

# Trigger of immune deficiency lead to fungal infection in animal

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**Abstract.** The immune system, as an important protection for animals and humans, ensures that they are not attacked by invading microorganisms and destroying them. Once immune system is damaged or defective, it allows harmful microorganisms to grow and spread within the body, attacking internal organs, leading to infections and diseases. When animals are infected with fungi and cause diseases, they can be treated with antibiotics or by surgery. However, probability of diseases caused by fungal infections in animals has gradually increased. Fungi, as a type of microorganisms, play a dominant role in fungal diseases. Therefore, in the article, it will study how microorganisms operate in animals to cause infection, and lead to fungal infectious diseases through analyzing the mechanism of microbial fungi in animals with immune system defects and their impact on animals. Many studies have shown that the common fungal pathogens of infectious diseases exist in the environment of daily life and inside an animal's body. Poor living conditions or improper feeding are the reasons that trigger the growth of microbial fungi in animals. Through research results, improving animal immunity, creating a good living environment and diet can prevent animals from being infected by fungi and leading to diseases. This series of movements of fungi in animals also reflects importance to both the animal body and the environment. Research on the mechanisms of various microorganisms in infections and diseases can also facilitate development for faster and more effective treatment methods, thereby reducing animal infection caused diseases.

**Keywords:** fungal infection, immune deficiency, aspergillosis, mucormycosis, candidiasis.

## 1. Introduction

Not only will humans get infected by fungi and cause diseases, but this can also happen in animals. Microorganisms and fungi that present in the environment do not have an impact on healthy animals most of the time, but they can be harmful in unhealthy animals. Like humans, animals also have an immune system in order to protect their body. Unhealthy animals are often accompanied by immune deficiencies. Not only on poultry, but also pets raised at home may be infected with fungi. Some diseases can even be transmitted between animals and humans. Even more severe cases may lead to their death. Disseminated aspergillosis is one of the common infectious diseases among dogs. When fungi enter a dog's body, they are able to attack organs throughout the body, leading to the disease. This infectious disease is also highly fatal in dogs. In poultry, if pregnant cows are infected with *Aspergillus*, it will lead to miscarriage or affect the newborn calves with skin infection [1]. Such diseases can usually be treated with antibiotics. Topical treatment is the most common method, with a

success rate of 80%. Surgery can also be added to remove the infected part. Although Aspergillosis can be alleviated and treated with antibiotics, the different types of antibiotics will have various effects. The degree of treatment and medical costs also vary. Even so, the 100% successful treatment rate is still not guaranteed [1]. Blastomycosis is also a fungal infection that easily infects cats and dogs. Mainly developing and spreading in the lungs of animals. The most susceptible areas are the lungs, skin, respiratory tract, and eyes, developing nodules. Antibiotics are also preferred method for treating blastomycosis, but they also cannot guarantee a 100% cure rate and there is a possibility of recurrence. Some animals may even be affected by the drug again. At the same time as reducing costs, the treatment cycle will also be extended [2]. Currently, the most common method of treating fungal infections is through use of antibiotics. Although there are treatable methods, they may not be able to clean the pathogen and there is still a possibility of recurrence. The cost and cycle of treatment are also closely related, which has become a major challenge in treatment. Identifying the causes that trigger and give fungi the opportunity to affect animals can prevent them from getting sick, thereby reducing the incidence of fungal infections in animals. Microbial fungi play a main role in diseases caused by fungal infections. Most animals infected with fungi have immune deficiencies that give fungi the chance to cause disease in the body. By analyzing infection cases of different fungi, aim to investigate how fungi can colonize in low immunity animals and spread of fungi within the body and ultimate impact to help prevent infection.

## **2. Microorganisms in fungal infectious diseases**

Microorganisms play an important role in many infectious diseases. Although some infectious diseases caused by fungi are relatively uncommon among animals and humans with healthy physical function and strong immune systems. But in the past few decades, more and more fungal diseases occur in animals, which makes the study of fungal infectious diseases of animals more significant [3]. Some fungal diseases can spread between humans and animals. Animals most susceptible to fungal infections are usually those with weak or defective immune systems. When fungi enter an animal's body, they can spread to various organs. Once they are able to develop and affect organs, it can lead to different types of diseases. *Candida albican*, the fungi that causes Candidiasis, which can cause diseases in the gastrointestinal tract, mouth, lungs, skin, and heart in birds. In dogs, it can cause inflammation in their skin and organs [3]. The *Aspergillus* that causes Aspergillosis can also cause inflammation and infections in animal's on the eyes, bronchi, intestines, mammary glands, and lungs. There is also a type of fungal infection that can infect different parts of an animal's body. *Mucorales* in mucormycosis enter a dog's body and cause infections, it can affect their gastrointestinal tract, skin, and blood vessels. If not treated promptly, it will lead to dog death. Deficiencies and declines in the immune system give fungi chances to grow and disturb the operation of other functions in the animal's body, which leads to the development of diseases [3].

Aspergillosis is one of the fungal infectious diseases that cannot spread between animals and humans. It's mainly caused by *aspergillus* and covers a wide range of types of diseases. Fungi are usually not considered as pathogens because they are ubiquitous in the environment, including *Aspergillus*. The spreading of *Aspergillus* is through spores produced by *Aspergillus* entering the animal's body [4]. Fungi under the form of spores have stronger survival ability, vitality, and higher transmission ability. Animals with healthy physical functions will not be affected although they consume a certain amount of spores [5]. It usually targets animals with weakened immune systems. Phagocytes in the immune system play an important role in protecting the animal body from attacks by harmful cells, microorganisms and other pathogens, and can remove harmful foreign bodies. Among Phagocyte cells, there is a white blood cell called a neutrophil, which has significant effects in the composition of the immune system and is the first "gate" to pass when pathogens enter the body. Since neutrophils belong to Phagocytes, they also have phagocytic capacity. Neutrophils will cooperate with other phagocytes and macrophages to destroy *Aspergillus* spores at the infection site, preventing further spread and infection of fungi [6]. Therefore, when *Aspergillus* spores enter an animal body with a strong immune system, they will be destroyed by phagocytes. But if it's an animal body with

low immunity, it will be accompanied by a decrease in neutrophils, and *Aspergillus* fungi can have the opportunity to grow in the body and affect other organs. According to reports, an infection caused by *Aspergillus flavus* accounts for 10% of Aspergillosis [7]. *Aspergillus flavus* is a type of corrosive fungi with a complex structure consisting of linear mycelium growth. It has faster growth ability and pathogenicity. Compare to the growth environment requirements of other ordinary fungi, the suitable temperature for *Aspergillus flavus* to growth is approximately 37 degrees Celsius, while the most suitable grow environment for ordinary fungi is between 25-42 degrees Celsius [8]. This adaptation to environmental conditions creates *Aspergillus flavus* pathogenicity and explains their ability to grow rapidly and cause damage in the animal body. The largest population is affected by Aspergillosis in birds, which is also one of the fungal infections with a high incidence and mortality rate among birds. In addition, their immune deficiency makes them unable to resist the ingestion of spores and grows in the body, producing toxins that damage organs in various parts, and even causing the growth of nodules. Environmental factors are also an indirect cause of the infection. The hygiene issues might cause *Aspergillus* in the soil to enter the bird's body, they can also adhere through the feed. If the hygiene of the environment and feed are not done properly, it's likely to further lead to the outbreak of *Aspergillus* and the infection of diseases [4]. Overall, microbial *Aspergillus* can have a significant impact in the environment and when entering an animal's body with low immune capacity, leading to the development of diseases.

Mucormycosis is also a type of fungal infection that has no infectious ability between animals and humans. Animals with immune deficiencies also have a higher probability of infection and illness. It's caused by the fungi called mucorales. Mucorales also exist widely in the environment, usually in soil, belonging to environmental organisms. Mucorales are rarely seen as pathogens for healthy animals and generally do not cause diseases due to their low toxicity. The spread and growth of mucorales are similar to *Aspergillus*, both of which propagate in the form of spores, and it's also a type of corrosive fungi [9,10]. The neutrophils in the immune system also can control Mucorales's function in the animal's body. When Mucorale enters the animal body with a healthy immune system, the neutrophils can damage and engulf the fungal structure of Mucorale, preventing their further infection and growth [11]. So if the immune system function of an animal is weakened and accompanied by the loss of neutrophils, it will cause further reproduction of Mucorales in the body, which cannot be controlled. The suitable environment for the growth of mucorale is around 25 - 37 Celcius, which is a heat-resistant fungus that sustains its ability to grow in the body. The characteristic of the mycelium of Mucorales can rapid growth and have various types of structure. The spore sac growing at the top of the mycelium can release spores for reproduction. Another characteristic of Mucorales is that they could obtain iron from the host they are attached on. Fungal pathogens can get iron from the host's hemoglobin. The most common site of fungal infection is in the blood vessels. They will attack blood vessels, leading to blockages and necrosis within it, as well as the formation of blood clots. The necrosis of cellular tissue and the resulting blockage of blood vessels can affect the normal operation of white blood cells and their inability to resist fungal invasion. This may even lead to the failure of other organs that transport blood to other parts of the body [11]. Mucormycosis also has a significant impact on dogs. When dogs with weakened immune systems are infected by Mucorales, they are able to rapidly and extensively reproduce in their skin, gastrointestinal tract, and other areas. The invasion of blood vessels gradually leads to a decrease in blood flow in the blood vessels, ultimately cutting off all blood vessel pathways, and damaging the body's tissues. If not treated in a timely manner, it will lead to the death of the dog [12]. Although microbial Mucorale exists in the living environment, once animals are affected by it and have the opportunity to grow and infect in the body, it will ultimately pose a threat to animal life.

Candidiasis is one of the most common fungal infections within animals. The cause of the infection is a pathogen called *Candida*. *Candida* usually exists by small amounts in the body, gastrointestinal tract, and oral cavity of animals, it's generally not considered a pathogen. But if the immune system or normal digestive microbiota are disrupted, it will increase the probability of contracting Candidiasis [13]. One of the main causes of Candidiasis is *Candida albicans*. In most cases, the presence of

*Candida albicans* in the body does not cause harm to the body or affect animal bodies, leading to disease. But at the same time, they are able to cause varying degrees of impact within the body, and even lead to a life crisis. In healthy animals, the pathogenicity of *Candida albicans* is not apparent, but in animals with immune system problems, the pathogenicity of *Candida albicans* is reflected. The range of species infected by *Candida albicans* is very diverse due to their variable attributes, which enable them to quickly adapt and survive under different conditions. When the yeast cells in *Candida albicans* have the opportunity to combine with the cells on the attached host, the fungi will change from the form of yeast to mycelium for growth and invade through phagocytes. Yeast cells can also generate biofilms, covering them below, while mycelium cells grow on top of the biofilm. Biofilm is formed by some of the most common substrates, and the maturity of the biofilm means that *Candida albicans* have much stronger resistance to attacks and clearance from the host immune system. Such a transformable appearance gives it flexible mobility. Not only does *Candida albicans* undergo morphological changes when in contact with cells invading their host, but they can also adjust and adapt to changes in environmental factors. When at low pH concentrations ( $<6$ ), *Candida albicans* will survive and grow in the form of yeast. When at high concentrations of pH ( $>7$ ), *Candida albicans* will grow in the form of hyphae. In addition to its powerful form transformation ability, *Candida albicans* also have different mechanisms for attacking invading animals. *Candida albicans* express specialized invasins proteins on the surface of host cells, when combined with host ligands, induce host cells to engulf fungal cells. Although fungal cells are engulfed and appear to be killed, they are actually absorbed. During this process, fungal cells do not need to have excessive activity, but rather passively produce effects. The strong stress response exhibited by *Candida albicans* in adapting to the environment has contributed to its survival ability and virulence. The constantly changing external conditions and simultaneous invasion of the host are the main reasons why *Candida albicans* can settle and grow in the host body [14]. Through series of infections of *Candida albicans* in animals eventually lead to disease, which shows that the microorganism *Candida albicans* has a great impact on animals in causing fungal infectious diseases.

Microorganisms are inseparable in daily life, not only affecting animal and human health, but also being one of the often overlook causes of diseases. When microorganisms enter an animal's body, they have the opportunity to grow and reproduce, it will affect the animal's body and infect it, ultimately developing into a disease. Some diseases can even threaten the lives of animals. In addition to environmental factors, hygiene and the food they come into contact with can promote the entry of microorganisms into the body, leading to infection. The deficiency of immune function is also one of the important reasons that fungi have the opportunity to spread and continue to grow in the body. A healthy immune system can destroy and engulf harmful microorganisms, viruses, and cells that enter the body. Being able to further prevent their continued diffusion within the body. When there is a problem with the immune system, invading microorganisms cannot be cleaned up or distinguished from normal cells, which can cause them to continue to spread and ultimately lead to diseases. The best way to prevent the impact of diseases is to increase and protect the immune system of animals, enabling them to have the most basic self-protection ability. The study on antibiotics can also be on the mechanism of microorganisms in animals. Clearing the source of infection before further severe infection can reduce the pain and mortality suffered by animals.

### **3. Conclusion**

According to the analyzed cases, immune deficiency is the main reason for fungal infections in animals. Animals with immune deficiency cannot resist and eliminate fungi that enter the body properly. Fungi that enter the body of animals can spread through their movement mechanisms, and some fungi can enter and spread to any part in the body. If detected early, it can be treated by using antibiotics. However, the efficacy of different antibiotics varies, the probability of successful treatment cannot be guaranteed also. The cost of treatment also depends on which type of antibiotic is used. If not treated in a timely manner, it can lead to the spread of fungi and have a greater impact, which can lead to animal death. By analyzing the mechanism of action of microorganisms and fungi in animals,

the importance of microorganisms in disease research and treatment cannot be underestimated. Microorganisms are able to spread in the body due to the inability of the immune system to function properly and warn that a healthy immune system is the most fundamental protection against any infection. Although there is currently no guaranteed treatment of fungal infection that can fully cure animals. Further research on microorganisms can help in finding more effective treatments and drugs. The importance of animal protection and health can help animals stay away from the troubles of diseases.

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