LESSON ASSIGNMENT

LESSON 3  Saprophytic Fungi

TEXT ASSIGNMENT  Paragraphs 3-1 through 3-21

TASK OBJECTIVES  After completing this lesson, you should be able to:

3-1. Select the statement that correctly describes the importance of saprophytic fungi.

3-2. List the disease characteristics that describe aspergillosis.

3-3. List the characteristics of a specific zygomycete.

3-4. List characteristics of a specific deuteromycete (Fungi Imperfecti).

SUGGESTION  After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 3
SAPROPHYTIC FUNGI

Section I. INTRODUCTION

3-1. REASONS FOR STUDYING

Saprophytic fungi are studied for two major reasons. First, because they often have an appearance similar to known fungal pathogens. Second, because under special conditions they may cause overt disease (opportunistic infections).

3-2. POTENTIAL CLINICAL IMPORTANCE

Even though saprophytic fungi isolated from clinical specimens may be "just contaminants," they should not be routinely labeled as such without first considering the following: (1) presence of a large number of colonies of a specific fungus or repeated isolation of the same fungus from consecutive specimens; (2) presence of the vegetative form of the fungus in the direct examination; and (3) patient's clinical history and current state of health. The laboratory determines points 1 and 2, whereas point 3 requires coordination with the physician. The infectious disease specialist should be consulted to assist with the evaluation.

3-3. OPPORTUNISTIC INFECTIONS

Opportunistic infections are becoming more of a problem because of the increasing use of instrumentation (catheters, inhalation therapy machines, and so forth), antibiotics, and other drugs that bypass or reduce the natural resistance of the host. Because of these conditions, organisms that were once considered as contaminants are now recognized as being capable of causing severe disease.

Section II. ZYGOMYCETES

3-4. INTRODUCTION

The zygomycetes are characterized by rarely septate hyphae, sporangiospores, and sexual zygospores. The zygomycetes include some genera which are ordinarily harmless but which can cause serious diseases in diabetics and other people with lowered resistance. These diseases are collectively called mucormycoses because the causative fungi all belong to the order Mucorales. Mucormycoses are serious, often fatal diseases of the respiratory tract, blood vessels, brain, or other organs. Some of the organisms that may cause mucormycoses include Mucor, Rhizopus, Absidia, and Syncephalastrum species.
3-5.  **MUCOR SPECIES**

The *Mucor* colony is rapid-growing, forming a cottony surface that fills the culture plate in 5 to 7 days. Aerial mycelium is white, later becoming gray to brown. The texture is extremely fluffy. Microscopically, branching sporangiophores arise from rarely septate hyphae. Spherical sporangiospores are seen within the sporangium and around the columella (a dome-shaped structure located at the top end of the sporangiophore). Rhizoids (specialized hyphae that resemble roots and whose presence or absence and location are key identification characteristics) are not produced by *Mucor* spp. (Figure 3-1.)

![Figure 3-1. Microscopic morphology of *Mucor* species.](image)

3-6.  **RHIZOPUS SPECIES**

The *Rhizopus* colony is rapid growing, with voluminous white to gray aerial mycelium presenting a peppered appearance. The texture is extremely fluffy. Microscopically, sporangiophores are long, unbranched, and clustered at nodes opposite rhizoids that form along a horizontal runner (stolon). The key identification characteristic for *Rhizopus* is the location of these rhizoids. *Rhizopus* has rhizoids that are located opposite of the sporangiophores. In other zygomycetes, rhizoids are not present or are in different location. Sporangia are dark-walled, spherical, and filled with round hyaline spores. A columella, which is thought to supply nutrients to the organism, is present. The columella is often obscured by sporangiospores. (Figure 3-2.)

![Figure 3-2. Microscopic morphology of *Rhizopus* species.](image)
3-7. **SYNCEPHALASTRUH SPECIES**

*Syncephalastrum* colonies are rapid growing. They are white at first but turn gray with age. The texture is dense and fluffy to cottony in appearance. The large, rarely septate hyphae are highly branched. Short, branched sporangiophores are erect and terminate in globose to oval vesicles giving rise to fingerlike tubular sporangia called meroспорangia, each of which has a single row of 2 to 10 sporangiospores. Rhizoids

![Figure 3-3. Microscopic morphology of Syncephalastrum species.](image)

3-8. **ABSIDIA SPECIES**

The *Absidia* colony is gray with a coarse, woolly texture. Microscopically, rhizoids are present, but the sporangiophores arise between the nodes of the stolon instead of opposite the nodes as in *Rhizopus*. Sporangia are pear-shaped, filled with round to oval spores, and contain a columella. (Figure 3-4.)

![Figure 3-4. Microscopic morphology of Absidia species.](image)
Section III. DEUTEROMYCETES

3-9. INTRODUCTION TO DEUTEROMYCETES (FUNGI IMPERFECTI)

Fungi that have no known sexual cycle of reproduction are classed as deuteromycetes. Since the sexual cycle is either nonexistent or undiscovered in these organisms, they are commonly called the "imperfect fungi." The only characteristic shared by all the fungi of this group is the absence of a known sexual cycle. Their appearance may resemble organisms in any of the other three classes. Most of the deuteromycetes, however, look like ascomycetes, with septate hyphae and similar asexual spores. Members of these imperfect fungi are continually being placed in other groups as their elusive sexual cycles are discovered. Many important pathogens, however, are still considered fungi imperfecti. Included in this group of fungi are Alternaria, Cladosporium, Drechslera, Curvularia, Penicillium, Paecilomyces, Aspergillus, Nigrospora, Scopulariopsis, Trichoderma, Sepedonium, and Fusarium species.

3-10. ASPERGILLOSIS

a. Aspergillosis is a complex group of diseases caused by certain species within the genus Aspergillus. Sites of infection include the lung, ear, sinus, eye, and skin. Pulmonary aspergillosis, the most common form of disease, is usually caused by Aspergillus fumigatus. Three forms of this disease are recognized:

1. Allergic aspergillosis, which may cause asthma-like symptoms or bronchitis, with plugging of the bronchi by mucus,

2. Aspergilloma, or "fungus ball," caused by growth of the fungus in preexisting lung cavities, and

3. Invasive aspergillosis, in which the fungus invades the tissue. The latter form of the disease is usually found in debilitated patients when the immune system has been impaired.

b. Clinical symptoms of pulmonary aspergillosis include fever, and cough with blood-tinged sputum. Infection occurs from inhaling spores of the fungus or by inoculation with material containing the fungal elements.

c. Aspergillus is found in soil, air, plants, and animals, and has a worldwide distribution. Because it is common in the environment and acts as an opportunistic pathogen, aseptic procedures should be exercised whenever possible during collection and transport of clinical specimens. When attempting to isolate organisms from sputum, multiple specimens must be collected, preferably early in the morning and on consecutive days. Direct microscopic examination of clinical specimens reveals long, branching, hyaline, septate hyphae. Specimens are inoculated to SDA and incubated at 25 to 30°C. Colonies appear in 3 to 4 days. Aspergillus is inhibited by media containing

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cycloheximide. Mycosel™ medium, which contains this antimicrobial agent, should not be used. The diagnosis of aspergillosis is usually made by clinical symptoms, demonstration of hyphae in clinical specimens, and repeated isolation of the same species from the same anatomic site.

d. Macroscopic examination—the surface color of the colony is white, becoming gray-green with age. The surface texture is cottony.

e. Microscopic examination—conidiophores are thin-walled, smooth, green, and end in a hemispherical vesicle. The vesicle is a swollen part of the cell located at the end. Phialides, the cells from which the conidia originate, are flask-shaped. Conidia are single-celled, globose, echinulate (covered with spines), thin-walled and are 2 to 3.5 mcm in diameter. (Figure 3-5.)

f. Unlike other species of the genus, Aspergillus fumigatus is thermotolerant and grows very well at 45ºC or higher. Thermo tolerance and specimen site information may be used as a screening procedure for this organism.

3-11. ALTERNARIA

a. Alternaria colonies are rapid growing, cottony, and gray to black. The conidiophores are dematiaceous. Dematiaceous is a term that refers to the brown or black color imparted to conidia or spores due to the presence of melanin. The conidia of Alternaria spp. develop branching chains at the apex of the conidiophore, with the youngest conidium at the apex of each chain. The conidia are dematiaceous and muriform (possessing both vertical and horizontal septations). (Figure 3-6.)

b. Isolates of Alternaria are occasionally encountered in the clinical laboratory. Several species have been reported as pathogens of man; however, in most instances, Alternaria spp. are recovered as skin contaminants and do not contribute to a disease process. (Figure 3-6.)
3-12. **CLADOSPORIUM**

a. *Cladosporium* isolates are rapid growing, velvety or cottony, and usually olive-gray to olive-brown or black. Tall, erect dematiaceous conidiophores arise from the mycelium. At the apex of the branching, conidiophores form branching chains consisting of one to several celled, smooth or rough, dematiaceous blastoconidia. The conidium at the bottom of the chains is larger, and due to its appearance, is commonly referred to as a shield cell. (Figure 3-7.)

b. *Cladosporium* is commonly recovered in the clinical laboratory. Most of the more common species of *Cladosporium* are soil fungi. The pathogenic species can be differentiated from nonpathogens by the tests for digestion of Loeffler's coagulated serum medium or for liquefaction of gelatin. These tests are usually negative for pathogens.

3-13. **DRECHSLERA**

a. *Drechslera* species form rapid-growing, woolly, gray-to-black colonies. The conidiophores are dematiaceous, solitary, or in groups; simple or branched, septate, and geniculate. The term geniculate refers to being bent like a knee. The dematiaceous, oblong-to-cylindrical conidia are multicelled. (Figure 3-8.)
b. *Drechslera* is frequently recovered in the clinical laboratory. Members of this genus are common soil organisms and some species are plant pathogens. Several *Drechslera* species cause opportunistic infections in humans, including meningitis, cutaneous, eye, nasal, and pulmonary infections.

### 3-14. CURVULARIA

a. *Curvularia* colonies are rapid growing, woolly, and gray to grayish black or brown. The conidiophores of *Curvularia* are brown, simple or branched, solitary or in groups and borne laterally or terminally from the septate hyphae. The poroconidia are usually curved, with one of the central cells being larger and darker than the other cells. (Figure 3-9.)

b. *Curvularia* spp. has been implicated in a number of opportunistic infections. Members of this genus cause endocarditis, eye infections, mycetoma, and pulmonary disease.
3-15. **PENICILLIUM**

a. *Penicillium* colonies are rapid growing. White colonies change with maturation to colors characteristic of each species. The most commonly isolated species are blue-green or yellow-green. The conidiophores are erect, distinct, usually branched, smooth to rough, and hyaline to colored. The branches, called metulae, may be either symmetrical or asymmetrical in relation to the conidiophore. Flask-shaped, hyaline phialides are borne at the apex of the terminal metulae. Each phialide produces chains of one-celled phialoconidia that may be hyaline to dark and smooth to rough-walled. (Figure 3-10.)

![Figure 3-10. Microscopic morphology of Penicillium species](image)

b. Isolates of *Penicillium* are commonly isolated in the clinical laboratory and are considered among the most prolific and ubiquitous groups of fungi. In most instances, they are contaminants, not pathogens. Infections have been reportedly associated with different stages of debilitation and with specimens from numerous anatomical sites. Repeated isolation and the demonstration of fungal elements in tissue are mandatory before a strain of *Penicillium* species can be considered an opportunistic pathogen.

3-16. **PAECILOHYCES**

a. Paecilomyces species resemble Penicillium species in growth characteristics and in some elements of microscopic appearance. The primary microscopic characteristic of Paecilomyces species is a Conidiophore with graceful, elongated, beak-like phialides curving outward, away from each other. Chains of phialoconidia generally are oval and may become enlarged in order chains. (Figure 3-11.)
b. Reports of patients with paecilomycosis usually give a history of exposure to infectious foreign material or traumatization of body tissue that later becomes infected.

3-17. **NIGROSPORA**

*Nigrospora* colonies are rapid-growing, woolly to cottony, and white to gray in color. The hyphae are septate. Conidiophores are simple, unbranched, and short, with inflated end or vesicle. The conidium is black, spherical, and borne on the end of the vesicle. (Figure 3-12.)

3-18. **SCOPULARIOPSIS**

a. *Scopulariopsis* colonies are rapid-growing, initially white in color, turning tan to brown with age. Texture is flat and powdery. Members of the species produce globose to pyriform annelloconidia in chains from annellides that are either solitary or grouped on a conidiophore. Mature conidia are often rough and echinulated (spiny). (Figure 3-13.)
b. *Scopulariopsis* spp. are commonly isolated in the clinical laboratory. They are often contaminants in humans but rarely pathogenic.

### 3-19. **TRICHOSTERMA**

Trichoderma colonies are rapid growing and white to green in color. Texture is cottony. Hyphae are septate and branched. Conidiophores are short and branched, with flask-shaped phialides. Phialoconidia are seen as clusters of single-celled microconidia. (Figure 3-14.)

Figure. 3-14. Microscopic morphology of *Trichoderma* species.

### 3-20. **FUSARIUM**

a. Fusarium species display colonies that are fluffy in texture and of variable color (typically violet to purple). Microscopically, *Fusarium* spp are characterized by the production of canoe-shaped, multicelled macroconidia and one or two-celled hyaline microconidia, usually held together in mucus balls. The macroconidia generally are borne in banana-like clusters, which dislodge easily and float free from the hyphae. Not all strains demonstrate both types of conidial production. (Figure 3-15.)
b. *Fusarium* is commonly cultured from specimens in the clinical laboratory. Best known as a laboratory contaminant, it is now recognized as an opportunistic pathogen causing eye infections in burn patients, recipients of renal transplants, postsurgical patients, and in animals, primarily dogs.

3-21. **SEPEDONIUH**

*Sepedonium* colonies are rapid growing, white in color and have a cottony texture. The species produces spiny, tuberculate conidia similar to the conidia of the pathogen *Histoplasma capsulatum*. *Sepedonium* do not convert to a yeast at 35°C to 37°C. Some species have amber-colored conidia. The asexual form of the organism may also be present in the same culture with *sepedonium*. (Figure 3-16.)

Figure 3-16. Microscopic morphology of *Sepedonium* species.

Continue with Exercises
EXERCISES, LESSON 3

INSTRUCTIONS: Answer the following exercises by marking the lettered response that best answers the exercise, by completing the incomplete statement, or by writing the answer in the space provided at the end of the exercise.

After you have completed all of these exercises, turn to "Solutions to Exercises" at the end of the lesson and check your answers. For each exercise answered incorrectly, reread the material referenced with the solution.

1. Opportunistic infections, caused by saprophytic fungi, are:
   a. Of little concern to the laboratory specialist.
   b. Rarely capable of causing disease.
   c. Of increasing importance due to increased instrumentation.
   d. Of increasing importance because new strains are being identified.

2. Culture of a specimen from a patient with pulmonary symptoms produces a colony whose microscopic morphology resembles the illustration below. The fungus most probably is:
   a. *Rhizopus.*
   b. *Aspergillus.*
   c. *Mucor.*
   d. *Candida.*

3. The group of fungi responsible for mucormycoses is:
   a. Zygomycetes.
   b. Ascomycetes.
   c. Basidiomycetes.
   d. Deuteromycetes.
4. Deuteromycetes are commonly called "fungi imperfecti" because they:
   a. Are dimorphic.
   b. Have no known sexual cycle.
   c. Are not true fungi.
   d. Cladosporium spp.

5. Shield cells are characteristic of which of the following?
   a. *Alternaria* spp.
   b. *Paecilomyces* spp.
   c. *Dreschlera* spp.
   d. *Cladosporium* spp.

6. An organism commonly appearing culture as a contaminant is:
   a. *Alternaria*.
   b. *Aspergillus*.
   c. *Penicillium*.
   d. *Absidia*.

7. The organism illustrated on the right is:
   a. *Paecilomyces*.
   b. *Nigrospora*.
   c. *Cladosporium*.
   d. *Penicillium*. 
8. When reviewed microscopically, *Fusarium* is characterized by:
   a. Canoe-shaped macroconidia.
   b. Truncate annelloconidia.
   c. Elongated phialides.
   d. Whorled conidia.

9. An organism producing spiny, tuberculate conidia similar to the conidia of the pathogen *Histoplasma capsulatum* is:
   b. *Sepedonium* spp.
   c. *Fusarium* spp.
   d. *Penicillium* spp.

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 3

1. c (para 3-3)
2. b (figure 3-5)
3. a (para 3-4)
4. b (para 3-9)
5. d (para 3-12b)
6. c (para 3-15b)
7. b (figure 3-12)
8. a (para 3-20a)
9. b (para 3-21)

End of Lesson 3