



Medical Mycology

Course Teaching Portfolio

Dr. Asaad Faraj Hamzah



Southern Technical University

Medical Technical College of Basrah

Department of Medical Laboratory techniques

Academic Year 2024–2025

Target group

Medical Technical Institute students, Medical Laboratory Technology Department - Second Stage

1. Course Description

Medical Mycology is the branch of microbiology that deals with fungi capable of causing disease in humans. This course introduces students to the morphology, classification, and pathogenicity of fungi. It covers fungal diseases, laboratory diagnostic methods, antifungal therapy, and biosafety practices. Students will develop theoretical understanding and practical laboratory skills to handle fungal pathogens safely and accurately.

2. Course Objectives

- • Understand the taxonomy and morphology of medically important fungi.
- • Recognize the clinical features of common fungal infections.
- • Perform fungal culture and microscopic identification.
- • Understand antifungal treatments and resistance.
- • Follow biosafety protocols when working with fungal specimens.

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3. Learning Outcomes (CLOs)

Cognitive (Knowledge):

- Describe fungal cell structures, growth characteristics, and classification.
- Explain the pathogenesis of fungal infections and their clinical relevance.
- Identify major fungal diseases and causative organisms.

Psychomotor (Skills):

- Perform fungal staining, culturing, and microscopic examination.
- Use laboratory tools safely and effectively in mycological investigations.
- Interpret lab findings related to fungal infections.

Affective (Attitudes):

-  • **Demonstrate responsibility and care when handling biohazardous materials.**
-  • **Collaborate effectively with peers during lab sessions.**
-  • **Show ethical and professional behavior in the lab.**

4. Weekly Course Schedule

Week	Theoretical Topic	Practical Session
1	Introduction of medical Fungi	Fungus isolation in general
2	Structure , reproduction and classification.	Equipment, chemicals needed for fungal media
3	Cultural characteristics, type of mycosis	Type of Fungal culture media
4	Cultural characteristics, type of mycosis	Isolation and cultured pathogenic Fungi
5	General principle in treatment.	Using biochemical tests for identification
6	Actinomyces, Nocardia, Mycetoma	Macroscopic examination of fungal colonies
7	Actinomyces, Nocardia, Mycetoma	Microscopic examination
8	Dermatophytes	<i>Dermatophyte</i> identification
9	Candidiasis	<i>Candida</i> identification
10	Cytococcosis	<i>Pencillium</i> identification
11	Cryptococcus	<i>Aspergillus</i> identification
12	Histoplasmosis, sporotrichosis	<i>Actinomyces</i> identification
13	Micellanaus fungi ,Aspergillosis, mucor	Antibiotic producing by fungus.
14	Rhizopus & penicillium	Anti fungal agents
15	Anti fungal agents , antibiotic produced by fungi	Thought

5. Teaching Methods

-  - Lectures (PowerPoint-based)
-  - Laboratory experiments and demonstrations
-  - Group discussions and presentations
-  - Case-based learning and clinical scenarios

6. Assessment Methods & Grading

Component	Weight
Theoretical Midterm Exam	20%
Practical Midterm Exam	20%
Lab Reports / Activities	5%
Attendance & Participation	5%
Final Theoretical Exam	40%
Final Practical Exam	10%
Total	100%

7. Required Textbooks & References

- **Medical Mycology by D.H. Howard**
- **Essentials of Clinical Mycology**
- **WHO Guidelines on fungal diseases**
- **CDC and recent peer-reviewed articles on medical mycology.**

8. Policies

-  - **Attendance:** Minimum 75% attendance required.
-  - **Punctuality:** Students must arrive on time to both theoretical and practical sessions.
-  - **Academic Integrity:** Cheating or plagiarism will result in disciplinary actions.
-  - **Lab Safety:** Strict adherence to safety protocols is mandatory.

9. Appendices (Optional)

-  - Lecture slides
-  - Practical lab manuals
-  - Previous exam samples
-  - Student feedback form
-  - Evaluation rubric



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Credit Hours: 1 hour theoretical, 2 hours practical (weekly)

Lecture 1: Introduction to Medical Fungi

- Learning Objectives

- Define fungi and their medical relevance
- Understand the role of fungi as human pathogens
- distinguished from other organisms
- Differentiate between fungal morphology types
- Beneficial and harmful Effects of Fungi
- Introduce common diseases caused by fungi (mycoses)

Pre questions

"What are fungi, and how do they differ from other living organisms?"

What are fungi, and how do they differ from

-Bacteria

-Animal

-Plant

1- The cell wall of fungi is composed of And..... .

2- The yeasts produce chains of elongated cells known as

3- fungi divided into two main groups (a)..... such as
(b) such as

.....

4-Diamorphic fungi appear in two forms,..... .

5- polymorphic fungi appear in more than two

.....forms such as

Q: Fill the blanks

- 1- The cell wall of fungi is composed of And..... .
- 2- The yeasts produce chains of elongated cells known as
- 3- fungi divided into two main groups (a)..... such as
(b) such as
- 4-Diamorphic fungi appear in two forms,..... .
- 5- polymorphic fungi appear in more than two
.....,.....,.....forms such as

Answer

1-

2-

3-a-

b-

4-

5-

First lecture : Introduction of medical Fungi

Mycologists: scientists who study fungi

Mycology: the branch of biology concerned with the study of fungi, including their genetic and biochemical properties,

Mycoses: diseases caused by fungi

Medical Mycology: Medical Mycology deals with fungi cause human diseases directly (**mycoses, allergies**) or indirectly **food poisoning.. Mycotoxins**

General properties of fungi:

1. They are **eukaryotic**; cells contain membrane bound **cell organelles** including nuclei, mitochondria, golgi apparatus, endoplasmic reticulum, lysosomes etc. They also exhibit mitosis.
2. Have **ergosterols** in their membranes and possesses 80S ribosomes.
3. Have a rigid cell wall and are therefore **non-motile**, a feature that separates them from animals. All fungi possess cell wall made of **chitin**.
4. Are **chemoheterotrophs** (require organic compounds for both carbon and energy sources) and fungi **lack chlorophyll** and are therefore not autotrophic.
5. Fungi are **osmotrophic**; they obtain their nutrients **by absorption**.
6. They obtain nutrients as **saprophytes** (**live off of decaying matter**) or as **parasites** (**live off of living matter**).
7. All fungi require water and oxygen and there are no **obligate anaerobes**.
8. Typically **reproduce asexually** and/or sexually by **producing spores**.
9. They grow either reproductively by **budding** or non-reproductively by **hyphal tip elongation**.
10. Food storage is generally in the form of **lipids and glycogen**.

Table 1 Some Differences between Fungi and Bacteria

Properties	Fungi	Bacteria
Nucleus	Eukaryotic; nuclear membrane; more than one chromosome; mitosis	Prokaryotic; no membrane; nucleoid; only one "chromosome"
Cytoplasm	Mitochondria; endoplasmic reticulum; 80S ribosomes	No mitochondria; no endoplasmic reticulum; 70S ribosomes
Cytoplasmic membrane	Sterols (ergosterol)	No sterols
Cell wall	Glucans, mannans, chitin, chitosan	Murein, teichoic acids (Gram-positive), proteins
Metabolism	Heterotrophic; mostly aerobes; no photosynthesis	Heterotrophic; obligate aerobes and anaerobes, facultative anaerobes
Size, mean diameter	Yeast cells: 3–5–10 μm . Molds: indefinable	1–5 μm
Dimorphism	In some species	None

What are the main differences between Fungi and animal ,plant ?

Differences between fungi and animals:

In fungi the nutrition is external, while in animal is mostly is internal Animals produce cholesterol, while fungi produce ergosterol

Differences between fungi and plants:

- 1- plants make their own food by photosynthesis, while fungi are unable to make their own, but are saprophytic or parasitic**
- 2- fungi do not have chlorophyll as in plants**
- 3- fungi reproduce by spores, while plants reproduce by seeds and pollen**
- 4- in an ecosystem, plants are productive while fungi are decomposers**
- 6- the cell wall in plants is made of cellulose while in fungi it is made of chitin**
- 7- plants are multicellular, while fungi may be unicellular or multicellular**

Importance of fungi

Fungi inhabit almost every niche in the environment and humans are exposed to these organisms in various fields of life.

Beneficial Effects of Fungi:

1. **Decomposition** - nutrient and carbon recycling.
2. **Biosynthetic factories**. The fermentation property is used for the industrial production of alcohols, fats, citric, oxalic and gluconic acids.
3. Important sources of **antibiotics**, such as Penicillin.
4. Model organisms for **biochemical and genetic studies**. Eg: *Neurospora crassa*
5. *Saccharomyces cerviciae* is extensively used in recombinant DNA technology, which includes the Hepatitis B Vaccine
6. Some fungi are **edible** (mushrooms).
7. Yeasts provide **nutritional supplements** such as vitamins and cofactors.
8. **Penicillium** is used to flavour Roquefort and Camembert cheeses.
9. **Ergot produced** by *Claviceps purpurea* contains medically important alkaloids that help in inducing uterine contractions, controlling bleeding and treating migraine.
10. Fungi (*Leptolegnia caudate* and *Aphanomyces laevis*) are **used to trap mosquito larvae in paddy fields** and thus help in malaria control

Harmful Effects of Fungi:

1. **Destruction of food**, lumber, paper, and cloth.
2. Animal and **human diseases**, including allergies.
3. **Toxins produced** by poisonous mushrooms and within food (Mycetism and Mycotoxicosis).
4. **Plant diseases**.
5. **Spoilage of agriculture produce** such as vegetables and cereals in the godown.
6. **Damage the products** such as magnetic tapes and disks, glass lenses, marble statues, bones and wax.

Post questions

Q8: Match between A and B

A :

- 1- *Saccharomyces cerviciae*
- 2- *Claviceps purpurea*
- 3- *Aphanomyces laevis*
- 4- *Neurospora crassa*

B :

A-used to trap mosquito larvae in paddy fields and thus help in malaria control

B-Model organisms for biochemical and genetic studies

C- contains medically important alkaloids that help in inducing uterine contractions

D- extensively used in recombinant DNA technology, which includes the Hepatitis B Vaccine

Answers :

1-

2-

3-

4-

Answers

Q8: Match between A and B

A :

- 1- *Saccharomyces cerviciae*
- 2- *Claviceps purpurea*
- 3- *Aphanomyces laevis*
- 4- *Neurospora crassa*

B :

A-used to trap mosquito larvae in paddy fields and thus help in malaria control

B-Model organisms for biochemical and genetic studies

C- contains medically important alkaloids that help in inducing uterine contractions

D- extensively used in recombinant DNA technology, which includes the Hepatitis B Vaccine

Answers :

1-D

2-C

3-A

4- B

Lecture two

Structure reproduction and Classification of fungi



Learning Objectives

- **Understand the structural components of fungal cells**
- **Describe fungal reproduction methods (sexual & asexual)**
- **Classify fungi based on morphology and reproduction**
- **Recognize medically important fungal groups**

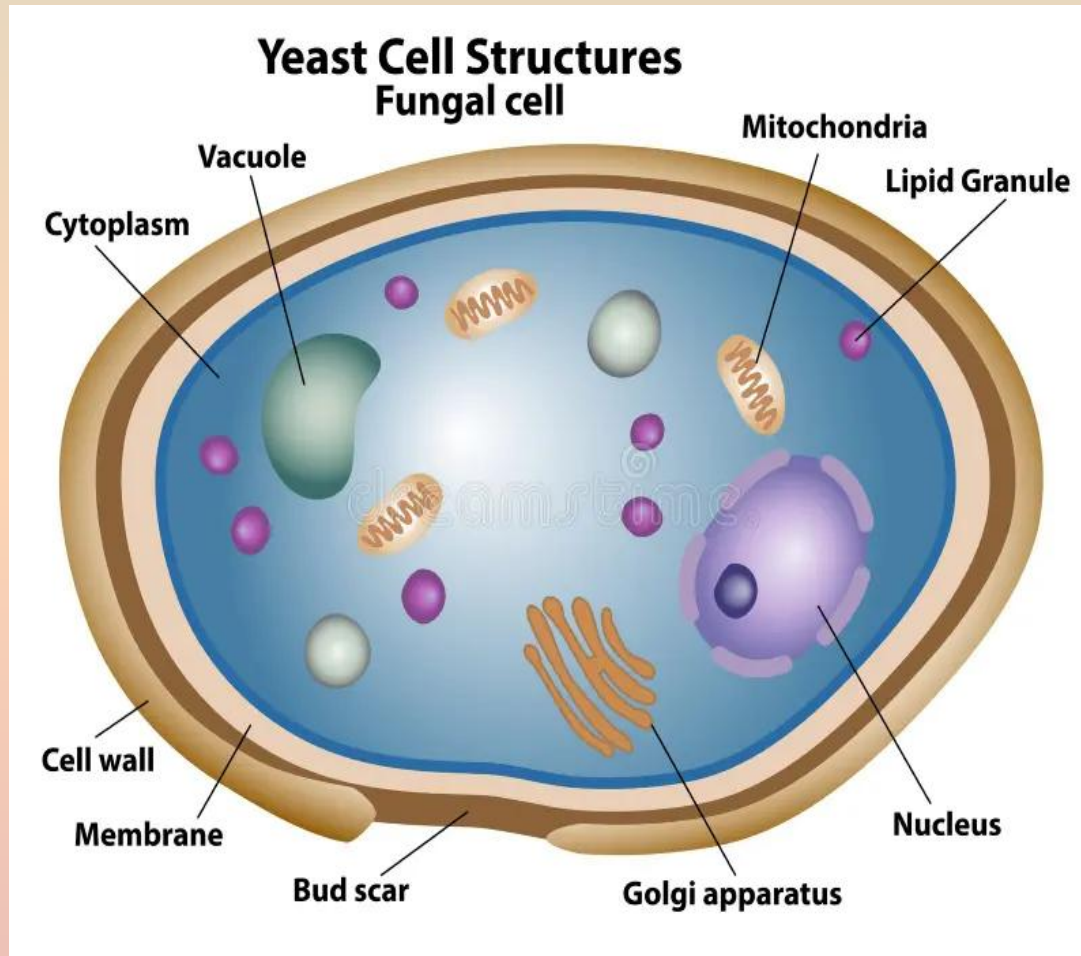
Prequestion : Fill the blanks

- 1- The cell wall of fungi is composed of And..... .
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- 5- polymorphic fungi appear in more than two
.....,.....,.....forms such as

Answer

- 1-
- 2-
- 3-a-
b-
- 4-
- 5-

what are characteristics of the fungal cell?



Structure of Fungi

The cell wall of fungi is composed of polysaccharides and chitin. Fungi vary in size and shape. They are broadly divided into two main groups.

(a) A unicellular or yeast form which is defined morphologically, as a **single-celled fungus** that reproduces by **simple budding** to form blastoconidia. The cell develops a protuberance that enlarges and separates from the parental cell. The yeasts produce chains of elongated cells known as **Pseudohyphae**.



Figure 1-1. Illustration of blastoconidia. Figure 1-2. Illustration of pseudohyphae

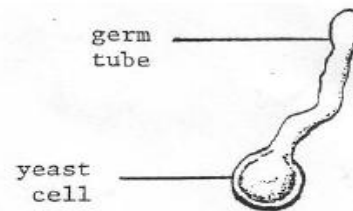
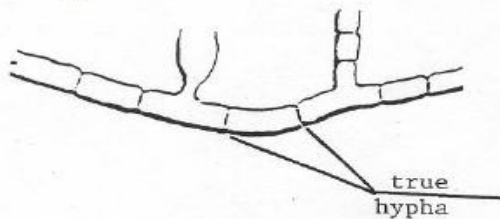
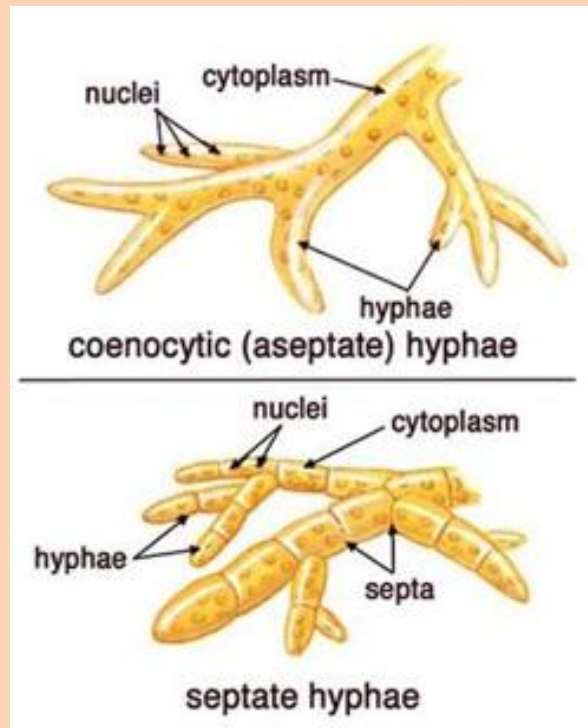


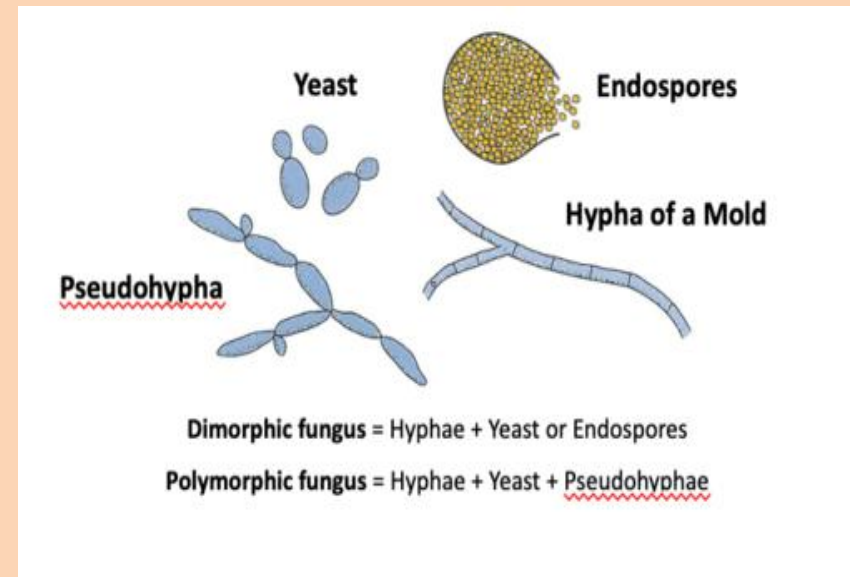
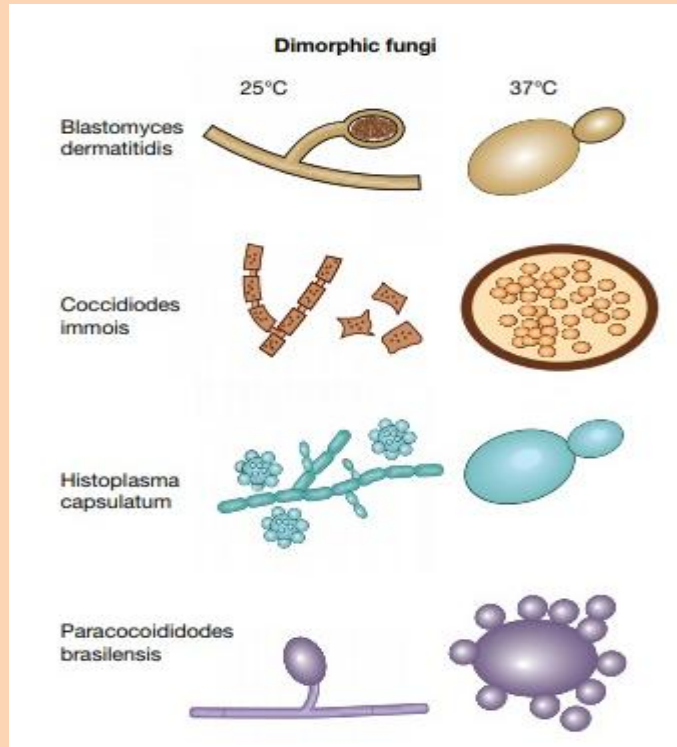
Figure 1-3. Illustration of true hyphae Figure 1-4. Illustration of germ tubes.

(b) A filamentous or mould form

which is a vegetative growth of **filaments**. consist simply of a number of filaments packed tightly together, and reproduction is by **spores or conidia**. Fungal filaments are known as **hyphae** and a mass of hyphae collectively make up the mycelium. There are two kinds of hyphae; non-septate (coenocytic) and septate



Some fungi exist in two forms (yeasts and molds), but in different conditions or environments called **Dimorphic fungi**



Some fungi exist in more than two forms, such as *Candida* sp., which is called **Polymorphic**

Classification of Fungi

Kingdom Fungi are classified based on different modes. The different classification of fungi is as follows:

Based on Mode of nutrition

On the basis of nutrition, kingdom fungi can be classified into 3 groups.

Saprophytic – The fungi obtain their nutrition by feeding on dead organic substances. Examples: *Rhizopus*, *Penicillium* and *Aspergillus*.

Parasitic – The fungi obtain their nutrition by living on other living organisms (plants or animals) and absorb nutrients from their host.

Examples: *Taphrina* and *Puccinia*.

Symbiotic – These fungi live by having an interdependent relationship with other species in which both are mutually benefited. Examples: *Lichens* and *mycorrhiza*. Lichens are the symbiotic association between algae and fungi.

Based on Spore Formation

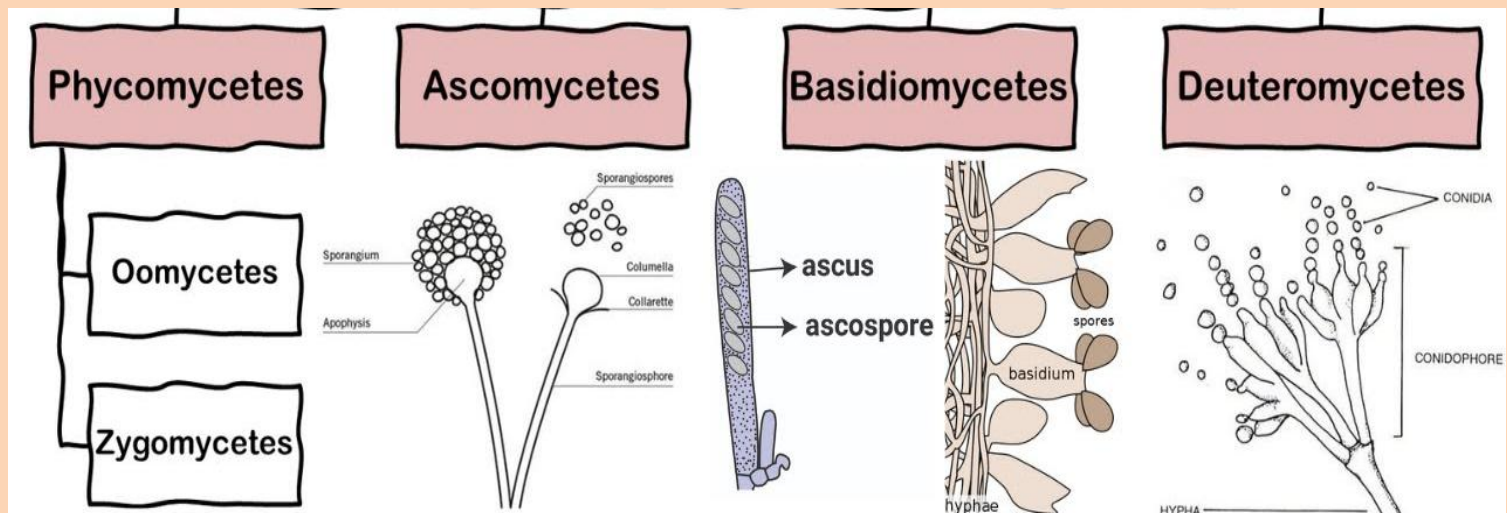
Kingdom Fungi are classified into the following based on the formation of spores:

Zygomycetes – These are formed by the fusion of two different cells. The sexual spores are known as zygospores, while the asexual spores are known as **sporangiospores**. The hyphae are without the septa. Example – *Mucor*.

Ascomycetes – They are also called sac fungi. They can be coprophilous, decomposers, parasitic or saprophytic. The sexual spores are called **ascospores**. Asexual reproduction occurs by conidiospores. Example – *Saccharomyces*.

Basidiomycetes – Mushrooms are the most commonly found basidiomycetes and mostly live as parasites. Sexual reproduction occurs by **basidiospores**. Asexual reproduction occurs by conidia, budding or fragmentation. Example- *Agaricus*.

Deuteromycetes – They are otherwise called imperfect fungi as they do not follow the regular reproduction cycle as the other fungi. They do not **reproduce sexually**. Asexual reproduction occurs by **conidia**. Example – *Trichoderma*.



Reproduction in Fungi

Reproduction in fungi is both by sexual and asexual means. The sexual mode of reproduction is referred to as teleomorph and the asexual mode of reproduction is referred to as anamorph.

Vegetative reproduction in fungi – This takes place by budding, fission and fragmentation.

Asexual reproduction – This takes place with the help of spores called conidia or zoospores, or sporangiospores.

Sexual reproduction – This occurs by ascospores, basidiospores, and oospores.

The form of fungus undergoing asexual reproduction is known as anamorph (or imperfect stage) and when the same fungus is undergoing sexual reproduction, the form is said to be teleomorph (or perfect stage). The whole fungus, including both the forms is referred as holomorph

Asexual reproduction: also called somatic or vegetative.

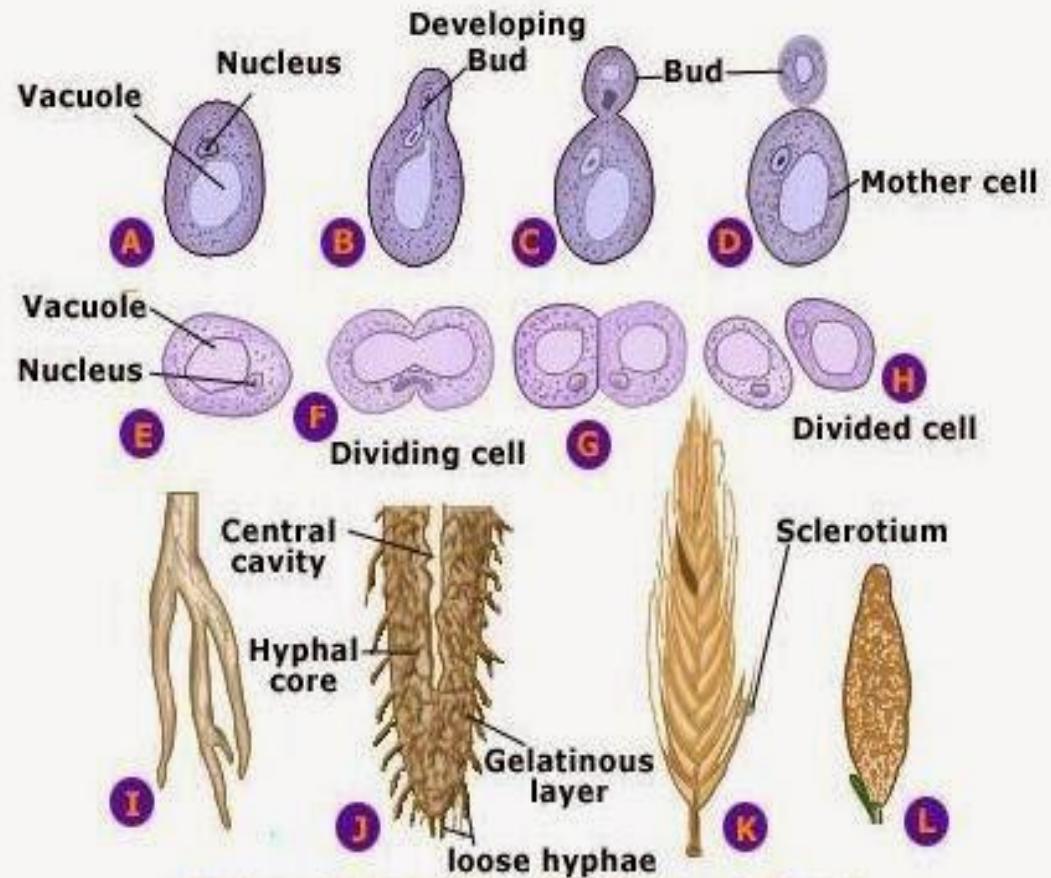
- Vegetative fragmentation method
- Transverse fission e.g *Schizosaccharomyces sp.*
- Budding
- Sclerotia
- spores
- Rhizomorph



Sclerotia



Rhizomorphs



Modes of vegetative reproduction in fungi.

A-D. Budding. E-H. Fission. I-J. Rhizomorph; K-L. Sclerotia

Some Examples of Asexual Spores

1-Sporangiospore

Examples:Rhizopus

2- Conidiospore:

Examples:Penicillium

3-Arthrospore:

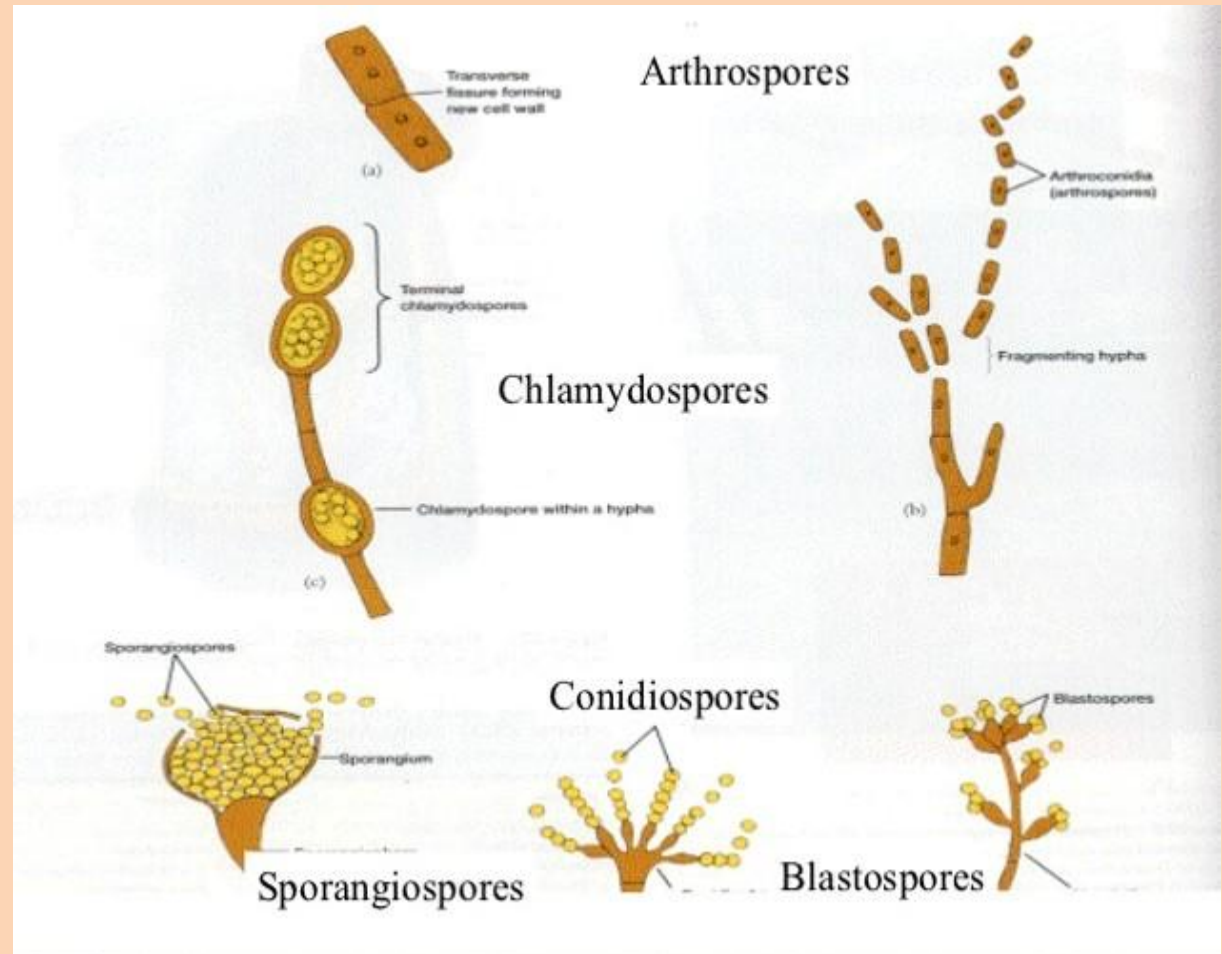
Examples:Trichosporium

4-Chlamydospore

EX: Histoplasma capsulatum

5-Blastospore

Examples:ascomycetes



Spores formation of fungi

sexual reproduction: it done in three consecutive steps

1-plasmogamy

2-karyogamy

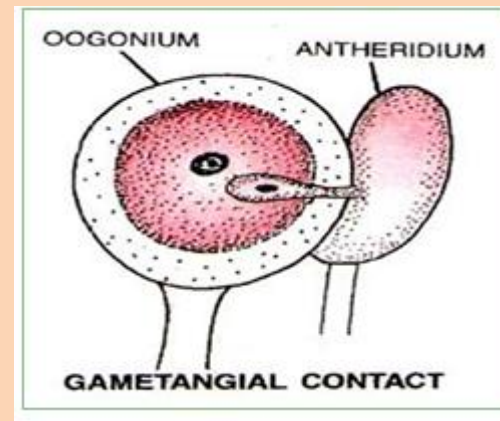
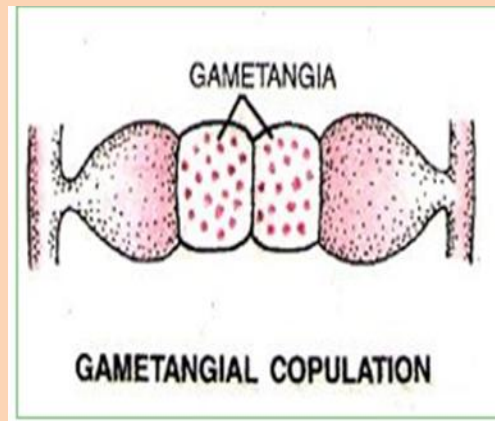
3-meiosis

Types of sexual reproductive

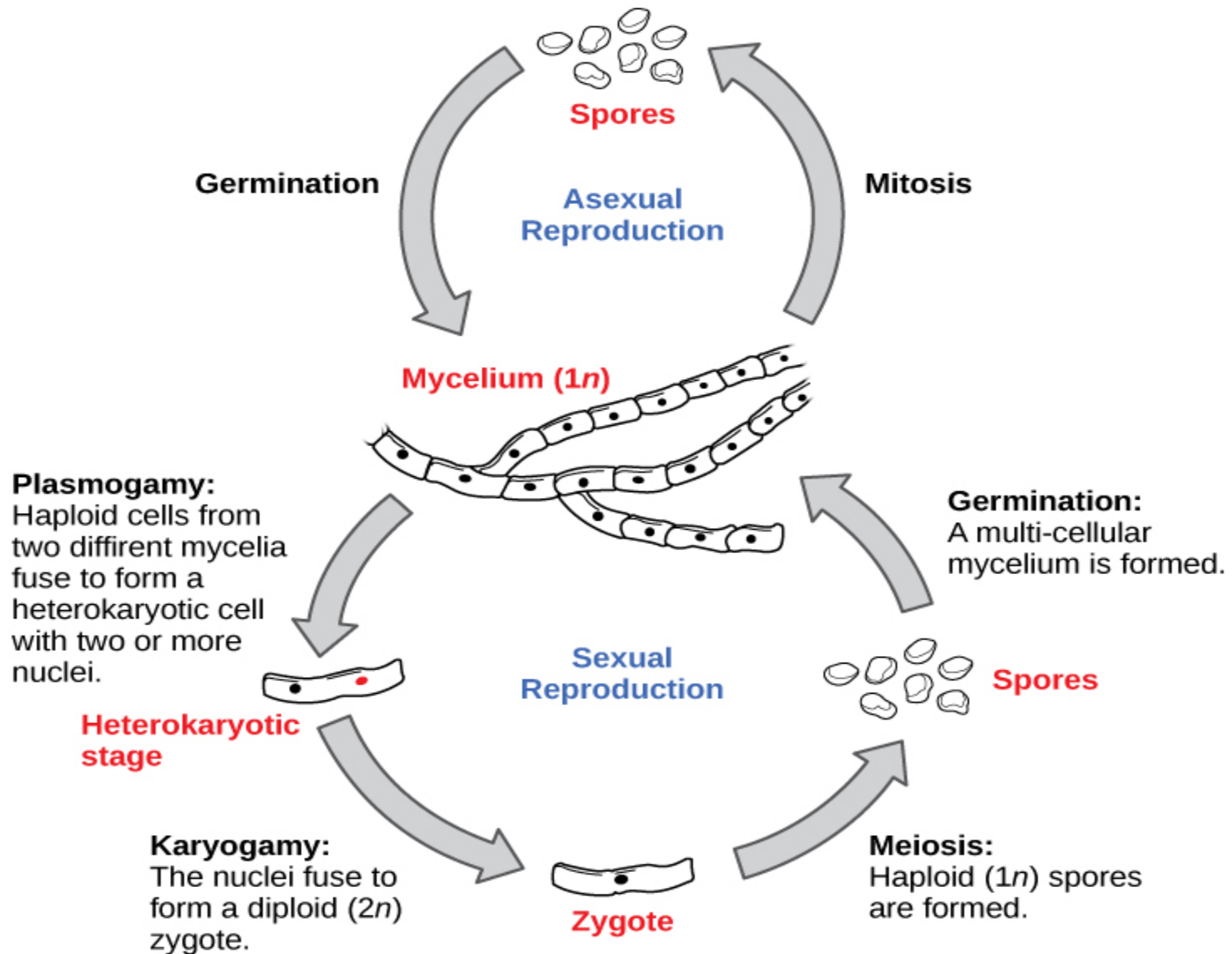
1-isogamy

2-heterogamy

3-gametes lose their cilia and remain within the gametophyte. The gametophytes are distinguished into large and small gametophytes
4- mold fungi have a special method by the union of parts of fungal hyphae



Fungi Life Cycle



Post-question :

Q: Kingdom Fungi are classified into four groups based on the formation of spores , what are these ,give example of each group ?

Q : Kingdom Fungi are classified into four groups based on the formation of sexual spores , explain by drawing ?

Q17 : Match between A with 3 from B

A

- 1-Vegetative reproduction**
- 2- Asexual reproduction**
- 3- Sexual spores**
- 4- dermatophytes**

B

- a-conidia**
- b-fission**
- c-Trichophyton**
- d-ascospores**
- e-zoospore**
- f-fragmentation**
- g-Microsporum**
- h-basidiospores**
- i-sporangiospores**
- j-budding**
- k-Epidermophyton**
- l-oospores**

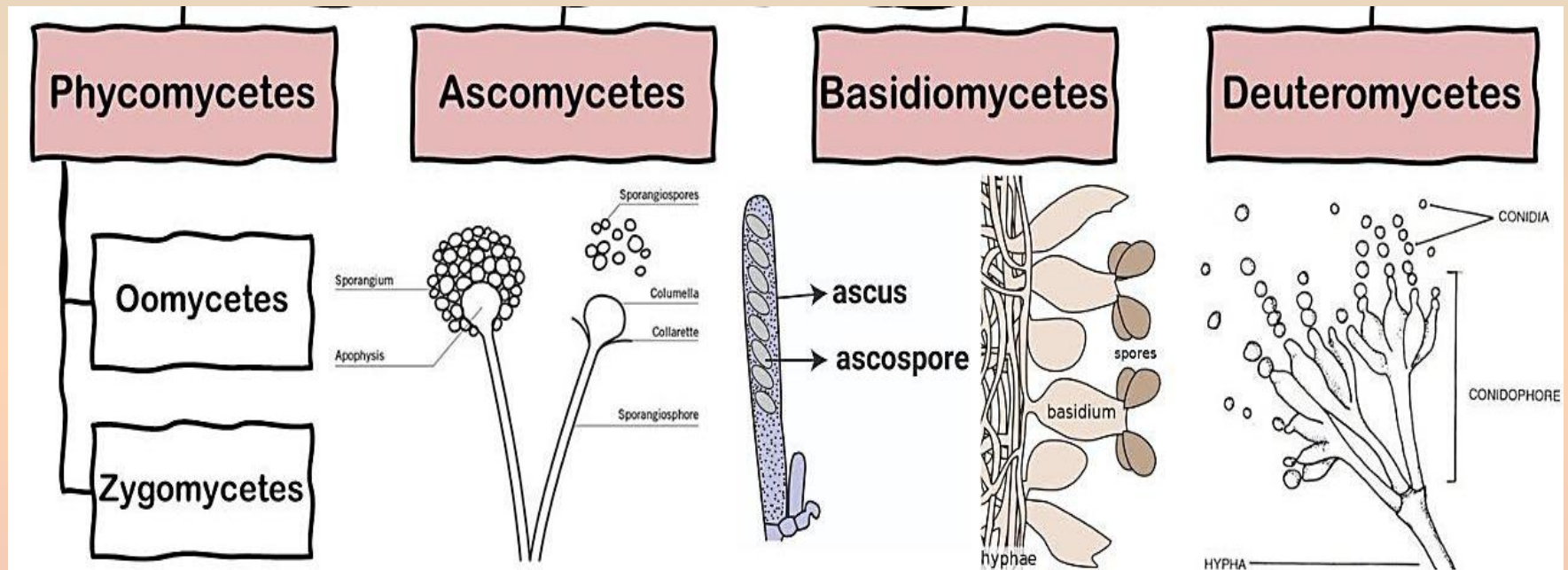
Key answers

Prequestion

Answers

- 1- 7-10 days , 24-72 hours , up to 6 weeks
- 2-bacterial , saprophytic
- 3- superficial or mucocutaneous , subcutaneous, deep infection
- 4- powdery or cottony
- 5- dermatomycetes and moulds
- 6--plasmogamy ,karyogamy , meiosis

Q16 : Kingdom Fungi are classified into four groups based on the formation of sexual spores , explain by drawing ?



Q15 : Kingdom Fungi are classified into four groups based on the formation of spores , what are these ,give example of each group ?

Zygomycetes – These are formed by the fusion of two different cells. The sexual spores are known as zygosporangia, while the asexual spores are known as **sporangiospores**. The hyphae are without the septa. Example – *Mucor*.

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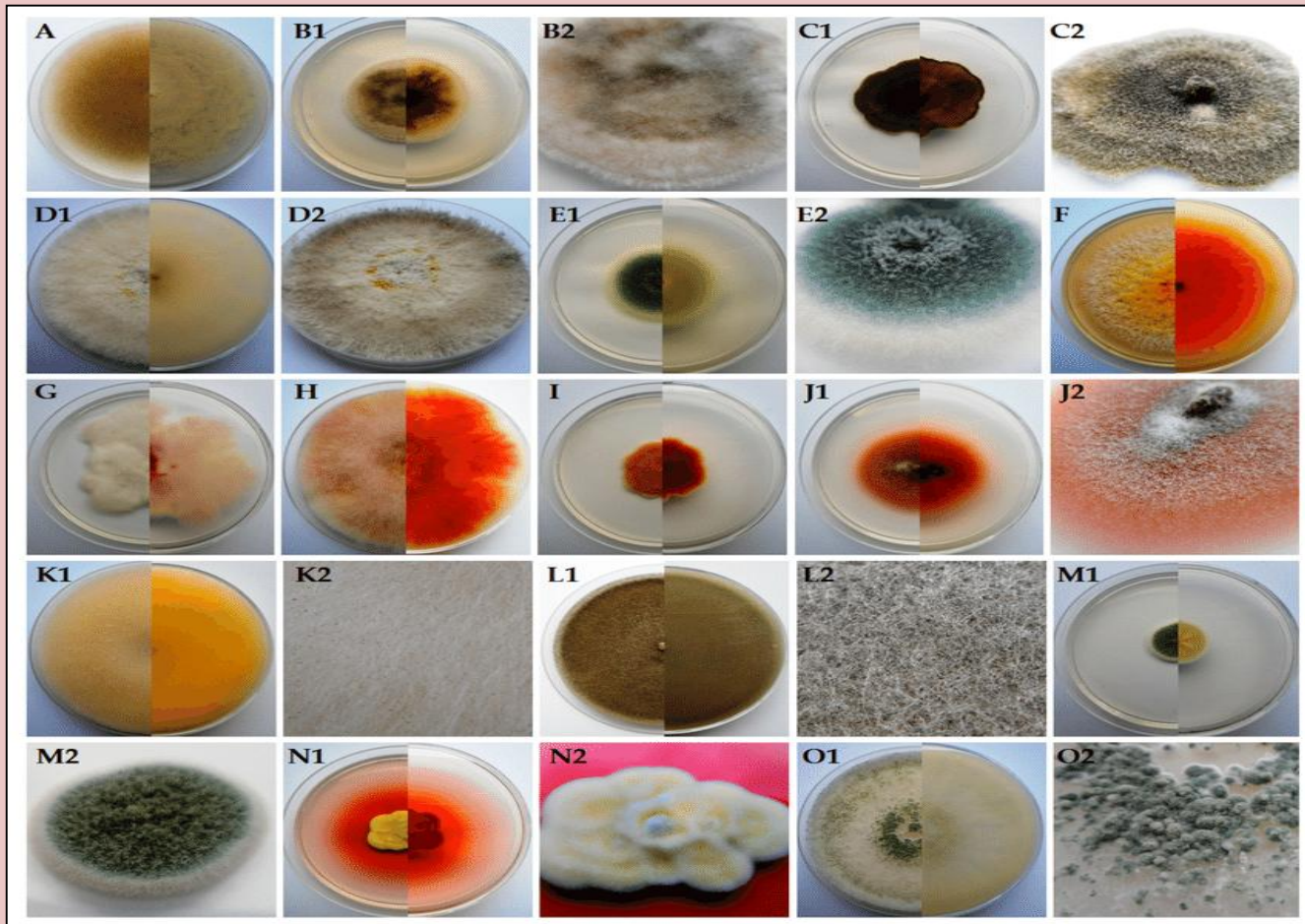
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Third lecture

Culture characteristic

Types of mycosis



Learning Objectives

- Know why we need cultivation of fungi
- Understand the Cultural characteristics
- Media Used for Isolation of Fungi
- Introduce common diseases caused by fungi (mycoses)

Pre-questions : what type of culture medium used in each of the following

- 1- media used to isolate *Cryptococcus neoformans* from contaminated cultures**
- 2- media used to convert dimorphic fungus *Blastomyces dermatitidis* from mycelial to yeast form**
- 3- Used to recover *Histoplasma capsulatum***
- 4- used in slide cultures; these induce spore formation**
- 5- used to promote spherule production by *Coccidioides immitis***

cultivation of fungi

Place a small amount of **hyphae or spores (or both)** on the center of the agar medium in a Petri dish by using inoculating needle .

Temperature requirements : majority of fungi (37° C), superficial mycosis(30 C), Dimorphic fungi(25-37C).

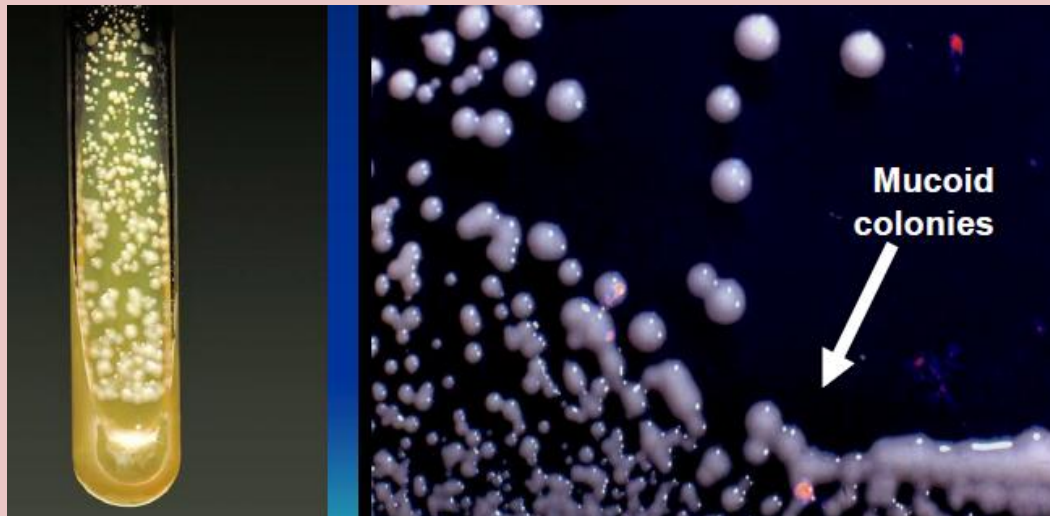
Incubating time : usually cultures are obtained **in 7-10 days, Candida & Aspergillus (24-72 hours)** and **Cryptococcus (up to 6 weeks)**.

Observe the development of colony over a period of incubation, noting **rate of growth, texture, pigmentation** on the surface and reverse side, as well as **folds or ridges** on the surface.

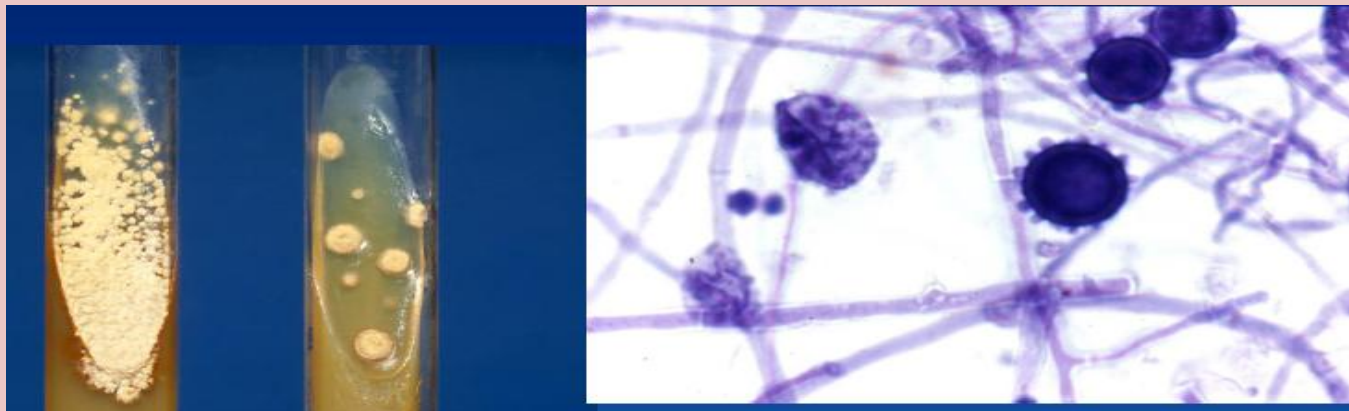
Cultural characteristics

In culture, fungi form colonies, which appear as collections of hyphae with or without spores that arise from a central cell or grouping of cells.

Yeast-like fungi and **dimorphic fungi at 37 °C** form colonies, resemble to bacterial ones: **smooth, creamy, with entire edges, colored in white, beige, and yellowish** Filamentous fungi and dimorphic fungi at 22 °C grow with formation **fluffy, velvety colonies with any color of reverse**.



Deuteromycetes usually form powdery or cottony colonies, pigmented on reverse Morphology of mycelium elements (hyphae, spores, sporangiofores and conidiophores, macroconidia) are important identification criteria for filamentous fungi (dermatomycetes and moulds)



Media Used for Isolation of Fungi

Sabouraud's dextrose agar (Sab-Dex) - classic medium, recommended for most studies

Sabouraud's dextrose agar with chloramphenicol - chloramphenicol inhibits bacterial growth

Mycosel agar - commercially available. Contains chloramphenicol to inhibit bacterial growth; **cycloheximide** to inhibit saprophytic fungi and some yeasts (including *Cryptococcus neoformans*)

Brain heart infusion slant (BHI) - more enriched than Sab-Dex. Used to recover *Histoplasma capsulatum*

Potato-dextrose agar (PDA) and Corn-meal agar - used in slide cultures; these induce spore formation, which greatly aids in identification

Special Applications Media

Caffeic Acid Agar - *Cryptococcus neoformans* will produce melanin **resulting in black colonies** (protect media from light during incubation)

Birdseed Agar - **used to isolate *Cryptococcus neoformans* from contaminated cultures**

KT Medium & Kelley Agar - used to convert **dimorphic fungus *Blastomyces dermatitidis* from mycelial to yeast form**

Modified Converse Liquid Medium (Levine's) - used to promote spherule production by *Coccidioides immitis*

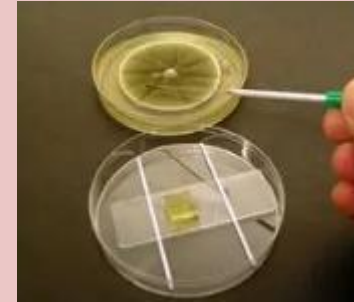
Christensen's urea agar - urea is hydrolyzed by some yeast to form ammonia. The pH increases turning the media from **yellow to dark pink**

Colony Morphology (macroscopic features)

- **Surface topography** - some fungal colonies may cover the entire surface of agar; others grow in a more restricted manner
- **Surface texture examples**: cottony or wooly (floccose), granular, chalky, velvety, powdery, silky, glabrous (smooth, creamy), waxy
- **Pigmentation** - fungi may be colorless or brightly colored.
- **Color** may be on fungus itself, on its sporulating apparatus, on the agar, or on the bottom of the colony (reverse pigmentation). Pigment color is due to the color of the sporulating apparatus. Pigment can diffuse into the agar. It is important to note the top pigment (obverse); the underside pigment (reverse); and any discoloration of the medium

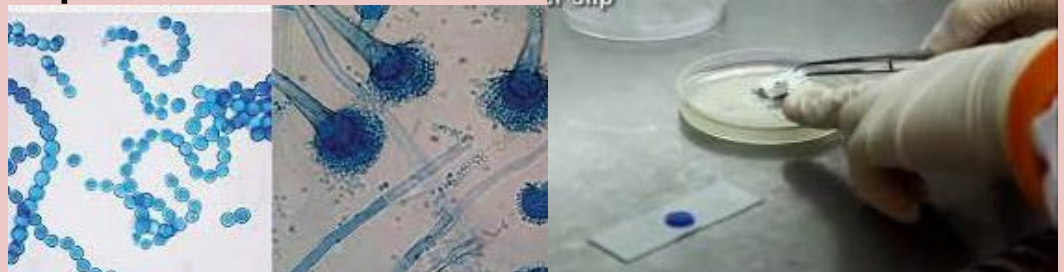
Microscopic Evaluation of Fungi

Teased Preparations – part of the colony is removed to a slide with inoculating needle.



- **Lactophenol** cotton blue stain often used

Slide Culture Techniques - provides a view of undisturbed microscopic morphology



- **Transparent Tape Preparation** – clear cellophane tape used to “lift” parts of a colony to a microscope slide



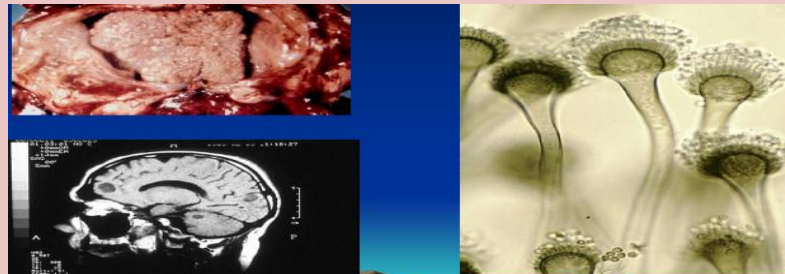
mycosis

Fungal infections, or **mycosis**, are diseases caused by a fungus (yeast or mold). Fungal infections are most common on **skin** or **nails**, but fungi (**plural of fungus**) can also cause infections in **mouth, throat, lungs, urinary tract** and many other parts of the body.

Fungal infections can be on the surface of your **skin, nails** or **mucous membranes** (**superficial or mucocutaneous**),



underneath **skin** (**subcutaneous**)
or inside other organs of your body — like **lungs, brain or heart** (**deep infection**).



Superficial fungal Infections

Superficial fungal Infections affect nails, skin and mucous membranes (like mouth, throat or vagina). Examples of superficial fungal infections include:

Ringworm (dermatophytosis). A group of fungi that live off of skin, hair and nail cells (dermatophytes) cause ringworm

Onychomycosis. Many types of fungi cause infections of your fingernails or toenails (onychomycosis). This can cause discolored and cracked nails.

Candidiasis. *Candida* (usually *Candida albicans*) causes skin and mucous membrane (mucocutaneous) infections called candidiasis.

Tinea versicolor/pityriasis versicolor.

The fungus *Malassezia* causes skin discoloration called tinea versicolor or pityriasis versicolor

Superficial mycoses



Subcutaneous fungal infections

Subcutaneous fungal infections are more common in tropical and subtropical areas of the world. Examples include:

Sporotrichosis (rose gardener's disease). *Sporothrix* fungus causes sporotrichosis. You can also get sporotrichosis in lungs or other parts of the body.

Chromoblastomycosis. Many different fungi can cause chromoblastomycosis. It can cause a long-lasting (chronic) skin infections. Rarely, it spreads to other parts of the body.

Eumycetoma. Many different fungi can cause eumycetoma. It most commonly affects the feet.



Deep fungal infections

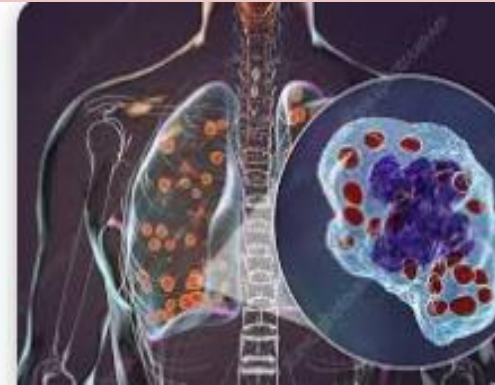
Deep fungal infections are found in places in body other than skin, like lungs, blood, urinary tract or brain. Some are opportunistic infections, meaning that they usually only cause disease in people with weakened immune systems.

Deep or invasive fungal infections include:

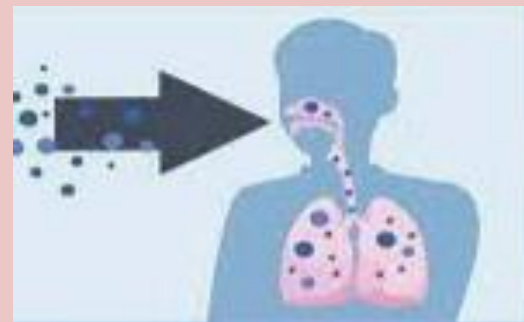
Histoplasmosis. *Histoplasma*, the fungus that causes histoplasmosis, can infect lungs, brain or other parts of the body

Coccidioidomycosis (Valley fever). Caused by the fungus *Coccidioides*,

Blastomycosis. *Blastomyces*, the fungus that causes blastomycosis, commonly infects your bones, skin and lungs. Rarely, it can also infect your brain and spinal cord.



Valley Fever (Coccidiomycosis)



Blastomycosis



Post question : Fill the blanks :

1-fungi incubating time : usually cultures are obtained in
for *Candida* & *Aspergillus* in..... and *Cryptococcus*.....

2- *Mycosel* agar - commercially available. Contains chloramphenicol
to inhibit growth; *cycloheximide* to inhibit
.....fungi

3-Fungal infections can be on the surface of *skin, nails* or *mucous
membranes* called, underneath *skin* called.....
or inside other organs of the body — like *lungs, brain or heart*
called

4- *Deuteromycetes* usually form Or colonies.

5- Morphology of mycelium elements are important identification
criteria for filamentous fungi And

Key answers

Pre questions

1-Bird seed Agar

2- KT Medium & Kelley Agar

3- Brain heart infusion slant (BHI)

4- Potato-dextrose agar (PDA) and Corn-meal agar

5- Modified Converse Liquid Medium (Levine's)

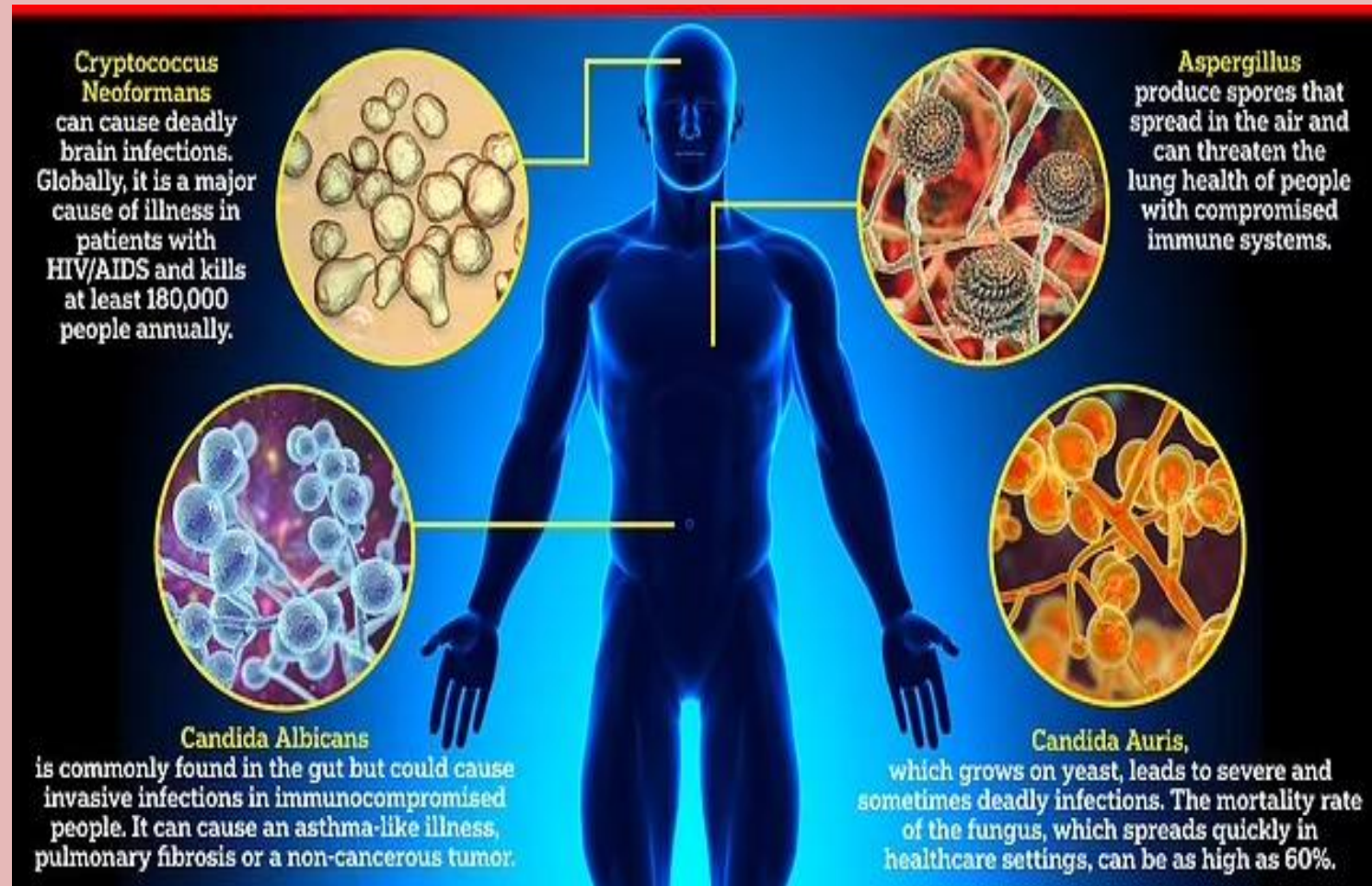
Key answers post questions

Answers

- 1- 7-10 days , 24-72 hours , up to 6 weeks
- 2-bacterial , saprophytic
- 3- superficial or mucocutaneous , subcutaneous, deep infection
- 4- powdery or cottony
- 5- dermatomycetes and moulds
- 6--plasmogamy ,karyogamy , meiosis

Lecture five :

General principle in fungal infection



Learning Objectives

- Understand the basic principles in treating fungal infections.
- Identify the role of host immunity in fungal infections.
- Recognize how antifungal drugs are selected.

Pre-Lecture Questions

- **What do you already know about fungal infections?**
 - **Can you name any common antifungal drugs?**
 - **How do you think the immune system interacts with fungal pathogens?**

It is important to have a systematic approach to antifungal management, as the number of treatment options for invasive molds have increased and each antifungal has unique advantages and disadvantages for the specific patient and time of use .

There are 10 principles for consideration in the individual patient

PRINCIPLE 1: KNOW THE SPECTRUM OF ACTIVITY OF COMMONLY USED ANTIFUNGALS

The three major classes of modern antifungals used in the treatment of mold infections consist of:

- the triazole antifungals**
- echinocandins**

AMB-based therapy(amphotericin B)

PRINCIPLE 2: KNOWLEDGE OF THE PATHOGENESIS AND NATURAL HISTORY OF MOLD INFECTIONS IS ESSENTIAL FOR EFFECTIVE USE OF ANTIFUNGAL THERAPY IN HIGH-RISK PATIENTS

Most antifungals are prescribed for prophylaxis or empirical treatment based on clinical signs and symptoms such as persistent fever.

PRINCIPLE 3: IT IS IMPORTANT FOR THE CLINICIAN TO KNOW THE PHARMACOKINETIC AND PHARMACODYNAMIC BEHAVIOR OF ANTIFUNGALS

Even the most broad-spectrum antifungals have notable pharmacokinetic limitations. These limitations are driven by the fact that these agents when given orally may not be absorbed in the setting of mucositis or poor appetite, as is the case with posaconazole.

PRINCIPLE 4: KNOW THE ADVERSE EFFECTS OF ANTIFUNGALS

Antifungal medications target fungi that are eukaryotic organisms. Not surprisingly, these drugs have some toxicities in humans that can be magnified or accelerated in medically complex patients receiving multiple medications

PRINCIPLE 5: EARLY DIAGNOSIS IS THE MOST IMPORTANT VARIABLE IN TREATMENT RESPONSE

Antifungal drugs work well when the inoculum is lowest and the risk of dissemination to other organs is low

PRINCIPLE 6: KNOW YOUR LOCAL EPIDEMIOLOGY

Analysis of the local epidemiology of invasive fungal infections is essential for effective infection control programs and antifungal stewardship

PRINCIPLE 7: THE PROGNOSIS OF INFECTION IS HEAVILY DEPENDENT ON THE DEGREE AND COURSE OF IMMUNOSUPPRESSION IN THE PATIENT

Immunosuppression, like immunity itself, is highly individualized and sometimes difficult to define objectively. Nevertheless, clinicians must have a concept of the patient's "net state of immunosuppression" and understanding of future immunosuppression risks when developing an individualized treatment plan

PRINCIPLE 8: VARIABLES INFLUENCING THE SELECTION OF AN ANTIFUNGAL AGENT CHANGE IN THE ACUTE VERSUS CHRONIC STATES OF TREATMENT

For an acutely ill patient, selection of an antifungal should initially focus on agents with the broadest spectrum of activity and pharmacokinetic predictability over patient convenience and risks of future toxicity.

PRINCIPLE 9: THE MANAGEMENT OF OPPORTUNISTIC MOLD INFECTION NEEDS MULTIDISCIPLINARY APPROACH

A coordinated approach by an expert clinical mycologist, in close collaboration with a hematologist, is of paramount importance

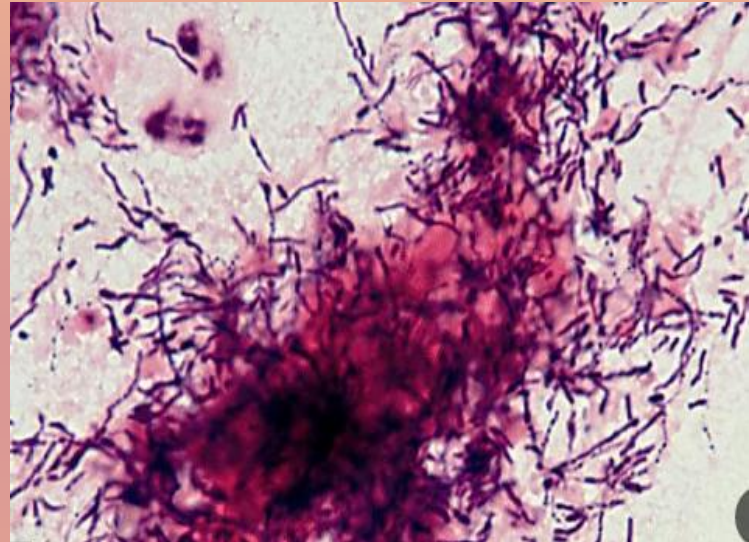
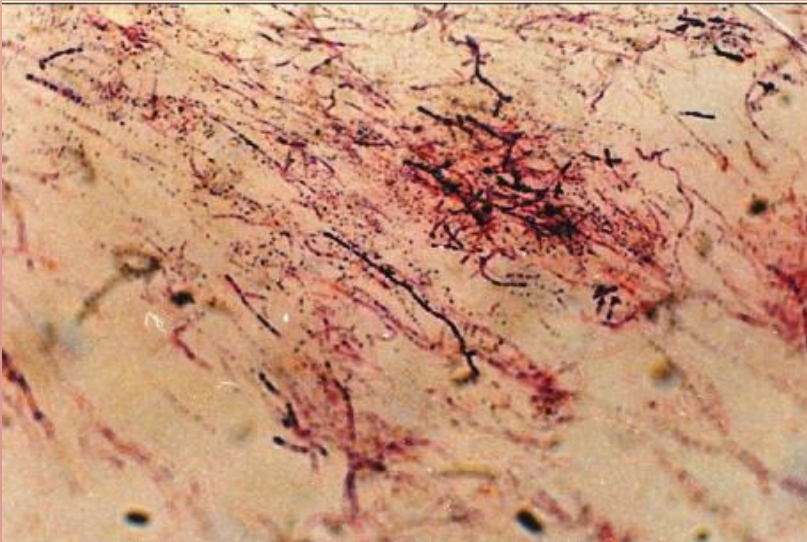
**PRINCIPLE 10: EVIDENCE-BASED TREATMENT
GUIDELINES ARE A STARTING POINT, NOT A ROADMAP,
FOR MANAGING PATIENTS WITH INVASIVE FUNGAL
INFECTIONS**

instructions treatment guidelines have been published that provide evidence-based recommendations for the diagnosis and treatment of invasive aspergillosis (Walsh et al. 2008) and empiric treatment of invasive fungal infections

Post-Lecture Questions

- What are the basic principles in managing fungal infections?
 - How does the immune system influence treatment choice?
 - What are some key classes of antifungal drugs and their mechanisms?

Lecture 5 – Actinomyces, Nocardia, Mycetoma



Learning Objectives

- Describe the morphology and clinical features of Actinomyces and Nocardia.
- Differentiate between actinomycetoma and eumycetoma.
- Understand diagnostic methods and treatment strategies.

Pre-Lecture Questions

- What are Actinomycetes and Nocardia ? Are they **Fungi or Bacteria**?
- Have you heard of Actinomyces or Nocardia before?
- Do you know what mycetoma means?
- What do you think causes chronic discharging skin sinuses?

lecture six :

Actinomycosis, Nocardiosis, and Actinomycetoma

Actinomycetes are **mould** like **bacteria** which were once thought to be **fungi**; because of their mycelial structure and formation of conidia on aerial branches (character of filamentous fungi). However, now they have been shown as **prokaryotes** and resemble bacteria in cell structure and chemical composition. Thus actinomycetes are Gram positive bacteria characterised by filament formation.

Nocardia species are thin, aerobic, gram-positive bacilli bacteria that form branching filaments showing **less beading than Actinomyces** .

Mycetoma is a chronic infection of the skin and the subcutaneous tissue. It can sometimes also affect **muscles, bones, tendons and joints**.

Mycetoma is characterised by nodules and sinus tracts that discharge watery fluid or pus containing grains .

Mycetoma is classified as:

Eumycetoma — when it is caused by a **fungus**;

Actinomycetoma— when it is caused by filamentous **bacteria** from the order, actinomycetes



Mycetoma foot



Eumycetoma



Actinomycetoma due to nocardia

Eumycetoma

Dark or black grains

Madurella mycetomatis



Mycetoma foot

the most common cause of eumycotic mycetoma worldwide, causing disease predominantly in South America, Africa, and India. Granules (0.5–5 mm diameter) are reddish brown or black and hard and are composed of hyphae embedded in a brown, cement-like matrix

White, pail or unstained grains

Thirteen species of fungi (3 belonging to the Ascomycota and 10 belonging to the Deuteromycota) are known to cause white grain eumycetoma

***Acremonium* spp**



What are the symptoms of mycetoma?

Mycetoma usually progresses slowly.

starts with a painless lump under the skin progresses to open infection discharging small 'grains' containing fungal spores causes swollen, disfigured body parts – most commonly hands and feet, back, and buttocks

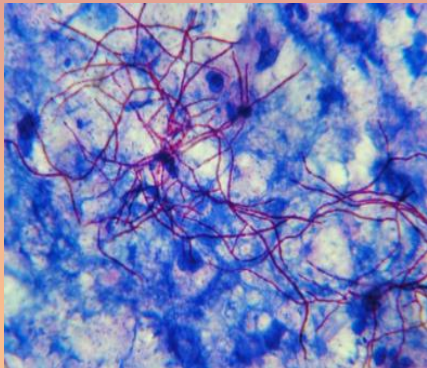
What is the treatment for mycetoma?

Mycetoma cannot be cured without active treatment.

It requires antibiotics (for actinomycetomas) or oral antifungals (for eumycetomas) for weeks, months or years. Damage to subcutaneous tissues (muscle, bones, joints or tendons) often persists, so local surgery (including amputation) and physiotherapy may be required

Nocardiosis is a disease caused by bacteria found in soil or standing water. It starts in lungs or skin, and can cause serious problems if it gets into bloodstream and infects other parts of the body.

Nocardiosis comes in two forms. You get the pulmonary (lung) version from breathing in the bacteria. The second type is primary cutaneous (skin). That's when the bacteria gets into an open wound like a scratch.



Actinomycetoma due to nocardia

Nocardia asteroides usually causes **pulmonary and disseminated infection**.

Nocardia brasiliensis most commonly causes **skin infection**, particularly in tropical climates. Infection is via inhalation or by direct inoculation of the skin.

Symptoms and Signs of Nocardiosis

The most common symptoms of pulmonary **involvement—cough, fever, chills, chest pain, weakness, anorexia, and weight loss**—are nonspecific and may resemble those of tuberculosis or suppurative pneumonia.

Skin or subcutaneous abscesses occur frequently, sometimes as a primary local inoculation.

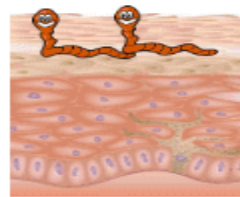
What is the Difference Between Nocardia and Actinomyces

NOCARDIA	ACTINOMYCES
A genus of aerobic Gram-positive bacteria which forms filamentous cells that fragment into rod-shaped or coccoid elements or L-forms	Any of a genus of filamentous or rod-shaped bacteria that includes usually commensal and sometimes pathogenic
A saprophytic organism with a worldwide distribution in the soil	A part of the normal flora of the mouth and gastrointestinal tract
An aerobic bacterium	An aerobic bacterium
Infections are acquired by inhalation of the bacteria or through the traumatic introduction	Cause opportunistic infections
Nocardiosis is the disease caused by <i>Nocardia</i>	<i>Actinomyces</i> causes painless "Lumpy jaws"

Post-Lecture Questions

- How can you differentiate actinomycetoma from eumycetoma?
- What diseases do Actinomyces and Nocardia cause?
- What is the role of laboratory diagnosis in managing these infections?

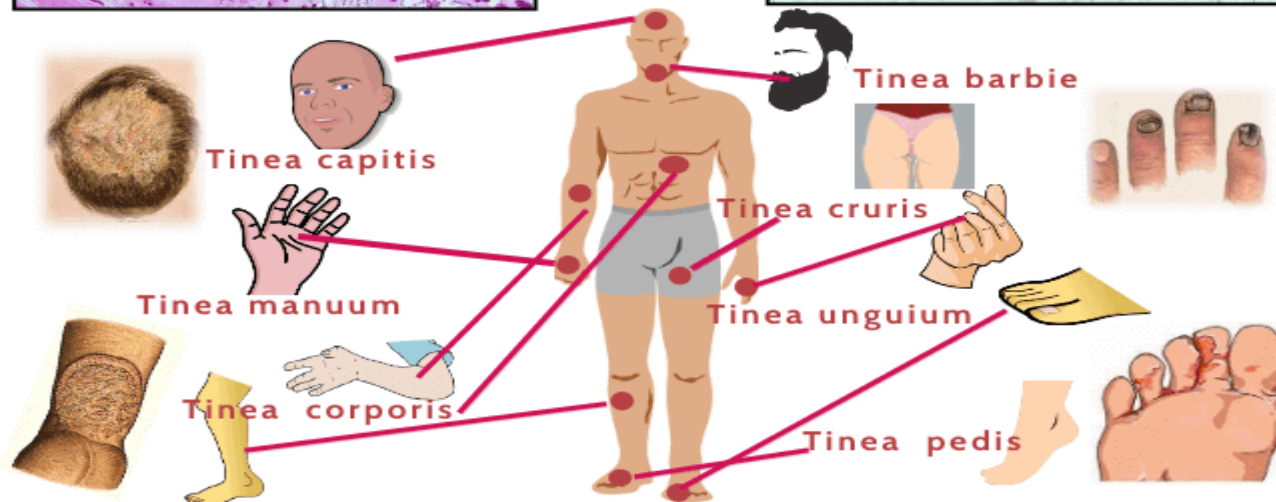
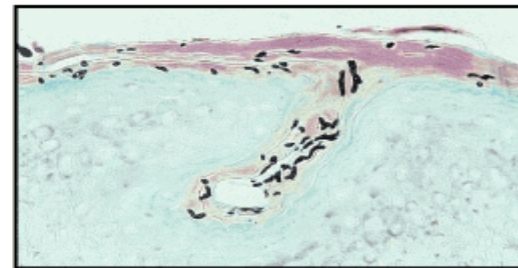
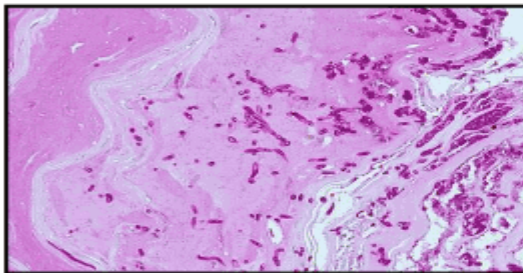
Lecture : eight Dermatophytes



Dermatophytosis (Ringworm, Tinea)



Fungal infection caused by dermatophytes - a group of fungi that invade and grow in dead keratin



#roypath

histopathology-india.net

Learning Objectives

- Identify the major dermatophyte genera.
- Classify different types of tinea infections.
- Explain diagnostic and treatment methods.

Pre-Lecture Questions

- What is a dermatophyte?
- Have you seen ringworm (tinea) in patients?
- What do you know about skin fungi?

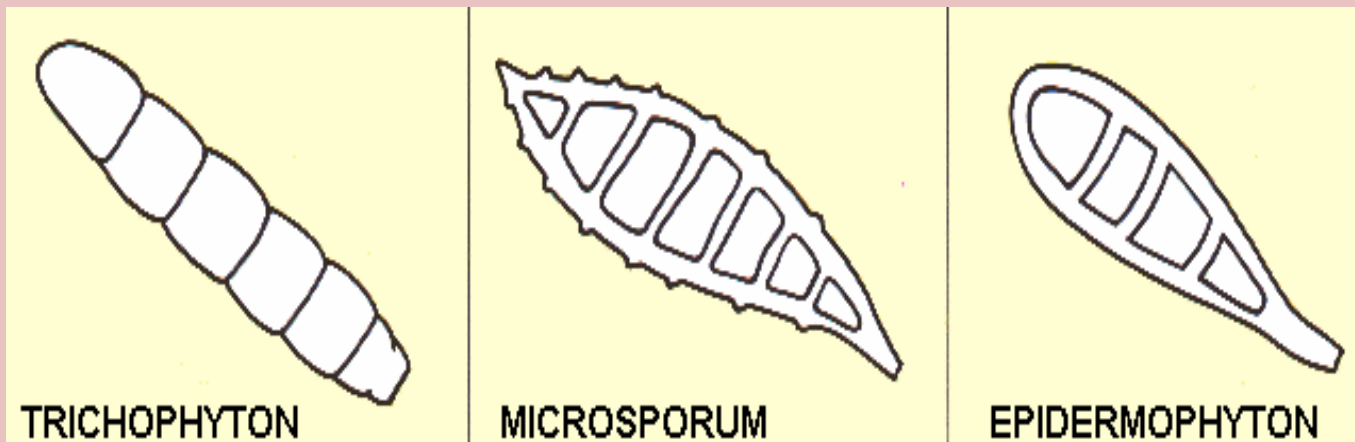
Dermatophytoses or infection of **superficial** keratinized tissues (**skin, nail and hair**) are characterized by **ring-shaped lesion**. Skin scrapings show hyaline septate branching hyphae or arthroconidia.

The principal causative agents are dermatophytes, which are subdivided into three groups (genera) are distinguished by the form of the **spores, or macroconidia** :

Trichophyton: thin-walled, smooth, four to **six septa**

Microsporum: thick-walled, with projections **five to more septa**

Epidermophyton: thick-walled, pear to oval shaped **four or fewer septa**



Depending on the **mode of transmission**, they are classified as -**Anthropophilic** (from humans) -**Zoophilic** (from animals) -**Geophilic** (from soil).

Types of dermatophytoses depending on **site of infection**

• Tinea capitis (head) • Tinea corporis (body)



• Tinea barbae (face)



• Tinea unguinum (nail)



• Tinea pedis (foot)





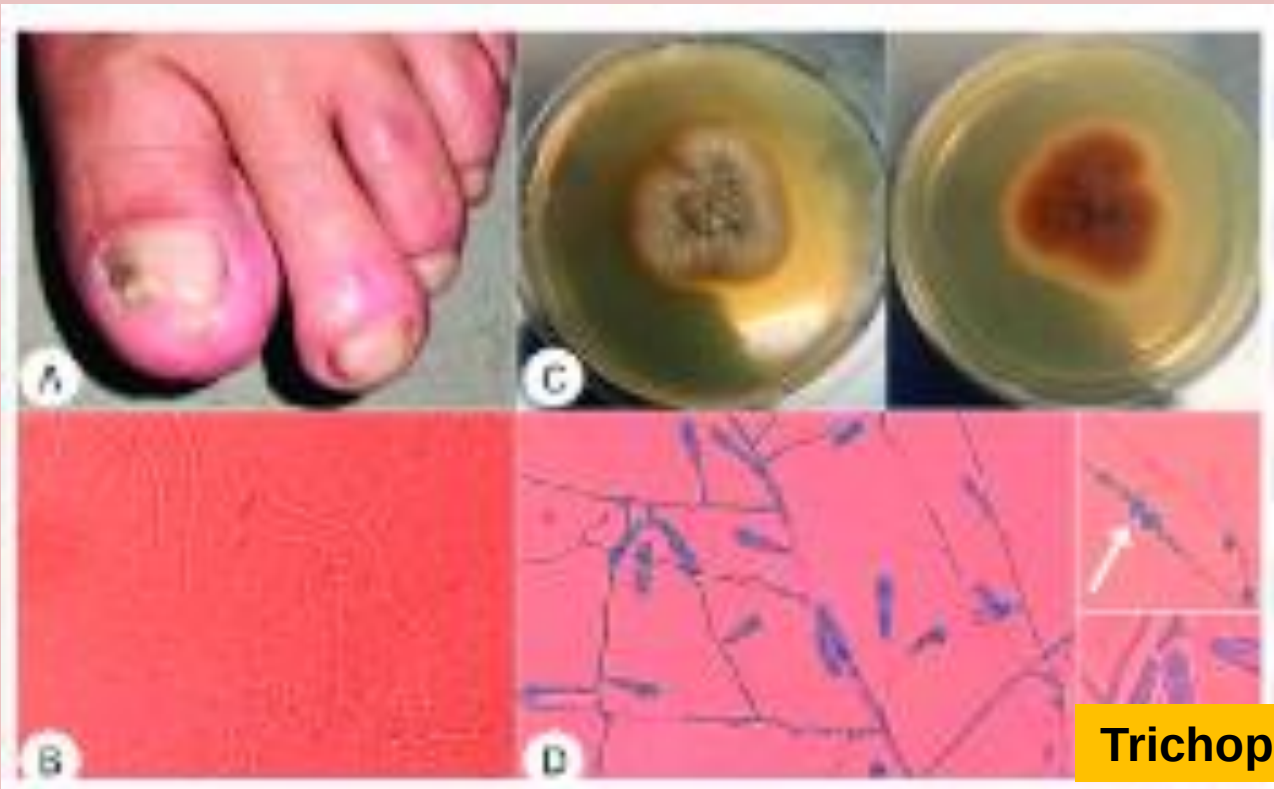
Tinea corporis (body)



Tinea capitis (head)

Microsporum. canis

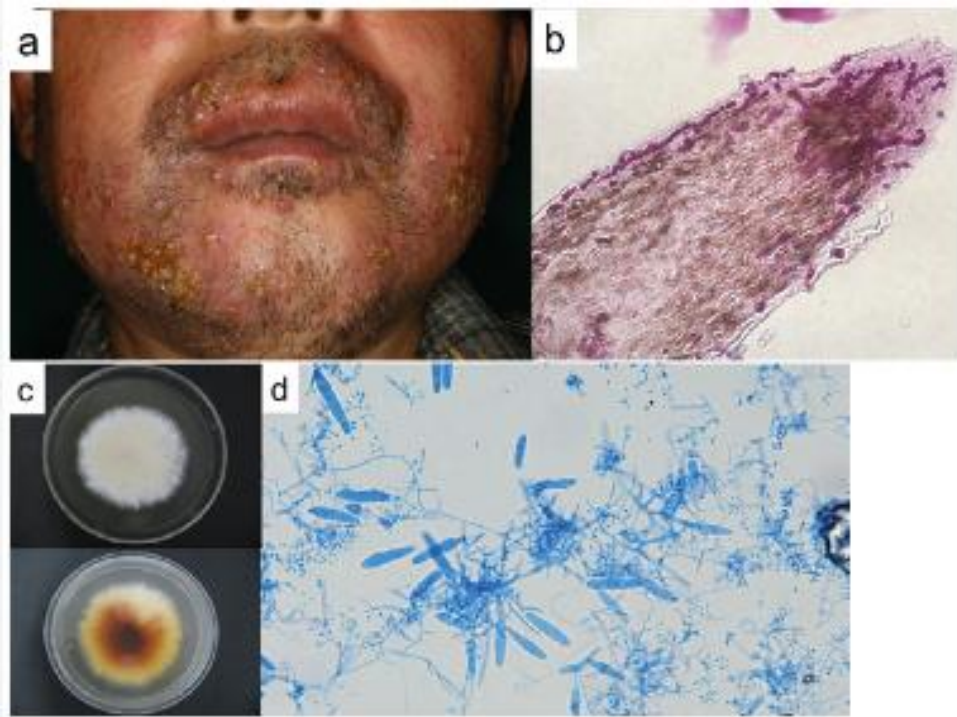
Tinea unguium (nail)



Trichophyton rubrum

Tinea barbae (face)

Trichophyton verrucosum



Trichophyton mentagrophytes



Dermatophyte Test Medium (DTM) is a specialized agar used in medical mycology.

It is based on

- **SDA** with added **cycloheximide** to inhibit saprotrophic growth, antibiotic to inhibit bacterial growth
- **phenol red a pH indicator**. changing from yellow to red indicates dermatophyte presence

The pH indicator is useful in distinguishing a dermatophyte fungus, which utilizes **nitrogenous material** for preferred metabolism, producing alkaline by-products, imparting a red color change to the medium.

Typical saprotrophic fungi utilized carbohydrates in the medium producing acidic by-products and no red color change.

.

Laboratory Diagnosis

The evolution of clinical presentation and varied manifestation poses a practical difficulty in differentiating dermatophytoses from non-dermatophytic or non-mycotic dermatoses. Hence, to initiate appropriate therapy, there is a need for appropriate laboratory diagnoses. To obtain optimal results, the quality and quantity of the clinical material examined is critical. Skin scrapings should be collected from the edge of the lesion and transported on a sterile black chart paper to keep the sample dry, thus preventing bacterial contamination.



Direct microscopic examination—10–40% KOH mount (10% for skin scrapings and 40% nail clippings) is useful for rapid detection of dermatophytoses



Fungal culture aids in definitive identification of fungal species, Species identification is based on the characteristics of colony, morphology and physiologic tests,



Molecular methods :have been developed to provide more rapid and accurate alternatives to existing dermatophyte identification methods due to overlapping phenotypic characteristics, variability and pleomorphism. **These include gene-specific PCR**

General Measures

- Use of loose-fitting clothes made of cotton should be encouraged.**
- Emphasis should be given on importance of regular use of medicines.**
- Sharing of bed linens, towels, clothes and shoes should be avoided.**
- All the clothing, especially socks, caps, undergarments, should be washed in boiling water, sun dried and ironed before reuse.**
- Patients with risk factors like obesity or excessive sweating should be encouraged to use absorbent powders, deodorants (to reduce perspiration), frequent changes of clothes and advised weight reduction appropriately.**
- In tinea pedis, prophylactic use of anti-fungal powders is advised. Patients should avoid the use of occlusive footwear.**

Medical Management

Topical anti-fungal therapy forms the mainstay of treatment in localized and naive dermatophytic infections. Topical anti-fungal agents are recommended for dermatophytoses affecting skin and presenting as localized infections

Dose and duration of systemic antifungals in dermatophytic infection.

	Fluconazole	Griseofulvin	Itraconazole	Terbinafine
Tinea Capitis	6 mg/kg/day × 3–6 weeks	10–15 mg/kg/day (ultramicrosize) 20–25 mg/kg/day (microsize suspension) × 6–8 weeks	5 mg/kg/day × 4–8 weeks	Adults: 250 mg/day × 3–4 weeks. Children: Granules: 125 mg (<25 kg), 187.5 mg (25–35 kg) or 250 mg (>35 kg) × 3–4 weeks
Tinea Corporis/Cruris	2–4 weeks	2–4 weeks	1 week	1 week
Tinea Unguium	3–4 months for fingernails. 5–7 months for toenails	1–2 g/day (microsize) or 750 mg/day (ultramicrosize) until nails are normal	200 mg/day × 12 weeks or 200 mg twice a day (BID) × 1 week/month for 2–4 consecutive months	12 weeks 6 weeks
Tinea pedis	4–6 weeks	4 weeks	1 week	2 weeks

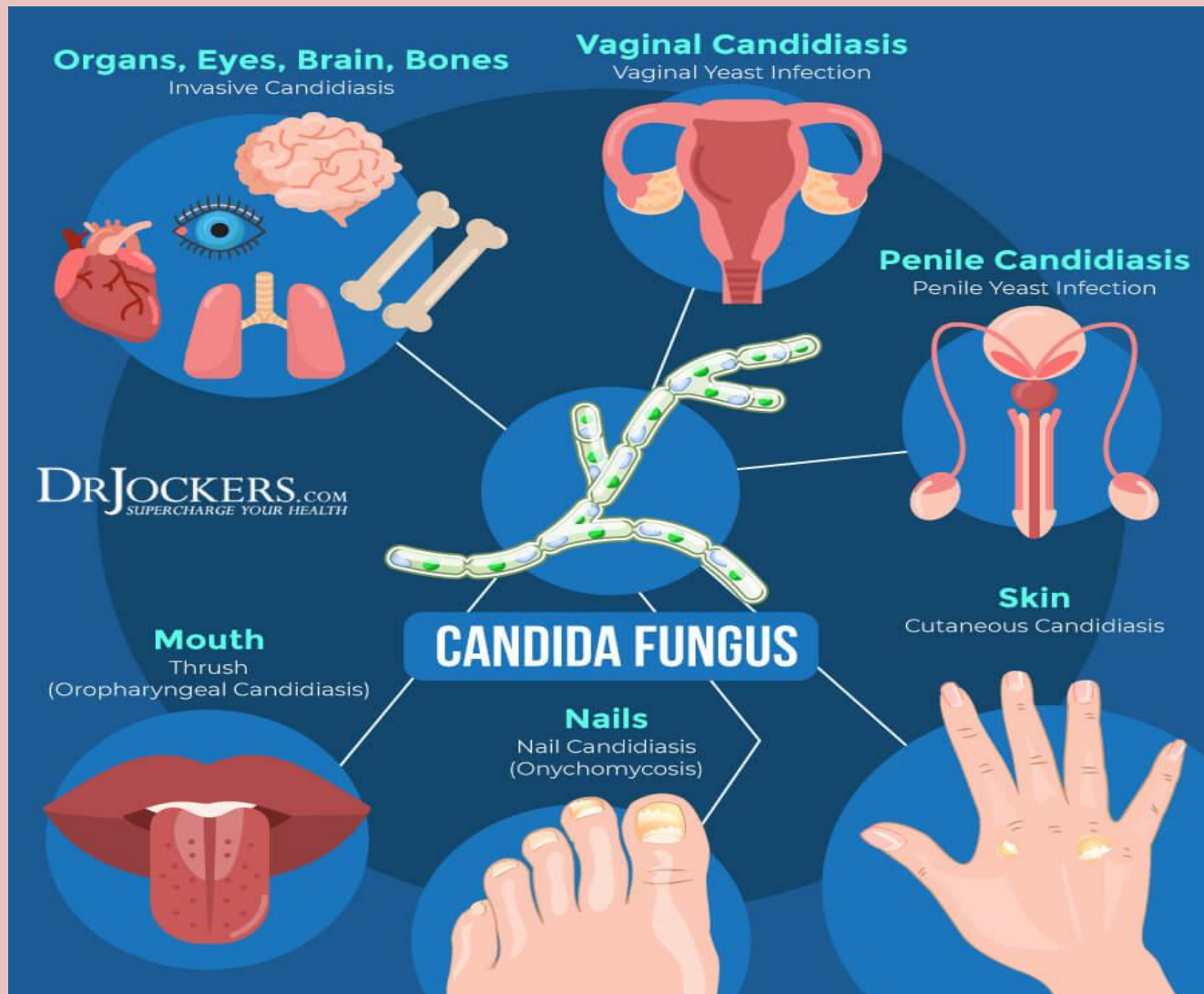
Post-Lecture Questions

- Name the main dermatophyte genera.
- How is tinea classified based on body location?
- What is the KOH test used for?

Learning Objectives

- Recognize common Candida species and their characteristics.
- Differentiate between superficial and systemic infections.
- Understand diagnostic tools and antifungal treatment.

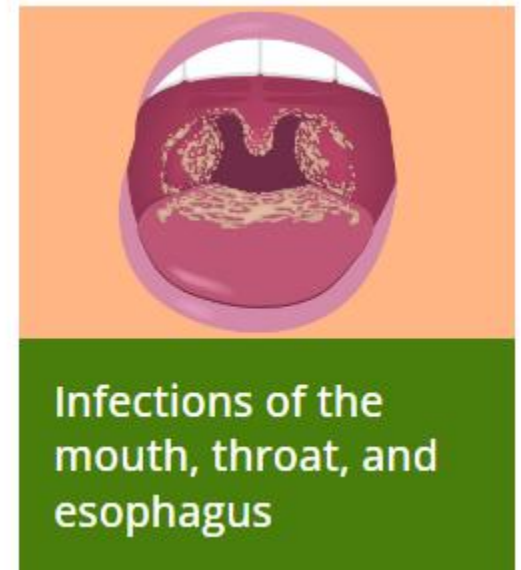
nine lecture :Candidiasis



Learning Objectives

- Recognize common Candida species and their characteristics.
- Differentiate between superficial and systemic infections.
- Understand diagnostic tools and antifungal treatment.

Candidiasis, also called **moniliasis** or **thrush**, is a kind of yeast infection caused by **yeasts** that belong to the **genus *Candida***. There exist over 20 species of *Candida* yeasts that can lead to infection in humans, among which the most common one is ***Candida albicans***. *Candida* yeasts generally exist in the **gastrointestinal tract** (gut) and can also be found on **skin**, in **mouth**, on **mucous membranes**, and in the **vagina** (in the case of women), without causing infection. However, overgrowth of these microorganisms can result in symptoms to develop.



Different Types of Candidiasis

There are several different types of candidiasis according to infectious organisms. The common types of *Candida* infections include:

Vaginal Candidiasis•

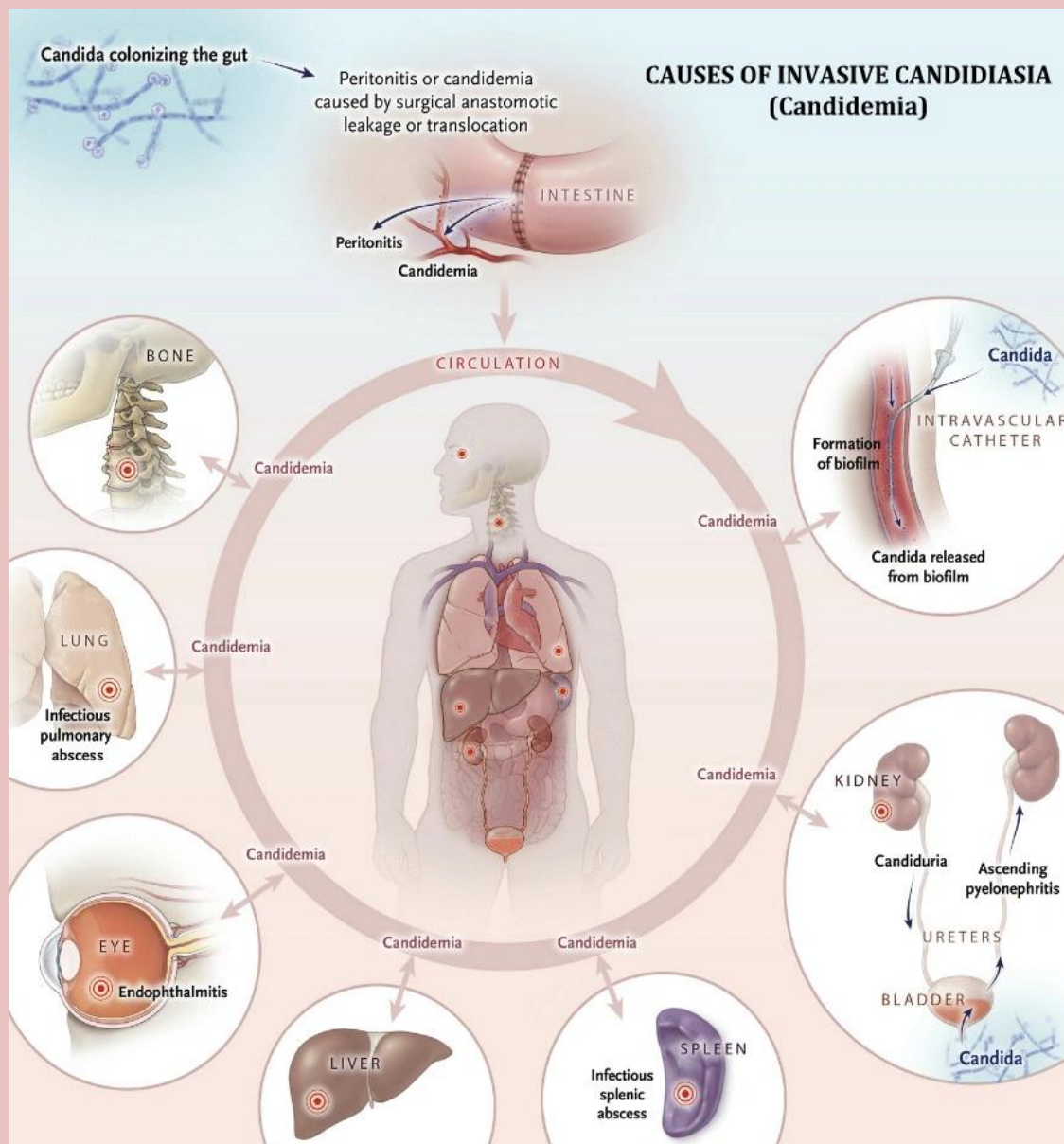
Candidiasis in the vagina is commonly called a “vaginal yeast infection.” This infection is also known as “vaginal candidiasis”, “candidal vaginitis” or “vulvovaginal candidiasis.” Vaginal candidiasis occurs when the environment inside the vagina changes in a way that encourages the growth of *Candida* yeasts

Invasive Candidiasis•

Invasive candidiasis occurs when *Candida* yeasts invade into the bloodstream and spread throughout the whole body. Invasive candidiasis is a serious infection which can affect the heart, brain, blood, bones, eyes, and other parts of the body. This type is a common infection in hospitalized patients..

Candida Infections of the Mouth, Throat, and Esophagus•

Candidiasis in the mouth and throat is commonly known as thrush or oropharyngeal candidiasis. Candidiasis in the esophagus is known as Candida esophagitis or esophageal candidiasis. Candida esophagitis is one of the most common fungal infections in patients living with HIV/AIDS.



Vaginal Candidiasis



Invasive Candidiasis

Candida Infections of the Mouth, Throat, and Esophagus

Symptoms of Candidiasis

The symptoms of candidiasis are various depending on the infection site of the body. Signs and symptoms of thrush include **white patches on the tongue** or other areas of the **mouth, throat, and esophagus**. Other symptoms manifest as soreness and swallowing difficulty. When it infects the vagina, symptoms are demonstrated as **genital itching, burning, and sometimes a white "cottage cheese-like" discharge from the vagina**. The *Candida* infections are rarely invasive, which may cause fevers along with other symptoms depending on the infection parts involved.

Diagnosis and Antifungal Drugs for Candidiasis

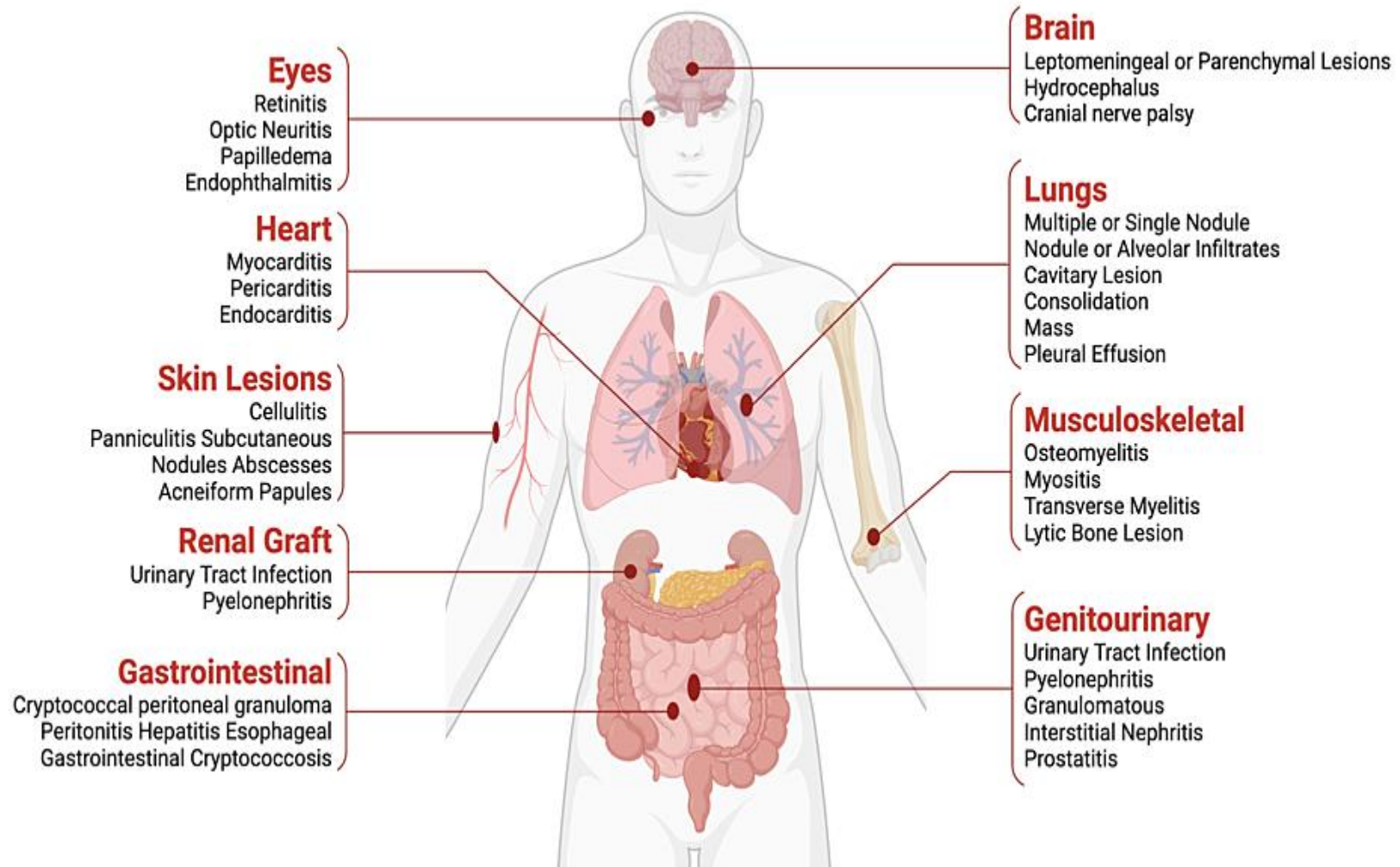
Candidiasis is considered easy to identify since the yeast can be easily seen under the microscope after being scraped off the affected area. Sometimes the appearance of the rash may be enough to make a definite diagnosis. Treatments of candidiasis are generally determined based on the severity of patients' symptoms.



Post-Lecture Questions

- How do superficial and systemic candidiasis differ?
- What is the significance of the germ tube test?
- Which antifungals are used for Candida?

Ten lecture : Cryptococcosis



Learning Objectives

- Describe characteristics of *Cryptococcus neoformans*.
- Understand diseases it causes (e.g., meningitis).
- Learn about CSF diagnosis and treatment options.

Pre-Lecture Questions

- Have you heard of Cryptococcus?
- What symptoms would you expect in fungal meningitis?
- How can fungi reach the brain?

Cryptococcosis is a serious fungal infection caused by breathing in fungal spores in the environment.

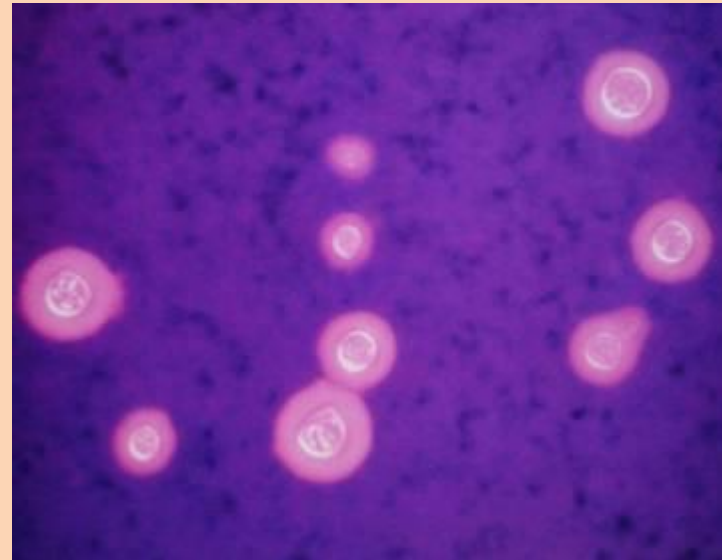
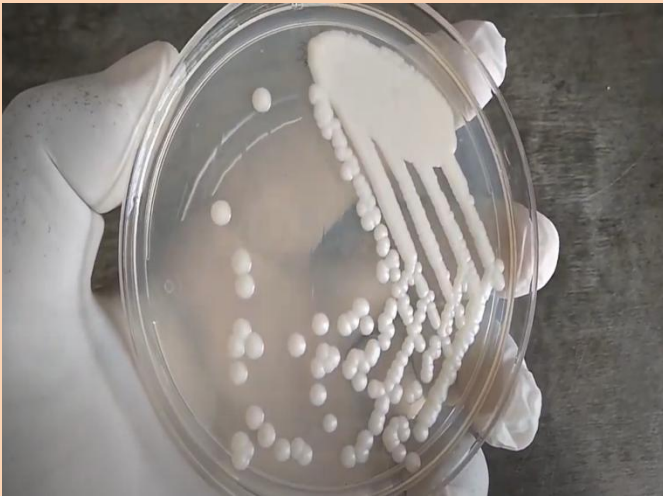
Cryptococcus neoformans and *Cryptococcus gattii* cause most infections.

Most infections occur in people with weakened immune systems, particularly people with HIV/AIDS.

Cryptococcus usually infects the lung or brain (cryptococcal meningitis).

Morphology of *Cryptococcus neoformans*

It is a true yeast characterized by wide carbohydrates capsule and budding, found both in culture and tissue fluid



Virulence of Marker

Polysaccharide capsule

Phenoloxides

Growth rate at 37 °C

Clinical Features

1-Pulmonary Cryptococcosis is characterized by :
formation of nodules in the *C. neoformans*. It is
mainly in immunocompetent hosts like AIDS, tuberculosis
and other immunosuppressive conditions.
It is a systemic infection.

2- Disseminated infections are as follows :
Cerebral cryptococcosis, disseminated cryptococcosis,
and cutaneous cryptococcosis.

A. (SNC) meningeal cryptococcosis

B. Visceral cryptococcosis/osseous cryptococcosis

C. cutaneous cryptococcosis

D. cutaneous cryptococcosis

Symptoms

The symptoms of infection depend on the parts of the body that are affected.

In the lungs

A cryptococcal infection in the lungs can cause a pneumonia-like illness. Symptoms include:

**Cough (most common) -Shortness of breath -Chest pain-
Fever**

In the brain (cryptococcal meningitis)

Infections with *Cryptococcus* can start out as cryptococcal meningitis or infections in the lungs can spread to the brain. Symptoms of cryptococcal meningitis include:
Headache

**Fever-Confusion or changes in behavior-Neck pain-
Nausea and vomiting- Sensitivity to light**

Laboratory Diagnosis of *Cryptococcus neoformans*

Specimen: It depends on the site of infection and the common sample are CSF, sputum, blood, pus, brain tissue, and skin scrapings.

Microscopic examination:

India ink preparation

Other stains: Mucicarmine stain which stains carminophilic cell wall of *C. neoformans*.

Culture:

Sabrose dextrose agar (SDA) without cycloheximide-Colony morphology on SDA are creamy colored and shiny, smooth, mucoid colony.

Selective culture medium: Birdseed agar, niger seed agar, and caffeic acid agar

These media show melanin production i.e. brown colored colonies.

Biochemical test:

Sugar fermentation and assimilation – Do not ferment Carbohydrates

Urea hydrolyzation test: positive

Serology

Antigen detection in the specimen

Method: Latex agglutination test, EIA.

Pathogenicity test: Inoculation of colonies in mice via intracerebral or intraperitoneally which is fatal for mice.

Molecular Test

Detection of *C. neoformans* DNA in tissue samples by Nested and Real-Time PCR Assays

Treatment of *Cryptococcus neoformans*

Following antifungal drugs are used to treat Cryptococcosis.

- Amphotericin B
- 5- fluorocytosine
- Imidazoles (miconazole, keratonazole)
- Triazoles (itraconazole, fluconazole)

Post-Lecture Questions

- What are the key features of Cryptococcus?
- How is cryptococcal meningitis diagnosed?
- What treatment is recommended?

Lecture 12 :

HISTOPLASMOSIS, Sporotrichosis



Learning Objectives

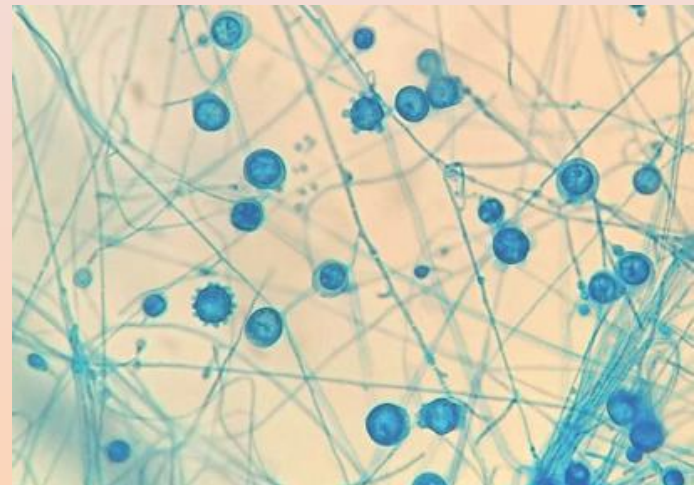
- Understand the dimorphism of Histoplasma and Sporothrix.
- Describe their clinical manifestations.
- Recognize lab diagnostics and treatments.

Pre-Lecture Questions

- What is a dimorphic fungus?
- Do you know diseases caused by soil or plants?
- What organs can fungi infect?

HISTOPLASMOSIS

- Darlings disease
- Causative fungus: *Histoplasma capsulatum*
- Disease of reticuloendothelial system
- Intracellular parasite
- Dimorphic fungus
- World wide in distribution but is most common in America



PATHOGENESIS

- Source of infection :soil enriched with excreta of birds or bats
- Route of infection :inhalation of spores

CLINICAL FEATURES

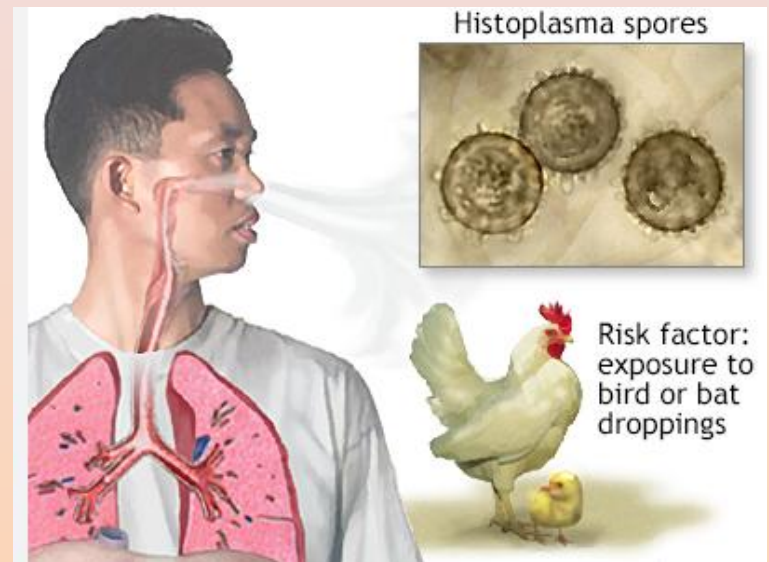
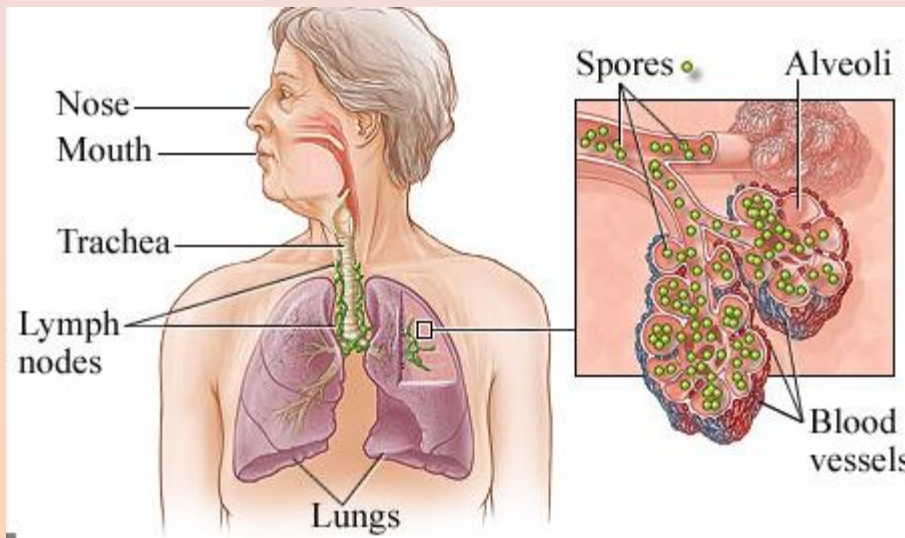
- 90-95% are asymptomatic Acute pulmonary histoplasmosis : flu like symptoms malaise fever chills profuse sweating sore throat

Continued.....

chest pain - cough – dyspnoea

Chronic progressive pulmonary histoplasmosis: acute stage progresses leading to

- haemoptysis
- Apical and subapical cavities



Disseminated histoplasmosis:

develops in minority of infected individuals

- Involvement of RES leads to lymphadenopathy hepatosplenomegaly fever and anaemia

- Cutaneous and mucocutaneous: granulomatous ulcerative lesions

LAB DIAGNOSIS SPECIMENS : sputum bone marrow aspirate peripheral blood scrapings from ulcers biopsies of lymph nodes and other organs

DIRECT EXAMINATION

- Smears of sputum or pus are stained with giemsa or wright stain
- On microscopic examination H.capsulatum appears as small,oval yeast cell (2-4micron)
Packed within the cytoplasm of macrophages or monocyte

CULTURE

- SDA or brain heart infusion (BHI) agar with cycloheximide and chloramphenicol are inoculated
- At 37c yeast phase is formed
 - At 25c appears as white cottony mycelial growth containing large (8-20 microns) thick walled, spherical spores with tubercles or finger like projections

SEROLOGICAL TESTS

latex agglutination precipitation complement fixation

They become positive 2 weeks after infection

- Increase in titre of antibody indicates a progressive disease

HISTOPLASMIN SKIN TEST

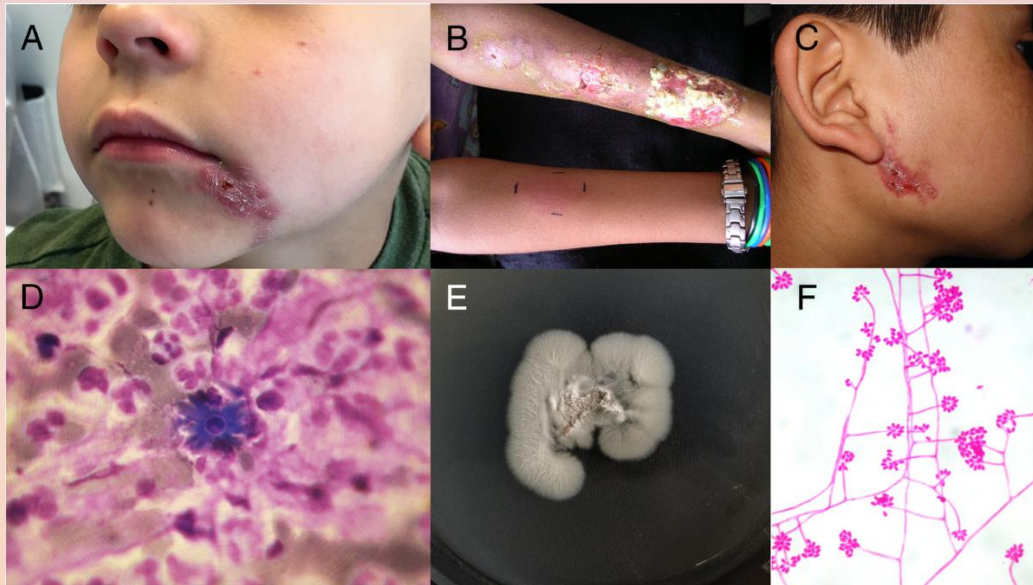
- Delayed hypersensitivity test
 - Similar to tuberculin test but antigen used is histoplasmin
 - Positive reaction indicates past or present infection, but does not differentiate active and passive infections

TREATMENT • Not recommended in asymptomatic cases

- AMPHOTERICIN B
- KETOCONAZOLE
- ITRACONAZOLE

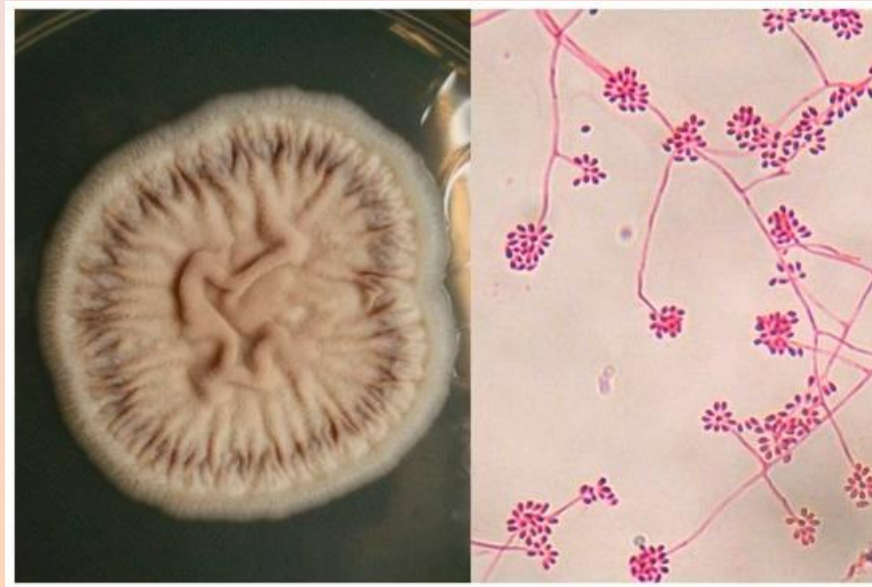
Sporotrichosis

- Subcutaneous Mycosis
- “Rose Gardener’s Disease”



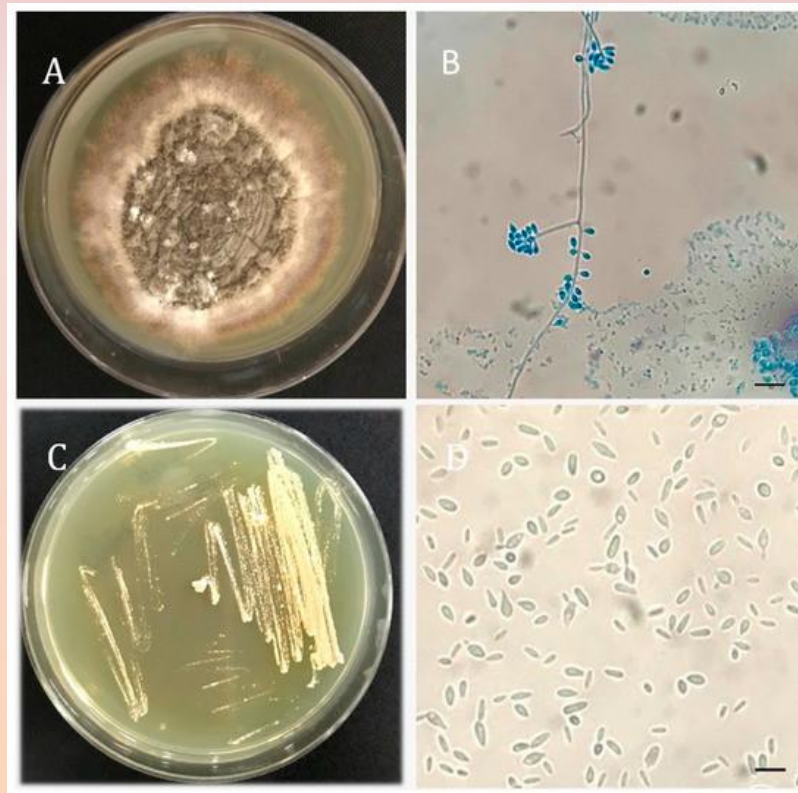
Ausative Agent: *Sporothrix schenckii* complex

- Dimorphic fungus (mold at 25°C, yeast at 37°C)
- Found in soil, decaying vegetation, sphagnum moss
- Belongs to: Order: Ophiostomatales
Class : Sordariomycetes



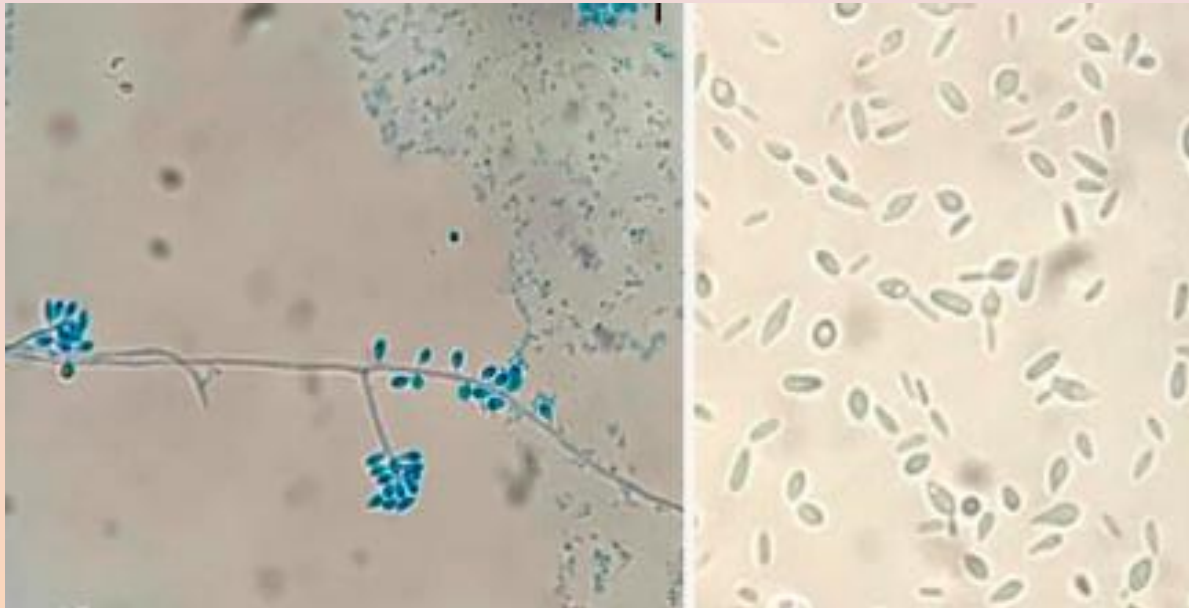
Cultural Characteristics:

- Grows on Sabouraud Dextrose Agar (SDA)
- Mold phase: moist, wrinkled, white → becomes dark brown/black with age
- Yeast phase (37°C): creamy, smooth colonies



Microscopic Features:

- Mold phase: Hyaline septate hyphae with conidiophores ending in flower-like arrangement (daisy or rosette)
- Yeast phase: Cigar-shaped yeast cells



- **Traumatic inoculation:** thorns, wood splinters (common in gardeners, farmers)
- Zoonotic: from infected cats
- Endemic in Latin America, South Africa, Japan



Clinical Forms:

1. Lymphocutaneous (most common): nodular lesions along lymphatics
2. Fixed cutaneous
3. Disseminated (rare, in immunocompromised)

Direct microscopy: low sensitivity

- Culture: definitive, gold standard
- Histopathology: granulomatous inflammation
- PCR or serology (less common)

Treatment:

itraconazole (drug of choice)

- Saturated solution of potassium iodide (SSKI)
- Severe cases: Amphotericin B
- Prognosis: Good if treated early

Aspergillosis & Mucormycosis

Opportunistic Fungal Infections – Pulmonary and Rhinocerebral Mycoses

Aspergillosis – Overview

- Caused by Aspergillus species, especially A. fumigatus
- Ubiquitous mold found in soil, decaying vegetation
- Affects immunocompromised individuals
- Types:
 - Allergic bronchopulmonary aspergillosis (ABPA)
 - Chronic pulmonary aspergillosis
 - Invasive aspergillosis (especially in neutropenic patients)

Aspergillosis – Microscopy & Culture

- Microscopy:
- Septate hyphae
- Acute angle (45°) branching
- Culture:
- Sabouraud Dextrose Agar (SDA)
- Green or blue-green colonies
- Conidiophores with terminal vesicles bearing chains of conidia

Mucormycosis – Overview

- Caused by fungi in the order Mucorales (e.g., Rhizopus, Mucor)
- Rapidly progressive, angioinvasive infection
- Common in:
 - Diabetics (especially in ketoacidosis)
 - Immunosuppressed patients
- Forms:
 - Rhinocerebral
 - Pulmonary
 - Cutaneous
 - Gastrointestinal
 - Disseminated

Mucormycosis – Microscopy & Culture

- Microscopy:
- Broad, ribbon-like, non-septate hyphae
- Irregular, right-angle branching
- Culture:
- Rapid growth on SDA
- Fluffy white to grey colonies
- Invades blood vessels → causes infarction and necrosis

Clinical Presentation :

- **Aspergillosis:**

- Cough, fever, chest pain, hemoptysis
- CT: halo sign or air-crescent sign

- **Mucormycosis:**

- Facial pain, swelling, black necrotic eschar on nasal or oral mucosa
- Eye involvement: proptosis, loss of vision
- Fever, mental status changes (in cerebral involvement)

Diagnosis

- **Aspergillosis:**

- Imaging (CT scan), histopathology
- Galactomannan antigen, β -D-glucan assay
- Culture and PCR

- **Mucormycosis:**

- Direct KOH wet mount
- Histopathology (tissue biopsy)
- Imaging (CT/MRI)
- Culture from deep tissue samples

Treatment

- **Aspergillosis:**

- First-line: Voriconazole
- Alternative: Amphotericin B, Isavuconazole

- **Mucormycosis:**

- First-line: Liposomal Amphotericin B
- Alternatives: Posaconazole, Isavuconazole
- Surgical debridement often necessary
- Urgent management of underlying condition (e.g., hyperglycemia)

Rhizopus & Penicillium

Commonly known as bread mold

Phylum: Zygomycota

Characteristics:

Hyphal structure with stolons and rhizoids

Asexual reproduction: sporangiospores

Sexual reproduction: zygospores

Morphological Characteristics:

Fuzzy, cotton-like colonies

Presence of stolons, rhizoids, sporangia

Microscopic Features:

Hyphae: aseptate, broad

Sporangiospores: produced inside sporangia

Diagnosis:

Culture on Sabouraud agar

Microscopic examination

Treatment:

Antifungals: Amphotericin B

Surgical debridement in invasive cases

Overview of Penicillium

Belongs to Ascomycota

Known for producing penicillin

Characteristics:

Conidiophores with brush-like conidia

Reproduces via conidia

Penicillium - Features & Diagnosis

Morphological Characteristics:

Blue-green colonies

Conidiophores with chains of conidia

Microscopic Features:

Septate hyphae

Conidiophores with phialides

Diagnosis:

Culture on Czapek-Dox agar

Microscopic identification

Treatment:

For infections: antifungals like itraconazole

Used safely in food industry

Summary & Conclusion

- Both fungi are industrially and medically significant
- Rhizopus: molds, decomposition, infections
- Penicillium: antibiotics, food industry
- Accurate diagnosis and treatment are vital



Lecture fifteenth

ANTIFUNGAL AGENTS

- **Antifungal agents classification:**
 - **Antifungal Antibiotics**
 - **Amphotericin B**
 - **Nystatin,**
 - **Griseofulvin**
 - **Synthetic Azole : Ketoconazole**
 - **Allylamines : Terbinafine**
 - **Pyrimidine : Flucytosine**

- **Polyene antibiotics**
- **Action :** The polyene antibiotics bind with sterols in the fungal cell membrane, principally ergosterol. This causes the cell's contents to **leak out and the cell dies**. Animal cells contain cholesterol instead of ergosterol and so they are much less susceptible.
 - Nystatin
 - Amphotericin B (may be administered liposomally)
 - Natamycin
 - Rimocidin
 - Filipin
 - Pimaricin

Amphotericin B

Produced by *Streptomyces nodosus*. Amphoteric polyene macrolide.

Pharmacological Effect: broad-spectrum

Mechanism: Binds to ergosterol in fungi (humans and Mycoplasma have cholesterol) to form pores. The pores permit leakage of intracellular contents leading to cell lysis and death.

Griseofulvin

Derived from a species of Penicillium called *Penicillium griseofulvum*.

Griseofulvin binds to polymerized microtubules and inhibits fungal mitosis.

Fungistatic drug.

Its deposited in newly forming skin where it binds to keratin, protecting the skin from new infection.

Its insoluble but administered in a microcrystalline form only.

Its used in the systemic treatment of dermatophytosis.

Azoles

Azoles are Synthetic compounds.

Classification is according to the number of nitrogen atoms in the five-membered azole ring

The imidazole and triazole groups of antifungal drugs **inhibit the enzyme cytochrome P450 14 α -demethylase**. This enzyme converts lanosterol to ergosterol, and is required in fungal cell membrane synthesis.

These drugs also **block steroid synthesis in humans**.

Mechanism of action of Azoles

- Reduction of ergosterol synthesis by inhibition of fungal **cytochrome P450 enzymes**.
- **Greater affinity for fungal** than for human cytochrome P450 enzymes.
- **Imidazoles exhibit a lesser degree of specificity than the triazoles**, accounting for their higher incidence of drug interactions and side effects.
- Ketoconazole was the first oral azole introduced into clinical use

Imidazole and triazole

Imidazoles: •

Bifonazole
Thiabendazole

Miconazole

Tiaconazole

Butoconazole

Ketoconazole

Sertaconazole

Econazole

Clotrimazole

Sulconazole

Fenticonazole

Mebendazole

Oxiconazole

Isoconazole •

Triazoles: are newer, and are less toxic and more effective: •

Posaconazole

Ravuconazole

Fluconazole •

Voriconazole

Itraconazole •

Allylamines

- Allylamines inhibit the **enzyme squalene epoxidase**, another enzyme required for ergosterol synthesis:
- Allylamines are non-competitive and reversible **inhibitors of Squalene epoxidase**.
- Examples: **Terbinafine, Amorolfine, Naftifine, Butenafine**,
- **Terbinafine** –is marketed as **Lamisil**
- Terbinafine is synthetic, oral formulation & Fungicidal treatment of **dermatophytoses**, especially **onychomycosis (nail infection)**. Its more effective than griseofulvin or itraconazole.

Echinocandin

Echinocandins irreversibly **inhibits** β -1,3 –D glucan **synthase**, the enzyme complex that forms glucan polymers in the fungal cell wall. Glucan polymers are responsible for providing rigidity to the cell wall.

Disruption of β -1,3-D glucan synthesis **leads to reduced cell wall integrity, cell rupture, and cell death.**

Examples include:

Anidulafungin

Caspofungin

Micafungin

Flucytosine

-Flucytosine is a Pyrimidine antimetabolite.

-Flucytosine (5-FC) is a water-soluble pyrimidine analog.

-Its spectrum of action is much narrower than that of amphotericin B.

-Mechanism of action: 5-FC (taken up by fungal cells via the enzyme cytosine permease) → 5-FU → F-dUMP and FUTP → thus inhibiting DNA and RNA synthesis, respectively.

-Synergy with amphotericin B.

-Spectrum of action: *Cryptococcus neoformans*, *Aspergillus*, some candida species (except *C.krusei*), and the dematiaceous molds that cause chromoblastomycosis

Others:

- Fluocinonide**
- Salicylic Acid (topical)**
- Tinactin or Tolnaftate**
- Potassium Iodide**

1. Multiple Choice Questions (MCQs):

- Which of the following antifungal agents inhibits the enzyme cytochrome P450 14 α -demethylase?

- A) Amphotericin B
- B) Azoles
- C) Echinocandins
- D) Flucytosine

- The main component of the fungal cell wall is:

- A) Cellulose
- B) Chitin
- C) Peptidoglycan
- D) Lipopolysaccharide

- Which genus is used as a model organism for biochemical and genetic studies?

- A) Candida
- B) Neurospora crassa
- C) Aspergillus
- D) Mucor

- The disease caused by fungi that infect keratinized tissues like skin, hair, and nails is called:

- A) Candidiasis
- B) Dermatophytosis
- C) Histoplasmosis
- D) Mucormycosis

- Which of the following fungi is responsible for producing penicillin?

- A) Aspergillus niger
- B) Penicillium
- C) Saccharomyces cerevisiae
- D) Candida albican

Q: The characteristic feature of dermatophyte infections is:

- A) Painless, slow-growing nodules
- B) Ring-shaped lesions with hyaline septate hyphae
- C) Rapid ulceration with pus formation
- D) Systemic dissemination in immunocompetent hosts

- Which culture medium is used to induce sporulation in fungi for identification purposes?

- A) Sabouraud Dextrose Agar
- B) Potato Dextrose Agar
- C) Cornmeal agar
- D) Birdseed agar

The primary mode of reproduction in fungi that forms conidia is:

- A) Sexual reproduction
- B) Asexual reproduction
- C) Binary fission
- D) Budding only

2. True/False Questions:

- Fungi are autotrophic organisms.
- The cell wall of fungi is mainly composed of cellulose.
- *Cryptococcus neoformans* produces melanin, which helps in its identification on specific media.
- All fungi are obligate aerobes.
- Dematiaceous fungi produce dark pigmented (melanin-like) hyphae or spores.
- *Candida albicans* can be identified by the germ tube test.
- Zygomycetes reproduce sexually by formation of zygospores.
- Dermatophytes are classified based on the shape of macroconidia.

3. Short Answer / Essay Questions:

- Describe the structural components of fungal cells and how they differ from bacterial and plant cells.
- Explain the classification of fungi based on spore formation and give examples of each group.
- Discuss the pathogenesis and clinical features of superficial fungal infections such as dermatophytoses and candidiasis.
- Outline the principles and methods of laboratory diagnosis of fungal infections.
- Describe the life cycle of *Cryptococcus neoformans* and how it differs from other pathogenic fungi.
- List and explain the main classes of antifungal drugs used in clinical practice.

A microscopic image of a fungus, likely Aspergillus, showing long, thin, branching hyphae and several large, round, textured spore heads. The image is overlaid with a semi-transparent blue filter.

Practical Mycology 2nd Class Lab.1
Mycology
Fungus isolation in genera

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Introduction to the Fungi

- The term Mycology derived from the Greek word mykes, a direct counterpart of Latin word fungus. Therefore mycology is the study of fungi.
- Fungi are eukaryotic organisms that include microorganisms such as yeasts, moulds and mushrooms. These organisms are classified under kingdom fungi.

Isolation Fungi

- ❖ can be isolated from virtually any place on earth, from the tropics to the poles and from the mountain tops to the deep oceans. Fungi can be found in many different environment.
- ❖ They will grow on almost anything.
- ❖ They can be found in forests and gardens; they can also grow on our body.
- ❖ Many species are often found on foods in the form of yeasts and molds.
- ❖ Fungi found in soil (especially containing organic matter), water and even in air.
- ❖ They have important role in decomposing and recycling of compound substances in ecosystem.



Fungi isolate from its natural habitat and cultured on selective media in order to identify the fungal species depending on its morphology of colony and characters of spores.

fungi isolated from:

1.Air

By opening Petri dish that contains sterilized PDA in laboratory air for about 5 minutes.

Then closed

Incubates at 25oC for 5-7 days.

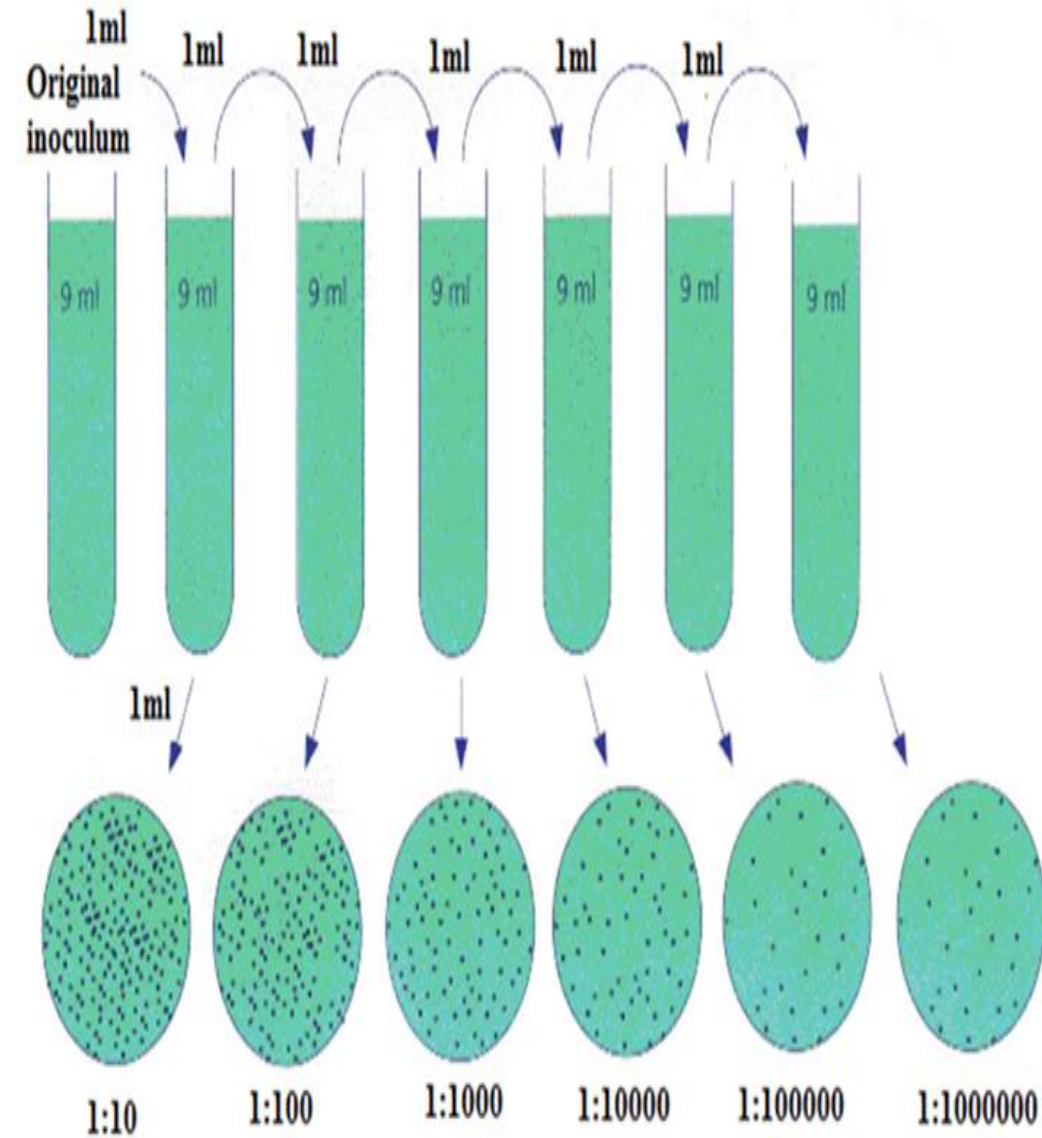
2. Water:

A- Tap water:

1ml of tap water pour into a Petri dish contains sterilized PDA Incubates at 25oC for 5-7 days.

B- Sewage water:

The fungal spores which was found in sewage water can be isolate by pouring 1ml of sewage water into a Petri dish contains sterilized PDA then incubates at 25oC for 5-7 days.



No. of Fungi/gm = No. of colonies on plate $\times$ reciprocal of dilution of sample

3.SOIL:

A-Directly:

1gm of soil takes randomly from 5 different places

Mixed well then spread some of soil into a Petri dish contains sterile PDA

Incubate at 25oC for 5-7 days

B- Indirectly:

Soil fungi can be isolated by serial dilution, for this purpose 1gm of soil transfer to 9ml of SDW

After shaking well 1ml of this suspension transfer to a tube containing 9ml SDW
by using sterile pipette

Shaking well serial dilution continued to 10^{-6}

Then 1ml of each dilution transfer to a Petri dish that contains sterile PDA

Then incubate at 25°C for 5-7 days

4. Infected human:

The infected area cleans with 70% ethanol, and then the specimens were collect as the followings:

1. Skin scales:

Collect by scraping the surface of the margin of the lesion by using a clean slide

2. Crusts:

Collected by removing part it on healthy skin, by using sterilized scissors or forceps

3. Nail pieces:

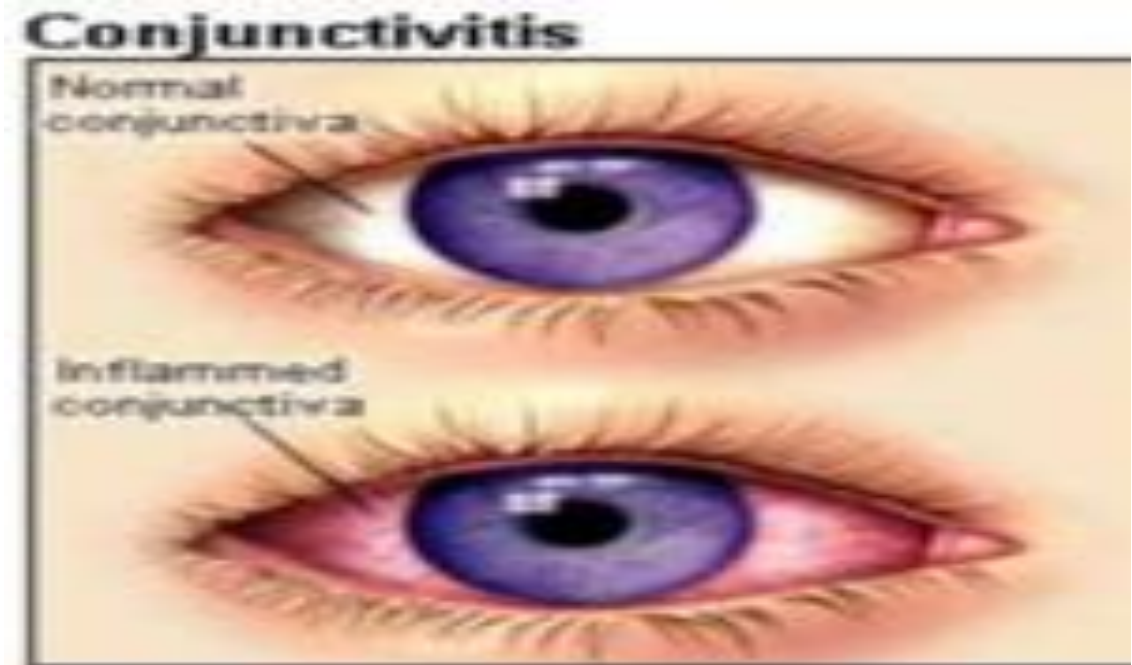
Collect by taking a part of the infected nail by using sterilized scissor

4. Hairs:

Collect by removing broken hairs from the margin of the lesion using sterilized forceps

5. Conjunctival swabs:

With sterile swabs, the conjunctival swabs are taken from the conjunctiva of patient with conjunctivitis in sterile saline.



6. Ear swabs:

With sterile swabs, the ear swabs are taken from the ear canal of diseased man or animals in sterile saline.

7. Nasal swabs:

With sterile swabs, the nasal swabs were taken from the nasal cavity of diseased man or animals in sterile saline.

8. Blood samples:

Blood samples are aseptically collected in tubes containing anticoagulant. The site is swabbed with alcohol then it is punctured with a sterile needle attached to the tube and an amount of 2ml are allowed to pass to the tube.

9. Faecal samples:

Faecal samples are collected in sterile plastic bags. The samples are prepared by mixing sample in sterile normal saline.

10. Oral swabs:

With sterile swabs, the oral swabs were taken from the site of infection in sterile saline.

These samples collect as above the:

1. Direct microscopic examination:

Part of the specimen used for direct microscopic examination, by adding a drop of KOH (20%), put a cover slide on it, then allow for about 15 minutes then diagnosed by light microscope directly.

2. Cultural examination:

Transfer the specimen to a Petri dish contains sterilized SDA (Sabouraud Dextrose Agar + Antibiotic (Chloramphenicol) + Antifungal-Antisaprophyte- (Cycloheximide) and then incubate at 37°C for 10-15 days.

**Practical Mycology 2nd
Class Lab.3
Fungi culture media**



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Culture Media for Fungi

Often the most direct and conclusive way of identifying the fungus causing an infection is to grow it from a patient sample, such as blood, CSF, pus, urine, tissue, respiratory samples (sputum, BAL), pleural, pericardial or peritoneal fluid, skin scraping, hair, nail clippings, oral or vaginal samples.

A microbiological medium is the food that we use for culturing bacteria, molds, and other microorganisms. Media may be either liquid (Broth), solid or semisolid (gel) media

- The growth requirements for fungi may vary from strain to strain, thus media generally contain source of Carbon, Nitrogen ,and Vitamins.
- Glucose(dextrose) is the most widely utilizable.
- Fructose and mannose are the next and are found in media from natural sources.
- Sucrose may be used in some media.
- Culture media for fungi are specific nutrient-rich environments designed to support the growth of different fungal species in laboratory settings.
- The choice of culture media depends on the specific requirements of the fungi being studied.

General Media

These media provide the basic nutrients required for the growth of a wide range of fungi. **Examples:** Sabouraud Dextrose Agar (SDA) and Potato Dextrose Agar (PDA).

Applications: General media are used for the initial isolation and cultivation of fungi from clinical or environmental samples.

Natural Media

These media consist of natural ingredients like potato, carrot, or rice.

Advantages: Natural media often provide a more complex nutrient source, supporting growth of fastidious fungi.

Examples: Potato dextrose agar (PDA) and Sabouraud's dextrose agar (SDA) are commonly used.

Synthetic Media

Composed of chemically defined components, offering precise control over nutrient composition.

Examples: Czapek Dox Agar and Glucose-Yeast Extract Agar.

Selective Media

Inhibit the growth of certain microorganisms while promoting the growth of others.

Applications: Used for isolating specific fungal species from mixed cultures or clinical specimens.

Example: Dichloran Rose Bengal Chloramphenicol Agar (DRBC).

Enrichment Media

Promote the growth of specific fungi by providing specific nutrients or conditions.

Applications:

Used to enhance the growth of particular fungi present in low numbers in samples.

Example: Sabouraud dextrose broth (SDB).

Differential Media

Distinguish between different fungal species based on their biochemical characteristics.

Applications: Used for identifying fungal species based on their ability to ferment sugars, produce pigments, or hydrolyze specific substrates.

Example: Bird seed agar, used to differentiate between various fungal species

some common types of culture media used for fungi

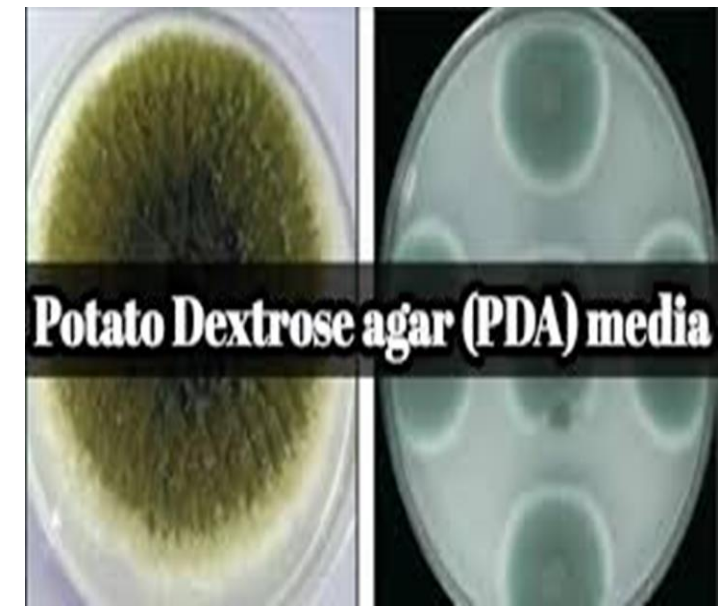
1. Sabouraud Dextrose Agar (SDA):

This is a general-purpose medium used for the cultivation of yeasts and molds.

It typically contains dextrose (glucose) as a carbohydrate source, peptones, and agar.

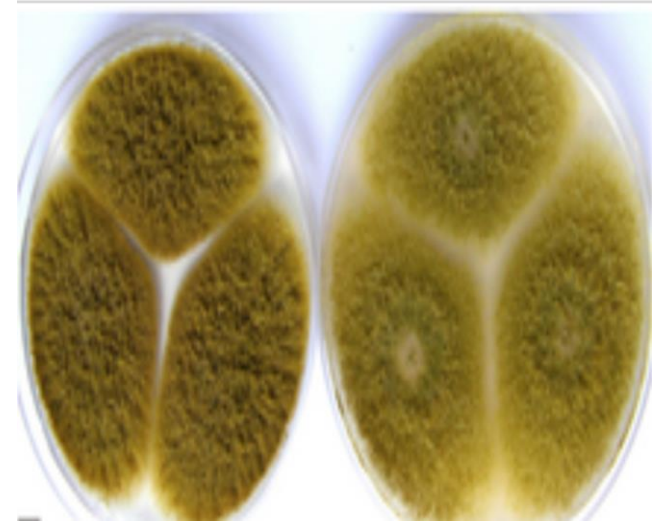
2. Potato Dextrose Agar (PDA):

PDA is another general-purpose medium used for cultivating fungi, especially molds. It includes potato infusion, dextrose, and agar.



3.Czapek-Dox Agar:

This medium is used for fungi that prefer less nutrient-rich environments. It contains sodium nitrate, dipotassium phosphate, magnesium sulfate, and sucrose, among other ingredients.



4.Malt Extract Agar (MEA):

MEA is particularly suitable for the cultivation of fungi that require a richer nutrient base. It contains malt extract, peptones, and agar.



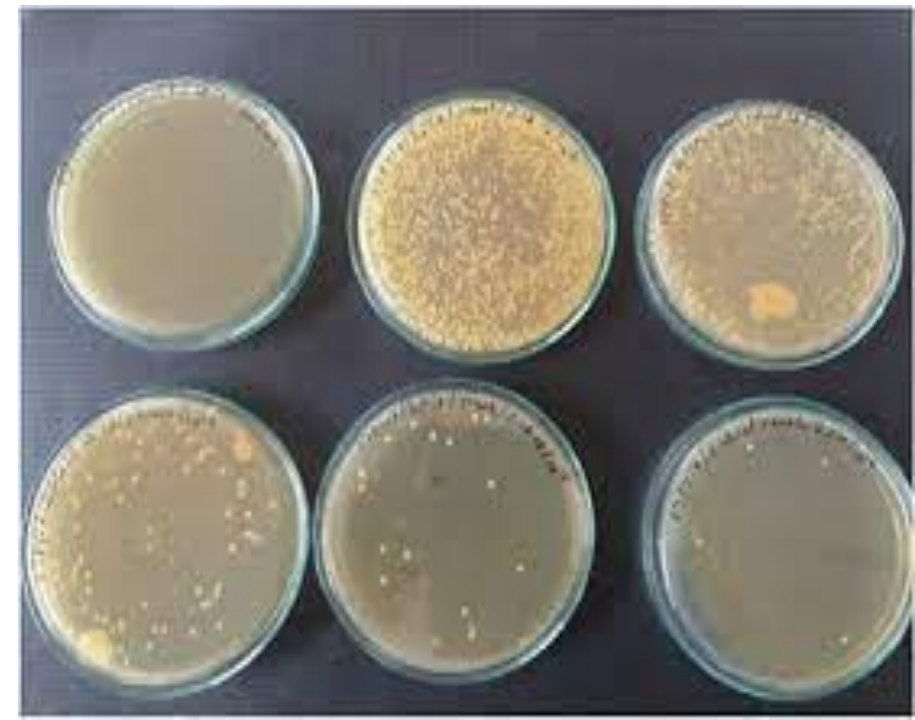
5. Sabouraud Dextrose Broth (SDB):

Similar to SDA, but in liquid form, SDB is used for cultivating yeasts and certain molds in liquid suspension.



6. Yeast Extract Peptone Dextrose (YPD) Agar:

YPD agar is a rich medium that supports the growth of many fungi and yeasts. It contains yeast extract, peptones, dextrose, and agar.



Practical Mycology 2nd Class Lab.4

Medical fungi

Isolation and culturing of pathogenic fungi

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Isolation and culturing of pathogenic fungi involve several steps:

Step 1: Sample Collection

Collect samples from infected tissues, such as skin scrapings, nail clippings, or tissue biopsies.

Step 2: Sample Preparation

Prepare the sample for culturing by grinding, homogenizing, or treating with enzymes to release fungal elements.

Step 3: Inoculation

Inoculate the prepared sample onto a suitable growth medium, such as Sabouraud dextrose agar or potato dextrose agar.

Step 4: Incubation

Incubate the inoculated medium at a suitable temperature (usually 25-30°C) for a period of time (usually 1-4 weeks), allowing the fungus to grow.

Step 5: Isolation

Isolate the fungal colonies by subculturing them onto a fresh medium, ensuring a pure culture.

Step 6: Identification

Identify the isolated fungus using various techniques, such as:

- ☐ Microscopic examination
- ☐ Biochemical tests
- ☐ Molecular analysis (e.g. PCR)



Common Pathogenic Fungi

Some common pathogenic fungi include:

- ❑ Dermatophytes: Trichophyton, Microsporum, Epidermophyton
- ❑ Candida: Candida albicans, Candida glabrata
- ❑ Aspergillus: Aspergillus fumigatus, Aspergillus flavus
- ❑ Cryptococcus: Cryptococcus neoformans
- ❑ Histoplasma: Histoplasma capsulatum

Importance of Isolation and Culturing

Isolation and culturing of pathogenic fungi are crucial for:

- ☐ Accurate diagnosis of fungal infections.
- ☐ Understanding fungal pathogenesis.
- ☐ Developing effective antifungal therapies.
- ☐ Monitoring antifungal resistance.

Challenges and Limitations

Challenges and limitations in isolating and culturing pathogenic fungi include:

- ☐ Fastidious growth requirements
- ☐ Slow growth rates
- ☐ Contamination with other microorganisms
- ☐ Limited availability of specialized media and equipment

Emerging Technologies for Rapid and Efficient Fungal Isolation

Molecular Methods

PCR-based techniques allow rapid and accurate identification of fungal species directly from clinical specimens.

Advanced Microscopy

Confocal and fluorescence microscopy offer high-resolution visualization of fungal structures and morphology.



Practical Mycology 2nd Class Lab.5

Medical fungi

Using Biochemical Tests for Fungal Identification

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University



Introduction to Fungal Identification

Accurate identification requires a combination of morphological, molecular, and biochemical techniques.

Biochemical tests are crucial for identifying fungi, particularly when morphological characteristics are insufficient for accurate identification

some common biochemical tests used:

1. Czapek's Medium Test: Detects nitrate reduction and carbohydrate utilization.
2. Urease Test: Identifies urease-producing fungi, such as *Cryptococcus* and *Trichosporon*.

3. Gelatin Hydrolysis Test: Detects gelatin-degrading enzymes, indicative of fungi like *Aspergillus*.
4. Starch Hydrolysis Test: Identifies starch-degrading enzymes, characteristic of fungi like *Trichoderma*.
5. Cellulose Decomposition Test: Detects cellulose degradation, typical of fungi like *Trichoderma* and *Fusarium*.
6. Lipase Test: Identifies lipase-producing fungi, such as *Candida* and *Aspergillus*.
7. Dermatophyte Test Medium (DTM): Selectively isolates dermatophytes, such as *Trichophyton* and *Microsporum*.

Molecular Techniques

- ❑ PCR (Polymerase Chain Reaction): Amplifies specific DNA sequences for identification.
- ❑ DNA Sequencing: Analyzes genetic material for precise identification.

Advantages of Biochemical Testing for Fungi

❑ High Accuracy:

Biochemical tests often achieve high levels of accuracy in fungal identification, particularly when combined with other techniques.

☐ **Speed and Efficiency:**

Biochemical tests are generally faster and more efficient than traditional methods, enabling rapid identification.

☐ **Versatility:**

They can be applied to a wide range of fungal isolates, including those that are difficult to identify using morphology alone.

Limitations and Considerations

- ☐ Contamination

- ☐ Limited Specificity

- ☐ Cost and Infrastructure

Practical Mycology 2nd Class Lab.7

Medical fungi

Dermatophyte identification

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Southern Technical University

Introduction to Dermatophytes

Definition:

- Dermatophytes are a group of fungi that cause infections in skin, hair, and nails.

Three main genera: Trichophyton, Microsporum, Epidermophyton.

Global impact: Dermatophytoses are infectious skin diseases of public health importance because of their transmissibility and high prevalence.

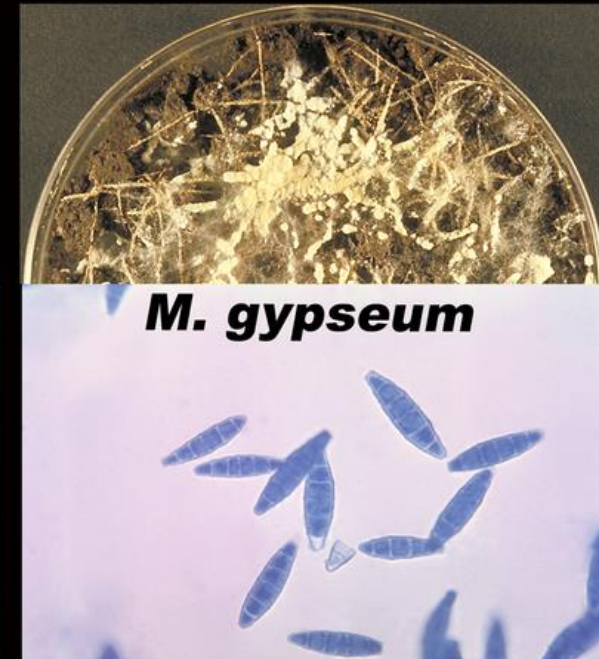
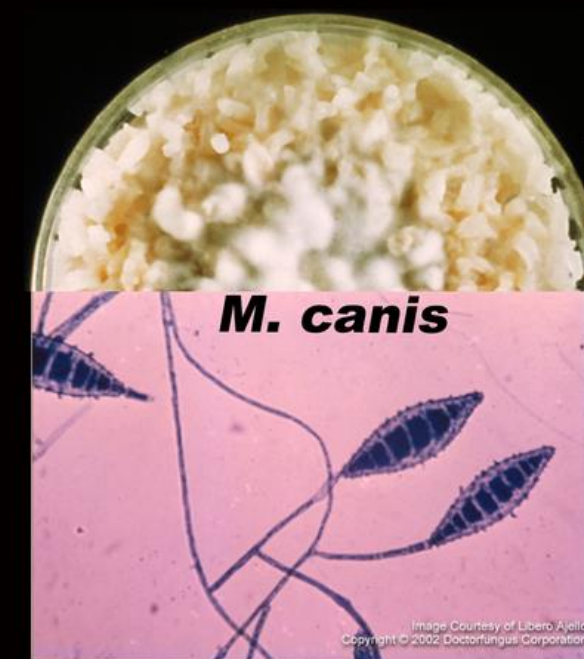
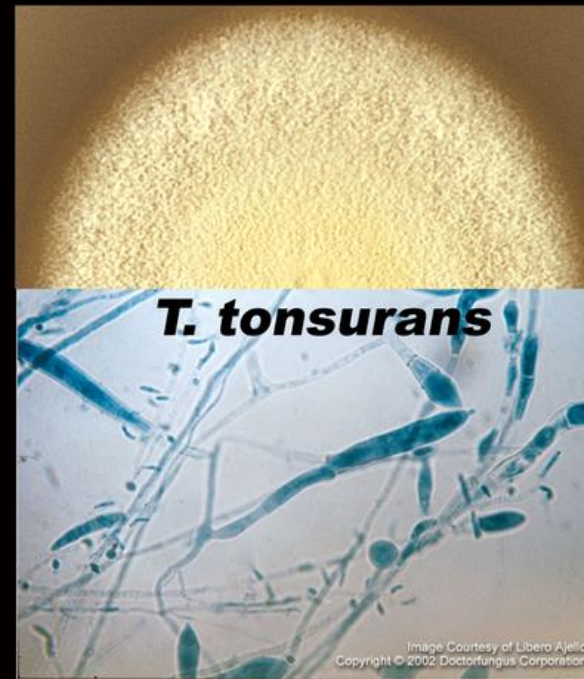
Dermatophytosis affects 20-25% of world's population.

Common Dermatophyte Genera:

Trichophyton (e.g., *T. rubrum*, *T. tonsurans*)

Microsporum (e.g., *M. canis*, *M. gypseum*)

Epidermophyton (e.g., *E. floccosum*)



Identification Methods

❑ Clinical Assessment

Appearance: Look for common signs of dermatophyte infections, such as ringworm (tinea corporis), athlete's foot (tinea pedis), or scalp infections (tinea capitis). Symptoms include redness, scaling, itching, and circular lesions.

❑ Direct Microscopy:

- Sample Collection: Obtain specimens from the affected site:
 - Skin: Scrape scales from the edge of the lesion.
 - Hair: Pluck infected hairs.
 - Nails: Collect clippings or debris from under the nail.
- KOH Preparation: Place the specimen in 10-20% potassium hydroxide (KOH) and examine under a microscope to detect fungal elements.

❏ Culture

- Media: Use specific fungal culture media to grow dermatophytes:
- Sabouraud Dextrose Agar (SDA) with antibiotics to inhibit bacterial growth.
- Dermatophyte Test Medium (DTM), which changes color (e.g., to red) in the presence of dermatophytes.
- Incubation: Incubate at 25–37°C for up to 4 weeks.

❏ **Macroscopic and Microscopic Morphology**

Macroscopic Examination:

Colony Morphology: Observe colony texture, pigmentation, and growth rate.

Microscopic Examination:

Prepare a slide with lactophenol cotton blue.

Examine conidia and hyphae (e.g., macroconidia, microconidia) to identify species.

Molecular Techniques:

- DNA Sequencing
- Polymerase chain reaction (PCR) can amplify specific fungal DNA for identification.

Practical Mycology 2nd Class Lab.8

Medical fungi

Candida identification

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Candida is a type of yeast (fungus) that naturally exists in small amounts in the human body, including the mouth, gut, skin, and vagina. While it is usually harmless, an overgrowth can cause infections known as candidiasis.

There are over 200 species of Candida, but the most common ones that cause infections include:

Candida albicans – The most common species, responsible for oral thrush, vaginal yeast infections, and systemic infections.

Candida glabrata – Can cause urinary tract infections (UTIs) and bloodstream infections, often resistant to antifungal drugs.

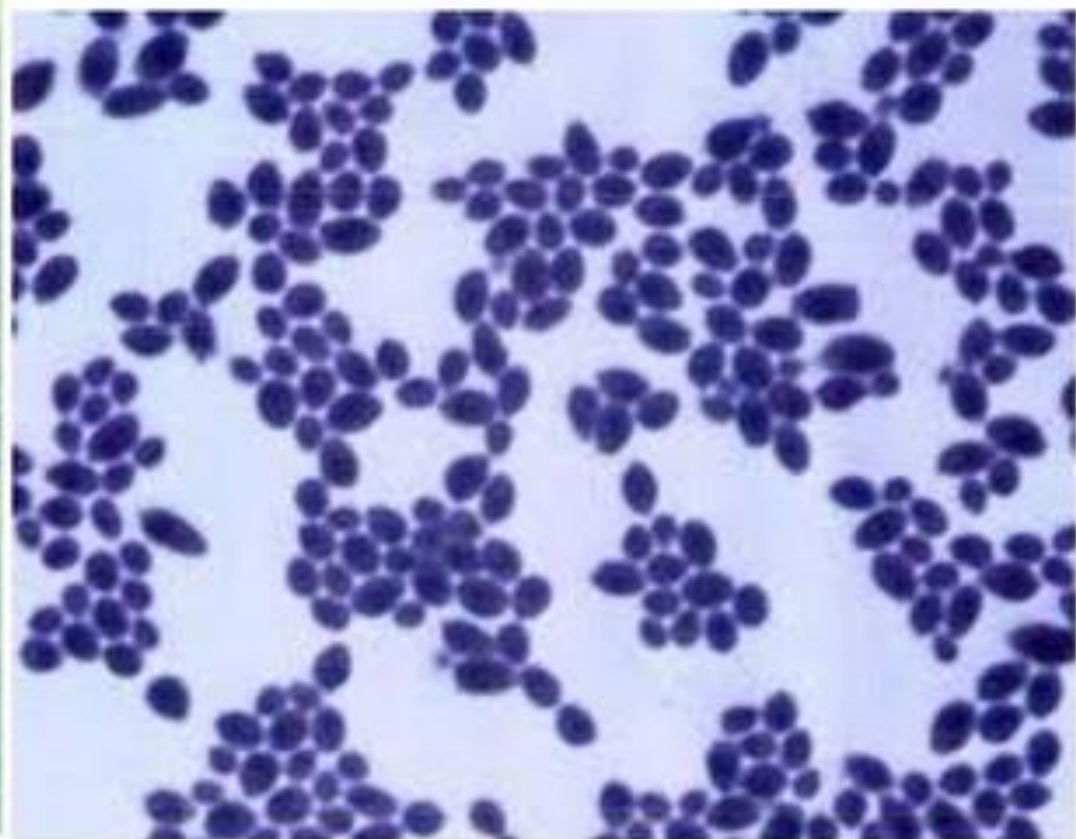
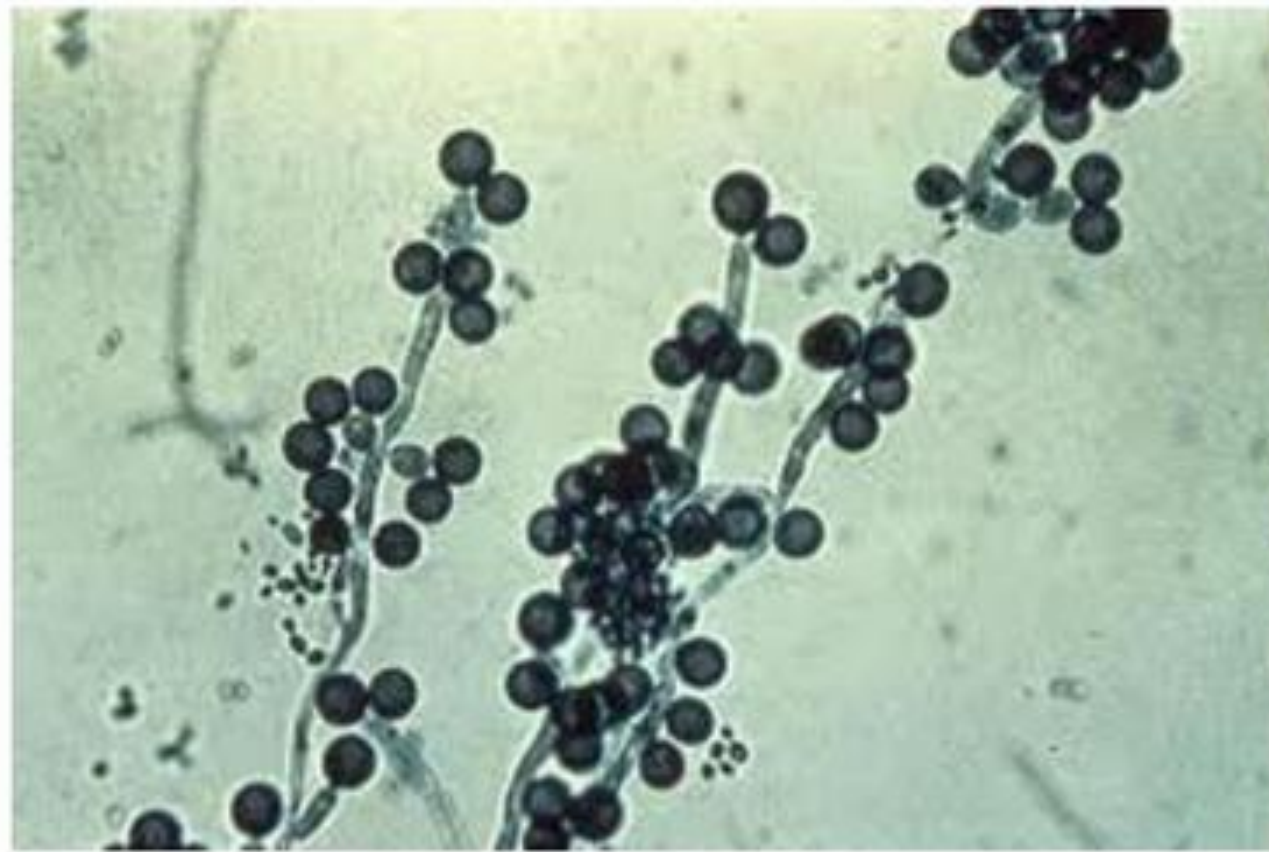
Candida parapsilosis – Frequently found in hospital-related infections, particularly in immunocompromised patients.

Candida tropicalis – Associated with bloodstream infections and commonly affects cancer patients.

Candida krusei – Naturally resistant to fluconazole, making it harder to treat.

Candida auris – A multidrug-resistant species that can cause severe hospital outbreaks.

Candida albicans



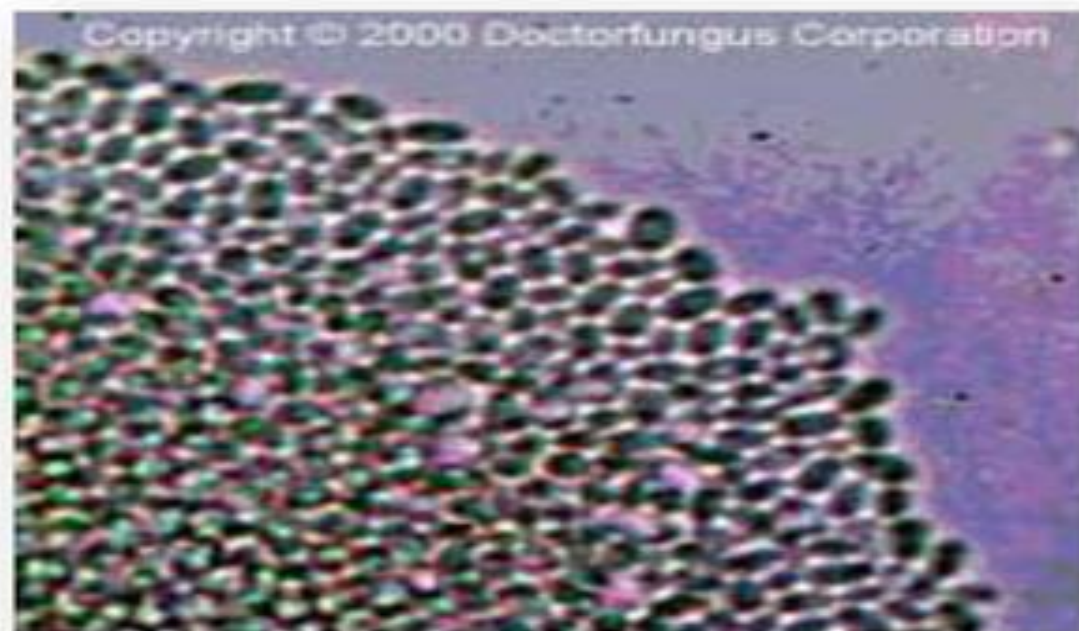
Morphology

solitary, unicellular ☐

reproduction via budding ☐

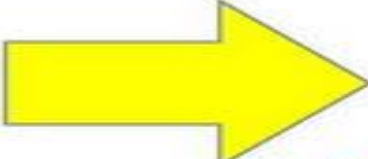
rounded shape ☐

moist & mucous colonies ☐

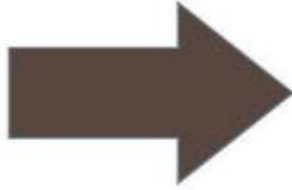


Laboratory diagnosis

Specimen  ***Scrapings of surfaces***

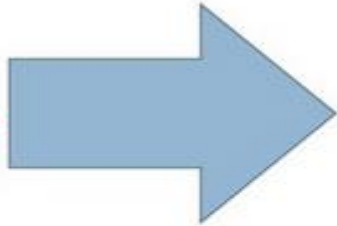
Slide preparations  ***KOH or saline***
***Visualization of pseudohyphae (mycelia)
and/or budding yeast (conidia)***

Staining



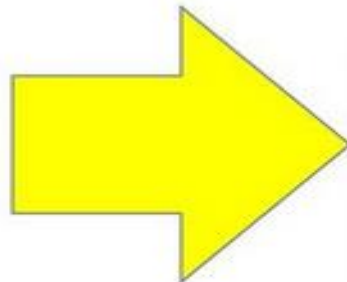
Lacto phenol blue
Gomoris methylvamine silver stains
(GMS)

Culture



Sabourauds glucose agar
medium
Brain heart infusion.

**Other Diagnostic
Methods**



**Skin test
PCR**

Candida culture

Candida Culture (Mixed)

