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An Indoor Aeromycological Study of Hospitals in Amravati District

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ABSTRACT

In hospitals, airborne fungal contamination can have serious health effects, especially for patients with weakened immune systems. This study examines the diversity and concentration of airborne fungi in indoor environment of two hospitals in Amravati district of Maharashtra state in India. From two rural hospitals general wards, pathology, and pharmacy were surveyed for aeromycological data. The samples were collected in the month of July 2022 to September 2022. Fungal spores were captured by collecting air samples using the settle plate method. The collected samples were cultured and different species were identified through microscopic examination. The results shows that aeromycoflora was abundant in both hospitals indoor environments. Cladosporium cladosporioides showed the highest percentage contribution in both hospital environments, with 41.93% in Hospital I and 68.55% in Hospital II. In contrast, Aspergillus ochraceus had the lowest contribution in Hospital I (17.74%), while Aspergillus flavus had the lowest in Hospital II (17.74%).

Keywords: Aeromycology, Hospital, Amravati, Cladosporium cladosporioide, Aspergillus ochraceus, Aspergillus flavus

I. INTRODUCTION

"Aerobiology as the interdisciplinary science is closely associated with ecology, botany, phenology, palynology, mycology, microbiology, meteorology, climatology, as well as chemistry and physics of the atmosphere"[22]. Aerobiology studies small particles from biological origin in the air[18].

Aeromycology is the branch of aerobiology that studies the dispersion of spores and other fungal elements in indoor and outdoor air, the changes in their concentrations, and the factors that affect those changes[20]. Aeromycology is the study of the intensity of aerial dispersal of organic matter such as pollen and fungal and/or bacterial spores, both indoors and outdoors[7].

Airborne fungal monitoring began in the 19th century and continued throughout the early part of the 20th century [22].These early studies aimed to measure the levels of airborne fungi in the outdoor environment[24][14][12]. Researchers have long recognized the connection between fungal spore levels in outdoor air and their presence indoors, as well as the health risks associated with exposure to these spores in both environments [29]. Noble and Clayton (1963) were among the first to demonstrate the presence of fungi in hospital air[26]. Since then, there has been ongoing discussion in the literature about fungi as potential contaminants or biocontaminants that can affect indoor air quality [23] [11] [8][6].

II. METHODS AND MATERIAL

Selection of Area:

This work was carried out at two different primary health centers of district Amravati, Maharashtra, India. Three wards which are general ward, pathology laboratory and pharmacy of the Hospitals were selected for sample collection. The sample was collected in the month of July 2022 to September 2022. Room temperature and humidity of collection sites was recorded.

Plate Exposure or Settle Plate Method:

Plate exposure or settle plate which involves the opening of plate with specific culture media was used for this study [5][9]. This method allows fungi carrying particles to settle on the respective culture media. prepared plates are exposed for about 10-15 minutes in the different wards. The plates containing potato dextrose agar (PDA) was used for sample collection. The exposed petri plates were brought into the laboratory and incubated at 28 ± 1º C for 7 days. After 3rd, 5th and 7th days of incubation the fungal colonies were counted. At the end of 7th days of incubation the fungus was isolated and pure culture was maintained.

For the purpose of identification and microphotography, slides were prepared with lacto-phenol cotton blue as the standard stain.

Identification of Collected Samples:

Fungal colonies was initially characterized by cultural, morphological characteristics while the fungal isolates were identified on the basis of colony appearance and microscopic examination, morphology of the spore and hyphae as per Fungal Key of Ellis 1971, Barnett HL, Hunter BB (1972).

Percentage contributions of individual species were calculated as per the standard formula:

III. RESULTS AND DISCUSSION

Table 1: The total count of fungal colonies from indoor environment of hospital-1 from July 2022 to September 2022 at temperature 30°C, 32°C and 31°C respectively.

Sr. no.	Spore Type	Sampling Sites	July	August	September	Total of colonies found in all the months
1	*Cladosporium cladosporioides*	Pathology Lab	6	4	1	11
		Pharmacy	3	6	3	12
		General -ward	2	-	1	3
		Total	11	10	5	26
2	*Aspergillus ochraceus*	Pathology Lab	1	2	4	7
		Pharmacy	-	1	2	3
		General –ward	-	-	1	1
		Total	1	3	7	11
3	*Aspergillus flavus*	Pathology Lab	2	2	2	6
		Pharmacy	7	1	4	12

Sr. no.	Spore Type	Sampling Sites	July	August	September	Total of colonies found in all the months
		General –ward	1	-	1	2
		Total	10	3	7	20
4	Unidentified	Pathology Lab	-	-	-	-
		Pharmacy	1	-	-	-
		General –ward	-	-	-	-
		Total	1	-	-	-
5	Sterile Hyphae	Pathology Lab	-	-	-	-
		Pharmacy	2	-	-	2
		General -ward	2	-	-	2
		Total	4	-	-	4
6	Total		27	16	19	62

<u>Table 2</u>: The total count of fungal colonies from indoor environment of hospital-II from July 2022 to September 2022 at temperature 29°C, 31°C and 31°C respectively.

Sr. no.	Spore Type	Sampling Sites	July	August	September	Total of all the months
1	*Cladosporium cladosporioides*	Pathology Lab	15	13	30	58
		Pharmacy	16	14	10	40
		General -ward	3	5	3	11
		Total	34	32	43	109
2	*Aspergillus ochraceus*	Pathology Lab	1	14	3	18
		Pharmacy	-	10	12	22
		General -ward	-	-	-	-
		Total	1	24	15	40
3	*Aspergillus flavus*	Pathology Lab	5	2	1	8
		Pharmacy	2	-	-	2
		General -ward	-	-	-	-
		Total	7	2	1	10
6	Total		42	58	59	159

Table 3: Percent count of fungal colonies from July 2022 to September 2022 at temperature 30°C, 32°C and 31°C respectively of hospital- I .

Sr. no.	Spore Type	July	August	September	Total Percent count of fungal colonies
1	*Cladosporium cladosporioides*	40.74%	62.5%	26.31%	41.93%
2	*Aspergillus ochraceus*	3.70%	18.75%	36.84%	17.74%
3	*Aspergillus flavus*	37.03%	18.75%	36.84%	32.25%
4	Unidentified	3.70%	-	-	-
5	Sterile Hyphae	51.85%	-	-	-

Table 4: Percent count of fungal colonies from July 2022 to September 2022 at temperature 29°C ,31°C and 31°C respectively of hospital- II.

Sr. no.	Spore Type	July	August	September	Total Percent count of fungal colonies
1	*Cladosporium cladosporioides*	80.95%	55.17%	72.88%	68.55%
2	*Aspergillus ochraceus*	2.38%	41.37%	25.42%	25.15%
3	*Aspergillus flavus*	16.66%	3.44%	1.6%	17.74%

Indoor aeromycological studies in two different hospitals was conducted in rural areas of Amravati district of Maharashtra, India in July 2022 to September 2022.According to the study's findings, aeromycoflora was abundant in both hospitals indoor environments.

From July to September 2022, a comprehensive assessment of the indoor air quality in Hospital-I was conducted, focusing on the identification of airborne fungal colonies. Over the three-month period, a total of 62 distinct fungal colonies were isolated from exposed Petri plate samples placed at various indoor locations within the hospital. Among these, three were categorized as spore types, four were sterile hyphae indicating fungal growth without visible reproductive structures and one colony remained unidentified due to insufficient morphological features.

Among the identified species, *Cladosporium cladosporioides* was the most dominant, accounting for 41.93% of the total fungal colonies. This species is a common airborne mold frequently found in indoor environments. *Aspergillus flavus* was the second most prevalent, contributing 32.25% to the total fungal load. This species is significant due to its known allergenic and toxigenic properties, particularly in healthcare settings [30] *Aspergillus ochraceus* had the lowest occurrence, representing only 17.74% of the identified colonies, but its presence is still noteworthy due to its ability to produce ochratoxins, which are harmful to human health[31]. Sterile hyphae shows 51.85% contribution in month July only and unidentified species shows 3.70 % contribution in month July only.

Overall, the findings highlight a seasonal trend in fungal diversity, The predominance of species such as *Cladosporium* spp. and *Aspergillus spp.* further emphasizes the need for continuous monitoring and effective indoor air management in hospital environments, particularly to protect immunocompromised patients from potential fungal exposure.

Between July to September 2022, a total of **159 fungal colonies** were isolated from the indoor environment of **Hospital-II**. The monthly distribution of fungal colonies revealed a progressive increase over the three months. This upward trend may reflect seasonal factors such as temperature, humidity, and air circulation, which are known to influence fungal proliferation and spore dispersal in indoor environments.

All identified colonies exhibited **three distinct spore types**, indicating a range of fungal diversity within the sampled environment.Based on morphological identification from exposed Petri plate samples, ***Cladosporium cladosporioides*** emerged as the **most dominant fungal species**, accounting for **68.55%** of the total isolates. This high prevalence aligns with its known adaptability and widespread occurrence in indoor air, particularly in environments with organic material and moisture. In contrast, ***Aspergillus flavus*** contributed the **lowest proportion**, making up only 17.74% of the total colonies. Although less prevalent, *A. flavus* is of particular concern in hospital settings due to its potential to produce aflatoxins and cause opportunistic infections [21]. ***Aspergillus ochraceus*** was moderately represented, comprising **25.15%** of the total isolates. This species, while not as dominant as *Cladosporium* ***cladosporioides***, is notable for its ability to produce ochratoxins, which can pose health risks, especially to immunocompromised individuals[31].

Overall, the data from Hospital-II suggest a relatively high fungal load during the late monsoon months (Rainy season). with *Cladosporium cladosporioides* being the predominant species throughout. The presence of toxigenic *Aspergillus* species, even at lower frequencies, highlights the importance of routine air quality assessments and fungal surveillance in hospital environments to prevent potential health hazards.

Similar to the findings from the "Dr. Manuel Gea Gonzalez" General Hospital, where reported *Cladosporium* spp. as the most frequently isolated fungal genus in the hospital environment with **no significant differences based on sampling time or height [28]** .Our study also identified *Cladosporium cladosporioides* as the **dominant airborne fungus** in both Hospital-I and Hospital-II. In Hospital-I, it accounted for **41.93%** of the total isolates, while in Hospital-II, it was even more prevalent, comprising **68.55%.** These consistent findings across different hospital environments support the idea that *Cladosporium* spp. is a common and persistent component of indoor air, likely due to its environmental adaptability and ability to colonize a wide range of surfaces. The uniformity in its distribution, regardless of sampling variables, further underscores the need for targeted indoor air quality management strategies to limit potential exposure, especially in healthcare settings.

High concentration of airborne spores may lead not only to plant diseases, but often cause skin, eye or nasal irritation and diseases of human respiratory systems, resulting in shortness of breath, alveolitis and asthma [16].

Fungal spores of several genera, such as Cladosporium spp., have been related to asthma exacerbation[20]. Fungus like Aspergillus species can be transmitted from patients or the environment[19]. Aspergillus species may be dangerous for patients of risk group [19]. In those at risk, the microscopic spores can easily enter the upper and lower airways and cause pulmonary aspergillosis[4].

IV. CONCLUSION

According to the current study, in both the hospitals indoor environments contain a variety of aeromycoflora. These research findings could be used to study the impact of airborne fungal spores on human health, which is another significant area of concern. Numerous allergies, airborne illnesses, and respiratory conditions are brought on by exposure to these indoor fungus spores. It might also demonstrate the direct effects on patients, healthcare professionals, and other people who are in indoor setting.

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