



Survey of Aeromycoflora of Commercial Complexes of Raipur City and the Effects of Fungal Spores in Causing Allergic Diseases

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ABSTRACT

The study deals with survey of Aeromycoflora of commercial complexes like shopping malls of Raipur city and other commercial buildings like restaurants, hotels, educational building, gyms, parlors, bakery, shops etc was done to find out fungal spore types present in air and how they affect humans by spreading variety of allergic diseases. Raipur is the capital city of Chhattisgarh is an industrial and commercial hub. Fungal spores are abundant in nature and much evidence is now available to show that fungi can cause atopic clinical illnesses. Many of these fungal spores are lesser than 10 microns in diameter and their deposition into lower airways is common. Fungal sensitization is a significant risk factor for developing asthma in later part of life. Molds grow in indoor and outdoor environments. An experiment was conducted during the session 2013-2014 in commercial complexes to see the aeromycoflora of Raipur city and to explore the different forms of fungi. In present investigation in Malls less number of fungal spores were found as compared to other commercial buildings. *Aspergillus*, *Penicillium*, *Cladosporium*, *Mucor*, *Curvularia* and *Alternaria* were found more prevalent in different commercial areas of the city. The present aerobiological investigation was carried out by using gravity petriplate method. Some important allergenic fungus like *Aspergillus*, *Penicillium*, *Alternaria*, *Curvularia*, *Fusarium*, *Cladosporium* were found more prevalent in other commercial complexes. Study of this fungal spores in commercial areas play an important role in tracing number of respiratory allergies and cause a wide range of symptoms, including allergic rhinitis, asthma, chronic bronchitis, Atopic dermatitis etc. in human beings.

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Introduction

Air pollution is one of the most serious problems to human health. Fungi are among the most important air pollutants, which can be pathogenic under special circumstances (Abdel Hafez, 1984, Shelton et al., 2002). Air is a natural medium which contain a variety of minute particles including many mycoflora. The air borne spores of many fungi are generally considered to be important causing many allergic diseases like allergic rhinitis, allergic sinusitis, allergic asthma, ezema, aspergilosis, mycosis etc. The present paper deals with air borne fungi present in the indoor environments of commercial complexes and their effects on human health causing allergic diseases. Commercial means involving or relating to the buying and selling of goods commercial complex is any property owned to produce income. It usually refers to shopping malls, shopping centers, Office buildings, hotels, restaurants, Gyms, Beauty parlors, shops, and other commercial buildings. Commercial complexes also includes medical and educational buildings. In present study air samples from 8 different Malls of Raipur city, medical complexes, beauty parlors, Gyms, Restaurants, hotels , automobile showrooms, and other commercial and educational buildings was done. People are exposed to aeroallergens in various settings, both at home and at work. Fungi are ubiquitous airborne allergens and are important causes of human diseases, especially in the upper and lower respiratory tracts. These diseases can occur in persons of various ages. Exposure to molds can cause human disease through several well-defined

mechanisms. In addition, many new mold-related illnesses have been hypothesized in recent years that remain largely or completely unproven. Concern about mold exposure and its effects are so common that all health care providers are frequently faced with issues regarding these real and asserted mold-related illnesses. **Aerobiology** is a branch of biology that studies organic particles, such as bacteria, fungal spores, very small insects, pollen grains and viruses, which are passively transported by the air (Spielsma, 1991) In other words **aerobiology** is the scientific discipline focusing on the study of the passive transport of microorganisms and particles of biological origin in the atmosphere. A survey of aeromycoflora of 12 Commercial complexes of Raipur city was carried out during the period of March 2013 to February 2014 .The aim of the present study was to evaluate the prevalent species of air borne fungi inside the commercial complexes. As most of the people of the Raipur city directly or indirectly come in contact with aero allergens in the environment which is the major causes of allergic diseases where people are much exposed to air borne fungi. . In this investigation, among twenty nine spore types, *Cladosporium cladosporoides*, *Cladosporium oxysporum*, *Aspergillus niger* , *Aspergillus versicolor*, *Penicillium aurocantiocandidum* was the most prevalent fungal genera followed by *Curvularia lunata*, *Alternaria radicina*, *Alternaria alternata* , *Fusarium*, *Dreschlera* , *Phoma*, *Tricothecium roseum* , *Rhizopus*, *Absidia*, and *Mucor sp.* were reported from Commercial complexes sites. During the investigation 314 fungal colonies

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belonging to 30 fungal species and 1 Mycelia sterile type was reported.

Objectives

- To survey Aeromycoflora of the selected indoor sites of Commercial Complexes of Raipur city.
- To survey the allergic disease prevalent in Raipur city.
- To identify an Aeromycoflora born allergic diseases.

Materials and Methods

In present study, for survey of Aeromycoflora commercial complexes like malls, Restaurants, Gyms, beauty parlors, and other commercial building were selected for our studies. As these are the places in Raipur city where most of the people visit for their regular needs. It has been already established that air is never free from micro organisms, specially fungal mycoflora. so we have taken these places to identify the allergies causing Aeromycoflora present in these places and find out the fungal spores responsible for allergic diseases. The study was carried out during for 1 year i.e from March 2013 to Feb 2014. The gravity plate exposure method was adopted for trapping of Aeromycoflora. PDA potato Dextrose Agar was used as cultural medium. 10 ml of sterilized PDA medium was aseptically poured in Petridish and allowed to solidify. These petridishes were then exposed in triplicates for five to ten minutes above the ground level at the above mentioned commercial complexes/sites. The study was conducted two times in a month at a regular interval of 15 days period. The exposed petridishes were brought back to the laboratory and incubated for 3 to 5 days at $26 \pm 1^\circ\text{C}$. After incubation period the fungal flora was isolated and identified. The identification was done by preparing microscopic slides with the help of glycerin gel as mounting media and cotton blue stain. The microscopic slides were observed under microscope and identified mainly on the basis of colony characteristics and spore morphology from available literatures (Ellis, 1971, Tilak, 1989 and Gregory et al. 1959) and finally identified by authentic authority. The results were recorded separately for different seasons. Microbial ecology was also done by calculating the percentage of frequency and percentage of contribution of fungal species by the following formula

Percentage frequency = $\frac{\text{(No. of observations in which species appeared)}}{\text{Total No. of observations}} \times 100$

Percentage Contribution = $\frac{\text{(Total number of colonies of a species in all the observations taken together)}}{\text{Total number of colonies in all species}} \times 100$

For the survey of prevalent allergic diseases in Raipur city. Raipur city was divided into 5 major parts like North Raipur, South Raipur, East Raipur, West Raipur and Central Raipur. In all these major parts of Raipur city, selected Hospitals, Nursing homes and Government hospitals were taken for the survey. Information from 60 doctors and 90 patients of these hospitals were recorded with the help of Questionnaire and interview. Medical Representatives of Raipur city were also included to note down the drugs or medicines largely used for allergic diseases. Medical shops of these areas were also visited to record the monthly sale of drugs in treatment process. Demographic survey of this area season wise, age and sex were also done to note the number, age group of people suffering from allergic diseases.

For identification of Aeromycoflora born allergic diseases - Different doctors of the above mentioned hospitals, nursing homes, clinic etc were interviewed. Patients of different age groups, sex suffering from Asthma, allergies, skin diseases were interviewed. Their houses were also visited and aero mycological studies were also done to find out the fungal flora responsible for allergies and asthma. On the basis of interview

given by doctors, data collected from different hospitals, medical stores and patients suffering from asthma and allergies, prevalent allergic diseases and aero mycoflora born allergic diseases were identified.



Fig 1. *Alternaria* sp

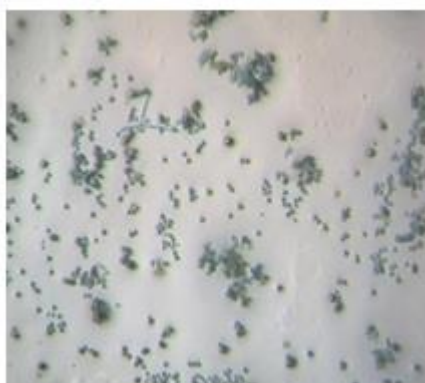


Fig 2. *Cladosporium* sp



Fig 3. *Fusarium* sp

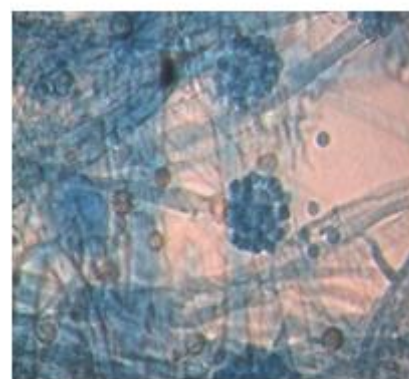
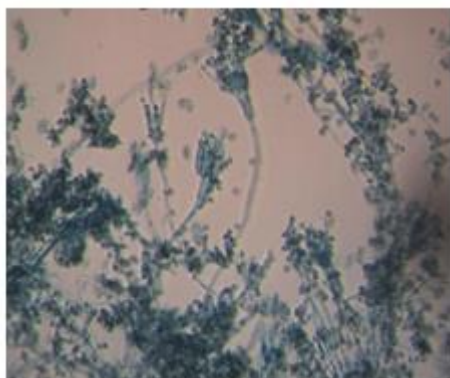
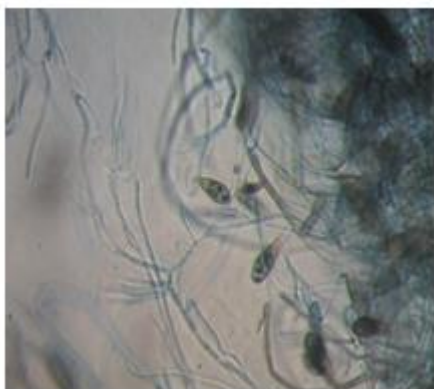
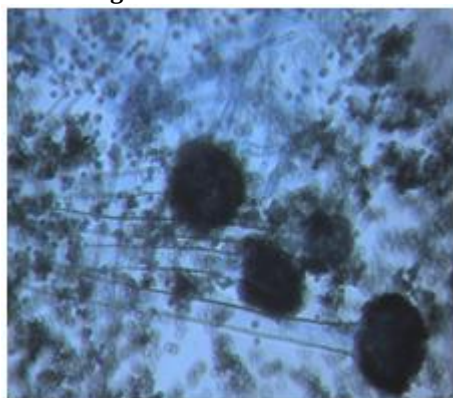


Fig 4. *Aspidia* sp

Fig 5. *Penicillium* spFig 6. *Aspergillus flavus*Fig 7. *Alternaria alternata*Fig 8. *Aspergillus niger*Fig 9. *Myrothecium* sp

Results And Discussion

In present investigations 402 fungal colonies belonging to 31 fungal species were recorded from commercial complexes of Raipur city. It was found that percentage of contribution of zygomycotina and Ascomycotina was less as compared to anamorphic fungi. During present investigations it was found that maximum percentage of contribution was found for *Cladosporium cladosporoides* (168 %), followed by *Aspergillus niger* (154.54 %), *Cladosporium oxysporum* (112.12%), *Cladosporium herbarium* (66.66%), *Alternaria alternata* (54.54%), *Aspergillus fumigatus* (51.51%), *Alternaria radicina* (48.48%), *Fusarium moniliformis* (48.48%), *Aspergillus flavus* (45.45%), *Aspergillus parasiticus* (42.42%), *Penicillium aurantiocandidum* (42.42%), *Fusarium pallidoroseum* (39.39%), *Penicillium jenseni* (39.39%), *Fusarium solani* (36.36%), *Dreschlera* sp. (36.36%), *Phoma* sp. (30.30%), *Alternaria citri* (27.27%), *Arthrinium* sp. (24.24%), *Myrothecium* sp. (21.21%), *Aspergillus terreus* and *Aspergillus versicolor* (18.18%), *Mucor racemosus* (15.15%) and *Aspergillus nidulans* (15.15%), *Rhizopus oryzae* and *Mucor* sp. (12.12%), *Rhizopus nigricans* and *Absidia* sp. (9.0%), *Chaetomium indicum* (9.0%).

The result of the present investigations reveal by various work done by other researchers. Tiewari et al. (2007) have also reported *Aspergillus niger* was most frequent fungal species during the investigation period. Majumdar and Rajan (2007) observed *Aspergillus*, *Cladosporium* in common Public places. Sajal Deo. (2009) observed maximum contribution of *Aspergillus* species in pond water.

Allergic Rhinitis, Allergic fungal Sinusitis and Allergic Asthma are the prevalent allergic diseases in Raipur city. These allergic diseases are thought to be due to allergic reactions to fungi. The causative fungi are dematiaceous. Allergic fungal sinusitis, allergic fungal rhinitis and asthma are frequent allergic diseases throughout the year. Present survey indicates that 70 -80% of people are exposed daily to fungal allergens (mainly dust containing fungal spores) are main causes of these diseases. Air of commercial complexes in spite of severe cleanliness is not free from allergic fungal spores. Present study proves that commercial complexes were thousands of people daily visits for their needs come in contact with these allergens and those who are hypersensitive to the dust allergens become victims of allergic rhinitis. If this Rhinitis is not properly treated it blocks the nasal cavity and create sinus problems. Fungal spores inhaled through nostrils not only blocks nasal cavity but it also reaches the respiratory cavity and creates respiratory allergic diseases like Asthma, Aspergillosis etc.

Table - 2 Showing Fungal distribution Aeromycoflora of commercial complexes during February 2013 to March 2014

S.N. Name of fungi		SUMMER SEASON					RAINY SEASON					WINTER SEASON					Total no. of fungal colonies	% Frequency	% Contribution
		Mar	Apr	May	Jun	Tot	Jul	Aug	Sep	Oct	Tot	Nov	Dec	Jan	Feb	Tot			
Zygomycotina																			
1	Absidia Spinosa	-	-	-	-	0	-	1	-	1	2	-	-	-	1	1	3	25.00	9.68
2	Mucor Sp. M1	-	-	1	-	1	-	-	2	-	2	-	-	-	1	1	4	25.00	12.90
3	Mucor racemosus M2	-	-	-	-	0	-	1	1	-	2	-	1	-	2	3	5	33.33	16.13
4	Rhizopus nigricans R1	-	-	-	1	1	-	-	-	1	1			1		1	3	25.00	9.68
5	Rhizopus oryzae R2	-	-	-	-	0	-	1	-	1	2	-	1	1	-	2	4	33.33	12.90
	Total No. of Fungal Colonies	0	0	1	1	2	0	3	3	3	9	0	2	2	4	8	19		
	Total No. of Fungal Species	0	0	1	1	2	0	3	2	3	5	0	2	2	3	5	5		

Cont..

Continue Table 2

S.N. Name of fungi		SUMMER SEASON					RAINY SEASON					WINTER SEASON					Total no. of fungal colonies	% Frequency	% Contribution
		Mar	Apr	May	Jun	Tot	Jul	Aug	Sep	Oct	Tot	Nov	Dec	Jan	Feb	Tot			
Ascomycotina																			
6	Chaetomium indicum	3	-	-	-	3	-	-	-	-	0	-	-	-	-	0	3	8.33	9.68
7	Emericella nidulance	-	1	-	-	1	-	-	-	-	0	-	-	2	-	2	3	16.67	12.90
	Total No. of Fungal Colonies	3	1	0	0	4	0	0	0	0	0	0	0	2	0	2	6	25.00	
	Total No. of Fungal Species	1	1	0	0	2	0	0	0	0	0	0	0	1	0	1	2		

Cont..

Continue Table 2

S.N.	Name of fungi	SUMMER SEASON					RAINY SEASON					WINTER SEASON					Total no. of fungal colonies	% Fre- quency	% Con- tribu- tion
		Mar	Apr	May	Jun	Tot	Jul	Aug	Sep	Oct	Tot	Nov	Dec	Jan	Feb	Tot			
	<i>Anamorphic fungi</i>																		
8	<i>Alternaria alternata</i>	3	-	3	-	6	2		3		5	1	2	2	2	7	18	66.67	58.06
9	<i>Alteraria radicina</i>		1	3	1	5	3	1		1	5	3		1	2	6	16	75.00	51.61
10	<i>Alternaria citri</i>					0	2			2	4	1	2	1	1	5	9	50.00	29.03
11	<i>Arthrinium sp,</i>			1		1			2		2	4	1			5	8	33.33	25.81
12	<i>Aspergillus flavus</i>		1			1	4	2	2	1	9	2	1	1	1	5	15	75.00	48.39
13	<i>Aspergellus fumigates</i>	3	1		1	5	3	1	2	2	8	1		2	1	4	17	83.33	54.84
14	<i>Aspergillus nidulence</i>				1	1	2		1		3	1				1	5	33.33	16.13
15	<i>Aspergillus niger</i>		2	1	6	9	6	4	7	5	22	7	7	5	5	24	55	91.67	177.42
16	<i>Aspergiller parasites ASPI</i>			1	2	3	3		2	1	6	3		2		5	14	58.33	45.16
17	<i>Aspergellus terreus ASP2</i>			1		1	1	1			2	2			1	3	6	41.67	19.35
18	<i>Aspergillus versicolor</i>					0	2			3	5	1				1	6	16.67	19.35
19	<i>Cladosporium Cladosporides</i>	6	6	4	3	19	6	6	6	4	22	2	2	4	3	11	52	100.00	167.74
	Total No. of Fungal Colonies	12	11	14	14	51	34	15	25	19	93	28	15	18	16	77	221		
	Total No. of Fungal Species	2	5	7	6	10	11	6	8	8	11	12	6	8	8	12	12		

Cont..

Continue Table 2

S.N.	Name of fungi	SUMMER SEASON					RAINY SEASON					WINTER SEASON					Total no. of fungal colonies	% Frequency	% Contribution
		Mar	Apr	May	Jun	Tot	Jul	Aug	Sep	Oct	Tot	Nov	Dec	Jan	Feb	Tot			
Ascomycotina																			
20	Cladosporium oxysporium	5	3	2	3	13	2	2	2	4	10	2	2	4	6	14	37	100.00	119.35
21	Curvularia lunata	-	-	-	-	0	2	1	4	2	9	1	1	2	-	4	13	58.33	41.94
22	Dreschlera	-	-	-	-	0	-	3	3	1	7	3	1	-	1	5	12	50.00	38.71
23	Fusarium monaliformis	-	-	-	-	0	3	2	3	1	9	3	2	2	-	7	16	50.00	51.61
24	Fusarium solani	2	-	-	-	2	2	1	2	1	6	2	3	1	-	6	14	66.67	45.16
25	Myrothecium	-	-	-	-	0	1	1	-	1	3	2	-	-	2	4	7	41.67	22.58
26	Penicillium aurocanticum candidum	-	2	-	-	2	3	-	-	-	3	3	2	2	2	9	14	50.00	45.16
27	Penicillium chrysogenum	3	-	-	-	3	2	3	2	1	8	1	2	-	2	5	16	66.67	51.61
28	Penicillium jenseni	-	-	-	3	3	-	3	-	3	6	2	-	2	-	4	13	41.67	41.94
29	Phoma	3	-	-	-	3	1	1	-	1	3	2	-	2	-	4	10	50.00	32.26
30	Tricothecium roseum	-	-	-	-	0	-	-	1	-	1	-	-	2	-	2	3	16.67	9.68
31	Mycellia sterillia white	-	-	-	-	0	-	-	-	-	0	-	1	-	-	1	1	8.33	3.23
	Total No. of Fungal Colonies	13	5	2	6	26	16	17	17	15	65	21	14	17	13	65	156		
	Total No. of Fungal Species	4	2	1	2	6	8	9	7	9	11	10	8	8	5	12	12		
	Grand Total of fungal colonies	28	17	17	21	83	50	35	45	37	167	49	31	39	33	152	402		
	Grand Total No. of Fungal Species	7	8	9	9	20	19	18	17	20	27	22	16	19	16	30	31		

Allergic fungal rhinitis and sinusitis are benign non invasive sinus diseases, believed to be an allergic reaction to aerosolized environmental fungi. Allergenic fungi found from commercial complexes are *Aspergillus*, *Alternaria*, *Cladosporium*, *Curvularia*, *Dreschlera*, *Helminthosporium*, *Fusarium*, *Penicillium* etc were thought to be allergic in nature. The important genera comprising were *Aspergillus*, *Penicillium*, *Cladosporium*, *Curvularia*, *Dreschlera*, *Rhizopus*, *Mucor* and *Fusarium* known to be allergenic in nature and cause allergic diseases like allergic rhinitis, allergic sinusitis and allergic asthma. In summer and Rainy seasons and allergic rhinitis, allergic sinusitis, allergic asthma, eczema, aspergillosis, atopic dermatitis etc in rainy and winter season due to presence of higher concentrations of fungal spores in air. Present study conducted through questionnaires in different Hospitals and Nursing homes showed that 60% people suffered from respiratory disorders. Studies indicated that fungal spores cause Allergic Rhinitis, Allergic Sinusitis and Allergic Asthma in Summer season and maximum allergic diseases caused during the rainy and winter seasons like Allergic Rhinitis, Allergic Sinusitis, Allergic Asthma, Eczema, Atopic Dermatitis, Mycoses and Aspergillosis. In rainy seasons and winter season higher concentration of fungal spores in the atmosphere was responsible for the allergic diseases. In spite of cleanliness in commercial complexes air of commercial complexes are not free of fungal allergenic spores. Maximum spores which are present throughout the year are mainly allergenic type and cause many allergic diseases like allergic rhinitis, allergic sinusitis, allergic asthma, Eczema, Atopic Dermatitis, Mycosis, Aspergillosis, Urticaria etc. In Raipur city Allergic rhinitis and Allergic sinusitis with allergic Asthma are common allergic prevalent diseases. Allergic eczema, atopic dermatitis, Urticaria, Aspergillosis are seasonal allergic diseases. Allergic diseases are more frequent in ladies of age group 20- 45 yrs of age. Males of age 40 – 65 suffers from allergic problems and teen agers of age group 15 – 22 yrs have allergic Rhinitis and Asthma problems. Old age persons of age group 60- 80 yrs have only asthma, and Eczema problems. Doctors generally prescribe Antihistamines and topical steroids for fungal allergic diseases. Citrizene,

Levocitizene, Mondesolar, Monlevo are some medicines largely used for allergic diseases.

Conclusions

Air of commercial complexes in spite of cleanliness contain many fungal spores which are allergic in nature and responsible for allergic diseases like Asthma, Allergic rhinitis, Allergic sinusitis, Eczema, Atopic dermatitis, Mycosis, Aspergillosis etc. Survey of Aeromycoflora of commercial complexes showed higher concentration of fungi in Winter and Rainy season and minimum concentration of fungi in summer seasons. Survey of fungal allergic diseases showed that Allergic rhinitis, Allergic Fungal sinusitis and Allergic asthma are frequent allergic diseases during winter and Rainy seasons and Eczema, atopic dermatitis and Asthma are common allergic diseases during summer season, where as Allergic rhinitis and allergic fungal sinusitis and asthma patients are regularly found in all the seasons. This may be due to higher concentrations of fungal spores in air during Rainy and Winter seasons and comparatively less number of spores in air during summer season. Fungal spores in air, hot temperature and maximum sweating during summer seasons may result in skin infections like Eczema, Atopic dermatitis, Mycosis etc. The results of this study are in general agreement with the results obtained by others in India and in other parts of the country. Present study showed that Allergic Rhinitis, Allergic fungal sinusitis, and Allergic Asthma are prevalent allergic diseases in Raipur city. Allergic Eczema, Atopic dermatitis. Spores of *Cladosporium*, *Aspergillus*, *Penicillium*, *Alternaria*, *Curvularia*, *Fusarium* are found regularly in all seasons. Allergenic nature of *Aspergillus*, *Penicillium*, *Alternaria*, *Cladosporium* and *Curvularia* etc has already been established. Present study also proves that Allergic Rhinitis, Allergic fungal sinusitis and allergic asthma are Aeromycoflora born allergic diseases in Raipur city.

Monitoring of air borne fungi can be helpful in prevention of fungal allergic diseases. Experimental survey proves that higher concentration of allergic fungal spores in the atmosphere which can cause allergic diseases. Study of this kind is highly interdisciplinary in nature and has tremendous scope to find the significant application in human health. Exposure to outdoor and

indoor air borne inhalant mold allergens develops respiratory disorders and allergic diseases in human. Thus clean environment is necessary to reduce the fungal spore load in the air. A comprehensive management plan incorporating medical and immunological care remains the most likely means of providing long term disease control for fungal allergic diseases.

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References

Abdel Hafez, S.I ,1984 , Survey of airborne fungusspores atFaif, Saudi Arabia.
 Ellis,M.B., (1971). *Dematiaceous hypomycetes*.Common Wealth Mycological Institute. Kew,Survey,England.
 Gregory , P.H., Guthrie, E.J . and Bunce, M. E, 1959 .

Experiment on splash dispersal of fungus spores.J.Gen. Microbiol.20: pp. 398-454.

Majumdar Manas , andRanjan 2007 An assessment of the indoor mycoflora of school buildings in Kolkata. 14th Nat conf. P33.

Sajal Deo ,2009 Diversity and biotechnological study of fungi in environment of pond.PhD Thesis Pt RSU, Raipur.

Shelton, B., K. Kirkland, W.D. Flanders and G.K. Morrisl, 2002Profiles of airborne fungi in buildings and outdoor environments in the united states. Appl. Environ. Microbiol., 68:pp.1743-53.

Spieksma, F.T., 1991.Aerobiology in the Ninetes. Aewrobiology and Pollinosis. International Aerobiology Newsletter, 34: 1

Tilak S.T .,1989 Airborne pollen and fungal spores, Vaijayanti Prakashan: PP. 316.

Tiwari ,K.L and Tiwari,P.2007 . Stusies of Seasonal Variation of Aeromycoflora of Catheranthus rosos Linn.(Abstr.)14th Nat.Conf. Aerobiol. Raipur. A-1:pp.5.