24.4A: Fungi as Plant, Animal, and Human Pathogens

From crop and food spoilage to severe infections in animal species, fungal parasites and pathogens are widespread and difficult to treat.

Learning Objectives

• Give examples of fungi that are plant and animal parasites and pathogens

Key Points

• In plants, fungi can destroy plant tissue directly or through the production of potent toxins, which usually ends in host death and can even lead to ergotism in animals like humans.

• During mycosis, fungi, like dermatophytes, successfully attack hosts directly by colonizing and destroying their tissues.

• Examples of fungal parasites and pathogens in animals that cause mycoses include *Batrachochytrium dendrobatidis*, *Geomyces destructans*, and *Histoplasma capsulatum*.

• Systemic mycoses, such as valley fever, Histoplasmosis, or pulmonary disease, are fungal diseases that spread to internal organs and commonly enter the body through the respiratory system.

• Opportunistic mycoses, fungal infections that are common in all environments, mainly take advantage of individuals who have a compromised immune system, such as AIDS patients.

• Fungi can also cause mycetismus, a disease caused by the ingestion of toxic mushrooms that leads to poisoning.
Key Terms

- **mycosis**: a fungal disease caused by infection and direct damage
- **dermatophyte**: a parasitic fungus that secretes extracellular enzymes that break down keratin, causing infections the skin, such as jock itch and athlete’s foot
- **aflatoxin**: toxic, carcinogenic compounds released by fungi of the genus Aspergillus; contaminate nut and grain harvests
- **ergot**: any fungus in the genus Claviceps which are parasitic on grasses

Fungal Parasites and Pathogens

The production of sufficient good-quality crops is essential to human existence. Plant diseases have ruined crops, bringing widespread famine. Many plant pathogens are fungi that cause tissue decay and eventual death of the host. In addition to destroying plant tissue directly, some plant pathogens spoil crops by producing potent toxins. Fungi are also responsible for food spoilage and the rotting of stored crops. For example, the fungus *Claviceps purpurea* causes ergot, a disease of cereal crops (especially of rye). Although the fungus reduces the yield of cereals, the effects of the ergot’s alkaloid toxins on humans and animals are of much greater significance. In animals, the disease is referred to as ergotism. The most common signs and symptoms are convulsions, hallucinations, gangrene, and loss of milk in cattle. The active ingredient of ergot is lysergic acid, which is a precursor of the drug LSD. Smuts, rusts, and powdery or downy mildew are other examples of common fungal pathogens that affect crops.

*Fungal pathogens*: Some fungal pathogens include (a) green mold on grapefruit, (b) powdery mildew on a zinnia, (c) stem rust on a sheaf of barley, and (d) grey rot on grapes.
Aflatoxins are toxic, carcinogenic compounds released by fungi of the genus *Aspergillus*. Periodically, harvests of nuts and grains are tainted by aflatoxins, leading to massive recall of produce. This sometimes ruins producers and causes food shortages in developing countries.

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**Animal and Human Parasites and Pathogens**

Fungi can affect animals, including humans, in several ways. A mycosis is a fungal disease that results from infection and direct damage. Fungi attack animals directly by colonizing and destroying tissues. Mycotoxicosis is the poisoning of humans (and other animals) by foods contaminated by fungal toxins (mycotoxins). Mycetismus describes the ingestion of preformed toxins in poisonous mushrooms. In addition, individuals who display hypersensitivity to molds and spores develop strong and dangerous allergic reactions. Fungal infections are generally very difficult to treat because, unlike bacteria, fungi are eukaryotes. Antibiotics only target prokaryotic cells, whereas compounds that kill fungi also harm the eukaryotic animal host.

Many fungal infections are superficial; that is, they occur on the animal’s skin. Termed cutaneous (“skin”) mycoses, they can have devastating effects. For example, the decline of the world’s frog population in recent years may be caused by the fungus *Batrachochytrium dendrobatidis*, which infects the skin of frogs and presumably interferes with gaseous exchange. Similarly, more than a million bats in the United States have been killed by white-nose syndrome, which appears as a white ring around the mouth of the bat. It is caused by the cold-loving fungus *Geomyces destructans*, which disseminates its deadly spores in caves where bats hibernate. Mycologists are researching the transmission, mechanism, and control of *G. destructans* to stop its spread.

Fungi that cause the superficial mycoses of the epidermis, hair, and nails rarely spread to the underlying tissue. These fungi are often misnamed “dermatophytes”, from the Greek words dermis meaning skin and phyte meaning plant, although they are not plants. Dermatophytes are also called “ringworms” because of the red ring they cause on skin. They secrete extracellular enzymes that break down keratin (a protein found in hair, skin, and nails), causing conditions such as athlete’s foot and jock itch. These conditions are usually treated with over-the-counter topical creams and powders; they are easily cleared. More persistent superficial mycoses may require prescription oral medications.

**Mycosis infection:** (a) Ringworm presents as a red ring on skin; (b) *Trichophyton violaceum*, shown in this bright field light micrograph, causes superficial mycoses on the scalp; (c) *Histoplasma capsulatum* is an ascomycete that infects airways and causes symptoms similar to influenza.

Systemic mycoses spread to internal organs, most commonly entering the body through the respiratory system. For example, coccidioidomycosis (valley fever) is commonly found in the southwestern United States where the fungus resides in the dust. Once inhaled, the spores develop in the lungs and cause symptoms similar to those of tuberculosis. Histoplasmosis is caused by the dimorphic fungus *Histoplasma capsulatum*. It also causes pulmonary infections. In rarer cases, it causes swelling of the membranes of the brain and spinal cord. Treatment of these and many other fungal...
diseases requires the use of antifungal medications that have serious side effects.

Opportunistic mycoses are fungal infections that are either common in all environments or are part of the normal biota. They mainly affect individuals who have a compromised immune system. Patients in the late stages of AIDS suffer from opportunistic mycoses that can be life threatening. The yeast *Candida sp.*, a common member of the natural biota, can grow unchecked and infect the vagina or mouth (oral thrush) if the pH of the surrounding environment, the person’s immune defenses, or the normal population of bacteria are altered.

Mycetismus can occur when poisonous mushrooms are eaten. It causes a number of human fatalities during mushroom-picking season. Many edible fruiting bodies of fungi resemble highly-poisonous relatives. Amateur mushroom hunters are cautioned to carefully inspect their harvest and avoid eating mushrooms of doubtful origin.

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