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STUDIES ON INDOOR AEROMYCOFLORA ASSOCIATED WITH LIBRARIES

C.Manoharachary
Department of Botany
Osmania University
Hyderabad - 500 007
Andhra Pradesh, India.

K.Vijaya Gopal
Department of Botany
Mycology Lab
Osmania University
Hyderabad - 500 007
Andhra Pradesh, India.

K.Umadevi
Department of Botany
Osmania University
Hyderabad - 500 007
Andhra Pradesh, India.

Libraries are the walled - in areas with an environment different from outdoor air. Although there have been some studies on indoor aeromycoflora of hospitals, ginnaries, cobbler shops, vegetable markets and farm houses, libraries have received little attention. The indoor air of two libraries located in Hyderabad were analysed for fungus spora. Air sampling, dust analysis and material plating revealed the association of 28 fungal species. Their total spora, percent abundance, sources of inoculum, health hazards, allergenic capacities and biodeterioration capacities were evaluated.

INTRODUCTION

Libraries are enclosed spaces. These are the walled - in areas with an environment different from the outdoor world. More polluted with substances posing a health hazard than the outside air and quality of indoor air is poorer than outdoor air. In recent years, the attention of experts in the field has been increasingly drawn to indoor air pollution. Library buildings are filled with air that may be contaminated heavily with dust, spores of infectious and allergenic microbes including bacteria, viruses and fungal spores. There is meagre information (2,3,5,6,7) available on the indoor aeromycoflora with special reference to libraries from tropical semi-arid tropical zones. The aims and objectives being to asses the indoor situation, contaminants, air pollutants, fungal spores, fungal spores as allergens and also biodeteriorating agents in libraries.

MATERIAL & METHODS

The modified Rotorod sampler (2) was operated inside the libraries besides the Tilak sampler (6) for a period of one year. After sampling the air, the Cellophane was mounted with 24 x 60 mm cover glass with a suitable mountant like glycerine jelly. The strips were scanned under the binocular microscope. The numbers thus obtained were estimated to the total number and percent contribution per cubic meter of air of the trap surface. The identification of various spore types is based on comparison with the fungal collection from the adjoing outdoor air.

Known quantity of dust both associated with library floor and book surfaces collected under aseptic conditions were analysed for fungi both quantitatively and qualitatively.

Fungi were identified upto species level. The regularly visiting population was surveyed at random for health hazards such as itching, sneezing, respiratory allergy, eczema, fever besides showing total number of cases having sensitivity to various fungal antigens (5) selected. Biodeteriorating fungi were evaluated for cellulytic enzyme production following standard methods.

RESULTS & DISCUSSION

Spore number and Abundance

Altogether 17 fungal spore types along with the spores of unidentified fungi were encountered through Air samplers (Table 1). This data clearly indicates the abundance of Alternaria, Aspergillus, Cladosporium, Drechslera and Penicillum spore types based on their total spore counts and percentage abundance.

Dust mycoflora

Dust samples collected from the floor region and also from that of books were subjected for the analysis of fungi both quantitatively and qualitatively employing dilution plating and dust plating using half a dozen agar media. One year survey revealed the presence of 28 fungal species mostly being dominated by Alternaria, Aspergilli, Cladosporium, Curvularia, Drechslera, Penicillium, Rhizopus and others (Table 2 and 3).

Along with fungal spores, insect scales, hair, dust particles, bacteria, cysts, pollen and other biota were also encountered (3,6,7,8).

Indoor environment

The general library though situated on an elevated place suffered maximum

book deterioration and health hazards, similar to that of Botany Department Library. Both the libraries are surrounded by good vegetation. A range of temperature 15-38°C. was observed. Seasonal variation has been observed both for physical factors and biotic communities. Both monsoon and winter months favoured more fungi in indoor environment of libraries because of optimum temperature and more humidity. Inspite of greater ventilation the general library building remained as a sick building (2,9) due to the entry of more dust and poor maintainance. The Botany Department Library suffered more due to lack of proper ventilation and accumulation of dust and excess microbial contamination as a result of more moisture and less temperature.

Sources and Factors

Dust, package materials, human and animal (rats etc.) interference, surrounding vegetation, exposure of certain books to indoor contaminants, unhygenic conditions poor maintainance and other related factors formed major factors influencing the indoor aeromycoflora (2,4,9).

Biodeteriorating Spore types

The role of biological agents and the deterioration with reference to library wealth has been worked by some. The sampling of air inside libraries revealed the presence of many saprophytic fungi which are the well established cellulose decomposers (3,6,7,8). The elaboration of cellulolytic enzymes and dry weight loss in paper as exhibited by Aspergillus fumigatus and Curvularia lunata further strengthens the existing chain of evidence indicating the role of Indoor aeromycoflora in the spoilage and deterioration of books, reading material and others (Table 4).

Indoor environment can be considered as independent ecological niche and investigation of such units would be of immense help not only in detecting the hazardous bioparticles but also suggesting suitable methods to control their effects on varied substrates.

Health hazards and Aeroallergenic spore types

A one year survey of mycoflora from Indoor environments of libraries at Hyderabad revealed 28 fungal species. Of which Alternaria, Aspergillus, Cladosporium Curvularia, Fusarium, Penicillium and Rhizopus were allergenic causing cold, irritation of eyes and nose, itching, skin eruption, fever, headache etc. (1,2,4,5,9) among the regular visitors of the library (Table 5). Daily 200-300 persons visit the library and seminar. Positive cases were selected out of 50 at random.

CONCLUSIONS & RECOMMENDATIONS

1. Libraries form important habitats for Indoor aeromycoflora and indepth studies are needed in this area.
2. Dust, package materials, ventilation, surrounding vegetation, human interference, proper maintainance and other related aspects need to be studied from the point of sources of Indoor air pollution and impact of factors.
3. Ecological and gaseous factors need to be elaborated in Indoor environment along with the study of biopollutants.
4. 28 fungal species, 16 spores types, their abundance and their role in biodeterioration of books have been worked out. However such studies are to be established under different climatic conditions.
5. Biopollutants, biodeteriorating spore types and aeroallergenic fungi were identified from that of indoor air in library, indicating indoor air is more health hazardous.
6. Prevention and control measures have to be worked out with special reference to biodeterjorating agents and aeroallergenic spores in the Indoor environment of libraries.

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TABLE 1 : Mycoflora associated with dust

	1	2	3	4
Alternaria alternata	+	+	+	+
Aureobasidium pullulans	+	-	+	-
Aspergillus candidus	+	-	+	-
A.flavas	+	+	+	+
A.fumigatus	+	-	+	-
A.niger	+	+	+	+
A.sydowi	-	+	+	-
A.versicolor	-	+	-	-
A.terreus	-	+	+	+
Cladosporium cladosporioides	+	+	+	+
C.berbarum	+	-	-	+
Cunninghamella echinulata	+	+	-	+
Curvularia lunata	+	-	+	+
C.pallescens	+	-	-	-
Drechslera halodes	+	+	-	-
D.rostrata	+	+	+	+
Fusarium oxysporum	+	+	+	+
Histoplasma sp	-	+	-	-
Mucor racemosus	+	+	+	+
Neurospora crassa	+	+	+	+
Penicillium citrinum	+	+	+	+
P.funiculosum	-	-	-	+
Pestalotiopsis mangiferae	-	-	+	-
Pithomyces sacchari	-	-	-	+
Rhizopus nigricans	+	-	+	+
Syncephalastrum racemosus	-	-	-	+
Sterile mycelium	+	-	+	+
Trichoderma viride	+	+	+	+

1 = Botany Library Floor dust
2 = Botany Library Books dust
3 = General Library Floor dust
4 = General Library Books dust

TABLE 2 : Physico-chemical data of the dust

Sampling month	pH				% organic carbon				% moisute			
	1	2	3	4	1	2	3	4	1	2	3	4
NOV	8.5	6.5	6.5	8.5	8	8	20	10	8	8	9	8
DEC	8.5	6.5	7.0	7.5	6	6	15	11	9	8	10	9
JAN	8.5	7.0	7.5	8.5	8	7	2	6	10	9	11	9
FEB	8.5	6.5	7.0	8.0	8	6	9	8	7	8	7	8
MAR	7.5	7.5	7.5	7.5	6	14	17	7	6	5	5	4
APR	9.0	7.0	8.0	7.5	3	16	17	11	5	5	3	4
MAY	6.5	7.5	7.5	8.0	12	6	14	7	5	5	4	3
JUN	7.0	7.5	8.0	8.0	11	13	18	8	7	6	7	5
JUL	7.5	8.0	8.0	7.5	12	6	11	10	8	8	10	11
AUG	7.0	7.5	8.0	7.5	2	20	14	10	10	10	8	9
SEP	6.5	7.0	7.5	7.0	8	9	5	10	11	12	9	8
OCT	6.5	7.5	7.0	7.0	7	9	4	10	10	11	8	9

1=Botany Library Floor dust; 2=Botany Library Books dust
3=General Library Floor dust; 4=General Library Books dust

TABLE 3: Fungal spore types and percentage abundance

Spore type	Total spore count & percentage				% abundance	
	1	%	2	%	1	2
Alternaria	335	21.54	345	16.8	29.2	21.4
Aspergillus	280	18.0	245	12.0	26.0	13.5
Cladosporium	30	1.9	100	4.8	19.0	21.6
Corynospora	-	-	5	0.2	-	33.0
Curvularia	390	25.0	49	24.0	32.0	30.0
Dreschslera	190	12.2	345	17.0	35.1	31.4
Fusarium	45	2.8	5	0.2	33.3	33.3
Helminthosporium	-	-	5	0.2	-	1.4
Monodictys	15	1.0	5	0.2	1.0	1.4
Penicillium	15	1.0	475	23.0	2.4	44.3
Pestalotia	5	0.3	-	-	1.0	-
Pithomyces	35	2.5	20	1.0	8.0	5.6
Popularia	20	1.2	-	-	3.3	-
Spegazzinia	45	2.8	5	0.2	7.4	1.4
Sporidesmium	-	-	10	0.5	-	2.8
Tetraploa	-	-	5	0.2	-	1.3
Torula	40	2.5	-	-	16.6	-
Unidentified	110	7.07	60	3.0	38.6	29.0

1=General Library Building, 2=Botany Department Library (Estimated through air samplers)

TABLE 4 : Cellulolytic enzyme elaboration by two fungi

Treatment	Filter paper wt. loss in grams	CI	CX
Control	0.010	-	-
Control + Filter paper	0.010	-	-
Filter paper + Czepeks liquid medium + Aspergillus fumigatus	0.130	+	+
Filter paper + Czepeks liquid medium + Curvularia lunata	0.150	+	+

TABLE 5 : Total No. of cases having sensitivity to various fungal antigens (number of visitors per day to library and seminar being 200-300)

Fungal antigen	Positive cases Count of 50 random selected	Grading of positive cases 1+	2+	3+
Alternaria	3	2		1
A.fumigatus	3		2	1
A.niger	1			1
Cladosporium	1		1	1