Airbornefungal Bioparticulate Allergens Predominant In Jharia Coalfield of Jaharkhand-Diversity and Classification

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Abstract- *Air monitoring (air sampling) was carried out in and around Jharia coalfields to assess the allergic components of microbial forms on weekly basis using volumetric Burkard air sampler for two consecutive years i.e. from April, 2004 to March, 2009. Analysis of the airspores in and around Jharia coalfields revealed 67 types of fungal spores, of which 36 belonged to Deuteromycotina contributed highest percentage to the total aerospores followed by Ascomycotina, Basidiomycotina, other types Zygomycotina and Myxomycotina, which accounted for 70.85%, 16.33%, 6.13%, 4.26%, 2.15%, and 0.25% respectively during the period 2006-2008 and 2008-2009. The fungal spores which are reported and considered to be potential allergens i.e. Cladosporium, Alternaria, AspergillamPenicillum, Chaetomium, Claviceps, didymosphaeria, Nodulospheria, Ganoderma, Cercaspora, Fusarium, Helminthosporium, Nigrospora, Periconia, Pithomyees, Pseudotorula, Spegazzinia and Torula were found in very high concentration.*

Keywords- Airborne Bioparticulate, allergens, Jharia Coalfield, Diversity

I. INTRODUCTION

Air monitoring (air sampling) was carried out in and around Jharia coalfields to assess the allergic components of microbial forms on weekly basis using volumetric Burkard air sampler for two consecutive years i.e. from April, 2004 to March, 2009. The study was aimed to monitor concentration of various biocomponents in the atmosphere over coalfields industrial area of Jharia. The investigations were mainly confined to the fungal spore population in the atmosphere and in addition to the pollen, epidermal hair, insect scales, protozoan cyst and algal filament were also taken in to consideration. The fungal organisms in the airspore were considered as 'spore type'. The spores or any other living entity which could not be identified due to its obscure nature or even otherwise was placed under 'unidentified types' as a heterogeneous group.

II. MATERIALS AND METHOD

To understand the airborne fungal spores of the area weekly sampling was carried using Burkard volumetric air sampler (Burkard manufacturing Co. Ltd. England). Slides were then scanned under scanning Trinoculer Microscope (Nikon made) for qualitative and quantitative analysis of fungal spores as per the guidelines provided by Tilak and Kulkarni (1989). The identification of the fungal spores types trapped was based on morphological characters, visual identification by comparing with reference slides prepared and by exposing culture plate method. Efforts were made to identify the fungal spores types as far as possible u[to generic level and wherever possivel upto speicies leved with the help of reference slide and by consulting published literature.

III. RESULTS AND DISCUSSION

During the course of investigation, 74 types of airborne fungal components were trapped form the air over the Jharia coalfields/coal based industrial areas. The components of the airspores were grouped under their taxonomic groups. The different fungal spore types identified were segregated into five groups of fungi- Myxomycotina, Ascomycotina, Zygomycotina, Basidiomycotna and Deuteromycotina besides hyphal fragments, insect scales, pollen, algal filaments, protozoan cysts and some unidentified groups, which together constitute other types.

Analysis of the airspores in and around Jharia coalfields revealed 67 types of fungal spores, of which 36 belonged to Deuteromycotina contributed highest percentage to the total aerospores followed by Ascomycotina, Basidiomycotina, other types Zygomycotina and Myxomycotina, which accounted for 70.85%, 16.33%, 6.13%, 4.26%, 2.15%, and 0.25% respectively during the period 2006-2008 and 2008-2009.

The Zygomycotina group, fourth in concentration was represented by four types in the airspore and in general most of the spores were encountered during rainy season due to high humidity and low temperature. Seasonal periodicity shows maximum spore count in the monsoon season (68.13%) followed by winter (27.2%) and summer (4.6%) during the year 2006-2008. Similar trend of spore count was recorded in monsoon (65.27%), winter (25.18%) and summer (9.55%) during 2008-2009. Among Zygomycotina, *Cunninghamella, Circinella, Mucor* and *Rhizopus* spores were trapped throughout the period of investigation except the summer months. This may be due to aquatic, semiaquatic or soil borne nature of these fungi having no special spore discharge mechanism.

The Basidiomycotina occupied third place in order of their abundance. They were observed in large concentration during rainy season from June to October, when temperature ranged between 20 and 30^{o}C and relative humidity was more than 75%. They contributed 6.24% to the total airspore in 2007-2008 and 5.25% in 2008-09. Seasonal periodicity shows that the maximum spore count was observed in the monsoon (51.3%) followed by summer (27.08%) and winter (21.62%) during the year 2008-09. While during the year 2006-08 maximum spore count was recorded in monsoon (55.78%) followed by summer (24.6%) and winter (19.62%). Four spore types were recorded form class Basidiomycotina. All basidiospores, expect rusts and smuts, were observed and grouped and studied together under 'Unclassified Basidiospores' which included both hyaline and coloured basidiospres. The class basidiomycotina contributed significantly to airspore. Most of the basidiosprores were prevalent during the rainy season. The basidiospores group was represented even tin the dry months but in low concentrations. They were maximum during rainy season. Tilak (1981) also reported high concentration of basidiospres in the atmosphere in the rainy months.

The Ascomycities spores, second in the order of dominance, contributed 18.8% to the total airspore in 2006-08 and 15.87% in 2008-09. Seasonal periodicity shows that the maximum spore count was observed in the monsoon (70.24%) followed by winter (18.02%) and summer (11.74%) during the year 2006-08. While during the year 2006-08 maximum spore count was recorded in monsoon (74.34%) followed by winter (15.3%) and summer (10.36%) Table-7. In Ascomycotina group, 21 ascospore types were identified. High frequency and abundance in occurrence of ascospores were encountered only due to the favourable environmental conditions for their formation and release with their seasonal maxima in rainy season. The incidence of most of the ascospore in the air depend upon the occurrence of rainfall. Some of the ascospores like *Claviceps, Leptosphaeria, Pleaospora, Sidymonsphaeria, Soradaria,* appeared in the air immediately after the rainfall. Observations clearly indicate their predominance in air during the months of July and September having close correlation between rainfall and release of ascospores. Similar observations were made by Ingold (1953) and found the effect of rainfall in some of the ascopore. Similar observation were also recorded by Rees (1964) and stated that Ascospores of *Hysterium* were collected only during season after the periods when the free moisture necessary for ejection of ascospore by this group of fungi.

The class Deuteromycotina dominated the air spores with highest percentage contribution and number of spore's type (36) to the total airspores. The group Deuteromycotina contributed significantly and was found dominant both qualitatively and quantitatively. It contributed 68.42% to the total airspores in 2006-08 and 69.92% in 2008-09. Seasonal periodicity shows that the maximum spore count was observed in the monsoon season (68.04%) followed by winter (16.64%) and summer (15.32%) during the year 2006-08. While during the year 2006-08 maximum spore count was also recorded in monsoon (63.04%) followed by winter (18.64%) and summer (18.32%). The fungal spores which are reported and considered to be potential allergens form this group like *Clasosporium, Alternaria, Aspergillus, Penicillium, Chaetiomiun, Claviceps, Didymosphaeria, Nodulospheria, Ganoderma, Cercospora, Fusarium, Helminthosporium, Nigrospora, Periconia, Pithomyes, Pseudotorula, Spegazzinai* and *Torula* were found in high concentration. *Cladosporium* a dominant fungus that contributed (58.13%) to the total airspore and important from allergic point of view, as it is a potential allergen and not the main components of airborne biota-causing biopollution, was found almost throughout the investigation. In the present investigation remarkable change occurred in the total airspores in different months, the difference in thespore concentration and type may be due to prevailing environmental conditions. Similar observation were reported form the other parts of the country and abroad form varies indoor and outdoor environments (Santra and Chanda 1981, 1989, Tilak 1981, 1990).

The Myxomycotina group, fifth in concentration, was represented by two types in the airspore and in general most of the spores were encountered during rainy season due to high humidity and low temperature. Seasonal periodicity show maximum spore count in the monsoon season (70.32%) followed by winter (18.02%) and summer (11.66%) during the year 2006-08. Similar trend of spore count was recorded in monsoon (72.43%), Winter (17.22%) and summer (10.35%) during 2008-09. Among Myxomycotina, *Physarum* and

Stemonitis spores were trapped throughout the period of monsoon and winter except summer months.

Table 1. Percentage contribution of each spore group to the total airspora in 2006-08

Spore group	MONSOON		WINTER		SUMMER	
	2006-08	2008-09	2006-08	2008-09	2006-08	2008-09
MYXOMYCOTINA	70.32	72.43	18.02	17.22	11.66	10.35
ZYGOMYCOTINA	68.13	65.27	27.2	25.18	4.67	9.55
ASCOMYCOTINA	70.24	74.34	18.02	15.3	11.74	10.36
BASIDIOMYCOTINA	51.3	55.78	21.62	19.62	27.08	24.6
DEUTEROMYCOTINA	68.04	63.04	16.64	18.64	15.32	18.32
OTHER TYPE	39.12	34.57	30.82	30.56	30.66	34.87

Table 2. Groupwise identified fungi and reported allergic species.

Group	**Fungal species**	**Reported allergenic species**
Myxomycotina	*Physarum, Stemonitis*	
Zygomycotian	*Circinella, Cunninghamella, Mucor and Rizopus*	*Cunninghamella, Mucor, Rhizopus*
Ascomycotina	*Bitrimonospora, Bombardia, calospora, Chaetomium, claviceps, Cucurbitaria, Kikymosphaeria, Hypoxylon, Hysterium, Leptoshaeria, Nodulospheria, Passereniells, Pleospora, Pringsheimia, Rosellina, Sordaria, Sporomia, Xylaria.*	*Chaetomium, Claviceps, Didymosphaeria, Nodulospheria.*
Basidiomycotina	Basidiospores (Unclassifies), *Ganoderma*, Smut spores, Rust spores.(4 nos.)	Ganoderma, Smut spores.
Deutero mycotina	*Alternaria, Aspergilli, Beltrania, Beltraniella, Bispora, Botriodiplodia, Botrytis, Cercospora, Cladosporium, curvularia, Dicoccum, Diplodia, Drechslera, Dpicoccum, Exosporium, fusarium, Fusariella, Haplosporella, Helminthosporium, Hendersonia, Heterosporium, Hendersonia, Heterosporium, Lacellian, Memnoniella, Myrothecium, Nigrospora, Papularia, Penicillium, Periconia, Pistalotia, Pithomyes, Pseudotorula, Spegazzinia, Sporedesmium, Sporothrix, Tetraploa and torula (36 nos).*	*Alternaria, Aspergilli, Cercosp0ra, Cladosporium, Curvularia, Nigrospora, Periconia, Helminthosporium, Pithomyces, Fusarium, Pseudotorula, Spegazzinia, Torula.*

Allergic fungal species within study area

The fungal spores which are reported and considered to be potential allergens i.e. *Cladosporium, Alternaria, AspergillamPenicillum, Chaetomium, Claviceps, didymosphaeria, Nodulospheria, Ganoderma, Cercaspora, Fusarium, Helminthosporium, Nigrospora, Periconia, Pithomyees, Pseudotorula, Spegazzinia* and Torula were found in very high concentration. *Cladosporium* is highly allergic and was found contributing more than fifty percent of the total air spore. Citron (1962) has reported that the Aspergillus fumigates spores, which are ubiquitous and airborne, may be inhaled and causes symptom in sensitive victims and act as allergens and give rise to allergic rhinitis and asthma. Pepys *et al* (1959, 1967, 1964, 1977) reported that Aspergillus fumigates is responsible for Type-I reactions giving rise to bronchial asthma and Type-III reaction giving rise to progressive pathological lesions in the lung parenchyma followed by intestinal fibrosis. In regards to clinical importance of *Alternaria*, Feinberg (1935, 1946) was the first to emphasize its importance as a cause of allergy. This genus was found to be the commonest factor, in a series of tests of

some patients with cutaneous and respiratory reactions to fungi. The clinical importance of *Alternaria* has been substantiated by Prath (1939,1941) and Chobot *et al* (1940). Dhrham (1937) concluded form an extensive survey of airborne fungal spores that *Alternaria* was the most abundant allergen in the Central United states from the rocky Mountains to the Apple chains and similar is the case in present investigation. Clinical investigations together with *Alternaria*spore count was carried out by Schultze-Warninghouse *et al.,* (1987). It was reported that the patients with respiratory allergies spores are usually aphotic and *Alternaria* allergy was in 2/3 of the patients characterized by seasonal increase in July in accordance with *Alternaria* spore count. Shaivpuri and Agarwas (1963) tested allergenicity which was followed by *Cladosporium* (10%), *Curvularia* (6.97%), *Alternaria* (6.77%), and *Nigrospora* (5.8%). Tilak and Jogdand (1981-83) carried out clinical investigations at Aurangabad and clearly indicated the significant allergenic nature of the following types- *Rhizopus,Chaetomium, Pleospora, Puccinia, Alternaria, Aspergillus, Cladosporium, curvularia, Epicoccum, Helminthosporium, Nigrospora, Stemphylium* and hyphal fragments. Mishra *et al*., (1988)reported more than 50% positive allergic diseases in the tropics.

Further, diversity to topography, variation of meteorological and climatic conditions from place to place is highly reflected in the incidence of aeroallergens (Chanda, 1980). The association between airborne fungi and symptoms of respiratory allergy and Asthma is now well established (Malling, 1986, Strachan,1988, Garrett et al., 1998). More than 80 genera of fungi have been reported to be associated with respiratory tract allergy (Latge and Paris, 1991, Horner *et al.,* 1995) and more than 100 species of fungi are involved with serious human and animal infections and many other species cause serious plant diseases (Cvetnic and Pepeljnjak, 1997). Sensitization to fungal allergens is sometimes associated with life-threatening asthma (Black et al., 2000).

IV. CONCLUSION

It is evident from the present investigation that environment in and around Jharia coalfields harbour a wide variety of fungi. The above investigation has clearly brought out the different microbiota present in Jharia coalfields of Dhanbad. The occurrence of fungal spores, their seasonal variation accordingto meteorological parameters and their implications are well revealed. Air monitoring for fungal spores in theenvironment of the Jharia coalfields has provided meaningful information of practical utility. The study is highly interdisciplinary in nature and has tremendous scope to find the sig1nificant application in human health.

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