Fungi (continued)

Fungi can produce reproductive hyphae which project above their growth substrate. These reproductive hyphae produce either asexual or sexual spores. Fungal spores are both resistant and reproductive cells. The spores land back upon the substrate and form new hyphae. Asexual spores produce new hyphae with the same genetics as the strain from which they came. Sexual spores will form hyphae with the mixed genetics from two different strains of the mold. Note illustration in chapter 12 on the life cycle of the mold *Rhizopus*.

Asexual spore types

1. **Blastospores**-these are the same as the buds found on yeast cells.
2. **Chlamydospores**- thick-walled spores that are highly resistant to adverse conditions.
3. **Arthrospores**-described as cast or barrel or cylindrically shaped. They are formed by the disjointing or fragmentation of hyphal cells.
4. **Sporangiospores**-spores formed within sacs at the end of hyphae. Example-*Rhizopus*.
5. **Conidiospores**-spores formed by extrusion of single cells from specialized area of hyphae. The spores are not enclosed in a sac. Examples-*Penicillium* (branching pattern) and *Aspergillus* (linear pattern).

Sexual spore types

1. **Zygospores**-large spores encased in a thick wall. Example-*Rhizopus*.
2. **Ascospores**-spores within a “pea pod” like structure known as an ascus. Examples *Penicillium* and *Aspergillus*.
3. **Basidiospores**-are found amongst the gills of the fleshy mushrooms.

Fungi imperfecti-this is a special category of fungi where sexual reproduction methods have not yet been observed. The fungi imperfecti category should be thought of as a temporary or holding category. At one time both *Aspergillus* and *Penicillium* were placed here. It is now known that these two genera produce sexual spores known as ascospores.

Review the beneficial and practical uses of fungi that were discussed earlier in this course.

A symbiosis (symbiotic relationship) is defined as the living together of two different organisms or populations. There are several kinds of symbioses in the living world. Two life forms coexist in the lichen, a fungus and an alga. Both life forms benefit from this coexistence. Therefore this represents a mutualistic symbiotic relationship. A mycorrhiza is a fungus growing in symbiosis with plant roots. Truffles, a mycorrhiza exists in a mutualistic symbiotic relationship with the roots of oak and beech trees. Truffles (mostly from the genus *Tuber*) are a mass of mycelia and ascospores wrapped around the roots of the tree. It is quite odiferous and is a food delicacy. Truffles benefit by gaining access to the tree’s carbohydrates, while the tree benefits from water and mineral content delivered by the truffles.
Fungal diseases (mycoses)

The mycoses are categorized by the level of tissue involvement in the host. There are 4 categories. They are: Superficial mycoses; cutaneous mycoses; subcutaneous mycoses and the systemic mycoses.

Superficial mycoses-only the outer layers of the hair and skin are affected. Generally these are quite mild and are mainly of cosmetic interest. Tinea versacolor (disease not agent) causes a mild discoloration and a brownish scaling on the trunk, neck or arms. Tinea nigra can present as black spots upon the palms of the hands. Tinea alba will produce white areas upon the skin.

Cutaneous mycoses-these infect the epidermis, hair and nails. Theses fungal organisms secrete the enzyme keratinase which is used to breakdown the protein keratin. Since keratin is required as a nitrogen source, these organisms are restricted to growing in the epidermis and areas where keratin is found. There are several tineas (ringworm) infections associated with cutaneous mycotic infections. Tinea pedis is ringworm of the foot and is also known as “Athletes Foot”. Tinea corporis is ringworm of the body. Tinea barbae is ringworm of the beard. Tinea cruris is ringworm of the groin area, also known as “jock itch”. Generally these are multiple fungal infections and are hard to treat. Three genera associated with these mycoses are: Microsporum, Epidermophyton and Trichophyton.

It is important to note that many of the fungi are opportunistic pathogens. They are generally part of the normal flora and we only see them as mild pathogens under certain circumstances. Debilitated individuals, trauma victims, those using broad spectrum antibiotics, those using immunosuppressive agents (corticosteroids), drug addicts, obese individuals, alcoholics, diabetics, undernourished, and those under stress are all subject to increased risk of serious infections with these opportunistic pathogens. In addition it is important to note that since fungal organisms are eukaryotes; our medicines for treatment are more likely to be toxic to our own eukaryotic cells.

Subcutaneous mycoses-most are caused by the yeast called Candida albicans. Candida is typically part of our own normal flora. This infection can involve the skin and the subcutaneous tissues without going any deeper. The disease is called candidiasis or moniliasis. It is also called “thrush” and can be seen in children and older adults as white patches on the inside of the mouth or tongue. This infection can also be seen in warm moist environments where irritation is oftentimes a factor. The axilla, intergluteal folds, groin area, inframammary folds and belt line are common areas of infection. AIDS patients will experience Candida infections as their immune systems are compromised. Candida can work its way into the blood stream and go systemic. It can infect the heart valves and cause a candidal endocarditis.

Systemic mycoses-fungal organisms that have spread throughout the body and have invaded deeper tissues. These are rare infections but can be very serious and difficult to treat. The yeast –like organisms that cause these are dimorphic (two appearances). At 37 degrees C. they are yeast-like. At 25 degrees C. they grow as hypha, and are mold -like. See handout on systemic mycoses.