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Comparative Study of Airborne Fungal Biodiversity with Seasonal Variability from Indoors of IT laboratories of Different Floors of the University campus

***[1]B. K. Nayak, [2]S. Nandita and [2]A. Nanda**

[1]Department of Botany, K. M. Centre for P.G. Studies (Autonomous), Lawspet, Pondicherry - 605008, India
[2]Dept. of Biomedical Engineering, Sathyabama University, Chennai-119, India

Abstract: Exposure of human beings to airborne micro flora may result in a variety of adverse health effects including infectious diseases, allergic and irritant responses, respiratory problems and hypersensitivity reactions. It has been studied by many researchers that human exposure usually occurs nearer to the ground and ground level had significantly higher concentration of some important fungal aeroallergens .The objective of this study was to estimate the total count of airborne fungi from ground floor and first floor of air conditioned IT laboratories of the Department of computer science in a Sathyabama University, Chennai. During the study period, a total number of 744 fungal CFUs m^{-3} of air were recorded from both the indoors of IT laboratories. Of which, ground floor laboratory contributed the higher number of CFUs (53%) and first floor laboratory contributed lesser number of CFUs (47%). indoor environment of both the laboratories have total of 18 fungal species belonging to 10 genera. Among the total number of isolated fungal species from indoor air of IT laboratories, *Aspergillus* contributed 6 species followed by 3 species of *Penicillium.* and 2 species of *Cladosporium* has been isolated from both the IT laboratories. In our study, Indoors of both the IT laboratory was occupied with many allergic fungi. *Cladosporium herbarum* was found to have the maximum percentage of occurance followed by *Aspergillus niger, Cladosporium cladosporioides*, *A. awamorii*, *A. flavus* and *A. ochraceous*. *Penicillium chrysogenum* was also recorded and its occurrence was followed by *Penicillium spinulosum*. it has been also revealed from our study that prevalence of fungal species was predominant during the months of December, January and February followed by August ,September and October. The least number of fungi were isolated in the months of April, May and June in both the IT laboratories.
Keywords: Ground floor, First Floor, IT laboratory, University, Allergy, Fungal CFUs.

Introduction

Human exposure to airborne mycoflora may result in a variety of adverse health effects which includes many infectious diseases, allergic and irritant responses, respiratory problems, and hypersensitivity reactions[1,2]. Airborne microorganisms have been identified and enumerated by using a variety of aerobiological sampling methods, yet the impact of airborne microorganisms on indoor air quality and human health remains poorly understood. In any University, the department of computer science or IT laboratory will have indoor air-conditioned environments with numbers of desktops. The atmospheric air, which is delivered into the laboratories through the AC system, should be free from most common bio-pollutants and ensure an ideal temperature and moisture. Unfortunately, bad maintenance of AC systems or their low efficiency can often lead to unintentional

contamination in this kind of working space. Therefore, the most important act is to maintain the indoor air quality (IAQ) of such kind of place and protect it from sick building syndrome (SBS)

Indoor air quality has become an important health concern and susceptible persons have a high chance of response to these allergens[3]. The quality of air inside buildings depends on numerous physical, chemical and biological factors[4]. Mycoflora of outdoor environment may also affect the indoor environment. Therefore, the aim of the present study was the comparative evaluation of the quantitative structure and seasonal variability of airborne fungi in indoors of IT laboratories of two different floors of Sathyabama University, Chennai, India through volumetric sampling.

Materials and Methods

The present aeromycological study was carried out in indoors of two different IT laboratories (ground floor and first floor) of the Sathyabama University, Chennai, Tamilnadu for one year from May2013 to April 2014 by employing Burkard portable air sampler.

A. Air Samplings

Sampling of air was performed for one year at monthly intervals, exposing media plates at 3-4 ft height from the floor level in indoors of both (ground floor and first floor) IT laboratories between 10 am-11 am. Three replicates of pre sterilized Tarsan media plates (90mm) containing Sabouraud Dextrose Agar medium with Rose Bengal and streptomycin/ penicillin (50 mg^{-1}) were carried to the study sites in sterilized container with surface sterilized Burkard portable air sampler for Agar plates. The sampler was run for five minutes to receive the sedimentation of air borne fungal spores on the media plates. The exposure time was standardized to get countable number of fungal colonies/colony forming units (CFUs) per plate.

B. Identification and Morphological Study of Fungi

After exposure of plates, each set were brought in the laboratory of the Department of Biomedical Engineering, Sathyabama University with maximum care and incubated in the culture room at 25±3°C upside down for 15 days with constant observation after 3-4 days of incubation. Fungal colonies developed in plates were counted for individual species and to get the total number CFUs. Microscopic slides stained with lactophenol cotton blue were prepared from each CFUs and observed microscopically to identify them up to species level. The colony forming units (CFUs) that could not be identified directly from plates were sub cultured in PDA/SDA/CDA media again and identified later on. The laboratory experience and taxonomic literature were employed to identify the fungal taxa. Annual and monthly percentage occurrence of individual fungus was determined.

Results & Discussion

During the study period, a total number of 744 fungal CFUs m^{-3} of air were recorded from both the indoors of IT laboratories. Of which, ground floor laboratory contributed the higher number of CFUs (53%) and first floor of the laboratory contributed lesser number of CFUs (47%). Incidence of airborne fungal species, their CFUs contribution and annual occurrence recorded in indoors of both the IT laboratories are given in Table I and II. Qualitatively, indoor environment of both the laboratories have total of 18 fungal species belonging to 10 genera. Among the total number of isolated fungal species from indoor air of IT laboratories, *Aspergillus* contributed 6 species followed by 3 species of *Penicillium.* and 2 species of *Cladosporium* has been isolated from both the IT laboratories.

Based on the annual occurrence of fungal colonies in indoors of ground floor IT laboratory, *Cladosporium herbarum* was found to be the maximum number of CFUs (79) followed by *Aspergillus niger* (58) whereas *Cladosporium cladosporioids* contributed 51 CFUs followed by *A. awamorii* (39), *A. ochraceous* (28) and *A. flavus* 26 CFUs. *Penicillium chrysogenum* was recorded with 21CFUs and followed by *Penicillium spinulosum* 11 CFUs.

In case of indoors of first floor IT laboratory, *Cladosporium herbarum* contributed maximum number of CFUs (70) followed by *Aspergillus niger* (56), *Aspergillus awamorii* and also contributed more number of CFUs

(34) which was followed by *Aspergillus flavus* (28) and *Aspergillus ochraceous* (27). *Penicillium chrysogenum* is also found to be the major contributor of CFUs (19) where as *Penicillium spinulosum* found to have 10 CFUs. Apart from these major contributors, other fungi like *Alternaria alternata, fusarium moniliformae, Rhizopus sp, Mucor sp,* white sterile and green sterile mycelia were also found.

In our study, Indoors of both the IT laboratory was occupied with many allergic fungi. *Cladosporium herbarum* was found to have the maximum percentage of occurance followed by *Aspergillus niger, Cladosporium cladosporioides*, *A. awamorii*, *A. flavus* and *A. ochraceous*. *Penicillium chrysogenum* was also recorded and its occurrence was followed by *Penicillium spinulosum*.

Monthly incidence of fungal spores recorded in the indoors of both the IT laboratory is given Fig 1. Prevalence of fungal species was predominant during the months of December, January and February followed by August, September and October. The least number of fungi were isolated in the months of April, May and June in both the IT laboratories (Fig1).The month of December revealed the maximum number of CFUs in of both IT laboratories. Overall, winter season contributed the maximum number of spores followed by rainy and summer seasons in both the floors of IT laboratories.(Fig 2).

Table 1: Monthly and annual incidence of air borne fungal CFUs isolated from Indoors of First floor IT laboratory of University during 2013-2014.

Sl No.	Fungi	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	% Occurence
1.	*Alternaria alternata*	1.0	1.0	1.0	2	0	1.0	2	2.0	2.0	1.0	1.0	0	14
2.	*Aspergillus amstelodami*	0	0	0	0	1.0	1.0	0	0	0	0	0	0	2.0
3.	*Aspergillus awamorii*	3	2	0	4	2	4	0	5	5	4	0	5	34
4.	*Aspergillus flavus*	1	1	2	2.0	2.0	2.0	3	3	3	3.0	4	2	28
5.	*Aspergillus glaucus*	0	0	0	1.0	0	1.0	1.0	0	0	0	0	0	3.0
6.	*Aspergillus niger*	2	4	2	3	4	5	6	7.0	7	6	6	4	56
7.	*Aspergillus ochraceous*	1.0	2.0	2.	3	2.0	2	3.0	3	2.0	2	4	1	27
8.	*Cladosporium cladosporiodes*	3	3.0	4	4.0	4	3	5	6.0	6	5	6	4.0	53
9.	*Cladosporium herbarum*	4.0	4.0	4	5.0	5	7.0	7.0	6	7	8.0	8.0	5	70
10.	*Curvularia lunata*	0	1.0	0	0	2.0	0	1.0	1	1.0	1.0	0	0	7
11.	*Fusarium moniliformae*	1.0	0	0	1.0	0	1.0	0	0	0	0	1.0	0	4.0
12.	Green Sterile mycelium	0	0	0	1.0	0	1.0	0	1.0	0	0	1.0	1.0	5.0
13.	*Penicillium chrysogenum*	0	1	2	1.0	1	2.0	2	3	1	3	2	1.0	19
14.	*Penicillium Janthinellum*	0	0	0	1.0	0	0	0	1.0	0	0	0	0	2.0
15.	*Penicillium spinulosum*	0	0	1	1.0	0	2	1.	0	2	1	1.0	1.0	10
16.	*Rhizopus stolonifer*	1.0	0	0	1.0	0	1.0	1.0	0	1.0	1.0	1.0	0	7.0
17.	*Saccharomyces cerevisiae*	1.0	0	1.0	0	1.0	1.0	0	0	0	1.0	0	0	5.0
18.	WhiteSterile mycelium	1.0	1.0	0	0	1.0	1.0	0	1.0	1.0	0	0	1.0	7.0

Table 2: Monthly and annual incidence of air borne fungal CFUs isolated from Indoors of ground floor IT laboratory of University during 2013-2014.

Sl No	Fungi	May	Jun	Jul	Aug	Sep	oct	Nov	Dec	Jan	Feb	Mar	Apr	% Occurence
1.	*Alternaria alternata*	2.0	2.0	2	0	2.0	2.0	2.0	3.0	3.0	2.0	0	2.0	22
2.	*Aspergillus amstelodami*	0	0	0	1.0	1.0	0	0	1	1	0	0	0	4.0
3.	*Aspergillus awamorii*	2	2	0	3	3	2	5	6	6	4	2	4	39
4.	*Aspergillus flavus*	2	1	2	0	2	2	3	5	3	2	2	2	26
5.	*Aspergillus glaucus*	0	0	0	0	1	0	0	1	1	0	0	0	3
6.	*Aspergillus niger*	3	4	2	3	5	5	7	8	7	7	4	3	58
7.	*Aspergillus ochraceous*	1	2	1	2	2	3	4	3	4	3	2	1	28
8.	*Cladosporium cladosporiodes*	2	4	3	3	4	4	6	6	7	5	4	3	51
9.	*Cladosporium herbarum*	7	5	5	5	4	7	7	9	9	8	8	5	79
10.	*Curvularia lunata*	1	1	0	0	0	2	2	2	1.0	1.0	0	0	10
11.	*Fusarium moniliformae*	1	0	0	0	1.0	1.0	1.0	1.0	1.0	0	0	1.0	7.0
12.	Green Sterile mycelium	0	0	0	0	1.0	0	1.0	1.0	1	0	1.0	1	6
13.	*Penicillium chrysogenum*	0	2	2	1.0	2.0	2.0	2.0	3.0	3.0	2.0	1.0	1	21
14.	*Penicillium Janthinellum*	0	0	0	0	0	0	1.0	1.0	0	0	0	1	3.0
15.	*Penicillium spinulosum*	1	0	1	0	2	0	0	2.0	1.0	1.0	1.0	2	11.0
16.	*Rhizopus stolonifer*	1	0	1.0	0	1.0	1.0	0	1.0	1.0	1.0	0	1.0	8.0
17.	*Saccharomyces cerevisiae*	1	0	1.0	1.0	1.0	0	0	1.0	1.0	0	0	1.0	7.0
18.	White Sterile mycelia	1	1	0	1.0	1.0	0	1.0	1.0	0	1.0	1.0	0	8.0

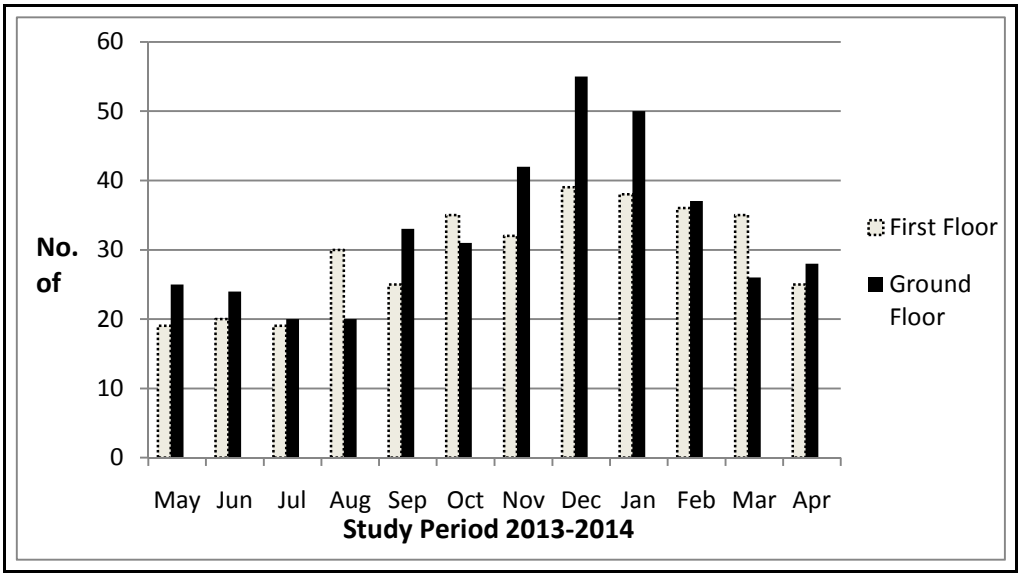

Fig 1: Monthly occurrence of fungal CFUs recorded from indoors of both (First Floor and Ground Floor) IT laboratories.

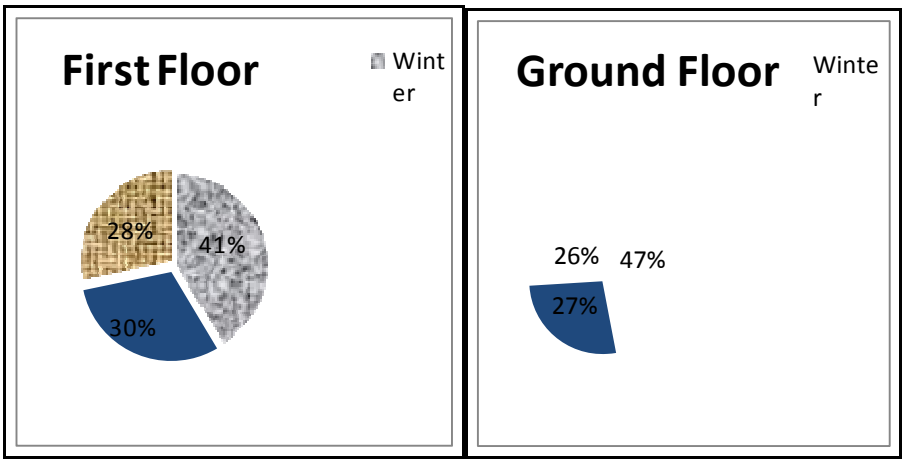

Fig 2: Seasonal variability of fungi from Indoors of both (First and Ground Floor) IT laboratories.

Human exposure usually occurs nearer to the ground. Ground level had significantly higher concentration of some important fungal aeroallergens[5].On the basis of our present study, it was observed that the predominant genera in indoors of IT laboratory of University campus were *Cladosporium, Aspergillus, Penicillium* and *Alternaria*. Many researchers have already studied and reported that *Cladosporium* is the most abundant genus found in both indoor and outdoor environment, which was confirmed from the present study[6]. Most of the isolated fungal species belonged to the members of Deuteromycetes followed by members of Zygomycetes, which has been already reported by many of the researchers [7,8,9]. *Aspergillus niger* was found in abundance which is a potential allergen and has been studied by many other workers [10,11]. In tropical environments these fungi i.e., aspergilli and penicilli are known for allergenicity. They are well known for the cause of allergic alveolities[9]. *Alternaria* species isolated from indoor environment of IT laboratory induces sub cutaneous infection[12]. *A. alternata* were found in various environment of different study sites, mostly involved in allergic rhinitis and asthma [7, 13].

Conclusion

The ground level had significantly higher concentrations of fungal spores of many important aeroallergens which is concluded by our present study. It was found that the indoor environment of the ground floor IT laboratory has higher number of aeromycoflora as compared to that of the first floor IT laboratory. From our present study, it

is also concluded that winter season contributed the maximum number of spores followed by rainy and summer seasons in both the floors of IT laboratories. In our study, Indoors of both the IT laboratory were infected with many allergic fungi. Exposure to these fungal spores can also trigger infectious diseases in persons.Therefore, effective maintenance of indoor air quality should be done at a regular interval of time because inadequate fresh air intake is not uncommon in closed air-conditioned (A/C) environments to make it sanitized and disinfected.

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References

1. Burge, H. A., and W. R. Solomon. 1987. Sampling and analysis of biological aerosols. Atmos. Environ. 21:451-456.
2. Burge H. A. Fungus allergen. Clin Rev Allergy 1985; 3(3): 319-29.
3. Cordasco E; Demeter S Zenz CEnvironmental respiratory diseases. Ed & Pub: New York:Van Nostrand Reinhold, 1995.4.
4. Dutkiewicz J, Górny RL. Biologiczne czynniki szkodliwe dla zdrowia—klasyfikacja ikryteria oceny narażenia [Biological factors hazardous to human health—classification and criteria of exposure assessment]. Med Pr. 2002; 53: 29–39.
5. Fiorina A, Mincarini M, Sivori M, Brchetto L, Scordamaglia A, Canonica GW. Aeropollinic sampling at three different heights by personal volumetric collector (Partrap FA 52). *Allergy*. 1999;54:1309 –1315.
6. Nayak, B. K., Nanda A. and Behera N. Atmospheric fungal spores in an Industrial area: seasonal and diurnal periodicity, Aerobiologia, Elsevier pub. 1998; 14: 59-67.
7. Green, B. J., Schmechel, D., & Tovey, E. R. Detection of aerosolized Alternaria alternata conidia, hyphae and fragments by using a novel-immunostaining technique.Clinical and Diagnostic Laboratory Immunology,2005; 12(9): 1114–1116.
8. Infante, F. G. P.; Galan, C.; Dominguez, E.; Angulo,J. and Mediavilla, A. Air spore microfungi in dwellings of south of Spain. Aerobiologia, 1992; 8: 245-253.
9. Lugauskas A, Krikštaponis A, Šveistyte L. Airborne fungi in industrial environments – otential agents of respiratory diseases. Ann Agric Environ Med. 2004; 11(1): 19-25.
10. Nanda, A., Nayak B. K. and Behera N. Allergenic Bioaerosols in Indoor Environments of Rural Houses. Environment, Health and Development, Ed: Pub. Dash Sharma; Ranchi, 2000; 35-50.
11. Nayak, B.K. and Behera, N.. Seasonal and diurnal prevalence of airborne fungal spores over Berhampur University Campus, Orissa. J. Palynology, 1996; 32 : 29-39.
12. Cho, S. H., Reponen, T., Le Masters, G., Levin, L., Huang, J.,Meklin,T., et al. Mold damage in homes and wheezing in infants. nnals of Allergy, Asthma & Immu-nology 2006; 97(4): 539–545.
13. Usha K., Nayak, B. K., Nadanakunjidam, S. and Nanda, A.: Annual incidence and seasonal periodicity of airborne microfungi in indoors and outdoors of a rural agricultural village in Pondicherry region. *Indian Journal of Aerobiol*. 2010; 23: 34-45.

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