

# Fungal Metabolites in Human Health and Diseases—An Overview

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Fungi produce a wide range of secondary metabolites. Some of these metabolites are toxic to humans and cause various health disorders, ranging from acute poisoning to chronic diseases. Contrary to this, some fungal metabolites are valuable sources in therapeutics, such as penicillin. Herein, researchers briefly highlight the role played by different fungal metabolites in human health and diseases and give an overview of the most common fungal genera.

Keywords: fungi ; secondary metabolites ; mycotoxin ; *Aspergillus* ; *Penicillium* ; *Fusarium* ; antibiotic ; anticancer

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Fungi are extraordinary in their ability to produce numerous natural products known as fungal secondary metabolites, which exhibit various biological activities <sup>[1][2]</sup>. Considering the reported biological properties of fungi toward human health, they can be classified as toxic “mycotoxins” or non-toxic metabolites <sup>[3]</sup>. Mycotoxins are natural contaminants of food commodities and pose a measurable health risk for animal and human health <sup>[4]</sup>. Health risks are classified based on organs that are affected by the toxins, for instance, they possess carcinogenic, immunosuppressive, hepatotoxic, nephrotoxic, and neurotoxic effects <sup>[4][5]</sup>. Hundreds of mycotoxins have been identified <sup>[6][7]</sup>. The mycotoxins that receive the most significant concern from scientists are aflatoxin B1 and M1, cyclopiazonic acid, ochratoxin A, patulin, T-2 toxin, deoxynivalenol, zearalenone, ergot alkaloids, and macrocyclic trichothecenes, due to their health and economic effects. For instance, aflatoxin B1 is classified as the most potent hepatocarcinogen and mutagen <sup>[8][9]</sup>. However, human exposure to mycotoxins is still underestimated as scientists only focus on economically important mycotoxins. Therefore, it is important to intensify efforts to discover more toxic fungal metabolites that contribute to diseases of unknown aetiology.

On the contrary, some fungal metabolites are beneficial for human health and are used to treat many human diseases, such as antibiotics. Therefore, researchers from different fields work together towards understanding the fungal secondary metabolites in terms of their regulation, function, and applications, and evaluate their toxicity <sup>[10][11][12][13]</sup>. These fungal metabolites are characterized by their chemical structures and effects on human health <sup>[1]</sup>. A recent review mentioned that more than 1,500 fungal metabolites had been isolated and half of them have been used for primary health care. The other half is still under safety and toxicity investigation <sup>[1]</sup>.

The scientific community has recently celebrated the 90th anniversary of Sir Alexander Fleming’s discovery of penicillin, which was the starting point of the antibiotic era <sup>[10]</sup>. Since then, scientists worldwide have started to consider and use innovative approaches to study fungi due to their health and biotechnological significance. Although drug discovery from fungal metabolites is increased due to the development of bioinformatics and genomics <sup>[14]</sup>, researchers expressed the need to ramp up the discovery of fungal metabolites to improve food quality or discover novel antibiotics. This was obvious during the pandemic when researchers initially struggled to find drugs to treat the SARS-CoV-2.

In the coming section, researchers will briefly discuss the importance of different fungal metabolites in human health and diseases with an overview of the fungal genera most frequently involved.

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