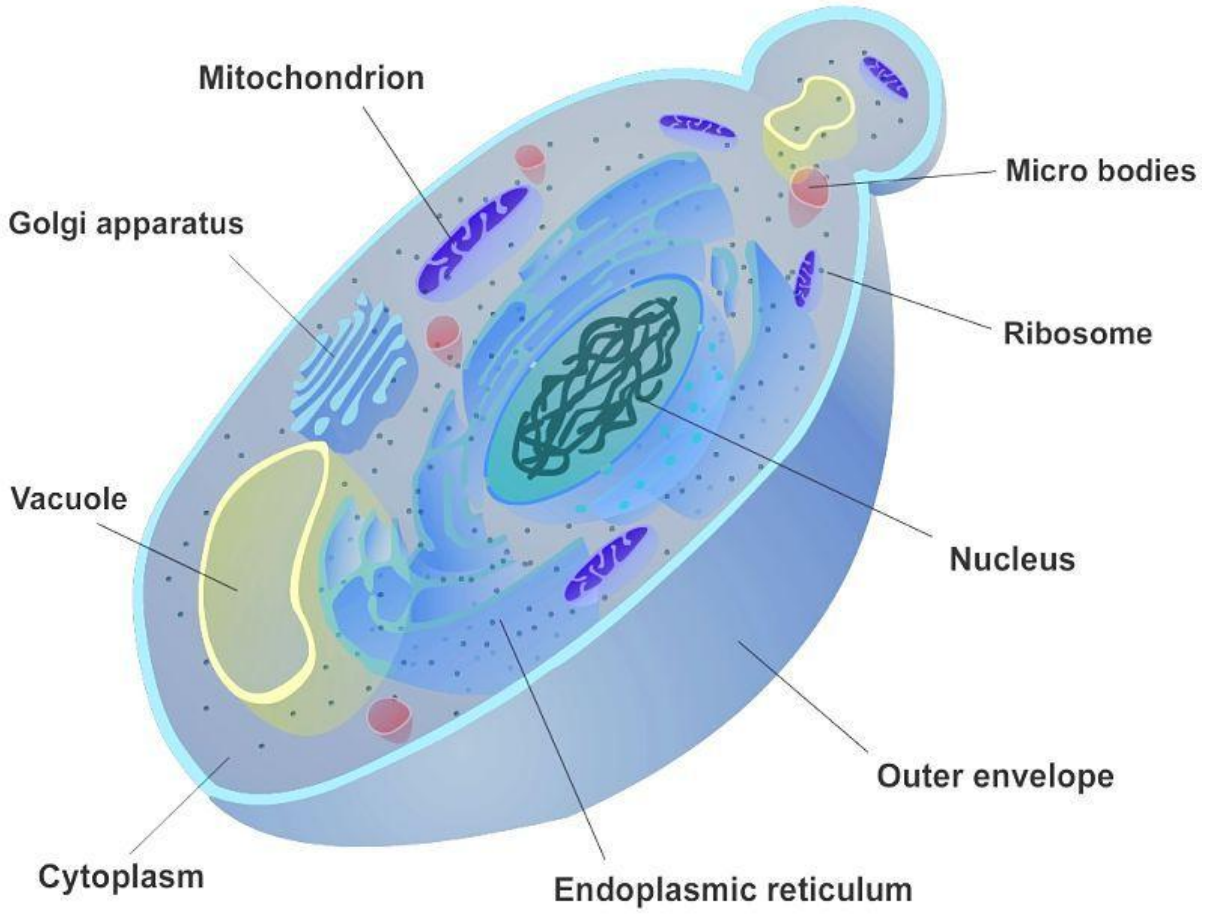


DIMORPHISM OF FUNGI





Hystoplasma capsulatum



Fungi cell Sructure

R – Ribosomes;

GA – Golgi apparatus;

CM – cytoplasmic membrane;

NM - nucleus membrane;

N – nucleus;

CM – Cell membrane;

S – cytolasm;

M – Mitochondria;

ER – endoplasmic reticulum

Reproduction of fungi

- Sexual reproduction - the formation of sexual gametes, the formation of sexual spores (zygospores, ascospores, basidospores)

Asexual reproduction-budding, fragmentation of hyphae, formation of asexual spores (arthroconidia, blastoconidia, chlamydoconidia)

It is divided into 2 parts depending on whether the fungus has sexual reproduction or not

Perfect (Reproduced both asexually and sexually)

Imperfect (Reproduced asexually)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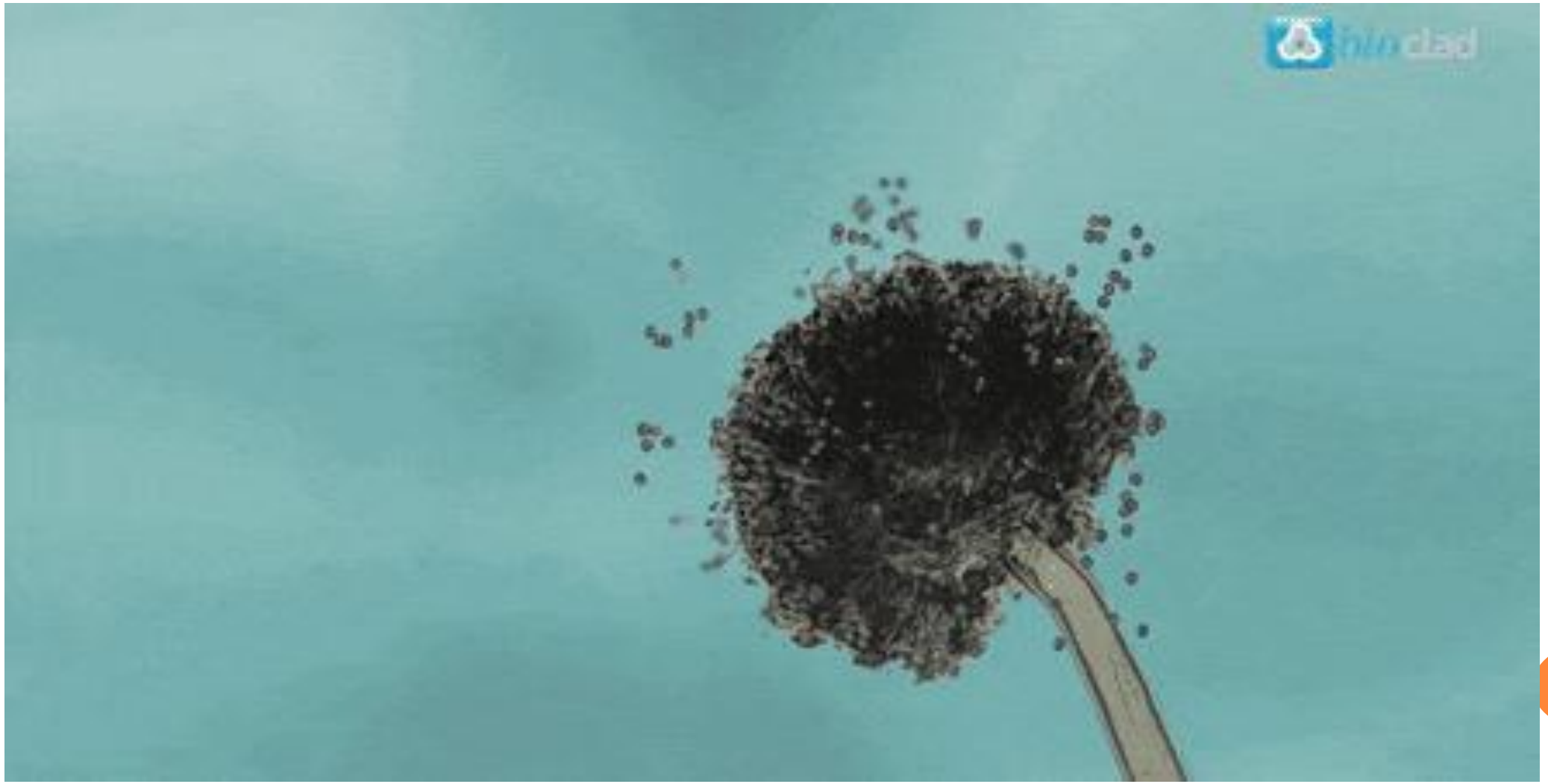
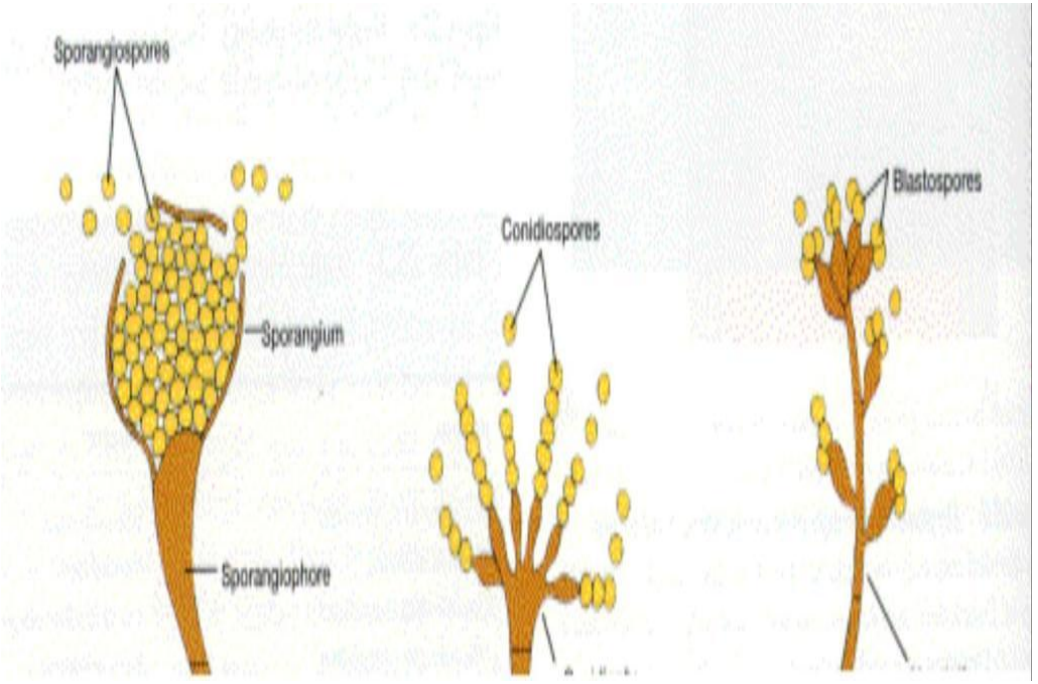
THE MAIN REPRODUCTIVE ORGAN OF FUNGI IS SPORES



THE MAIN REPRODUCTIVE ORGAN OF FUNGI IS SPORES

- If the spore is located inside the mycelium, it is called an endospore
- Endospores are formed within special structures - sporangia. This type of spore formation is characteristic of fungi of the genus Mucor
- Spores that form outside the mycelium are called exospores or conidia

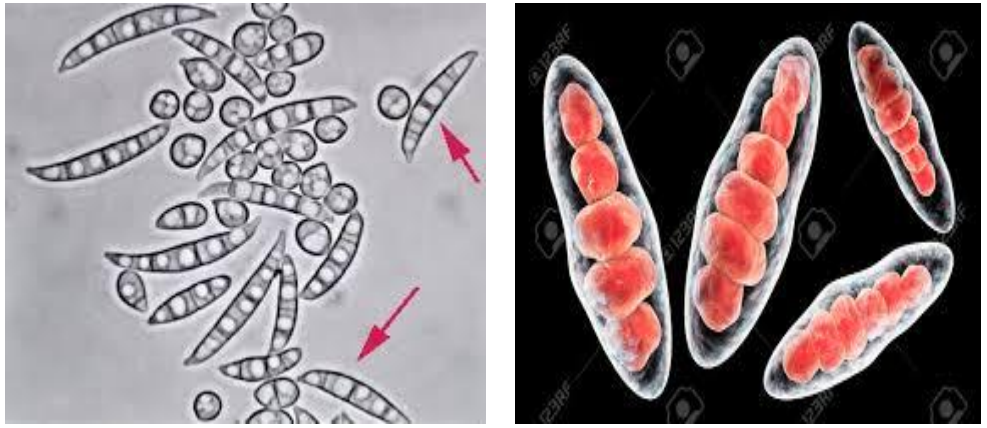


endospores **exospores**

Sexual spores	Types
Basidiospores *(basidomycetes)*	**Cryptococcus**
Ascospores *(askomycetes) septate hyphae*	**Histoplasma, Blastomyces, Piedraia hortae, Coccidiodes, Candida, Saccharomyces cerevisiae**
Zygospores *(zygomycetes)* aseptate *hyphae*	**Mucor Rhizopus, Apsidia Pilobolus**
Oospores	**Don't cause infection in human**

Asexual spores	Types
Blastospores	**Candida albicans**
Arthrospores	**Dermatofitlər, Trichosporon beigelii, Coccidioides immitis, Geotrichum candidum**
Chlamydospores	**Candida albicans**
Sporangiospores	**Mucor, Rhizopus, Prototheca**
Conidiospores	

- In the fungi **Penicillium** and **Aspergillus**, elongated cells-sterigums are formed at the ends of the reproductive mycelium-conidia. Conidia are arranged in a chain on them. Conidia may be unicellular (microconidia) and multicellular (macroconidia)**.**



macroconidia

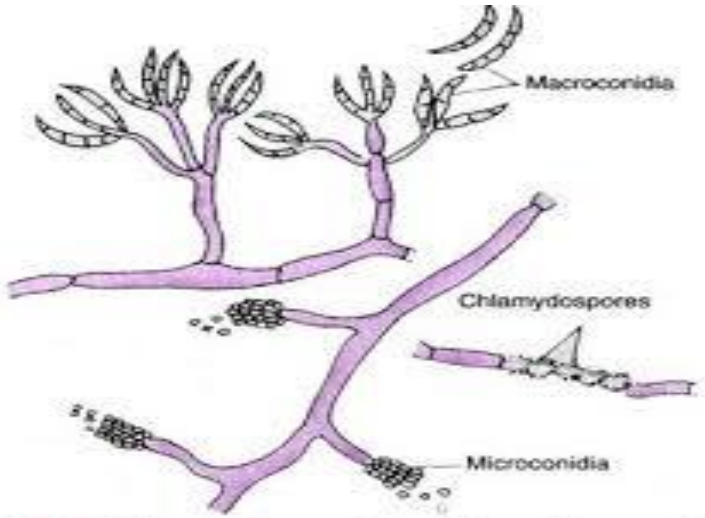
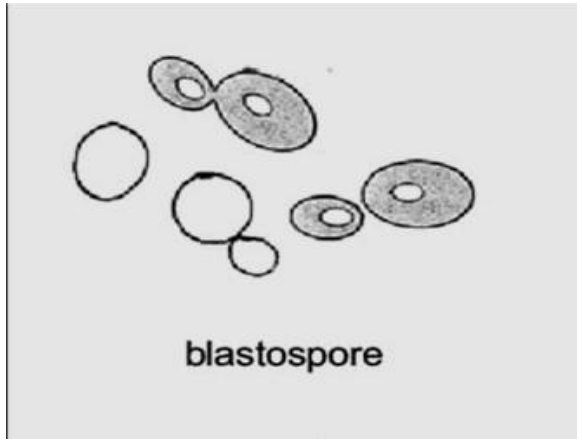


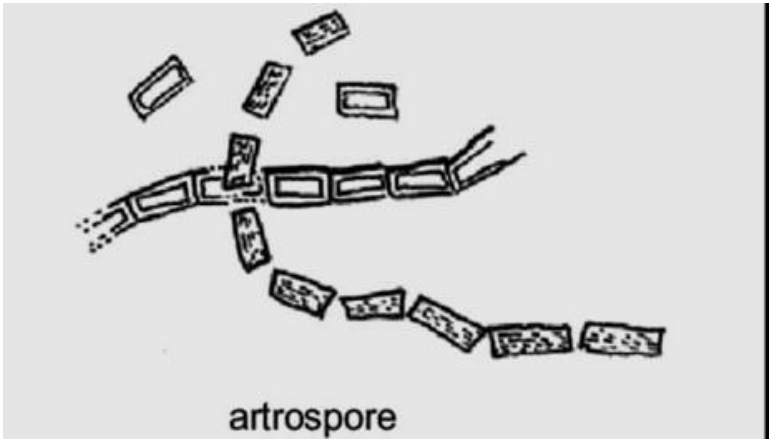
Fig. 16.7. *Fusarium*. Macroconidia and clustered microconidia. Portion of a hypha bearing chlamydospores is also shown.

Micro- and macroconidia

In addition to endo and exospores, thallospores are also present

Blastospores	Arthrospores	Chlamydospores
Specific to yeast-like fungi. These are formed as a result of the budding of the mother cell	They are barrel-shaped or rectangular. They are formed as a result of breaking and fragmentation of the mycelium at the ends. The formed mycelial segment is covered with a membrane and turns into spores (Geotrichium, Coccidiodies species)	It is formed as a result of the transformation of mycelial or pseudomycelial cells into thick-walled spores (Candida species).





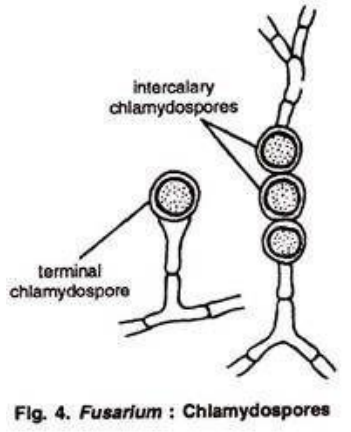


Fig. 4. *Fusarium* : Chlamydospores

Classification of fungi

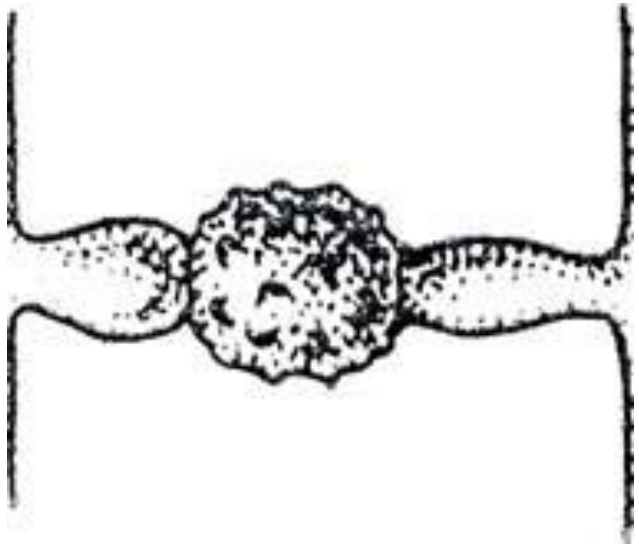
- In the modern classification, fungi are divided into types.
- Depending on whether there is sexual reproduction, all fungi are divided into advanced and immature fungi.
- Advanced fungi reproduce not only asexually but also sexually.
- In immature fungi, no sexual reproduction has been detected, but this is a condition, as they are referred to the appropriate types as soon as sexual reproduction is detected in these fungi.

CLASSIFICATION OF FUNGI

Zyqomycota	**Rhizopus** **Absidia**	**Mucor species**
Ascomycota	**Blastomyces** **Histoplasma** **Candida species**	**Microsporium** **Trichophyton** **Coccidoides**
Basidiomycota	**Filobasidiella neoformans** **Cryptococcus neoformans**	**Cap fungi**
Deiteromycota	**Epidermophyton** **Paracoccidioides**	**Sporothrix** **Aspergillus**

Classification of fungi

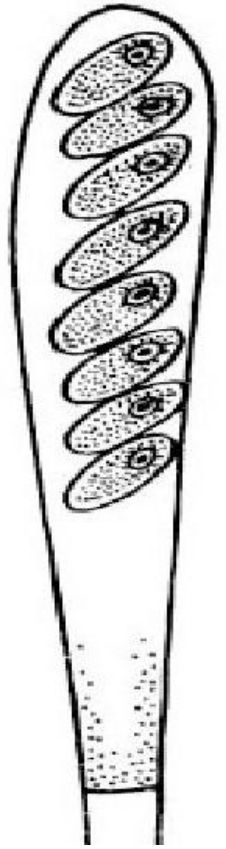
- *Zygomycotes (Zyqomycota) - Reproduced sexually and asexually. Sexual reproduction is through zygospores (zygos-mergers), and asexual reproduction is through sporangiospores. Vegetative forms are aseptate.* ***Pathogenic types to humans are Rhizopus, Absidia, Mucor, etc.***



CLASSIFICATION OF FUNGI

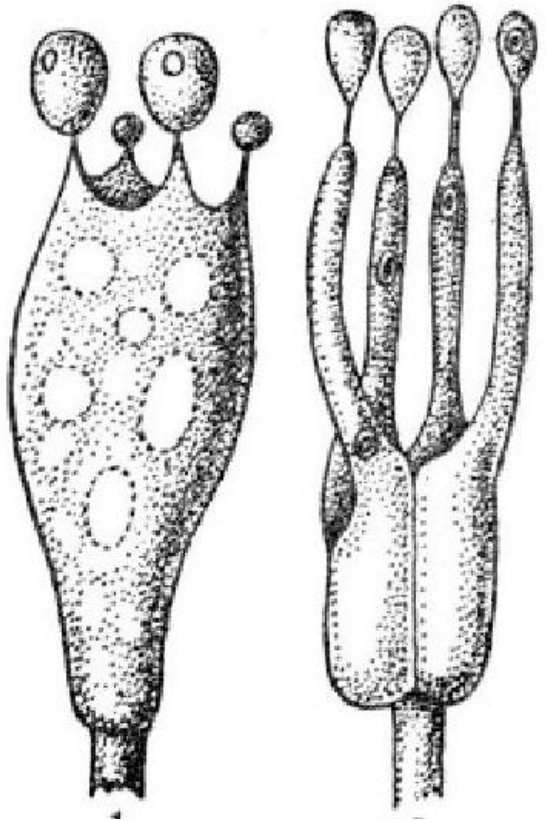
Ascomycota - The largest type of fungus. Sexual reproduction i through ascospores (asc-sac), asexual reproduction is throug conidia. Vegetative mycelium is septate. It contains about 85% o fungi that are pathogenic to humans.

Blastomyces, Histoplasma, Candida, Trichophyton, Coccidoides Arthrodernma, Saccharomyces, etc



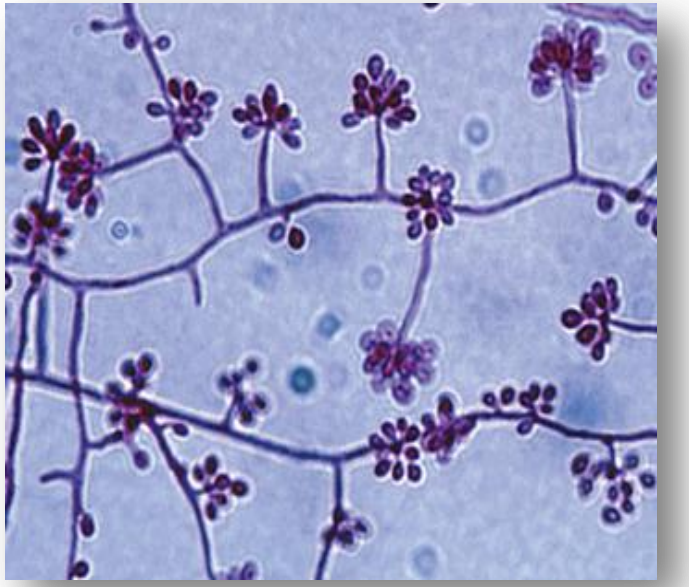
CLASSIFICATION OF FUNGI

- ***Basidiomycotes*** *- sexual reproduction occurs through basidiospores (basidiomycetes). The mycelium is septate.*
- *Pathogen types for humans - Filobasidiella neoformans, Cryptococcus neoformans, etc.*

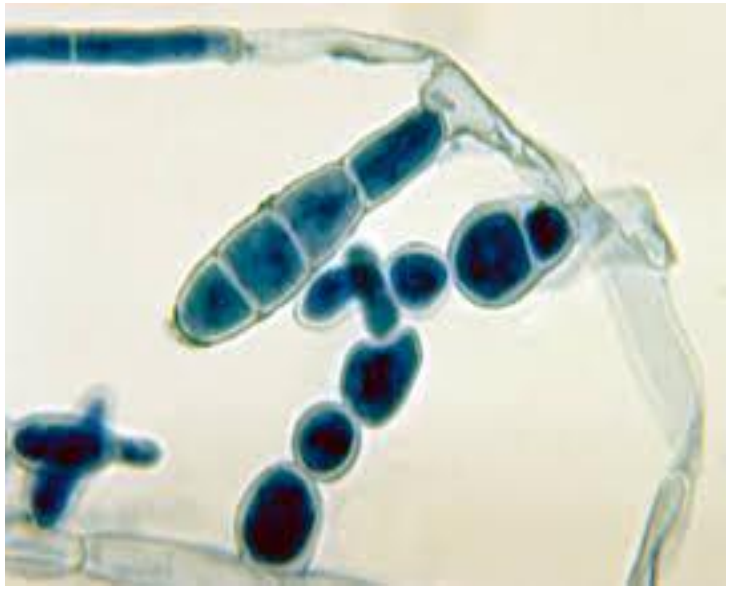


- Deuteromycetes (immature fungi - Deiteromtcota, Fungi imperfecti) - this is a conventional type.
- Pathogen types for humans- *Coccidioides immitis, coccidioides posadasii, Sporothrix, Aspergillus, Epidermophyton, Paracoccidioides, Phialophora, etc.*

Phialophora



Sporothrix



Epidermophyton

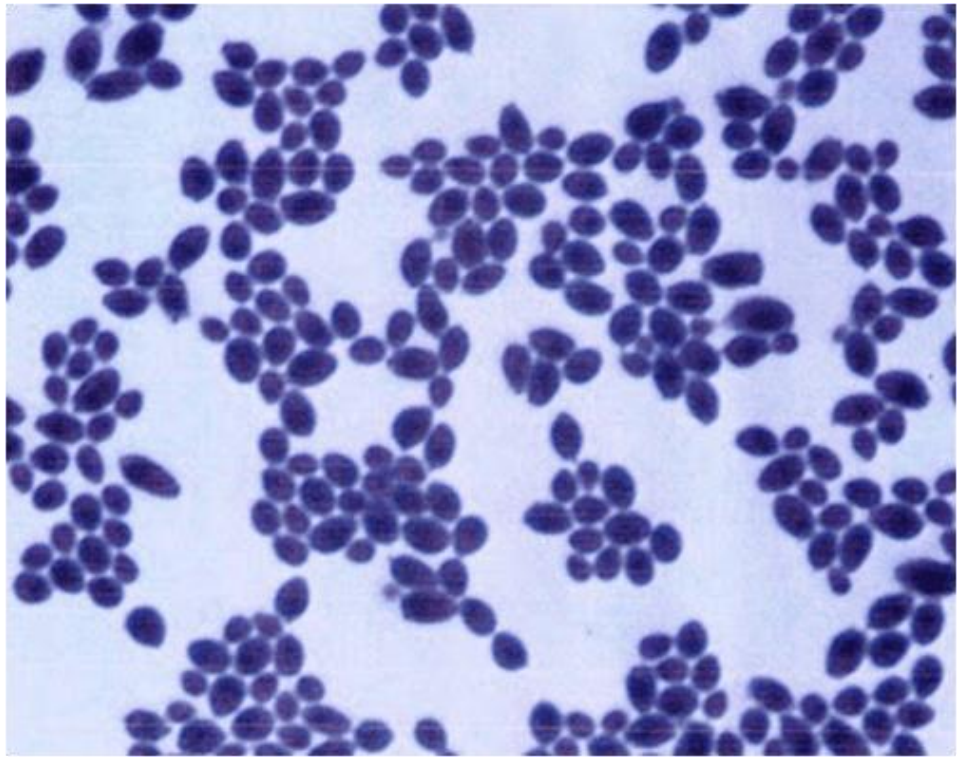
METHODS OF STUDYING MORPHOLOGY OF FUNGI

- Simple staining, Gram staining, lactophenol staining, etc.

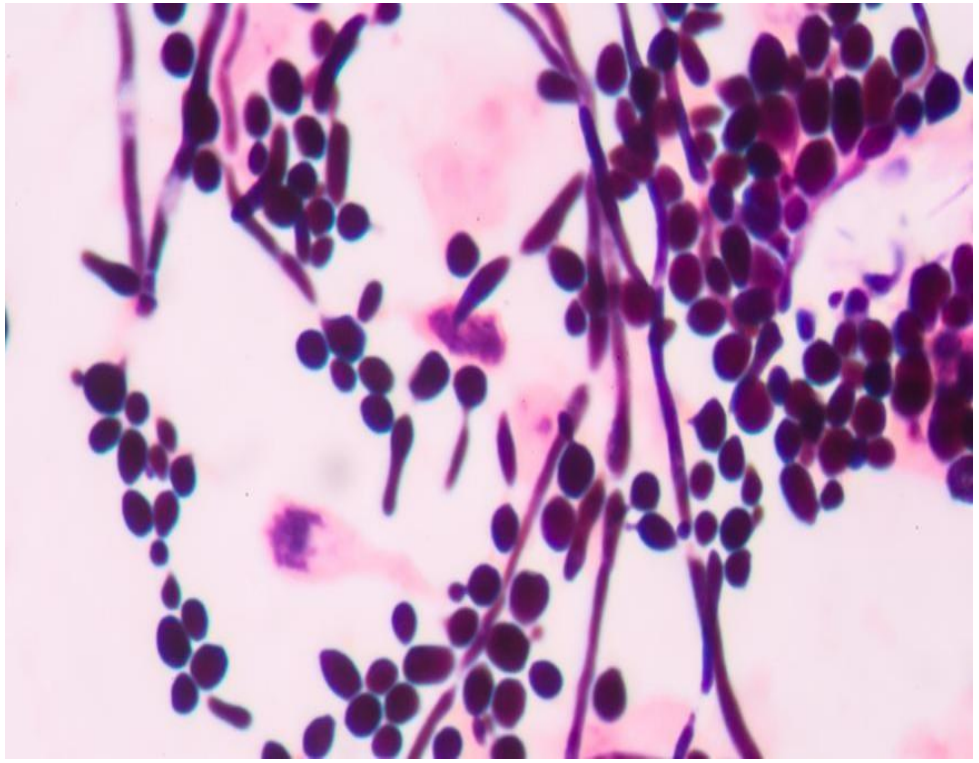
  The crushed drop method

  skin scales, hairs, nails, etc. preparations for the detection of fungal elements are performed with an alkaline solution (15-20% KOH)

METHODS OF LEARNING THE MORPHOLOGY OF FUNGI

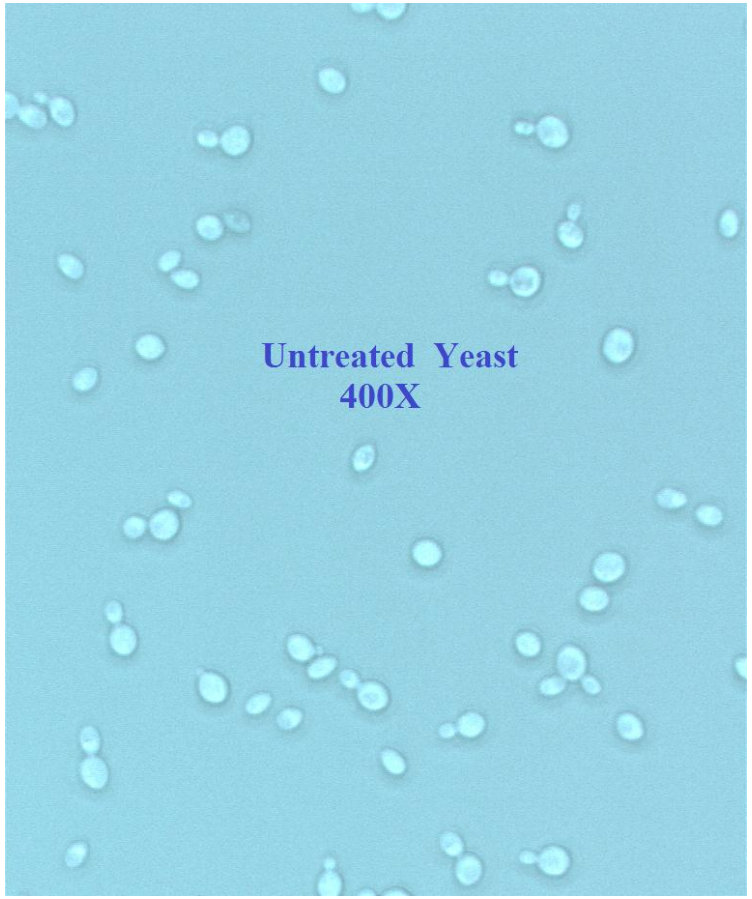


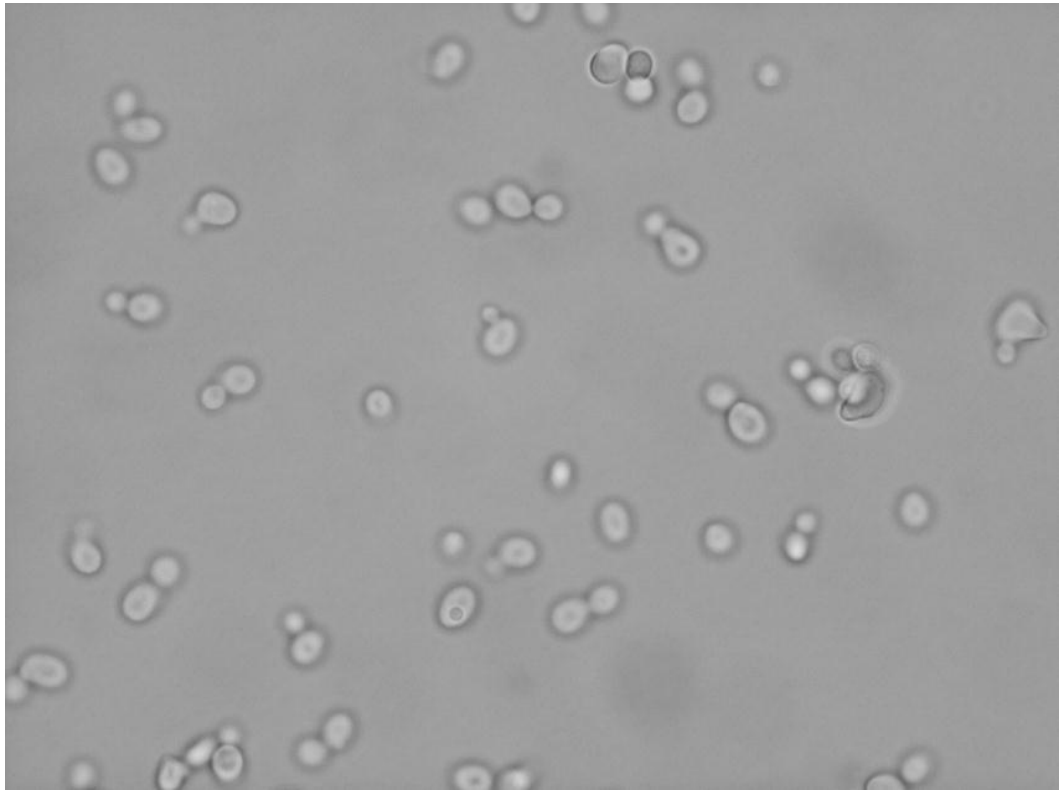
Candida spp.
(Methilene blue)



Candida spp.
(Gram stain)

METHODS OF LEARNING THE MORPHOLOGY OF FUNGI

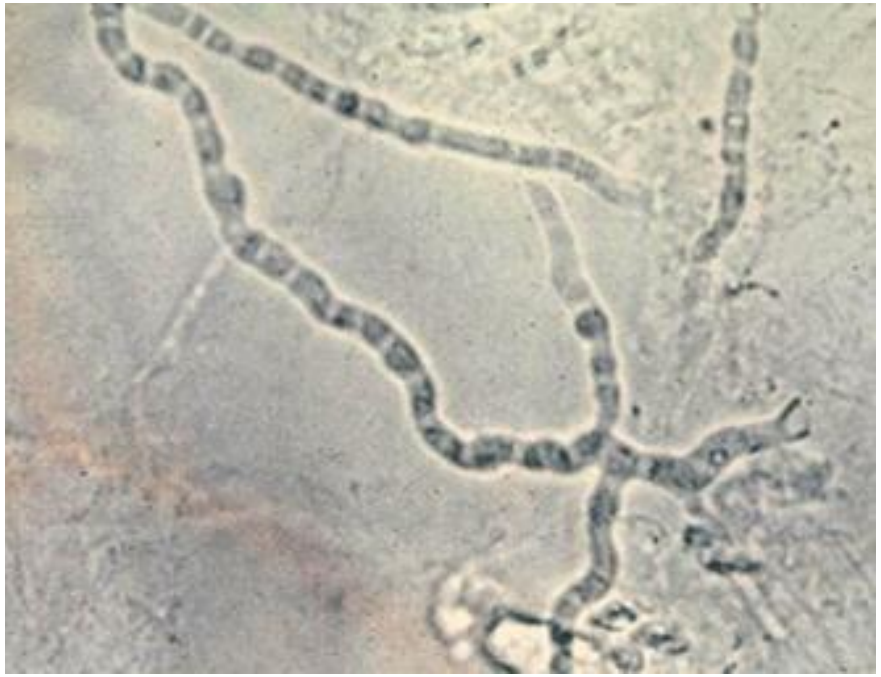




Candida spp.

«Crushed» drop method

METHODS OF LEARNING THE MORPHOLOGY OF FUNGI



Microscopic view of fungal cells in skin scales