

Variation in Aeromycoflora of Raipur city with special reference to allergic diseases

Shahla Khan^{1*}, V.K. Kanungo² and S.K. Jadhav³

^{1*}Center for Basic Sciences, Pt. Ravishankar Shukla University,
Raipur, Chhattisgarh (India)

²Department of Botany, Govt. Nagarjuna P.G. College of Science,
Raipur, Chhattisgarh (India)

³School of Studies in Biotechnology, Pt. Ravishankar Shukla University,
Raipur, Chhattisgarh (India)

Corresponding Author –Email: khan_shahala@yahoo.com

Abstract

Raipur is a capital of Chhattisgarh and also an industrial and commercial hub of the state. Air pollution poses serious problems to human health in the city. More than 20- 30% of the world population is known to suffer from one or other allergic ailments such as allergic fungal sinusitis, allergic rhinitis, allergic asthma, eczema, atopic dermatitis, aspergillosis, mycosis etc. The main objective of the present study was to survey the diversity of aeromycoflora of Raipur city and to identify the important fungal spores or allergens responsible for various allergic diseases prevalent in Raipur city. In light of above facts aeromycological survey of some indoor sites and outdoor sites of Raipur city was conducted in monthly interval during the year 2013-2014. The fungal spores was studied by using Petri plate method. The results of the study indicated 67 fungal species in indoor sites while, a total of 82 fungal species in outdoor sites of Raipur city. The class wise respective number of fungal species in indoor sites was Zygomycotina 9, Ascomycotina 3, Anamorphic Fungi 54 and Mycellia sterillia type 1 while, in outdoor site number recorded was Zygomycotina 8, Ascomycotina 5, Anamorphic Fungi 67 and Mycellia sterillia 2. Survey on allergic diseases in Raipur city revealed that the allergic rhinitis and allergic asthma were dominant allergic diseases in Raipur city. Fungal spores of 11 species viz. *Cladosporium cladosporides*, *Aspergillus niger*, *Cladosporium oxysporium*, *Aspergillus versicolor*, *Penicillium chrysogenum*, *Curvularia lunata*, *Alternaria alternata*, *Aspergillus flavus*, *Fusarium monalliformis*, *Phoma exigua*, and *Rhizopus nigricans* were found to be the main cause of allergic diseases in Raipur city.

Raipur city is prone to allergic diseases due to environmental pollution and bioaerosol. Increased urbanization and industrialization in Raipur city has made a significant impact on air quality. According to World Health Organization (WHO) report Raipur is the 3rd most polluted city in India. A variety of bio pollutants / bio particles are suspended in the air and they are the main cause of allergy. Hence the study of aeromycoflora in Raipur City has become a subject of utmost importance. The airborne bio-particles/pollutants transported through air current are the main cause of human allergic disorders. According to Burge² Air borne fungal spores, the major allergens cause asthma, allergic rhinitis, allergic fungal sinusitis, allergic broncho pulmonary aspergillosis, eczema, mycoses and other allergic diseases. The magnitude of allergic problems in Raipur is alarming as more than 10% of the population is estimated to suffer from major allergic diseases of which asthmatics constitute 1%, while allergic rhinitis is about 3-4. The magnitude and quality of fungal spores in the atmosphere varies from season to season and year to year, and also from region to region depending on local flora, topography, landscape and human interferences. Allergic disorders are caused due to the bio particulate material in the environment known as allergens. Allergen is an organic compound, containing hydrogen, oxygen and nitrogen, which form an important part of living organisms is responsible for Allergy. Allergy is used to describe a response, within the body to a substance, which is not necessarily harmful in itself, but results in an immune response. Amongst all the biotic pollutant, the fungal spores contribute significantly; hence the study of fungal spores and parts of fungal components in the air is very essential. The

allergenicity of airborne fungal spores and knowledge of their significance in the management of naso bronchial allergy has been convincingly demonstrated in many studies. In light of above facts aeromycological survey of some indoor sites and outdoor sites of Raipur city and allergic diseases was conducted to find out the relationship between aeromycoflora and the prevalent allergic diseases in Raipur city.

Aeromycoflora was surveyed in 3 indoor and 3 outdoor sites in Raipur city. Indoor sites selected were inside houses, inside commercial complexes, inside hospitals and outdoor sites were premises of hospitals, vegetable markets and railway Station. All outdoor sites were crowded places of Raipur city. The survey of Aeromycoflora in indoor and outdoor sites was done by Gravity plate method. PDA potato Dextrose Agar was used as a cultural medium. 10 ml of sterilized PDA medium was aseptically poured in Petri dish and allowed to solidify. These Petri dishes were then exposed in triplicates for five to ten minutes above the ground level at the above-mentioned indoor and outdoor sites. The study was conducted in fortnight interval. The exposed Petri dishes were 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 was observed under microscope and identified mainly on the basis of colony characteristics and spore morphology by following Ellis,³ Tilak,¹¹ and Gregory *et al.*⁴.

The survey of prevalent allergic diseases in Raipur city was done in 5 parts of

the city like North Raipur, South Raipur, East Raipur, West Raipur and Central Raipur. In all these parts of Raipur city, Private hospitals, nursing homes and government hospitals were considered for the survey. Information from 100 doctors and 402 patients of these hospitals were recorded with the help of questionnaire and interview. Questionnaire contained 20 questions related to names of allergic diseases, causes, symptoms, methods of diagnosis and treatments, causal organisms, outcome of the treatments, modes of transmission, time of recovery, cost of medicine etc. Data and information about the prevalent allergic diseases was correlated with the collected fungal spores.

The results of the present study showed a total of 67 fungal species in 1682 fungal colonies collected from indoor site while, a total of 82 fungal species in 1309 fungal colonies from outdoor sites of the Raipur city. The class wise respective number of fungal species recorded in indoor sites was Zygomycotina 9, Ascomycotina 3, Anamorphic Fungi 54 and Mycellia Sterillia type1 while, in outdoor sites number recorded was Zygomycotina 8, Ascomycotina 5, Anamorphic Fungi 67 and Mycellia Sterillia 2. The dominant species recorded were *Cladosporium cladosporides*, *Aspergillus niger*, *Cladosporium oxysporium*, *Aspergillus versicolor*, *Penicillium chrysogenum*, *Curvularia lunata*, *Alternaria alternata*, *Aspergillus flavus*, *Fusarium moniliformis*, *Phoma exigua*, and *Rhizopus nigricans* in indoor and outdoor sites.

Survey of aeromycoflora of indoor and outdoor environments showed greater number of fungal spores in outdoor environments than in indoors. Indoor environment contain more

number of fungal colonies due to constant humidity and temperature inside. Outdoor sites contain more species and less number of colonies because of fluctuating temperature, and exposure of pollutants outside than inside. Class wise number of fungal colony was maximum in anamorphic group both in indoor and outdoor sites. A similar result was noted by workers like Saluja⁹, Singh¹⁰, Lall⁸, Jadhav and Kunjam⁶ on aeromycoflora of a tribal area of Chhattisgarh. A seasonal variation in the diversity of fungal species was observed in the study throughout the year. Seasonal variation in fungal flora showed minimum fungal colony in summer, moderate in rainy and high concentration of fungal spores in winter, which is in accordance with the results of others workers in India and abroad like Tilak and Kulkarni¹², Tripathy¹⁴, Tiwari *et al.*¹³, Kulshrestha and Chauhan⁷. Seasonal variation of aeromycoflora of inside houses was more as compared to other indoor sites. Total number of fungal colony observed inside houses was 695, inside hospital were 599 and in commercial complex were 417, while maximum 573 fungal colony was observed from railway station, 445 from premises of hospital and 327 fungal colony was observed from vegetable market. (Table-1).

Allergic rhinitis and allergic asthma were dominant allergic diseases recorded in Raipur city. Females were found more affected to allergic rhinitis than males. Out of total 36.07%, 15.67% were males and 20.40% were females found suffering from allergic rhinitis and out of 23.63 %, 11.69% were males and 11.94% were female sufferer of Allergic asthma. (Table-2) and (Table-3). Inhalation or ingestion is a principal route of exposure to

Table – 1. Survey of seasonal variation in aeromycoflora of Indoor and Outdoor sites of Raipur City, investigated during the year 2013-14

S.no.	Name of the aeromycoflora	Indoor Sites (Colonies/plate)										Outdoor Sites (Colonies/plate)									
		Indoor Houses		Commercial complexes		Inside Hospitals		Premises of Hospital				Vegetable Markets		Railway Station		Premises of Hospital		Vegetable Markets		Railway Station	
		Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W	Re mns	rd W
Zygomycotina																					
1	<i>Absidia cylindrosporum</i>	3	4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	<i>Absidia spinosa</i>	4	5	6	0	2	3	2	2	4	28	4	1	2	2	2	2	0	1	1	15
3	<i>Cunninghamella elegans</i>	0	2	3	-	-	-	0	2	3	10	0	1	2	-	-	-	-	-	-	3
4	<i>Rhizopus nigricans</i>	2	2	1	1	1	3	2	2	1	15	3	4	2	5	5	6	0	3	2	30
5	<i>Rhizopus oryzae</i>	7	6	4	0	2	2	-	-	-	21	-	-	-	3	3	7	1	2	2	18
6	<i>Syncephalastrum racemosus</i>	0	3	2	-	-	-	-	-	-	5	-	-	-	3	0	2	-	-	-	5
7	<i>Mucor racemosus</i>	0	3	5	0	2	3	1	1	0	15	4	4	4	4	1	4	5	1	2	26
8	<i>Mucor Sp.</i>	0	2	2	-	-	-	-	-	-	4	-	-	-	-	-	-	-	1	2	5
9	<i>Rhizopus stolonifer</i>	0	0	0	-	-	-	0	1	1	2	-	-	-	-	-	-	-	-	-	0
	Total	16	27	25	1	7	11	5	8	9	109	11	10	10	14	14	22	3	13	10	107
Ascomycotina																					
10	<i>Chaetomium indicum</i>	1	2	2	3	0	0	0	0	2	10	-	-	-	1	0	2	-	-	-	3
11	<i>Chaetomium globosum</i>	-	-	-	-	-	-	-	-	-	0	2	0	0	-	-	-	1	1	0	4
12	<i>Emericella nidulans</i>	13	4	4	1	0	2	0	4	6	37	-	-	-	1	1	0	1	0	1	4
13	<i>Eupenicillium crustratum</i>	0	2	1	-	-	-	-	-	-	3	1	3	1	1	1	0	1	2	2	14
14	<i>Thielavia terricola</i>	-	-	-	-	-	-	1	1	0	2	-	-	-	0	0	2	-	-	-	2
	Total	14	8	7	4	0	2	4	5	8	52	3	3	3	2	4	4	3	3	3	27

41	<i>Aspergillus parasiticus</i>	5	1	3	3	6	5	9	1	0	33	0	4	0	1	3	1	0	7	3	19
42	<i>Aspergillus splenius</i>	-	-	-	-	-	-	0	-	3	3	4	2	3	1	0	2	3	-	-	15
43	<i>Cladosporium herbarum</i>	10	5	21	-	-	-	-	-	-	36	4	3	5	1	0	1	1	5	6	26
44	<i>Cladosporium sphaerospermum</i>	-	-	-	-	-	-	1	1	3	5	-	-	-	-	-	-	-	-	-	0
45	<i>Cladosporium cladosporoides</i>	24	32	31	19	22	11	12	18	11	180	5	6	7	7	7	11	5	7	11	66
46	<i>Cladosporium oxysporum</i>	12	10	11	13	10	14	7	12	15	104	6	6	5	7	9	6	4	3	4	50
47	<i>Cornespora</i> sp.	-	-	-	-	-	-	-	-	-	0	2	0	3	-	-	-	0	4	4	13
48	<i>Curvularia clavata</i>	-	-	-	-	-	-	-	-	-	0	3	0	2	-	-	-	-	-	-	6
49	<i>Curvularia eragrostioides</i>	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0	4	2	6
50	<i>Curvularia geniculata</i>	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0	2	1	3
51	<i>Curvularia lunata</i>	3	3	19	0	9	4	7	12	9	66	7	8	10	-	-	-	1	5	11	42
52	<i>Curvularia oryzae</i>	3	4	6	-	-	-	6	5	15	39	3	13	14	0	1	1	-	-	-	32
53	<i>Curvularia brachyspora</i>	0	0	5	-	-	-	-	-	-	5	2	3	4	0	0	3	-	-	-	12
54	<i>Dreschlera australianis</i>	-	-	-	-	-	-	6	3	10	19	-	-	-	0	0	3	3	2	4	12
55	<i>Dreschlera oryzae</i>	0	2	4	0	7	7	-	-	-	20	2	1	4	0	0	3	-	-	-	10
56	<i>Fusarium chlamydosporium</i>	-	-	-	-	-	-	-	-	-	0	2	0	0	2	2	1	0	5	4	16
57	<i>Fuorium oxysporum</i>	0	6	12	-	-	-	-	-	-	18	-	-	-	-	-	-	-	-	-	0
58	<i>Fusarium monaliformis</i>	2	8	5	0	9	7	10	8	4	53	2	4	4	-	-	-	2	7	7	26
59	<i>Fusarium pallidoroseum</i>	1	0	3	-	-	-	6	12	11	33	3	3	6	-	-	-	4	4	4	24
60	<i>Fusarium solani</i>	2	3	7	2	6	8	2	1	5	36	0	1	3	1	3	2	2	3	6	21
61	<i>Helminthosporium</i> sp.	-	-	-	-	-	-	0	0	3	3	2	0	3	0	2	1	0	3	3	14
62	<i>Humicola</i> sp.	3	2	0	-	-	-	-	-	-	5	-	-	-	-	-	-	0	2	3	5
63	<i>Khuskia oryzae</i>	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	2	1	2	5
64	<i>Monolia</i> sp.	-	-	-	-	-	-	0	3	3	6	-	-	-	0	2	4	0	2	5	13

65	<i>Myrothecium</i> sp.	-	-	-	0	3	4	1	1	1	10	0	3	0	0	2	1	2	4	7	19
66	<i>Neosartoria fisheri</i>	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0	4	3	7
67	<i>Nigrospora oryzae</i>	-	-	-	-	-	-	0	8	4	12	3	2	3	0	2	5	0	7	7	29
68	<i>Penicillium aurocantiocandidum</i>	-	-	-	2	3	10	8	5	10	38	-	-	-	-	-	-	3	2	4	9
69	<i>Penicillium chrysogenum</i>	4	5	15	3	8	5	4	7	9	60	5	4	9	3	5	7	3	8	9	53
70	<i>Penicillium funiculosum</i>	0	3	3	-	-	-	-	-	-	6	1	4	2	2	2	3	1	4	4	23
71	<i>Penicillium godlewski</i>	4	0	4	-	-	-	-	-	-	8	1	3	8	-	-	-	-	-	-	12
72	<i>Penicillium jensani</i>	6	9	5	3	6	4	-	-	-	33	3	3	2	2	2	1	2	5	7	27
73	<i>Penicillium notatum</i>	0	0	5	-	-	-	6	7	11	29	-	-	-	-	-	-	-	-	-	0
74	<i>Penicillium oxalicum</i>	-	-	-	-	-	-	3	2	3	8	-	-	-	1	3	1	-	-	-	5
75	<i>Penicillium purpurogenum</i>	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	2	4	6	12
76	<i>Penicillium verruculosum</i>	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	1	3	5	9
77	<i>Periconia atra</i>	0	0	6	-	-	-	2	3	5	16	0	1	4	0	1	0	1	2	2	11
78	<i>Pestalotopsis glandiola</i>	0	1	2	-	-	-	-	-	-	3	-	-	-	0	1	3	0	5	4	13
79	<i>Phoma exigua</i>	0	2	2	3	3	4	0	3	5	22	5	4	3	2	4	4	0	5	3	30
80	<i>Phoma</i> sp.	0	3	2	-	-	-	0	4	3	12	-	-	-	-	-	-	4	3	2	9
81	<i>Stemphylium</i> sp.	0	0	4	-	-	-	-	-	-	4	-	-	-	0	3	1	-	-	-	4
82	<i>Torula caligans</i>	0	1	1	-	-	-	-	-	-	2	-	-	-	-	-	-	0	0	3	3
83	<i>Tricoderma viridae</i>	0	2	2	-	-	-	3	5	7	19	4	2	4	-	-	-	3	2	5	20
84	<i>Trichothecium roseum</i>	0	0	1	0	1	2	4	4	2	14	3	2	3	0	3	1	0	2	4	18
85	<i>Ulocladium</i> sp.	-	-	-	-	-	-	0	1	1	2	0	0	3	0	1	1	0	2	4	11
86	<i>Mycelia sterilia</i> grey	-	-	-	-	-	-	1	0	0	1	-	-	-	-	-	-	-	-	-	0
87	<i>Mycelia sterilia</i> white	0	0	2	0	0	1	-	-	-	3	-	-	-	-	-	-	0	0	1	1
	Total	159	190	248	77	158	153	155	174	207	1521	111	126	163	56	81	113	89	190	246	1175
	Grand Total	189	225	280	82	165	166	164	187	224	1682	125	139	176	73	97	139	95	206	259	1309

Table -2. Survey of aeromycoflora born allergic diseases in Raipur city,
investigated during the year 2013-14

S. No.	Name of the allergic diseases	No. of patients suffering from Allergic diseases		Total no. of patients	% of patients suffering from Allergic diseases		Total % of patients
		Male	Female		Male	Female	
1	Allergic Rhinitis	63	82	145	15.67	20.40	36.07
2	Asthma	47	48	95	11.69	11.94	23.63
3	Allergic Rhinitis + Allergic sinusitis	09	17	26	2.24	4.23	6.47
4	Asthma + Rhinitis	04	18	22	1.00	4.48	5.47
5	Allergic Sinusitis	05	09	14	1.24	2.24	3.48
6	Eczema	08	08	16	1.99	1.99	3.98
7	Mycosis	04	05	09	1.00	1.24	2.24
8	Candidiasis	04	06	10	1.00	1.49	2.49
9	Asthma + Rhinitis+ Sinusitis	05	06	11	1.24	1.49	2.74
10	Atopic dermatitis	03	03	06	0.75	0.75	1.49
11	Aspergillosis	03	04	07	0.75	1.00	1.74
12	Rhinitis + Eczema	04	04	08	1.00	1.00	1.99
13	Pneumonites Pneumonia	01	01	02	0.25	0.25	0.50
14	Vaginitis	0	02	02	0.00	0.50	0.50
15	Conjunctivitis	01	00	01	0.25	0.00	0.25
16	Allergic Rhinitis + Candidiasis	01	01	02	0.25	0.25	0.50
17	Asthma + Vaginitis	0	02	02	0.00	0.50	0.50
18	Asthma + Candidiasis	01	00	01	0.25	0.00	0.25
19	Allergic Rhinitis + Mycosis	0	01	01	0.00	0.25	0.25
20	Asthma + Conjunctivites	0	01	01	0.00	0.25	0.25
21	Eczema + Mycosis + Atopic Dermatitis	01	00	01	0.25	0.00	0.25
22	Ring worm + Fungal infection	01	01	02	0.25	0.25	0.50
23	Asthma + Ring worm	01	01	02	0.25	0.25	0.50
24	Eye infection + Eczema	01	0	01	0.25	0.00	0.25
25	Eye infection + Ring worm	01	0	01	0.25	0.00	0.25
26	Allergic Rhinitis + Pneumonitis	01	0	01	0.25	0.00	0.25
27	Rhinitis + Ring worm	0	01	01	0.00	0.25	0.25
28	Eczema+ Aspergillosis	0	01	01	0.00	0.25	0.25
29	Asthma + Sinusitis	0	01	01	0.00	0.25	0.25

Table-3. Survey of aeromycoflora borne allergic diseases and their causal organism in Raipur city, investigated during the year 2013-14.

S.No.	Name of Allergic disease	Causal organism
1	Allergic asthma	<i>Alternaria</i> , <i>Aspergillus</i> , <i>Cladosporium</i> , <i>Curvularia</i> , <i>Dreschlera</i> , <i>Fusarium</i> , <i>Helminthosporium</i> , <i>Penicillium</i> , <i>Phoma</i> , <i>Stemphyllum</i> , <i>Trocoderma</i> , <i>Trichothecium</i> , <i>Ulocladium</i> .
2	Allergic rhinitis	<i>Alternaria</i> , <i>Aspergillus</i> , <i>Cladosporium</i> , <i>Penicillium</i> , <i>Bipolaris</i> , <i>Curvularia</i>
3	Allergic fungal sinusitis	<i>Aspergillus</i> , <i>Cladosporium</i> , <i>Curvularia</i> , <i>Alternaria</i> , <i>Bipolaris</i>
4	Eczema/ Atopic dermatitis	<i>Malassezia yeast</i>
5	Aspergillosis	Fungal spores of <i>Aspergillus fumigatus</i>
6	Mycosis	<i>Tinea versicolor</i> ; <i>Trichophyton</i> , <i>Microsporium</i> and <i>Epidermophyton</i> .
7	Vaginitis	<i>Candida albicans</i>
8	Candidiasis	Yeast
9	Fungal eye infections	Fungus <i>Fusarium</i> sp.
10	Pneumocystis pneumonia	Fungus <i>Pneumocystis jirovecii</i> .
11	Ringworm	<i>Trichophyton</i> , <i>Microsporium</i> and <i>Epidermophyton</i> .

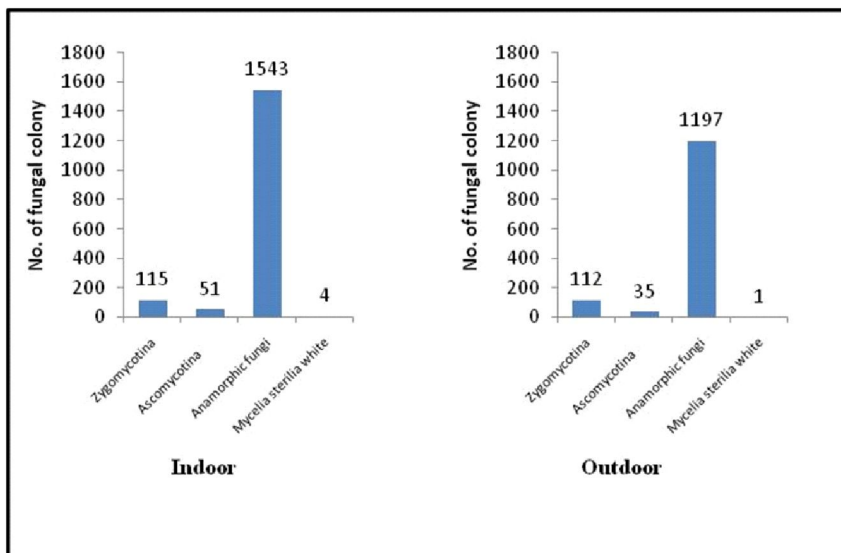


Fig. 1. Classwise number of fungal colonies observed in all the three Indoor and Outdoor sites of the Raipur city, investigated during the year 2013-2014.

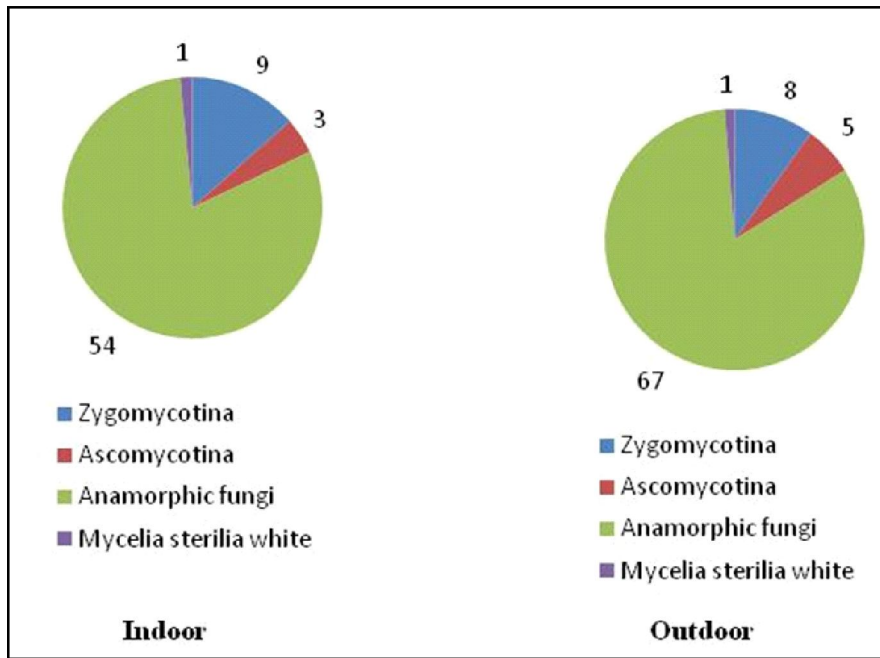


Fig. 2. Classwise number of fungal species observed in all the three Indoor and Outdoor sites of the Raipur city, investigated during the year 2013-14.

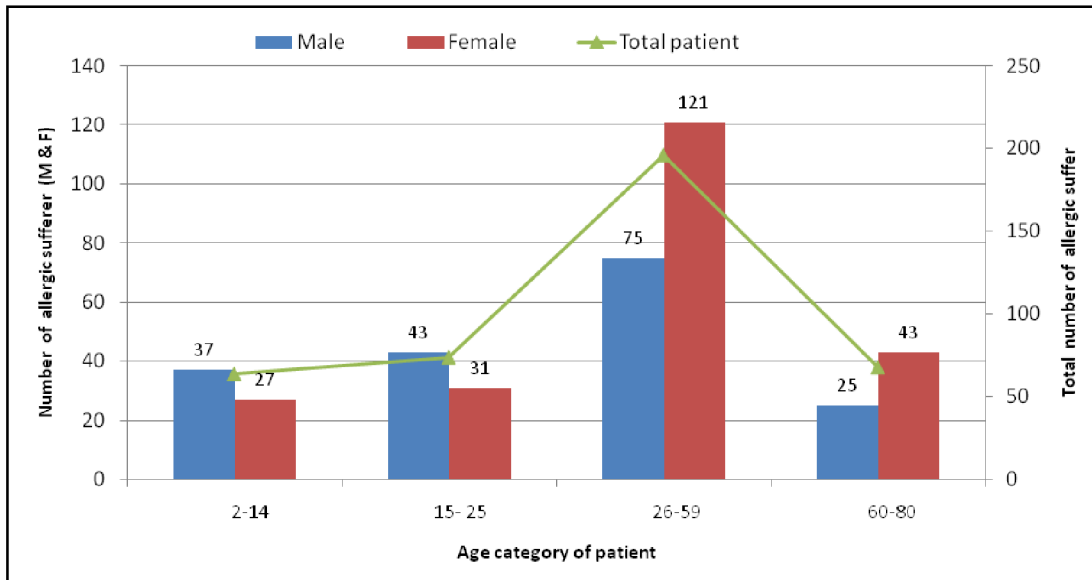


Fig. 3. Male, Female and Total patients of aeromycoflora borne allergic diseases in Raipur city investigated during the year (2013-14)

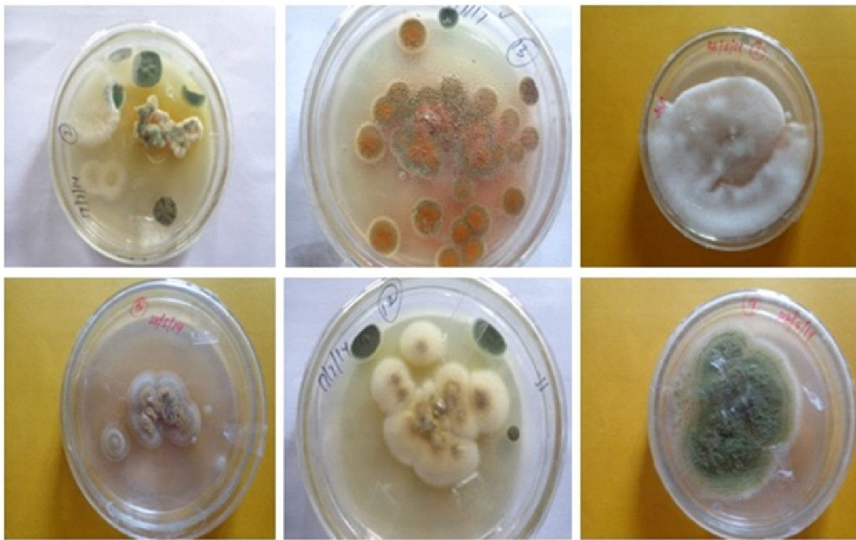


Plate 1.
Photographs of
fungal plates
containing fungal
colonies

fungal propagules. Exposure to a variety of fungi such as *Aspergillus*, *Cladosporium*, *Penicillium*, *Curvularia*, *Alternaria*, *Fusarium* were noted as the main cause of respiratory allergic diseases in immune compromised persons observed by Boyacioglu *et al.*,¹; Hedayati *et al.*,⁵ and Uztan *et al.*, (2010). People with impaired immune system who spend most of their time in indoor as well as outdoor environments contaminated by fungi develop serious fungal infections noted by Wang *et al.*, (2010a,b). Similar observations was noticed during the present study. Higher concentration of *Aspergillus*, *Cladosporium*, *Penicillium*, *Curvularia*, *Alternaria*, *Fusarium*, *Rhizopus* and *Phoma* sp. in both indoor and outdoor environments were found to be the main cause of allergies. Survey also indicated that out of various prevalent allergic diseases in Raipur city, allergic rhinitis and asthma was found to be dominant. Present study indicated that fungal extracts was the cause allergic rhinitis and bronchial asthma in indoor due to dust and fungal allergens, while in outdoors

fungal spores and air propagates were the main cause of allergies. Study suggested that monitoring of airborne fungi could be helpful in prevention of fungal allergic diseases.

A higher count of most of the fungal spores in both indoor and outdoor sites were the main cause of allergic diseases. Allergenic nature of *Cladosporium cladosporides*, *Aspergillus niger*, *Cladosporium oxysporium*, *Aspergillus versicolor*, *Penicillium crysogenum*, *Curvularia lunata*, *Alternaria alternate*, *Aspergillus flavus*, *Fusarium monaliformis*, *Phoma exigua*, and *Rhizopus nigricans* etc. has already been established by various workers in India and abroad. Similar observations were made during the present study. Fungal spores of 11 species were found to be the main cause of allergic diseases in Raipur city. Survey exhibited that 36% people of Raipur city suffer from allergic respiratory disorders. Present study also indicated that fungal spores caused allergic rhinitis, sinusitis and allergic asthma in indoor environments and allergic rhinitis and

asthma in outdoor environments. Study revealed that *Alternaria* caused allergies, fungal rhinitis and allergic asthma. *Aspergillus* was noted to be a cause of allergic fungal sinusitis (AFS), fungal balls production, hypersensitivity pneumonitis, allergies, fungal rhinitis and allergic asthma. *Curvularia* fungi was observed to cause allergic fungal sinusitis (AFS), fungal balls and rhinitis. *Penicillium* species was reported to be the cause of hypersensitivity pneumonitis, rhinitis and allergic asthma. *Cladosporium* fungi was noticed to cause allergies, rhinitis and allergic asthma. *Alternaria alternata* was found associated with atopic dermatitis. *Fusarium* fungi was noted the main cause of allergic fungal sinusitis (AFS). Exposure to outdoor and indoor airborne inhalant mould allergens develops respiratory symptoms and airway diseases and allergies. Thus clean environment is prime importance to reduce the fungal spore load in the air. More such studies may help in better understanding of the condition which can lead to proper diagnosis and management of allergic diseases.

The first author acknowledges Dr. S.K. Jadhav, Head S.O.S Biotechnology Pt. Ravi Shankar Shukla University Raipur, C.G. for providing Laboratory facilities and Dr. V.K Kanungo, Assistant Professor of Govt. N.P.G college of science, Raipur for their continuous support during the work.

References :

1. Boyacioglu, H., A. Haliki, M. Ates, A. Guvensen and O. Abaci (2007) *Environmental Monitoring and Assesment.*; 161(1-4): 473-483.
2. Burge, H. A. (1989) *Immunol Allergy clin North Am.* 9 : 307-319.
3. Ellis, M.B. (1971) *Dematiaceous hypomycetes*. Common Wealth Mycological Institute. Kew, Survey, England.
4. Gregory, P.H., E.J. Guthrie and M.E. Bunce (1959) *J. Gen. Microbiol.* 20: 398-454.
5. Hedayati, M.T., S. Mayahi and D.W. Denning (2010) *Environmental Monitoring and Assessment.*; 168(1-4): 481-487.
6. Jadhav, S.K. and S. Kunjam (2009) *Indian J. Aerobiol.*, 22(1&2) : 21.
7. Kulshrestha, A. and S.V.S. Chauhan (2001) *J. Aerobiol* 14(1&2): 33-35.
8. Lall, B.M. (2008) Studies of Indoor and Outdoor Aeromycoflora of Dr. Bhim Rao Ambedkar Hospital, Raipur. Ph.D Thesis. Pt. Ravishankar Shukla University, Raipur. (C.G).
9. Saluja, P.K. (2005) Studies of Aeromycoflora in relation to leaf surface mycoflora of *Catharanthus roseus* Linn. Ph.D. Thesis Pt. Ravishankar Shukla University, Raipur (C.G.).
10. Singh, N.B. (2006) Studies of aeromycoflora in relation to leaf surface mycoflora of *Mentha arvensis* Linn. Ph.D. Thesis, Pt. Ravishankar Shukla University, Raipur (C.G).
11. Tilak, S.T. (1989) *Airborne pollen and fungal spores*, Vaijayanti Prakashan: PP. 316.
12. Tilak, S.T. and R.L. Kulkarni (1972) *Curr. Sci.* 23: 850-851.
13. Tiwari, K.L., K. Sahu and S. K. Jadhav (1995) *Ad.Plant Sci.*, 18 (1): 46-51.
14. Tripathi, R.N. (1987) *Water, Air, soil pollut.* 34: 125-134.
15. Uztan, A.H., M. Ates, O. Abaci, O. Gulbahar, N. Erdem, O. Ciftci and H. Boyacioglu (2010) *Environmental Monitoring and Assesment.*; 168(1-4): 691-702.
16. Wadhvani, K. (1994) *Curr. Trends Life Sci.*, 20: 271-277.