**A COMPREHENSIVE PICTURE OF FUNGI**

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**ABSTRACT**

Fungi play key role in ecosystem as mutualists, pathogens and decomposers. The symbiotic association of fungi with forest trees and algae is one of the examples of mutualism. Mutualists conferred disease resistance, drought tolerance and /or growth enhancement to host plants. Pathogenic fungi cause disease in humans or other organisms. Fungal symbionts express a variety of symbiotic lifestyles including mutualism, parasitism and commensalism. Plant symbiotic fungi are generally thought to express a single lifestyle that might increase (mutualism), decrease (parasitism) or have no influence (commensalism) on host plants.

Fungi as decomposers decompose organic matter by releasing enzyme to break down the decaying material after which they absorb the nutrients from the decaying material. The objective of this article is to provide a comprehensive and a detailed account of both the positive and negative roles of fungi so that this research article can be beneficial for the protection of environment and creation of awareness regarding all the aspects of fungi.

**KEYWORDS: Fungi, decomposers, mucormycosis, bioindicators, cryptococcus**

**INTRODUCTION**

Fungi have been on earth for millions and millions of years (5). They are not a plant even though they can look like plants, nor are they an animal – fungi are actually a really ancient type of vegetable. There are over 1 million different species of fungi on earth today. In a single teaspoon of earth, we could find about 120,000 fungi. Fungi of some sort or other are seen every day. The most common fungi are mushrooms and truffles, yeast that is made to make bread or molds and mildew which are useful but not so pleasant.

Although some fungi have many cells, they cannot make their own food like plants do as they do not have chlorophyll (plants use chlorophyll to make food from the light of the sun). Fungi are parasites and grow on plants, animals, humans, dead and decaying organic matter, anywhere, in fact, where it is warm and damp. They get their food by making enzymes that digest food from the surface they are growing on and absorbing the digested nutrients through their cell walls. Fungi mainly absorb water and digest sugars and starches which they use to grow.

Fungi have adapted to many different environments and can be found in the air, in the ground, in water, on plants, on you. All of these places provide the nutrients, warmth and moisture fungi need. Some fungi have adapted to grow in the desert where water is scarce, in very cold parts of the world and in fresh or seawater where there is too much or the wrong kind of water. Fungi have been around so long, they have adapted to grow almost anywhere.

Fungi, along with bacteria, are one of the best decomposers of organic material. Without them, dead plants and animals would just hang around and the nutrients from the dead material would not return to the ground. Other plants, animals and micro-organisms that rely on that food would also die and the delicate balance of the ecosystem would be lost.

Fungi are pretty simple structures really. Mushrooms, toadstools, puff balls and the hard fungus you see growing like plates on the sides of trees, all have the same structure. They grow in bunches of filaments (which look like sewing thread) called hyphae, although you cannot always see this. The hyphae grow together to form mycelium which can form a fruiting body which is the part of the mushroom you can see. Fungi can’t move about, they stay where they grow, so how do they make more fungi? Underneath the fruiting body of the mushroom, the bit you can see that looks like an umbrella, there are rows of ‘gills’. In these gills, tiny microscopic spores are produced. Spores are the seeds for the next generation of fungi and they are carried to new places by the wind and rain. When the spores come into contact with the right growing conditions – generally somewhere there is food, moisture and warmth – they germinate (start to grow) and break through the surface and grow.

Fungal spores are spread in different ways. They can be carried by the air, on animals, on your clothing, by traffic, washed away to new places by the rain or rivers even when you breathe, you are breathing in the tiny spores! When you cough or sneeze, it disperses the spores in new places and if the conditions are right, they will begin to grow. If the fungus doesn’t have the right conditions for growth, they hibernate (become dormant) until the right conditions come along or until they are moved to a better spot.

**ADVANTAGES AND DISADVANTAGES**

Fungi are considered as one of the most prolific types of life on earth which are found nearby everywhere around us. There are many different types of fungi some of which are very beneficial for mankind. It has immense economic applications and plays a major role in producing a number of products like drugs, antibiotic Penicillin, food like mushrooms, yeast, bread and alcoholic beverages.

Fungi are of great economic value. **Mushroom** (Agaricus) is edible. The role of yeast (*Saccharomyces cerevisiae*, a sugar eating fungus) in fermentation is of great value. **Penicillin** drug is obtained from *Penicillium*. An important drug is obtained from *Claviceps purpurea*. **Lichens** are best bioindicators. a major group of fungi cause the degradation of matter thereby helping in removing pollution.

**POSITIVE:**

Fungi play both positive and negative roles in the environment and nature. Overall we must emphasize on the benefits of its positive aspects like the utility and usefulness of medicines, vegetable like mushrooms, and the yeast for the fermentation process used in bakery.

**MEDICINAL MUSHROOM: Cordyceps**

Himalaya is the place of medicinal plants which cannot be found anywhere else. Their rarity and remarkable healing power makes them expensive in the global market. One such rich biological resource is *Cordyceps sinensis* which is locally known as keedajadi or Yartsa gengu. Keedajadi is basically a fungus which grows as a parasite on the larvae of a particular kind of caterpillar. The fungus evolves in the living larvae which kills and mummifies the larva and then develops as a stalk like fruiting figure. Caterpillars take 5 yrs to grow underground in Alpine grass and shrub-lands before finally pupating from larva and are attached by the fungus while feeding on roots. It can cure a variety of ailments such as fatigue, cancer and impotency. It is also known as caterpillar fungus(8)



Figure Cordyceps sinensis

**LARGEST MUSHROOM: Armillaria**

A mushroom  Armillaria ostoyae, commonly known as the honey mushroom, is bigger than animals like whale and elephant and is considered the largest and oldest organism on Earth. The mushroom covers 3,726563 m2 of Malheur National Forest, Oregon, and is estimated to be around 8,650 years old (6). The fungus was examined more closely by researchers when Catherine Parks, Scientist at the Pacific Northwest Research Station in La Grande, Oregon, heard about a big tree die-off from root rot in the forest east of Prairie City. Parks collected root samples from 112 trees and recognized the fungus through DNA testing. By comparing the 112 samples, she determined that 61 were from the same organism, meaning a single fungus had grown bigger than anything anyone had ever described before.

The honey mushroom exists in other places, such as Michigan and Germany; however, Oregon’s mushroom is the [largest ever measured](http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_033146.pdf). Scientists who study this species of fungus assume that the huge size may be a function of the dry climate in eastern Oregon. Spores have a hard time establishing new organisms, making room for the old-timers to spread; without competition from other specimens this enormous Armillaria has been able to grow and spread unchecked.



Figure Armilllaria ostoyae

**YEAST**

Yeast is single-celled fungi. It takes 20,000,000,000 (twenty billion) yeast cells to weigh one gram, or 1/28 of an ounce, of cake yeast, a tiny organism with a long name. The scientific name for the yeast that bakers use is *Saccharomyces cerevisiae*, or “sugar-eating fungus.” A very long name for such a tiny organism! They play a major role in fermentation process for creating wine, beer, bread, yoghurt and other foods. The substances like glucose are broken down into simple substance anaerobically.

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Figure Saccharomyces cerevisiae

**LICHENS**

A lichen, or lichenized fungus, is actually two organisms functioning as a single, stable unit. Lichens comprise a fungus living in a symbiotic relationship with an alga or *Cyanobacterium* (or both in some instances). There are about 17,000 species of lichen worldwide (1). Lichens are bizarre organisms and no two are alike. Lichens are a complex life form that is a symbiotic partnership of two separate organisms, a fungus and an alga. The dominant partner is the fungus, which gives the lichen the majority of its characteristics, from its thallus shape to its fruiting bodies.

Bioindicators are living organisms that respond in an especially clear way to a change in the environment. The hardy lichens are useful bioindicators for air pollution, especially sulfur dioxide pollution, since they derive their water and essential nutrients mainly from the atmosphere rather than from the soil. It also helps that they are able to react to air pollutants all year round. Compared with most physical/chemical monitors, they are inexpensive to use in evaluating air pollution.
Lichens can also be used to measure toxic elemental pollutants and radioactive metals because they bind these substances in their fungal threads where they concentrate them over time. Environmental scientists can then evaluate this accumulation to determine the history of the local air.

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Figure Lichen

**NEGATIVE:**

A fungus plays a very significant role to maintain ecological balance on earth (4). The purpose of this article is to create awareness among people about fungi so that they can reap on the benefits and avoid the ill effects of fungi.

**MUCORMYCOSIS**

Mucormycosis is an aggressive and invasive fungal infection that can affect various vital organs such as the brain and cause internal damage to the ear, nose, throat and mouth (10). It is not contagious but can be fatal if not detected early. It is a rare but serious infection that is caused by a group of moulds called mucormycetes. Colloquially termed ‘Black Fungus’, it was previously known as Zygomycosis.

Mucormycosis largely affects people who have health problems or use medicines that depress the body’s ability to combat germs and illness. It reduces the ability to fight environmental pathogens. It most commonly afflicts the sinuses or the lungs after inhaling fungal spores from the air. It can also happen on the skin after a burn, cut or other type of skin wound through which the fungus enters the skin. It can also affect the brain. People having co-morbities, variconazole therapy, uncontrolled diabetes mellitus, and immunosuppression by steroids or prolonged ICU stay can get predisposed to the fungal infection. Warning signs include headache, fever, coughing, blood vomits, breathlessness and altered mental status.



Figure Mucor

**CRYPTOCOCCUS**

*Cryptococcus neoformans* is a fungus that lives in the environment throughout the world. People can become infected with C. neoformans after breathing in the microscopic fungus, although most people who are exposed to the fungus never get sick from it (9).



Figure Cryptococcus

**KERATINOPHILIC FUNGI**

Fungi play an important role in the degradation of keratinous substrates also (3). The keratinous matter is subjected to microbial decay in soil which comes from several sources like hairs, feathers, nails and hoofs. Degradation of various types of keratin by Dermatophytes has been the subject of several investigations. The ability of keratinophilic fungi to attack and perforate hair in vitro has been considered to be restricted to Dermatophytes and related fungi. The diversity of keratinophilic fungi in different habitats of India is studied by several authors. (2)

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Figure Colonies of keratinophilic fungi

**CONCLUSION**

Fungi, along with bacteria, are one of the best decomposers of organic material. Without them, dead plants and animals would just hang around and the nutrients from the dead material would not return to the ground. Other plants, animals and micro-organisms that rely on that food would also die and the delicate balance of the ecosystem would be lost.

We can say that the fungi are playing a double role by helping at one hand and harming at other hand. Just like a coin has two aspects, fungi also have two aspects. We have to be careful while dealing with the fungi that play a negative role and take advantage of the fungi that are beneficial to us. Thus a proper balance has to be maintained and a comprehensive picture of the fungi will be justified.

So far we have observed fungi plays negative role such as spreading disease like mucormycosis and Cryptococcus, skin disease like dermatomycosis, spoils food items such as pickles, bread and objects like leather and wood. The awareness of the negative role of fungi can certainly give us methodology and technique to get rid of such type of problems. In order to protect ourselves from pathogenic fungi some methods are carried out although more stringent measures are required.

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