

ORIGINAL RESEARCH ARTICLE

Aerial Molds in the Campus of an Educational Institution, Chennai (Tamil Nadu), India

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ABSTRACT

The control of indoor air is related to the guarantee of quality for internal environments. The aerobe in the campus of the City College was analyzed to determine the level of *Aerobial mycoflora* found in suspension. The variability of airborne fungal flora and their distribution in the atmosphere in different locations of campus were investigated by means of the settle plate method. Developing fungal colonies on the sampling plates were isolated and enumerated. The number of colony from each plates were expressed as Colony Forming Units (CFU). From this a total of 12 species belonging to 9 genera of fungal colonies were isolated. The predominant species were *Cladosporium cladosporioide*, *Penicillium*, *Trichoderma viride*, *Aspergillus niger* and *Fusarium* sp. In addition most of fungi isolated were important aeroallergens and their role in the airborne diseases was discussed. This information could be used for further studies of a medical and/or agronomical character about the effect of environmental factors on the abundance and dispersion of airborne fungi. High number of Colony Forming Units reported sites were considered to be contaminated on respirable air, which may results in many infectious diseases to those who are exposed or spending more time in such places.

Key words: *Aerobial mycoflora*, settle plate, aeroallergens and colony forming units.

1. INTRODUCTION

The term indoor air usually applies to the air of non-industrial interior environments, like colleges, hospitals, offices, restaurants, homes and similar partially closed settings. The indoor air quality (IAQ) came to be taken into consideration during the past 60's when the problems on biological contamination came into the focus by environmental researchers like Pelczar and Reid [1]. Since air is an important vehicle for the dissemination of infectious agents and allergic components developing potential undesirable effects on human beings, the control of the microbial charge became an important key to define the environmental quality of ambient media surrounding wide human populations which are largely exposed to indoor air during their daily activities.

The presence of high concentration of airborne microorganisms within the indoor environments reflects an increasing concern with respect to

many acute diseases, infections and allergies [2] and it is an indication of degree of cleanliness of that particular environment. Some fungi can cause serious diseases in humans, and some of which may be fatal if untreated.

Fungi are ubiquitous in the natural environment, appearing in air, water and soil. The air quality depends on loads of contaminants in the air. This is an important problem in children, senile aging and immune compromised persons. Fungal spores constitute a significant fraction of airborne bioparticles [3] and they are often 100–1000 times more numerous than other airborne bioparticles like pollen grains [4]. In average, man inhales approximately 10 m³ of air per day [5]. The fungi transported in the atmospheric air are highly important, since they are responsible from significant fungal disease epidemics in plants and allergic rhinitis and allergic asthma in humans. The intensity of fungi spores increases depending

on air pollution [6]. Nevertheless, fungal density in the air varies in accordance with geographical regions and seasons.

2. MATERIALS AND METHODS

Sampling location

The air samples were collected from an educational institution located in Chennai city. Samples from principal room, seminar hall, hostel kitchen, science labs, MBA block, IT block, playground and entry and exit gate of the Institution were collected.

Air sampling

Passive sampling was performed to determine the level of fungal contamination by exposing the petriplates (9 cm in diameter) containing Sabouraud Dextrose Agar (SDA) medium in to the atmospheric air up to 30 minutes at the height of 1 meter above the ground level [7, 8]. The fungal fragment in the air of the study locations were settled in the surface of the agar by gravitation. The sampling was done between 11:00 am to 11:30 am at all the selected locations. The exposed plates were immediately closed and brought to the laboratory for incubation ($28 \pm 2^{\circ}\text{C}$ for 4 to 5 days) and for further analysis.

Identification of fungi

The fungal colonies were identified according to their morphological characters [9, 10] with the help of available literature and identification keys of Subramanian [11], Barnett [12] and Gilman [13]. Lacto Phenol Cotton Blue (LPCB) stain was used and slides were prepared for microscopic examination of colonies.

Presentation of data

Air sapling (Polish Standard PN 89/N-04008/08[30])

The colonies of individual organisms were converted to number/ m^3 of air by multiplying with a factor calculated as follows and the counts were expressed as colony forming units (cfu)/cubic meter of air (m^3) according to equation (30) [14].

$$\text{CFU}/\text{m}^3 = a \times 1000/p \times t \times 0.2$$

Where; a = the number of colonies on the Petri plate

p = the surface of the Petri plate

t = the time of Petri plate exposure

Percent contribution

The term percent contribution refers to the contribution of individual organism to the total and is calculated as follows.

$$\text{Percent contribution} = \frac{\text{No. of cfu}/\text{m}^3 \text{ of an individual organism}}{\text{Total no. of cfu}/\text{m}^3 \text{ of all organisms}} \times 100$$

3. RESULTS

Isolation and identification of fungal population present in the atmospheric air of an educational institution was done by collecting samples from 9 selected sites. The reported fungal colonies are tabulated based on the difference in location. A total of 128 fungal colonies were isolated from a 9 locations. In this the genus *Cladosporium* alone contributes for 29% over other species, followed by the genus *Curvilaria* with 18% tabulated in table 1 and shown plates.

According to the World Health Organization [15] 'Guidelines for indoor air quality are dampness causing mould', "as the relations between dampness, microbial exposure and health effects cannot be quantified precisely, no quantitative health-based guideline values or thresholds can be recommended for acceptable levels of contamination with microorganisms. Instead, it is recommended that dampness and mould-related problems should be prevented. When they occur, they should be remediated because they increase the risk of hazardous exposure to microbes and chemicals".

Plate 1: Showing fungal growth on Sabouraud dextrose agar (SDA) medium

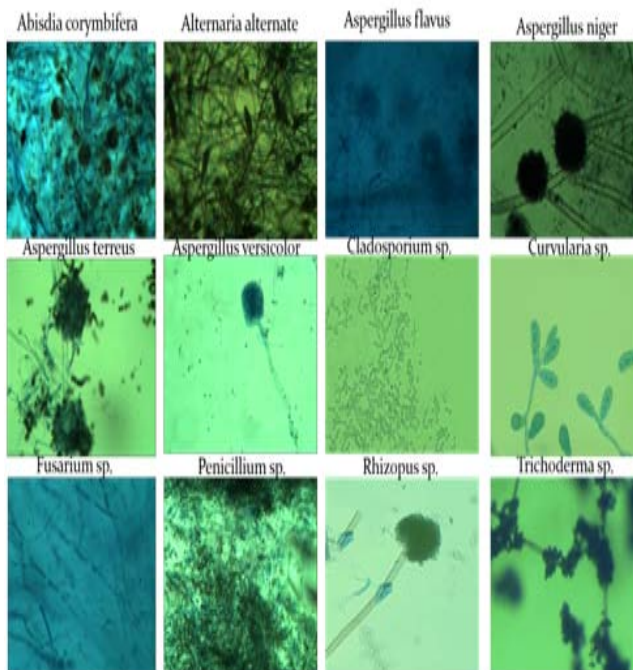
SABOURAUD DEXTROSE AGAR (SDA) PLATES SHOWING FUNGAL GROWTH



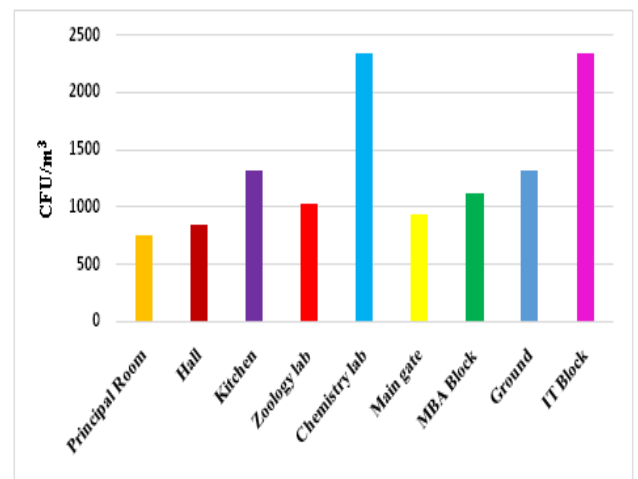
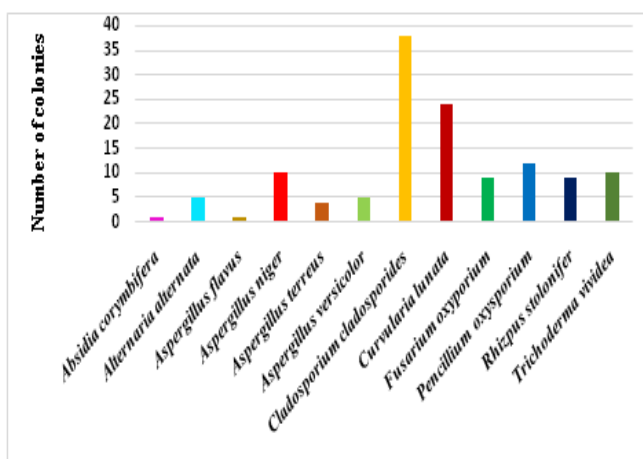
Table 1: Collection of fungal strains from different areas

Species	Principal Room	Hall	Kitchen	Science Block		Main gate	MBA Block	Ground	IT Block	Total	CFU/m ³	% Contribution
				Zoology lab	Chemistry lab							
<i>Absidia corymbifera</i>	-	-	1	-	-	-	-	-	-	1	0.8	8.3
<i>Alternaria alternate</i>	-	-	1	-	-	-	1	-	3	5	3.9	25.0
<i>Aspergillus flavus</i>	-	1	-	-	-	-	-	-	-	1	0.8	8.3
<i>Aspergillus niger</i>	-	-	5	-	-	3	-	1	1	10	7.8	33.3
<i>Aspergillus terreus</i>	-	3	1	-	-	-	-	-	-	4	3.1	16.7
<i>Aspergillus versicolor</i>	-	5	-	-	-	-	-	-	-	5	3.9	8.3
<i>Cladosporium cladosporides</i>	2	-	3	5	-	7	3	-	18	38	29.7	50.0
<i>Curvularia lunata</i>	-	-	-	5	19	-	-	-	-	24	18.8	16.7
<i>Fusarium oxysporium</i>	2	-	1	1	-	-	5	-	-	9	7.0	33.3
<i>Penicillium oxysporium</i>	2	-	-	-	-	-	3	4	3	12	9.4	33.3
<i>Rhizopus stolonifer</i>	-	-	-	-	3	-	-	6	-	9	7.0	16.7
<i>Trichoderma vividea</i>	2	-	2	-	3	-	-	3	-	10	7.8	33.3
Total	8	9	14	11	25	10	12	14	25	128	100	100
CFU/m ³	750	844	1313	1031	2344	938	1125	1313	2344	1200	-	-
% Contribution	6.3	7.0	10.9	8.6	19.5	7.8	9.4	10.9	19.5	100	-	-

Plate 2: Different types of fungal strains



Graf Plates Showing The Isolated Fungal Colonies



The present study was conducted with the objective of analyzing the fungal presence in the atmospheric air of an educational institution. Prevailing winds, vegetation, documental and daily waste storage areas, active population structure and high altitude are thought to be contributory effect to the higher fungal density in the locations of an educational institution. *Cladosporium* species may be found in agricultural areas where vegetation is more intense, but it is found in the urban atmosphere (a college campus with green vegetation). While the density of *Penicillium* and *Aspergillus* may be higher in locations closer to dumping areas^[16], as college hostel waste and leaf litter is dumped.

Interestingly the Chemistry department and IT block were recorded with high fungal contribution among the 9 places of a selected institution followed by Ground and Kitchen may be

chemistry department used both the organic and inorganic chemicals for their experimental studies ground used by students for game and the kitchen being the preparatory ground of food with scattered waste of food wastage. More over the Principal room were recorded as low fungal concentration, because of controlled air flow, managing cleanness and low people movements compare with other locations. More over main gate of the institution was recorded with 4th lowest in fungal contamination followed by Zoology lab, Hall and Principal room. As it is very nearby road side and dumping areas it was properly cleaned and maintained by Eco-tech unit and the gardeners of the college to keep the entrance of the college neat and clean.

Though they are cleaned the presence of the fungal colonies will have its impact and disease as mentioned below.

Proper cleaning procedure and care or disinfectant are not applied or painted of the walls is not done, their fungal spores which fly in air will cause allergic and reinitiations, these include Aspergillosis, Candidosis, Coccidioidomycosis, Cryptococcosis, Histoplasmosis, Mycetomas, and Paracoccidioidomycosis. Furthermore, persons with Immuno-deficiencies are susceptible to disease by genera such as *Aspergillus*, *Candida*, *Cryptococcus* [17 - 19], *Histoplasma* [20] and *Pneumocystis* [21]. Other fungi can attack eyes, nails, hair, and especially skin, the so-called dermatophytic and keratinophilic fungi, and cause local infections such as ringworm and athlete's foot [22]. Fungal spores are also a cause of allergies, and fungi from different taxonomic groups can evoke allergic reactions [23] diseases to the inhabitants.

Some of fungi isolated intensively in the research in the area allergens and cause serious health problems in human and animals due to the mycotoxin they produce. Among these, some species of *Penicillium* may cause degeneration in liver and kidney in domestic animals by the ochratoxin they produce, edema and bleeding in lungs and brain, degeneration in kidneys and paralysis in motor nerves by the patulin they produce and may trigger the formation of cancer in high organisms [24]. Aflatoxin produced by a few species of *Aspergillus* causes aminotoxicity in human and domestic animals, weight loss, intestinal bleeding, fatigue, growth retardation, loss of appetite. Vomitoxin produced by fusarium in corn and cereals may cause loss of appetite and

weight loss and zearalenon may cause toxicity, abnormalities and degeneration in reproduction systems, and miscarriage [24]. The fungi isolated in the air are significant due to the diseases they cause in human and animals, as well as efficiency and quality loss in plants.

CONCLUSION

This study indicates the number of disease caused by the fungus present in the indoor and outdoor premises of an educational institution. To prevent the fungal infections we should maintain our environment clean and hygienic; we need to wash the floors of the building by using anti-fungal agents. Toilet sink to be washed by disinfecting agents, fumigation should be done to kill all the fungi in the atmospheric air, wastage to be removed properly and regularly, it should not dump in the college campus. We have to maintain a clean and green campus, because the coming days are very much population increasing, hence wastes (solid and liquid) should be periodically removed to maintain to clean environment, to have healthy atmosphere for the both the inhabitants and the environment.

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