An Introduction to Mycology

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TOPIC: An Introduction to Mycology

THEME: Fungi

DEPARTMENT: Botany

Wood decaying mushroom growing on a dead branch
Source: NMK Mycology

Lesson Objectives

1. The participants shall define mycology and fungi.
2. The participants shall appreciate the importance of fungi to the ecosystem.
3. The participants shall explore conservation status of fungi.
4. The participants shall be introduced to fungi-culture.
5. The participants shall appreciate the role of National Museums of Kenya, Mycology Section, in research and conservation of fungi.

Learning resources

1. Text
2. Video
3. Photo

What is mycology?

Mycology is the study of fungi: their genetics, biochemical properties, taxonomy and use to humans as a source of food and traditional medicine; as well as their dangers such as toxicity or infection.

What are fungi?

Fungi are a group of organisms that produce spores, and are different from plants and animals. They belong to a group of their own known as the Kingdom fungi. However, they are closer to animals than plants because they do not make their own food.

Fungi depend on the enzymes that they release to the environment to break down organic matter. The organic matter releases nutrients that the fungi can easily absorb.

Fungi grow through the hyphal structures that usually extend to obtain nutrients for the fungi. A network of hyphae (fungal threads) is known as **mycelium**.

Fungi are either observed above ground such as mushrooms or recovered below ground such as mycorrhizal fungi.

Groups of fungi

There are three major groups of fungi:

1. Mushroom (Basidiomycetes): These are macroscopic filamentous fungi that bear large fruiting bodies, for example *Polyporus squamosus*.
2. Yeast (Ascomycetes): They are single cell microscopic fungi, for example *Saccharomyces sp.*
3. Moulds (Zygomycetes): They are multicellular and filamentous, for example *Fusarium sp.*

Green and yellow mould contaminant
Source: NMK Mycology

Bakers yeast Saccharomyces cerevisiae
Source: NMK Mycology

Characteristics of fungi

Fungi have well defined characteristics that make them different from other organisms. These include:

- Fungi are eukaryotes meaning that their cells have a nucleus and other membrane-bound organelles.
- They are non-photosynthetic and unlike plants they cannot make their own food.
- They contain a cell wall made of chitin (a fibrous substance which is the major constituent in the cell walls of fungi).
- They are heterotrophic. They obtain nutrition from other sources of organic carbon, mainly plant or animal matter.
- Fungi reproduce through spores. Spores can be made by means of asexual or sexual reproduction.

Nutrition in fungi

Fungi cannot ingest their food like animals do, nor manufacture their own food like plants do. They feed by absorption of nutrients from the surrounding environment. They accomplish this by growing through and within the substrate on which they are feeding. Some fungi feed on insects and are commonly known as cordyceps.

Fungi obtain nutrients in three different ways:

1. As saprophytes: feeding on dead organic matter.
2. As parasites: feeding on the living host.
3. Symbiotically: feeding on the host as the host also benefits from the fungi.

Saprophytic fungi growing on a dead tree stump
Source: NMK Mycology

Parasitic fungi Ganoderma lucidum *(medicinal)*
Source: NMK Mycology

Importance of fungi to human and the ecosystem

Fungi play a very important role to humans and the ecosystem:

- They decompose organic matter in the environment such as leaves, logs, branches and stumps, and recycle back the nutrients to the soil.
- Fungi are a source of antibiotics such as penicillin.
- They are a source of food to humans and wild animals. For example, wild edible mushrooms.
- Fungi are used in the industrial production of bread, beer and cheese.

Conservation status of fungi

Fungi are threatened and therefore decreasing. Some species of fungi are almost going extinct. By conservation status assessment published in 2022 International Union for Conservation of Nature (IUCN) Red List, approximately 50% are threatened, 10% near threatened and 9% data deficient. This is as a result of environmental changes caused by both natural and human processes.

Environmental changes include various factors such as natural disasters for example floods and famine; human interferences for example logging, conversion of indigenous forests to plantation forests, clearing of the forests for road construction and settlements, charcoal burning and environmental pollution.

How can we protect fungi?

To conserve fungi, the following measures should be undertaken:

- Carry out field studies to document fungi, their habitats, geographical locations and populations. This data is important in determining the conservation status of the fungi and for RED-listing of the species.
- Restoring and maintaining the natural habitats for fungi development and survival.
- Creating awareness among the communities on the importance of fungi and the need to conserve the environment.

Pleurotus mushroom culture
Source: NMK Mycology

Fungi-culture (cultivation of mushrooms)

Fungi-culture is the cultivation of fungi as a nutritional source and for income generation and ex situ conservation of germplasm. Fungi-culture can yield foods, mostly mushrooms, medicine and construction materials.

Cultivating mushrooms starts with the establishment of tissue culture in the laboratory under sterile conditions. Steps in mushroom cultivation are as follows:

Step 1: Use of artificial culture media such as Potato Dextrose Agar as the main food source for fungi cultivated in petri dishes. The culture is incubated for at least 7 days at 25°C - 30°C until fully colonised.

Sterilized artificial media made from Potato dextrose and Malt extract Agar
Source: NMK Mycology

Step 2: Prepare a substrate using grains such as sorghum, millet, corn, wheat and rye. Wash and pasteurise the grains, then transfer into bottles. Once cooled, inoculate the grains with mycelia from the Petri dishes. Incubate the bottles at 25°C - 30°C for at least 14-21 days until fully colonised.

Mushroom spawn at incubation stage
Source: NMK Mycology

Step 3: Expand the grain bottle at a steady rapid rate to create grain spawn (grain/mycelium mixture).

Refrigerated ready mushroom spawn
Source: NMK Mycology

Step 4: Spawn the grain into a suitable substrate e.g. agricultural waste including vegetable peels and place in a fruiting container.

Mushroom spawn at different stages of mycelia colonization
Source: NMK Mycology

Step 5: Allow the mycelium to take over the substrate.
Step 6: Induce pinning of the mycelium by altering the environmental condition for fruiting to take place.
Step 7: Allow the mushrooms to fruit. Harvest your mushroom in subsequent flushes.

Advantages of mushroom cultivation

The benefits of mushroom cultivation are significant, as mushrooms can be grown using agricultural and industrial waste, including manure or animal waste. Various forms of agricultural waste, such as maize cobs, maize husks, stalks, leftover beans after harvesting, banana fibre, and wood shavings from trees, are suitable for mushroom cultivation. Additionally, depending on the specific mushroom species being cultivated, manure can be utilised, especially for humus-decomposing mushrooms like button mushrooms. This approach not only promotes sustainable agricultural practices but also offers a versatile and eco-friendly method for mushroom production.

Role of Mycology Section at National Museums of Kenya

Labelling plant specimens is a crucial step in the process of plant collection, preservation, and storage. The following are the typical steps involved in labelling plant specimens:

The role of Mycology section include:

- Collection, documentation, taxonomy, conservation, preservation, identification of wild mushrooms and mycorrhiza in soils and plant roots.
- Greenhouse propagation of single species of arbuscular mycorrhizal and ectomycorrhizal spores for inoculum production for applications as a bioinoculant (organic alternative to inorganic fertiliser) in agriculture and reafforestation.
- Production of quality mushroom spawn for the farming communities in Kenya.
- Advising mushroom farmers on best practice in mushroom cultivation, market linkages and farmer network linkages.
- Training communities and school children on mushroom cultivation.
- Promoting consumption and commercialization of mushrooms in Kenya by creating awareness during institutional open days.

Mushroom germplasm of an indigenous species
Source: NMK Mycology