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AIRBORN FUNGAL FLORA

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ABSTRACT

Fungi that are airborne have a big impact on both indoor and outdoor habitats, agriculture, and ecological systems in addition to human health. It is crucial to identify and describe airborne fungus in order to comprehend their range, variety, and possible dangers. An overview of the several approaches used to identify and characterize airborne fungi is given in this abstract. These methods include modern imaging technologies, molecular techniques like next-generation sequencing (NGS) and polymerase chain reaction (PCR), and traditional culture-based methods. Furthermore, methods for regulating the amount of airborne fungal particles via ventilation systems, environmental control, and focused antifungal treatments are covered. To reduce airborne fungal effects on human health and the environment, it is essential to comprehend their dynamics and put appropriate control measures in place.

Introduction

It is crucial to comprehend the variety, quantity, and dynamics of airborne fungus in order to evaluate indoor air quality and its effects on human health. A complex and varied group of microorganisms, airborne fungus can arise from a variety of sources, such as outside air, building materials, and activities carried out by occupants. Fungal spores can spread throughout indoor spaces once they become airborne, creating a health concern for respiratory infections, allergies, and worsening asthma.(Ahmed and Shakil,2007,Tajikei et al.,2021,Garrett et al.,1998)Because of their small size, widespread distribution, and rich taxonomy, studying airborne fungus brings special problems. Isolating and counting airborne fungus has long been accomplished using conventional culture-based techniques like agar plate culturing. While culture-based methods are useful for learning about cultivable fungi, they frequently underestimate the variety of all fungal species because many of them are still viable in the laboratory but are not culturable.(Yassin et al.,2010,Menezes et al.,2004,Ghajari et al.,2015)In this work, we looked into indoor fungal communities in the air using a combination of molecular and culture-based methods. We sought to include both cultivable and non-cultivable fungal species, offering a more thorough evaluation of indoor fungal diversity, by combining conventional cultivation techniques with DNA analysis.(Raisi et al.,2013, Näsman et al.,1999)To further advance our knowledge of indoor air quality and microbial ecology, we also aimed to investigate the impact of environmental conditions on the distribution and composition of airborne fungal communities. The diversity and distribution of fungi on residential surfaces. (Lu Yixuan et al.,2022)

Air born Fungal spore

A significant portion of particulate matter in both indoor and outdoor environments is made up of airborne fungal spores, commonly referred to as fungal aerosols. Fungal communities are distributed around the world because to these microscopic structures, which act as the main means of fungal dispersal. They help the fungi settle in new areas. The dynamics of ecosystems, atmospheric processes, and human health are significantly impacted by fungal aerosols, which is why they are of great scientific and public health importance.Fungal particles that are airborne and originate from indoor surfaces, outdoor air, and building materials are present in a variety of populations inside indoor environments. The release, movement, and survivability of fungal aerosols indoors are influenced by variables like temperature, humidity, and air currents. Once in the air, fungal aerosols can land on indoor surfaces or hang out there for a long time, which can be harmful to people's health when they breathe in or come into touch with their skin and others. High diversity of fungus in air particle matter.(Ahmed and Shakil,2007, Burge et al.,1977,Hughes et al.,2022,Kanaani et al.,2008)

Significant Fungal Species

1.Fungal species, or myco, are important in many fields, such as ecology, biotechnology, medicine, and industry.(Yadav et al.,2021) The eukaryotic kingdom of fungi is diverse and includes microorganisms that are essential to the operation of ecosystems, the cycling of nutrients, and symbiotic connections with other creatures.(Dighton and John,2018) Fungi, which are thought to comprise between 2.2 and 3.8 million species globally, are a huge and little-explored source of biodiversity, providing a wealth of opportunities for both practical and scientific study. (Hawksworth et al.,2017)

2.Mycota play an important role in the creation of soil, the breakdown of organic matter, and the recycling of nutrients in ecological environments. These processes influence the composition and dynamics of both terrestrial and aquatic ecosystems. (Taylor et al.,2015, Hawksworth et al.,2017)

3. For the synthesis of enzymes, antibiotics, biofuels, and biodegradable materials, mycota provide important resources in biotechnological applications. The food processing, textile manufacturing, and waste treatment industries employ a variety of fungal enzymes, including cellulases, proteases, and lipases.(Aggarwal et al., 2024,McKelvey et al.,2017)

Methods of Capture and Analysis

Perception the distribution, content, and possible health effects of fungal spores in indoor environments requires an awareness of techniques for airborne fungal sampling and examination. These techniques cover a range of strategies for collecting fungi that are in the air and examining their properties, such as species composition, abundance, and viability. Reliable and thorough sampling and analysis methods are essential for determining probable fungal contamination sources, evaluating indoor air quality, and putting mitigation plans into action. Examining techniques are used to identify and characterize airborne fungal spores when air samples are obtained. Conventional microscopy techniques, such as light and scanning electron microscopy, enable visual examination of the morphology, size, and structure of the fungus. The amount of useful information that may be obtained on fungal diversity, abundance, and potential health risks through microscopic study may be restricted due to the requirement for specific tools and knowledge. Molecular approaches are being utilized more often in addition to microscopy to examine fungal samples that are carried by air. Fungal DNA can be found and identified in air samples using PCR and DNA sequencing techniques, which provide information about the genetic diversity and taxonomic makeup of airborne fungal communities. Next-generation sequencing (NGS), a high-throughput sequencing technology, makes it possible to analyse fungal populations in great detail and find uncommon or unculturable species. (Pyrri et al., 2007,Das et al., 2012,Fernández-Rodríguez et al., 2014,Banchi et al.,2020,Ökten et al.,2020,Núñez et al.,2017,Aguayo et al., 2018)

1.Volumetric Samplers: Since about 637 samplers of this kind in use worldwide, the Hirst spore trap has been the fundamental instrument for PBAPs study. Over 73% of Hirst samplers are used for monitoring fungal spores, despite being primarily used for pollen collection. Because optical identification analysis is a time-consuming technique, only a tiny subset of individual samples is analysed. Therefore, extrapolation is used to determine the total count. Since the accuracy of the data also depends on the operator's expertise, there have recently been concentrated attempts to assess the quality of the data and standardize such procedures. **(**Burge et al.,1977,Pyrri et al., 2007,Das et al., 2012,Clancy, Jerry et al.,2024,Martinez-Bracero et al.,2024)

2.Non - Volumetric Samplers: While measuring the volume of air sampled, non-volumetric samplers use a variety of sampling principles and techniques to collect fungal spores in the air onto collection substrates such agar plates, cassettes, or slides. These tools are frequently employed for spot or short-term sample applications, giving quick evaluations of fungal contamination in specific regions or microenvironments. When it comes to initial screenings, indoor air quality investigations, and quick assessments in the event of fungal contamination, qualitative airborne fungal sampling equipment is quite helpful. (Horner et al.,2004,Li et al., 1995,Morris et al.,2000,Araujo et al.,2010)

Culture Methods

Airborne fungal content has been assessed using culture-based approaches, utilizing both possessive active melodology. The Andersen sampler is the most widely used sampler that makes use of this technique. This sampler gathers spores onto agar plates using a multi-stage (cascade) impactor. This sampler has been employed in both indoor and outdoor settings in recent studies, allowing different sized spores to be grown independently. The Burkard portable air sampler, which uses agar plates, is an additional illustration of a volumetric sampler that uses Petri dishes. (Samson et al.,2004,Jensen et al.,1998, Morris et al.,2000,Grinshpun et al.,2016,Lacey, et al.,2020)

Conclusion

A number of sampling strategies and methodologies are used in the investigation of airborne fungal spores and their effects on indoor air quality and human health. We have investigated both volumetric and non-volumetric sampling techniques throughout this study, as each has special benefits and uses for determining the level of fungal contamination in interior spaces.Fungal spore concentrations can be precisely measured with the help of volumetric samplers, which include filtration and impaction devices. These samplers offer quantitative data on fungal spore concentrations. As they enable the identification of possible fungal spore sources and the detection of low levels of fungal contamination, these instruments are especially helpful for long-term monitoring and quantitative evaluations of indoor air quality.The identification and characterisation of fungal spore types and distributions is the primary emphasis of non-volumetric samplers, such as tape lift and settle plate devices, which provide qualitative assessments of fungal contamination.

Despite not being able to provide quantitative information on the amounts of fungal spores, these samplers are useful for quick screening, preliminary evaluations, and focused research on fungal contamination in certain locations or spaces. This study has allowed for a thorough evaluation of airborne fungal spores in interior environments by combining both volumetric and non-volumetric sampling methods. We have learned more about the types, numbers, and origins of airborne fungus as well as the possible health effects they may have on building occupants by utilizing a combination of quantitative and qualitative sampling methodologies.

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