

Review Article

Fungal Importance in Our Environment

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Abstract: The fungi kingdom comprises eukaryotic, heterotrophic organisms with diverse structures, functions, growth forms, and lifestyles; it's more than 1.5 million members positively or negatively impacts all existing forms of life and, therefore, all ecosystems. Fungi are organisms that have unique qualities among all living beings. These capabilities have a detrimental or beneficial impact on human activity due to their use at various important historical points. These Organisms are used in food processing or in the production of antibiotics. However, they have caused diseases in plants and animals, constituting a constant challenge in the areas of research, diagnosis, treatment, and control. For all this, mushrooms have played an important role in the theatrical work of human development and prosperity.

Keywords: Fungi, heterotrophic, eukaryotic, environment.

INTRODUCTION

The presence and interaction of fungi on the planet and in human life can be compared to a play. The mushrooms may be the only actors, playing both antagonistic characters; heroes and villains. Fungi are organisms that have a defined nucleus and that have characteristics similar to plants and animals. However, they are not made up of organs such as leaves, roots, heart, or lungs. Its cells are elongated and when aligned with each other they form filaments called hyphae. These are intertwined in a mass similar to cotton called mycelium. (Figure 1) These fungi are called filamentous. However, some fungi can be made up of a single cell; in the case of yeasts. (ALEXOPOULUS, 1996) (DURAND, 1997) (RUIZ, 2001) (DEACON, 2010). The appearance of fungi is estimated between the last 660 million and 2.15 billion years. There is also evidence that shows that fungi were the first beings that emerged from the seas to conquer land. This conquest eventually allowed the terrestrial establishment of plants, and with it, the indirect establishment of the animals that feed on them, through the formation of symbiotic relationships, as will be indicated later. A fundamental condition that allowed the development of the tissues, organs, and systems that are currently present the plants and animals. This is why most experts consider fungi as the "inventors" of multicellular forms. (ALEXOPOULUS, 1996) (RUIZ, 2001).



Figure 1: Mass of mycelium growth on Peach fruits

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In the 19th century, the mushrooms were classified within the plant kingdom (Plantae) because they are immobile organisms and are anatomically similar to these. Although the plants have roots, stems, and aerial structures that form seeds, and fungi for their part, they conform by hyphae and mycelia attached to the soil, a protruding aerial thallus, and aerial structures complex where they form spores. It is the case of the wild mushrooms, which can be observed in the fields (Figure 2). (DURAND, 1997) (BIAL-ARISTEGUI, 2002) (RUIZ, 2001).



Figure 2: Cultivation of white mushrooms (*Agaricus bisporus*)

With the advances of the microscope and the beginning of the molecular analysis, fungi are closer to the animal kingdom (Animalia) than to the kingdom of floors. Fungi do not contain chlorophyll or chloroplasts (plant components that allow obtaining energy through sunlight). That is, they do not obtain their nutrients through photosynthesis, but rather by absorption. Likewise, fungi have a lifestyle similar to that of animals, which are not capable of producing their own food and are nourished by components made by other organisms. Additionally and similar to the external skeleton of insects, fungi have chitin (carbohydrate that provides rigidity) in its cell wall (DURAND, 1997) (RUIZ, 2001).

In 1821, the Swedish botanist Elías Magnus Frías (1794-1878) published, in the work *Systema mycologicum*, the first modern classification of fungi based on external morphological characteristics, size, shape and color. Currently, based on their morphological, physiological, biochemical and molecular properties, fungi are classified into, and They make up the biological kingdom called Fungi. Which has approximately 1.5 million members impacting all forms of life in diverse ways existing, and with it, to all ecosystems. The impact of fungi on ecosystems is due to the fact that they can behave as symbiotic, saprophytic organisms. And parasites. Symbionts obtain nutrients from a close relationship with organisms of another species and both benefit. The saprophytes, for their part, feed on dead organic matter, while parasites obtain all their nutrients from the living tissues of another organism without providing benefits to the latter (DURAND, 1997) (DEACON, 2010).

Mushrooms History

Are defined as beings who distinguish themselves by performing extraordinary feats, their qualities are a constant source of admiration and pride. Without a doubt, mushrooms fit this definition without complications because from the beginning of life have performed heroic deeds that helped the evolution of plants, the feeding of animals, the recycling of compounds in various ecosystems, and human prosperity.

Fungi established symbiotic relationships with plants approximately 500 million years ago, giving rise to mycorrhizae. These are formed when the Hyphae of the fungus branch in the soil, creating an extensive network of hyphae that underground interconnect the roots of the plants, whether they are the same or different. species. In this relationship, the plants (interconnected) provide nutrients to the fungi, and in turn, the latter serve as extensions of the roots to obtain minerals and nitrogen. It is currently known that about 90% of vascular plants have mycorrhizae, and therefore, it is possible to suggest that without these relationships plants would not grow or would grow inefficiently (DURAND, 1997) (RUIZ, 2001) (CAMARGO-RICALDE, 2012).

Likewise, there are other symbiotic relationships with animals. One of them is the relationship established with some ants, which cultivate and feed on the fungus. When changing anthills they take them with them so they can feed on them in your new home. Without this relationship, perhaps the ants would lack an important food source in the development

of their communities (RUIZ, 2001). Although some symbiotic fungi have established close relationships with plants and animals, all of these have made important contributions to the environment that surrounds them in almost all ecosystems.

Saprophytic fungi are, par excellence, the best degraders of organic matter that exist, since they have the capacity to degrade compounds such as cellulose, chitin and lignin (components present in the tissues of plants, animals and trees, respectively). Therefore, saprophytes participate in the recycling of dead matter when it has to be degraded. As part of the cycles of nature, for example, in the carbon, phosphorus cycle and nitrogen (DEACON, 2010). The leading role of fungi, without a doubt, is vital for life in the earth and, therefore, in human history. Great deeds make great heroes and there are two very important feats in which fungi have marked history of human civilization. The first of them is food preparation, specifically fermentation. This is a process that does not require oxygen in which some Fungi, especially yeast, degrade complex molecules such as carbohydrates. Carbon and sugars to transform them into various compounds such as alcohol and carbon dioxide (FANRWORTH, 2008). The most representative example is that of the *Saccharomyces cerevisiae* yeast, which has been used since time immemorial in the production of bread, beer and wine. A timeline is shown in Figure 3 with some of the historical facts.

In addition to the fungi used in food fermentation, there are fungi that are found in the food sector for their flavor, smell and the benefits they provide health. This is the case of huitlacoche, also known as “corn smut” or “Mexican truffle,” this corn fungus can do so much more than tortilla filled with cheese and heated. This food prepared in Mexico from corn and a parasitic fungus (*Ustilago maydis*) of this crop. This food, in addition to having a pleasant flavor to the palate, promotes the synthesis of essential amino acids for the human body (Yu., *et al.*, 2023) (Figure 3).



Figure 3: *Ustilago maydis* parasitic on corn crop (huitlacoche)

Another case is that of mushrooms, which are cultivated industrially as human food. The second great feat in this story is related to medicine. In 1928, Alexander Fleming carried out experiments on bacteria in various cultures, which an unusual way began to die in the presence of a strange fungus appearance that grew unexpectedly in the culture medium. Upon making more detailed observations, Fleming realized that this fungus produced a substance capable of causing the death of bacteria with the potential to make humans sick. He the fungus was named *Penicillium chrysogenum*, while the substance with antibacterial properties produced by the fungus was called Penicillin. With this this discovery gave birth to antibiotics that have simply cured human beings of various illnesses and diseases throughout the planet. Mushrooms are real heroes. (García-Estrada, *et al.*, 2020).

With the advent of antibiotics, humans have opened the way to exploring the possibility of taking advantage of the peculiar characteristics that they have mushrooms. That is why these organizations are currently used in the pharmaceutical, textile and paper sectors, in the production of different substances such as vaccines and vitamins.

In order to find environmentally friendly ways to dispose of dyes and heavy metals such as copper that are discharged into wastewater, some fungi such as *Aspergillus terreus*, *Trichoderma* and *Dictyuchus* have been used to remove Congo red and azo dyes, other toxic dyes and copper from different environments. (Al-Makhrab and Al-Shammari 2023) (Ali *et al.*, 2023) (Al-Shammari *et al.*, 2023).

The filamentous fungi *Aspergillus niger*, represented by effective biomass, was used to remove heavy metals extracted from mobile phone waste, which is also an environmentally friendly method. (Al-Shammari *et al.*, 2023).

In the field of bioremediation, *Fusarium* sp is used in the biosynthesis of zinc oxide nanoparticles against *Saprolegnia parasitica* isolated from eggs of common carp in a fish hatchery. (Al-Shammari *et al.*, 2022).

Filamentous Fungi Importance

Fungi are beings who lack nobility, who commit harmful and harmful actions. By common understanding, the villain is the evil being who opposes the hero of the story and in this context, mushrooms can also perform feats that lack any kindness causing diseases in animals, plants and humans. Some qualities can be used in both beneficial and harmful ways. Thus, fungi not only use their ability to degrade organic matter, favoring the recycling of organic compounds in ecosystems, but they also cause the degradation of foods that are widely consumed by the human being. These degraders are known as molds, cause foods to quickly reach their decomposition state by using them as their own source of nutrients. This process is favored by the warm and humid conditions that they allow them to grow and reproduce.

Penicillium, Aspergillus, Fusarium and Rhizopus are some of the mold genera that can be found in foods (DEACON, 2010). Some have the ability to form mycotoxins (poisonous fungi) harmful substances whose ingestion, inhalation or skin absorption causes diseases, for example, ergotism (also known as St. Anthony's fever due to the hugging sensation experienced by the victims), an illness caused by ingesting rye contaminated with mycotoxins from the *Claviceps purpurea* fungus that affected numerous parts of Europe in the year 943 (LAVAL, 2004).

In the case of animals and humans, the diseases that cause Microscopic fungi are known as mycoses. Most of these diseases are accidental and some are even transmissible from person to person (Pneumonia caused by the fungus *Pneumocystis jirovecii* and acute meningitis caused by *Cryptococcus neoformans*). However, it is rarely possible to detect infection from the fungus due to its size. The most common mycoses in humans are; Athlete's foot (tinea pedis) a superficial skin infections and nail infections, these pathologies fungal infections are caused by dermatophytes (fungi that reside in the skin) such as *Trichophyton*, *Microsporum* and *Epidermophyton*. However, these diseases are not as common in animals and humans as other diseases caused by bacteria. And viruses (Figure 4) (REBELL AND TAPLIN, 1970) (ELEWNSKI, 1992) (QUINDÓS, 2015) (Diongue *et al.*, 2016).



Figure 4: Athlete's foot

In contrast to what happens in animals and humans, plant diseases are caused mainly by fungi, which developed strategies that allowed them to go from saprophytes to pathogens (organisms that cause disease) and attack, among others, crops of economic importance such as corn, beans, sorghum, soybeans, wheat, etc. These fungi belong to a group formed by almost 10,000 members called phytopathogens (AGRIOS, 1995) (DEACON, 2010). Within the phytopathogenic fungi *Macrophomina phaseolina* has been distinguished with honors as one of the major causes of plant diseases, approximately 500 species of them. The best known disease is called rot carbonosa (Ghosh, *et al.*, 2018), in which it is possible to observe the rotting of various organs of the plant such as the roots, the stem, the leaves, including the seeds, accompanied by a large

number of black dots and dark lesions on it. Without a doubt, a true villain who can steal the show completely, compared to other phytopathogenic fungi of the genus such as *Fusarium*, *Sclerotinia* or *Aspergillus* (DHINGRA AND SINCLAIR, 1978) (figure 5).



Figure 5: Gray stem rot or carbonosa, caused by *Macrophomina Phaseolina* in soybeans

CONCLUSIONS

Fungi are organisms that have unique qualities among all living beings. These abilities can be used to harm or benefit organisms living things and ecosystems. They have evolved together with the development of human beings and are currently used in various areas as food, elements transformers thereof and cure of diseases. Unquestionably, the importance of fungi in the biosphere is due to their capacity for decomposition and recycling of organic matter, regulate the release of nutrients and essentially its role in the survival of plants and animals. However, the fungal capabilities are not of the all beneficial due to their impact on human health, and as causes of diseases in crops of economic importance.

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