International Journal of Pharmaceutical Science Invention
ISSN (Online): 2319 – 6718, ISSN (Print): 2319 – 670X
www.ijpsi.org Volume 2 Issue 2 // February 2013 // PP.01-04

Airborne fungal diversity of residential dwellings in Imphal, Manipur, India

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ABSTRACT: *Airborne fungal spores constitute one of the important components of microbial population of ambient air. Aeromycological study was conducted for two years (January, 2009 to December, 2010) using Rotorod air sampler in the indoor air of certain residential dwellings in Imphal West District, Manipur, India. During the present investigation, 29 fungal types were detected of which Aspergilli – Penicilli spores contributed highest concentration. Maximum concentration of fungal spores was observed in the month of July in 2009 and September in 2010 while minimum concentration was observed in the month of March in both years. Allergenically significant fungal spores responsible for serious health hazards were detected throughout the investigation period. Seasonal variation of airborne fungal spores was correlated with meteorological parameters.*

Keywords*: Allergy, indoor aerobiology, meteorological parameters, seasonal variation.*

I. INTRODUCTION

It is a well known fact that indoor air is not free from micro organisms. Indoor aerobiology deals with the problems of airborne materials like a close system like building, hospital, glass house, etc. Since many people spend most of their time indoors, there is continuous contact between airborne microorganisms and the human occupying the indoor environment. Further, human exposure to airborne microorganisms may result in a variety of infectious diseases, allergic and irritant responses, respiratory problems and hypersensitivity reactions [1,2]. Many workers reported that indoor air with natural ventilation to the ambient atmosphere contain seasonally occurring pollen grains and fungal spores[3,4]. Spore concentration in the air increases with human activity within the buildings such as sweeping, bed making and building repairing works[5]. Fungal airspora of residential dwelling was reported by many workers [6-11]. Inhalation of airborne fungal spores causes respiratory disorders, allergic diseases such as asthma and seasonal allergenic rhinities[1,6]. In Manipur, Singh and his co-workers are actively engaged in the field of aerobiology using various techniques with reference to airspora inside bakery, hostel kitchen, saw mill, rice mill, library, rice grains store cum sale shops, cowshed, etc. besides airspora of field crops [12-14]. So far, no work has been done on the fungal airspora of residential dwellings of Imphal. In the light of the above facts, the present investigation was undertaken to detect the components of fungal airspora, their seasonal variations and possible sources from the indoor air of residential dwellings in Imphal West District, Manipur, India.

II. MATERIALS AND METHODS

Monitoring of indoor fungal airspora was carried out in three dwelling houses at Imphal for two consecutive years (January, 2009 to December, 2010) by employing Tilak's rotorod air sampler. Transparent cellotape was applied to the rods of the sampler, trimmed back to the width of the rods and coated with vaseline. The sampler was operated at weekly intervals twice a day (9.30 to 10 a.m. and 4.30 to 5 p.m.) by keeping at a height of 1 metre above ground level. Slides were prepared using glycerine jelly mountant and scanned regularly. The spore count was multiplied by the conversion factor, 5. The spores so trapped were identified based on morphological characters, visual identification by comparison with reference slides, published literatures and culture plate identifications [2,15,16].

During the investigation period, meteorological parameters were obtained from ICAR Research Centre, Imphal.

III. RESULTS AND DISCUSSION

Airborne spores detected were presented under two categories – fungal spores and other types. Altogether 29 fungal types were identified and grouped as fungal spores while epidermal hairs, insect scales, mycelial fragments, unidentified types, etc. were grouped as other types. Fungal spores contributed 99.54% and other types contributed 0.46% of the total airspora. The present result revealed wide range coverage of taxonomic composition of fungal spores. The abundance and frequency of different spores were presented in Table I. The dominant fungal types scoring 100% abundance during the present study were *Alternaria*, Aspergilli-Penicilli, basidiospores, *Botryodiplodia*, *Chaetomium*, *Cladosporium*, *Curvularia*, *Drechslera*, *Fusarium*, fusiform ascospores, *Helminthosporium*, *Nigrospora*, *Periconia*, *Pithomyces*, round spores (*Rhizopus-Mucor* type), *Sclerotium*, *Trichoderma* and other types. Similar results were reported by previous workers [9,10]. Among the fungal types, Aspergilli-Penicilli contributed highest concentration (28.73%) which was followed by fusiform ascospores (14.13%), round spores (*Rhizopus-Mucor* type)(12.41%), *Chaetomium* (11.74%), *Nigrospora* (6.85%), *Cladosporium* (5.37%), *Curvularia* (4.85%), basidiospores (4.79%), *Botryodiplodia* (4.63%), etc. The finding was in agreement with other reports [5,6].

Table I: Fungal airspora and their contribution (%) in the indoor air of residential house in Imphal

Sl. No.	Spore Types	2009		2010		Total of 2009 & 2010	
		Abundance (%)	Frequency (%)	Abundance (%)	Frequency (%)	Abundance (%)	Frequency (%)
1.	*Alternaria*	100.00	0.16	100.00	0.21	100.00	0.37
2.	Aspergilli–Penicilli	100.00	14.79	100.00	13.94	100.00	28.73
3.	Basidiospores	100.00	1.61	100.00	3.18	100.00	4.79
4.	*Beltrania*	83.33	0.0025	75.00	0.0022	79.16	0.0047
5.	*Bispora*	83.33	0.0032	83.33	0.0047	83.33	0.0079
6.	*Botryodiplodia*	100.00	1.55	100.00	3.08	100.00	0.63
7.	*Chaetomium*	100.00	5.09	100.00	6.65	100.00	11.74
8.	*Cladosporium*	100.00	2.74	100.00	2.63	100.00	5.37
9.	*Colletotrichum*	83.33	0.0025	75.00	0.0024	79.16	0.0049
10.	*Corynespora*	91.66	0.0029	100.00	0.0031	95.83	0.0060
11.	*Curvularia*	100.00	1.68	100.00	3.17	100.00	4.85
12.	*Drechslera*	100.00	0.0318	100.00	0.0398	100.00	0.0716
13.	*Epicoccum*	91.66	0.0039	91.66	0.0036	91.66	0.0075
14.	*Fusarium*	100.00	1.69	100.00	1.20	100.00	2.89
15.	Fusiform ascospores	100.00	7.81	100.00	6.32	100.00	14.13
16.	*Helminthosporium*	100.00	1.15	100.00	0.91	100.00	2.06
17.	*Memnoniella*	83.33	0.0039	83.33	0.0024	83.33	0.0063
18.	*Nigrospora*	100.00	3.06	100.00	3.79	100.00	6.85
19.	*Periconia*	100.00	0.0246	100.00	0.0221	100.00	0.0467
20.	*Pestalotiopsis*	91.66	0.0031	91.66	0.0032	91.66	0.0063
21.	*Pithomyces*	100.00	0.0032	100.00	0.0029	100.00	0.0061
22.	Round spores (*Rhizopus–Mucor* type)	100.00	5.63	100.00	6.78	100.00	12.41
23.	*Sclerotium*	100.00	0.0239	100.00	0.0231	100.00	0.047
24.	*Spegazzinia*	75.00	0.002	91.66	0.0024	83.33	0.0044
25.	*Tetraploa*	91.66	0.0031	100.00	0.0029	95.83	0.0060
26.	*Torula*	91.66	0.0098	91.66	0.0062	91.66	0.016
27.	*Trichoconis*	91.66	0.0065	91.66	0.0133	91.66	0.0198
28.	*Trichoderma*	100.00	0.1861	100.00	0.2549	100.00	0.441
29.	*Trichothecium*	91.66	0.0052	75.00	0.0029	83.33	0.0081
30.	Hyphal fragments	91.66	0.04	83.33	0.03	87.49	0.07
31.	Other types*	100.00	0.18	100.00	0.21	100.00	0.39

* excluding hyphal fragments

During 2009, the highest (2.59%) spore catch was observed on the 30th July which corresponds to temperature (max. 28.5^{0}C and min. 22.4^{0}C), relative humidity (88%) and rainfall (3.2 mm) and the lowest (0.33%) spore catch was observed on the 12th March which corresponds to temperature (max.26.6^{0}C and min.16.5^{0}C), relative humidity (41.5%) and rainfall (nil) whereas during 2010, the highest (1.81%) spore catch was observed on the 17th June which corresponds to temperature (max. 27.3^{0}C and min. 22.8^{0}C), relative humidity (80.1%) and rainfall (nil) and the lowest (0.45%) spore catch was observed on the 25th March which corresponds to temperature (max. 30.6^{0}C and min. 19.3^{0}C), relative humidity (65%) and rainfall (nil). The present finding clearly showed that the concentration of fungal spores have seasonal variations. From the perusal of the above analysis, it was clear that there was a wide range of variations in relative humidity in between the distribution of highest and lowest concentration of airspora. Thus, showed that there was a close correlation between meteorological factors and the concentration of airspora. The present result also emphasized the associate effect of meteorological and other artificial factors like availability of substrates, disturbance of substrates due to sweeping, cleaning, repairing works, etc. and infiltration of airspora from outdoor environments. The finding was in agreement with that of other workers [3,6,10].

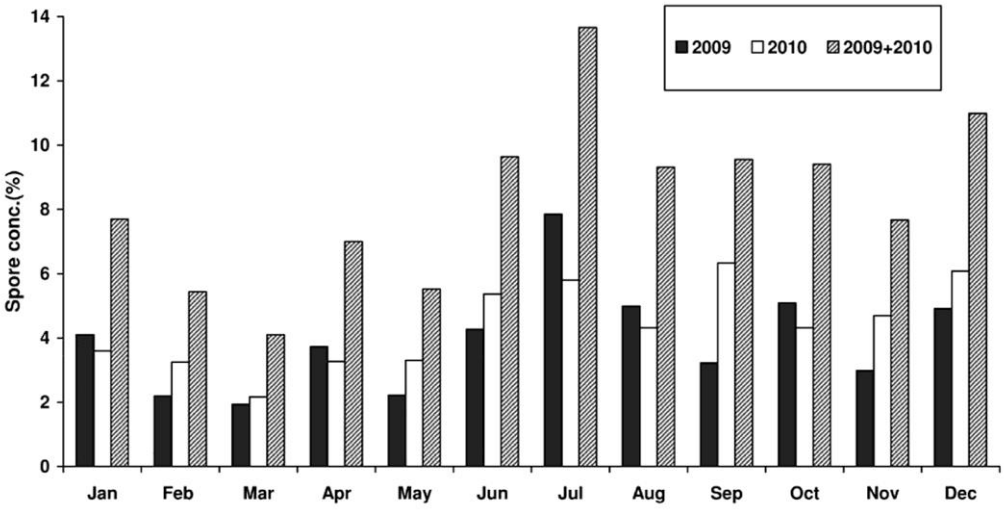

Fig. 1 : Monthly variations of total indoor fungal airspora of residential house for 2009, 2010 and sum of 2009 and 2010

Fig. 1 revealed the concentration of spores in different months as recorded in each exposure. During 2009, the highest (7.86%) spore catch was observed in July which corresponds to temperature (max. 29.75^{0}C and min. 22.59^{0}C), relative humidity (86.52%) and rainfall (5.84 mm) whereas the lowest (1.93%) spore catch was observed in March which corresponds to temperature (max. 26.63^{0}C and min. 13.06^{0}C), relative humidity (53.7%) and rainfall (1.64 mm). During 2010, the highest (6.33%) spore catch was observed in September which corresponds to temperature (max. 28.6^{0}C and min. 21.6^{0}C), relative humidity (95.5%) and rainfall (8.7 mm) whereas the lowest (2.17%) spore catch was observed in March which corresponds to temperature (max. 28.7^{0}C and min. 12.7^{0}C), relative humidity (55.8%) and rainfall (4.1 mm). High concentration of airborne fungal spores might be due to the existence of favourable weather conditions such as high relative humidity (>85%) and moderate temperature (28^{0}C). During the whole investigation period, March received lowest relative humidity which tends to limit the viability of most of the fungi. Further, it was evident that favourable meteorological factors influence the luxuriant growth of fungi and consequently increase the concentration in the indoor air of residential house. The finding was supported by other workers [9,11]

During the present investigation, it was observed that a large number of fungi, viz. *Aspergillus, Penicillium, Mucor, Rhizopus, Trichoderma, Cladosporium, Epicoccum, Fusarium, Curvularia, Chaetomium*, etc. were present which were known to be associated with respiratory and allied allergy [2]. Significant mould allergen from similar environment was reported by other workers[4,6,7]. The role of different sources and their contribution to the total airspora inside the house with reference to dust, vegetable remains, patches attached on surface, corner, wall, etc. have reflected a large number of fungal types, viz. *Aspergillus, Penicillium, Fusarium, Curvularia, Chaetomium, Sclerotium, Trichoderma*, etc. The present finding was in agreement with the previous reports [6,7]. It was evident from the present finding that the existence of airborne fungal biopllutants, qualitatively and quantitatively as well as fluctuations in their occurrence were definitely controlled by meteorological factors besides the presence of abundant substrates in the indoor environment. The present finding was in congruity with results reported earlier from different parts of the country [9,11]

IV. CONCLUSION

Fungal spores formed a large, often dominant part of the airspora inside residential dwellings in Imphal. Known fungal allergens were frequently detected during the investigation period. The present study revealed that there exists seasonal variation of airborne spores which correlates with meteorological factors in addition to available substrates and ambiant air movement. Long term studies on the spore loads present in the

indoor air might be helpful in apprehension of an outbreak of allergic diseases. Further, it is suggested that well organised and widespread air monitoring of biopollutants in different indoor environments be made in the state of Manipur in general and Imphal in particular.

ACKNOWLEDGEMENTS

The author is grateful to the Principal, Standard College for laboratory facilities and to Meteorological Section, ICAR Research Complex, Imphal for meteorological data.

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