

Unraveling the Enigmatic Black Aspergilli: Fungi of Great Significance

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Description

Black aspergilli are a group of filamentous fungi belonging to the genus *Aspergillus*. They are characterized by their dark-colored spores and diverse ecological niches. While some species of black aspergilli are commonly found in the environment and play beneficial roles, others can cause serious health issues. In this article, we delve into the intricacies of black aspergilli, exploring their characteristics, ecological roles, and their impact on human health.

Otomycosis refers to the fungal infection of the external auditory canal, and less commonly the middle ear. Although globally distributed, this disease is more prevalent in hot, humid, and dusty climates. Otomycosis usually presents with itching, tinnitus, otalgia, aural discharge, and hearing problems.

A wide range of fungi can cause this disease, however, the most common etiologies are species of *Aspergillus* and *Candida*. Until recent years, *Aspergillus niger* was thought to be the prevailing species of the genus *Aspergillus* that causes otomycosis. These results were based on morphological characteristics of the isolated fungi. Using molecular methods, now, it is known that *Aspergillus* section *Nigri* comprises several morphologically similar species. Accordingly, for the past few years, molecular methods have been used for the identification of black *Aspergillus* isolates morphologically compatible with *Aspergillus niger* in patients with otomycosis. In this review, we focus on black aspergilli and their role in otomycosis.

Black aspergilli are known for their beneficial role in producing various enzymes, vitamins, etc. In contrast, some of them could have a negative impact on human health by producing mycotoxins or causing infections. Regarding their morphology, members of *Aspergillus* section *Nigri* present with dark-brown to black conidia, uniseriate or biseriate conidiophores, spherical vesicles, and hyaline or lightly pigmented hyphae near the apex. Due to the shared features.

For years, *Aspergillus niger* was thought to be, and reported as the leading cause of otomycosis in various studies. For instance, in a review of more than 20 articles on otomycosis from Iran, *Aspergillus niger* was responsible for 51.15% (781 out of 1527) of cases. In these studies, the identification was based on morphological methods. Because the accurate speciation of black aspergilli based on morphological criteria is impossible

The black aspergilli (*Aspergillus* section *Nigri*) is an important group of species in food mycology, medical mycology and biotechnology. Many species cause food spoilage, but on the other hand are also used in the fermentation industry to produce hydrolytic enzymes, such as amylases or lipases, and organic acids, such as citric acid and gluconic acid. They are also candidates for genetic manipulation in the biotechnology industries since *A. niger* used under certain industrial conditions has been granted the GRAS (generally regarded as safe) status by the Food and Drug Administration of the US government. Although the main source of black aspergilli is soil, members of this section have been isolated from various other sources. Besides their economic importance, black aspergilli are also important as ochratoxin producing organisms which contaminate several agricultural products including grape derived products, coffee and cocoa.

Black aspergilli are one of the more difficult groups concerning classification and identification and several taxonomic schemes have been proposed. New molecular approaches have shown that there is a high biodiversity, but that taxa are difficult to be recognised based solely on their. Murakami only reluctantly recommended to use nitrite as sole nitrogen-source as a diagnostic medium in *Aspergillus* taxonomy. 20 % tannic acid agar seems to be less useful for diagnostic purposes as most black aspergilli can grow on it.

In this paper we have compiled the most relevant methods to be used in the diagnostics of the known and accepted species. Some additional methods have been listed.

Understanding Black Aspergilli

Taxonomy and Diversity: Black aspergilli comprise several species within the genus *Aspergillus*, including *Aspergillus niger*, *Aspergillus tubingensis*, *Aspergillus carbonarius*, and *Aspergillus aculeatus*. These fungi are known for their dark-colored spores and distinctive morphological features. Each species has its unique characteristics, ecological preferences, and metabolic capabilities.

Ecological Roles: Black aspergilli are ubiquitous in nature and can be found in various environments, including soil, decaying organic matter, indoor environments, and food products. They play essential ecological roles as decomposers, participating in the breakdown of complex organic materials. Some species are

involved in the production of enzymes, such as amylases and proteases, which have industrial applications in food processing and biotechnology.

Black Aspergilli and Human Health

Toxin Production: Certain species of black aspergilli are notorious for their ability to produce mycotoxins, secondary metabolites that can pose health risks to humans and animals. *Aspergillus niger*, for instance, can produce ochratoxin A, a mycotoxin associated with nephrotoxicity and potentially carcinogenic effects. Similarly, *Aspergillus carbonarius* is known for producing ochratoxin A and other mycotoxins such as fumonisins, which can have harmful effects on human health.

Allergies and Respiratory Issues: Black aspergilli can also trigger allergic reactions and respiratory issues in susceptible individuals. Inhalation of fungal spores or fragments can lead to allergic bronchopulmonary aspergillosis (ABPA), a hypersensitivity reaction that affects the respiratory system. Symptoms of ABPA include wheezing, coughing, chest tightness, and recurrent respiratory infections. Individuals with asthma or cystic fibrosis are particularly at risk of developing ABPA.

Invasive Aspergillosis: In immunocompromised individuals, black aspergilli can cause invasive aspergillosis, a severe and potentially fatal infection. This condition occurs when the fungus invades tissues and organs, primarily affecting the lungs. Invasive aspergillosis is often associated with high mortality rates, especially in patients with underlying conditions such as hematological malignancies, solid organ transplantation, or prolonged immunosuppressive therapy.

Detection, Diagnosis, and Treatment: The detection and diagnosis of black aspergilli infections involve a combination of clinical evaluation, imaging studies, and laboratory tests. Chest imaging techniques, such as computed tomography (CT) scans, can help identify characteristic signs of aspergillosis, including lung nodules, cavities, or infiltrates. Laboratory tests, such as sputum or tissue sample analysis, can aid in the identification of the specific species and determine antifungal susceptibility.

Treatment Options: The management of black aspergilli-related infections requires antifungal therapy tailored to the specific species and the severity of the infection. Voriconazole is considered the primary.