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A study of air microflora in selected areas of Visakhapatnam

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Abstract

The presence of aeroallergens can be of great significance in humans as they because severe allergic reactions and they consist of bacteria, fungal spores, organic dust or pollen grains. A study of air micro flora was conducted in order to estimate the bioallergens present in different locations in Visakhapatnam. During the period of survey a seasonal variation in the aerospora was observed. Fungal species were dominant during the winter season compared to rainy and summer season. The fungal density in the air varied from $1x10^1$ to $5.6x10^{6.}$ In the present study twenty fungal species were reported. The most common fungi identified were *Aspergillus, Cladosporium, Alternaria, Penicillum, Curvularia, Mucor* and *Rhizopus*. *Aspergillus* strains were present in alarming levels followed by *Cladosporium*, *Alternaria* and *Curvularia*. Fungal spores are known to be potential aeroallergen and could well be a health hazard to all people traveling regularly in these areas.

Keywords: microflora, aeroallergens, fungal density

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Introduction

Due to increase in population, development was seen in transportation and industrial sector which resulted in the release of different types of pollutants into the atmosphere. The release of different pollutants can cause several short term and long term respiratory diseases to humans. Respiratory allergies and pathogenic infections of the respiratory tract caused due to particulate matter. Aeroallergens can cause allergic reactions in humans due to the presence of fungi. Allergic sensitization of the intrathorasic airways (asthma) or lung parenchyma (hypersensitive pneumonitic) may be a major health problem and this is of concern in the long term for exposure to in haled aeroallergens (Dutkiewicz, 1997). Presence of fungal spores and by-products of microbial metabolism, as particulate liquid or volatile organic compounds can be components of aeroallergens (Stetzenbach, 2005). Certain microorganisms of non-infectious origin inhaled can cause inflammation of respiratory system, while antigens and allergens may activate the immune system and cause allergic and immunotoxic effects (Malmberg, 1990).

Aeroallergens and its effect on human health

Spores of fungi are mainly non-infectious, when inhaled it may show adverse effects on respiratory tract causing allergic rhinitis. Fungus like *Alternaria, Aspergillus* and *Cladosporium* cause diseases like asthma or cystic fibrosis which develop a chronic allergic reaction with cough. The lining bronchi and alveoli become inflamed severely reducing the capacity to inhale. A life threatening disease Allergic Bronchopulmonary Aspergillosis (ABPA) mostly caused due to *Aspergillus*. Immunotoxic disease caused by inflammation of small air way and the alveoli of the fungus due to mycotoxins and endotoxins produced by fungus and bacteria. The symptoms of this disease resemble those of influenza with high temperature shivering, nasal congestion, irritation of throat, headache and cough (Abdel Hameed). Certain agencies like OSHA (Occupational Safety Health Administration) and ACGIH (American conference of

governmental Industrial Hygienists) in most of the developed countries which give health alerts periodically. Official statistics regarding occupational diseases in most of the industries exist in these countries. For an effective treatment of the allergy it is very important to know about the prevalence and annual variation of aeroallergens of the area. A study has therefore been undertaken to evaluate the fungal population in the air in some selected area of the Visakhapatnam and identify the potent aeroallergens which cause various types of allergies.

Materials and methods

Sampling sites

Samples were collected from traffic area, vegetable market, hospital area, cereal market and slum area in the city of Visakhapatnam due to heavy population residing and representing different environmental conditions.

Gravity petri-plate method was used to isolate fungi in selected areas of Visakhapatnam

Air samples were collected twice daily for a period of one year (October 2010-September 2011). Samples were collected when high density population was floating between 8 a.m to 10 a.m. Twenty Petri-plates containing Rose Bengal agar were exposed to air 200cms above the ground. This makes the spores to trap or blow into the Petri-plate. After exposing the open Petri-plates for 5 minute these plates were closed and incubated for 5 days at 25ºC. The fungi that developed after five days were examined under compound microscope after staining with cotton blue. The cultural and morphological characteristics of fungi were identified by the use of pictorial atlas of soil and seed fungi (Watnabe, 2002).

Results and discussion

The results obtained by a survey conducted in different areas of Visakhapatnam was listed in table 1. The study was carried out for one year using petri-plate method, sample analysis was done twice in a week on monthly basis to observe seasonal variation. 20 species of 12 genera were trapped, isolated and identified. Most of the fungal species are *Alternaria alternata, Alternaria solani, Aspergillus candidus, Aspergillus flavus, Aspergillus parasiticus, Aspergillus niger, Botrytis* sp, *Cladosporium cladosporioides, Curvularia affinis, Curvularia lunata, Fusarium moniliforme, Fusarium solani, Mucor microsporus, Penicillium* sp, *Rhizopus oryzae, Rhizopus stolonifera, Stachybotrys, Trichothecium* sp, *Trichoderma* sp. The most dominating species among the isolated fungi are *Aspergillus, Alternaria* and *Cladosporium.* The data obtained from five different areas in the city observed variation in fungi in air depending on months. For 20 fungal species the average number colonies found were 196. Density of fungi in the air reached high during December, January and February. Spores of fungi present in air, water, soil, man and animals almost every part of environment.

Fungi can survive at low temperature in winter and high temperature in summer and transported to air from several factors (Suerdem and Yildirim, 2009). In winter maximum fungi was found in all sampling sites. Fig. 1 shows high frequency of *Aspergillus flavus* during winter season. This might be a cause of allergic rhinitis. *Aspergillus, Cladosporium* was abundant in winter season and can cause respiratory diseases (Li Li, 2010) in our study these two genera are commonly reported in all sampling sites. Similarly figs. 2 and 3 shows the variation of fungi in different months. Most of fungi are plant pathogens (Agrios, 2005) apart from plant pathogens; fungi can cause hay fever and allergic diseases (Larsen and Gravesen, 1991; Sen and Asan, 2001). The population of fungal spores is high in all sampling site during winter season compared to other two seasons. The range of fungal population varied from $1.0x10^1$ to $5.6x10^6$ shown in table 2.

Table 1. No. of fungal colonies in selected areas of Visakhapatnam during the period of study

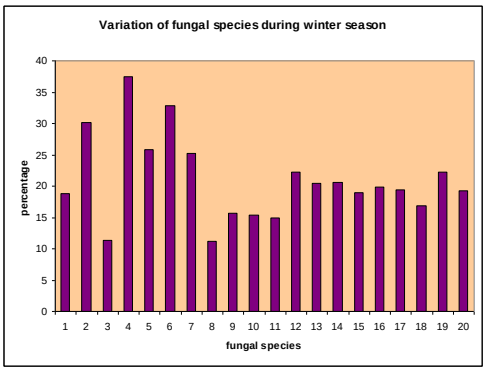
Fungal Species	Winter					Summer					Monsoon				
	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Alternaria alternata	29	11	36	15	36	5	6	8	2	-	12	11	5	9	3
Alternaria solani	33	40	23	26	16	-	-	6	-	-	-	-	-	3	1
Aspergillus candidus	9	12	6	8	5	1	3		1	0	9	1	0	0	0
Aspergillus flavus	41	49	46	43	48	5	3	4	6	2	11	14	12	10	16
Aspergillus fumigatus	22	25	26	24	12	3	0	0	9	2	9	14	10	6	7
Aspergillus parasiticus	36	35	39	35	32	12	6	5	3	2	10	12	14	18	17
Aspergillus niger	21	26	24	12	28	5	0	3	2	0	9	8	11	6	3
Botrytis sp.	11	10	9	6	5	0	0	0	0	0	3	0	0	5	0
Cladosporium cladosporioides	18	16	14	15	20	0	0	3	0	0	9	8	5	4	0
Curvularia affinis	15	12	14	20	16	5	3	0	0	0	8	7	6	5	2
Curvularia lunata	19	17	16	13	12	0	0	5	4	0	9	0	7	5	9
Fusarium moniliforme	20	25	26	27	23	5	6	7	5	3	11	14	5	16	12
Fusarium solani	25	26	24	12	13	6	7	8	3	0	14	15	13	11	10
Mucor microsporus	26	21	20	18	14	0	0	6	4	3	11	12	9	8	4
Penicillium sp	31	15	26	20	9	11	0	3	4	0	9	7	0	3	6
Rhizopus oryzae	26	14	19	16	17	0	1	4	0	2	7	10	6	5	2
Rhizopus stolonifera	23	19	14	18	18	0	3	0	0	6	2	9	8	4	6
Stachybotrys	25	16	16	15	14	3	5	2	3	5	4	8	9	10	11
Trichothecium sp	30	29	18	20	16	5	0	0	2	4	6	5	3	7	6
Trichoderma sp	24	21	13	14	19	6	0	3	6	3	9	11	8	9	11
Total	484	439	429	377	373	72	43	67	54	32	162	166	131	144	126

S1= Traffic area, S2= Vegetable market, S3= Hospital area, S4= Cereal market and S5= Slum area

Table 2. Colony forming units of Fungi

Sampling area	Fungi		
	Winter	Summer	Monsoon
Traffic area	$6.5x10^5$	$2.2x10^1$	$4.2x10^3$
Vegetable market	$7.5x10^4$	$1.2x10^1$	$5.8x10^3$
Hospital area	$5.6x10^5$	---	$3.7x10^4$
Cereal market	$4.7x10^5$	$1.0x10^1$	$2.7x10^4$
Slum area	$5.6x10^6$	$1.0x10^1$	$4.4x10^4$

Fig. 1. Variation of different fungi in winter season



Air borne fungal spores and its effect on respiratory function was studied in grain storage workers in Kolkata in India (Bhaskar, 2007). The fungal spores found in that area, was reported in all sampling sites of the study area. In the present study the spores of *Aspergillus* and *Alternaria* were found high through out the year. Due to *Aspergillus flavus* and *Aspergillus fumigatus* a disease called Aspergillosis was noticed in the farm workers (Mulhausen, 1987). In the present study these two species were found in all the sampling sites. *Aspergillus*, *Cladosporium*, *Penicillum* is frequent fungi from Bikaner (Arora and Jain, 2005). In our study same species was found. Mycotoxins produced by certain fungi can cause serious health impacts on human and animals. Studies on fungi *Penicillium* resulted in degeneration in kidneys in some animals (Agrios, 2005).

Fig. 2. Variation of different fungi in summer season

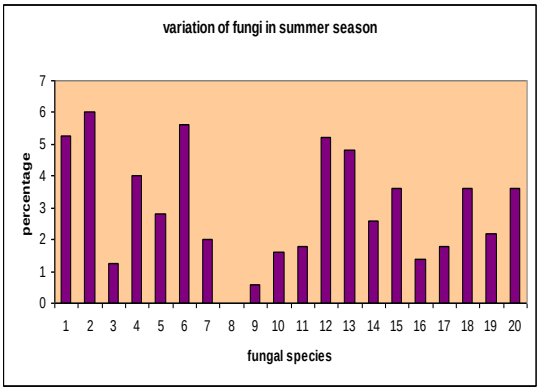
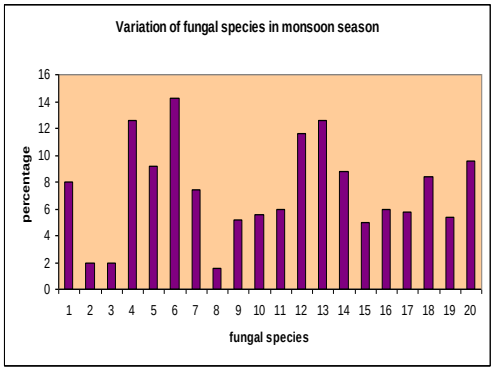


Fig. 3. Variation of different fungi in monsoon season



List of species as depicted in the graphs, 1. *Alternaria alternate* 2. *Alternaria solani* 3. *Aspergillus candidus* 4. *Aspergillus flavus* 5. *Aspergillus fumigatus* 6. *Aspergillus parasiticus* 7. *Aspergillus niger* 8. *Botrytis* sp. 9. *Cladosporium cladosporioides* 10. *Curvularia affinis* 11. *Curvularia lunata* 12. *Fusarium moniliforme* 13. *Fusarium solani* 14. *Mucor microsporus* 15.*Penicillium* sp 16. *Rhizopus oryzae* 17. *Rhizopus stolonifera* 18. *Stachybotrys* 19. *Trichothecium* sp 20. *Trichoderma* sp. In the present study, a seasonal variation among the fungal species was observed in selected areas. Due to high prevalence of certain species like *Aspergillus, Alternaria, Cladosporium* during winter season can be a cause allergic disease. The study of aeroallergens in most of the developed countries was done routinely. Time studies across different years would indicate the levels of aeroallergens to which people are being exposed to in different parts of the city. Occupational exposure limit and levels of aeroallergens should be determined and proper legislation be made to ameliorate the hazards of dust pollution. Similar type of studies will also enable local physicians to take the results into consideration during diagnosis and would help them for proper treatment.

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