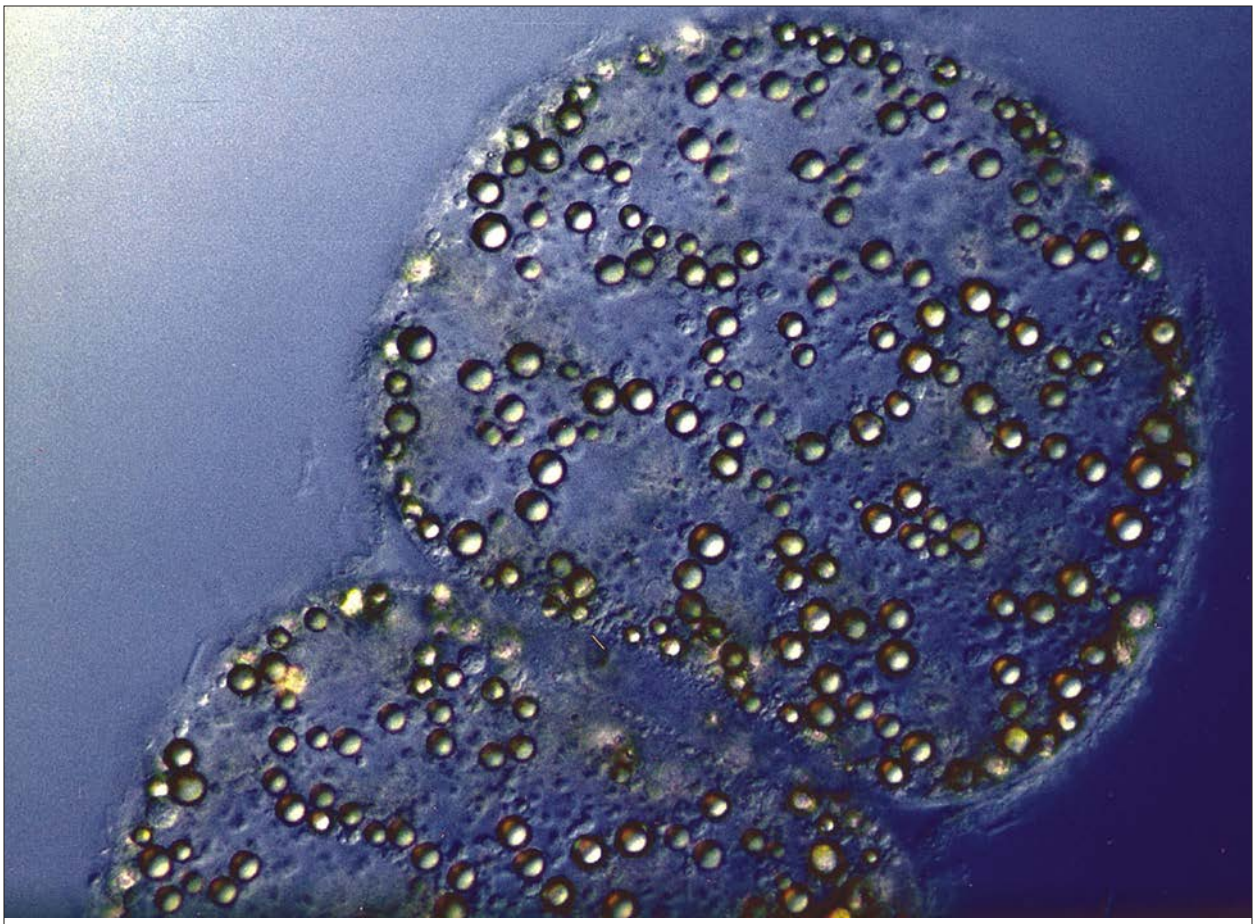

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Air Borne Fungal Spores in the Atmosphere of Industrial Town Korba-Chhattisgarh, India

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ABSTRACT

The study deals with the survey of the fungal spores at Korba an industrial town of Chhattisgarh. The study aimed to understand the fungal spectrum present in air, which is further helpful in disease forecasting and study of allergic diseases. The study was carried out from March 2007 to February 2008. During the study air samples were taken by Rotorod air sampler using Vaseline coated slide. After sampling slides were mounted with glycerin-jelly and scanned under microscope. A total of 23 fungal genera were obtained in which *Fusarium* (7.04%), *Alternaria* (6.86%), *Rhizopus* (6.77%) and *Aspergillus fumigates* (6.31%) were dominant. Some spores as *Aspergillus*, *Penicillium*, *Mucor* etc. are human pathogenic. During the study August 2007 is the month of highest occurrence where, as March and June 2007 are the months of lowest occurrence.

Key words: Rotorod sampler, *Aspergillus*, *Penicillium*, *Mucor*, pathogenic, fungal spectrum

INTRODUCTION

In the bioassay one can use presence /absence/abundance/distribution/morphology and biochemical characteristics of bio-particles to arrive at a conclusion regarding air quality of that area. There are plants and animal groups including human being are sensitive to the air particles, which can be monitored through proper quantification and standardization of habitat responses and sensitivity in biological species (Agarwal *et al.*, 1969). In this concern the study on airborne biological materials, mainly fungal spores and pollens and their impact on biological species is an important aspect. Jacobs (1951) elaborated the term to include dispersion of air borne insect populations, fungal spores, pollen and bacteria. Since fungal spores have long been known as one of the important environmental bio-particles causing dermatitis, respiratory and cardiac diseases along with allergic manifestation in human beings. Therefore, a preliminary study on air borne fungi has been conducted in Korba town, which is one of the biggest industrial towns in the country.

The biopollutants in developing countries like India causing various health hazard to life of great concern for environmentalist. Connection between the occurrences of air borne allergy symptoms has been established by the elution of protein antigen in contact with mucous surface. Fungal spores gain entry in to the respiratory tract of warm blooded animals with the rhythmical inhalation of the air through nostrils. Size, shape and surface structure of air borne fungi are important factor in the inhalation, retention and exhalation of man. The air almost always contains spores, but their number and types depends on the time of days, weather, season and geographical location (Wadhwani, 1994).

In Korba, there are many thermal power plants, explosive industries and numerous open and underground coal mines along with aluminum plant. This is one of the biggest energy capital in India which is indeed, unequally placed as for as its study on biological index is concern. In industrial development more than 95% of primary vegetation has been destroyed. Knowingly that plant species can accumulate industrial pollutants in a big way no study has been carried out on the relationship between the industrial units and the destruction of habitat loss. In hydrophobic system of more than 20 km radius of Korba, except the human population, no other groups either of decomposer/consumer/producer could achieve a significant number over the land surface for their identity. Since, the living organisms can serve as excellent quantitative as well as qualitative indices of the pollution of the environment therefore, it is essential to establish a scientific basis for the systematic approach to catalogue the microbial diversity related with plants and human health.

The bio-monitoring provides a simple, quick and convenient measure to ascertain the state of health of the environment. Seasonal evaluation of fungal spores in polluted environment can serve as a valuable and inexpensive tool to distinguish health problem particularly in the human infants. Singh and Babu (1983) studied airborne fungal flora of Delhi. Verma and Saini (2001) reported air borne fungal spores in Agriculture College at Jabalpur. Tiwari and Sahu (1994), studied air borne fungi at Raipur, India. Al Falih (2001) has done a quantitative survey of air borne fungal spore from school in Riyad. Verma and Pathak (2002) studied comprehensive analysis of mahayajna on controlling aero biopollutants. Hazarika *et al.* (2008) reported fungal spores from paper mill complex at Jageroad, Assam. Mishra *et al.* (2008) reported fungal spores from atmosphere of Obra town which is also a industrial town of India. Afzal and Mehdi (2002) studied the atmosphere of Karanchi town, Pakistan. Objective of present research is to study the biotic particles present in the atmosphere especially fungal spores, their identification, preparation of fungal calendar of the town and study of fungal spores in relation to human health.

MATERIALS AND METHODS

Korba is the industrial hub and power capital of Chhattisagrh state was accorded the status of a full-fledged revenue district on 25th May 1998 covering an area of 7,14,544 ha and located an altitude of 304.8 m above sea level. Korba experiences a hot, arid temperate climate and receives an average 1506.7 mm rainfall annually. Korba is situated in the north of Chhattisgarh and lies between 22° 01' - 23° 01' latitude and 82° 08' - 83° 09' longitude. It is surrounded by Ambikapur distt.in North, Raigarh distt. In east, Janjgir distt. in south and Bilaspur distt. in west (www.korba.gov.in).

Korba is the biggest industrial town. There are many thermal power plants, explosive industries and numerous open and underground coal mines along with an aluminum plant. This is one of the most polluted cities of India (Fig. 1).

During present investigation an extensive survey was conducted for the air sampling particularly in a center place (Transport Nagar) of Korba town. The seasonal air sampling was carried out at the height of 20 feet above the ground level for a period of one year i.e., from March 2007 to February 2008. Some of the samples were grown in agar medium for the, purpose of their identification

The samples of fungal spores were taken fortnightly using Rotorod air sampler (Giri and Saoji, 1996). The Vaseline coated slides were exposed 10 am to 6 pm (Every one hour the sampler was switched off for 15 min). After sampling the slides were mounted with glycerin-jelly and scanned under microscope. Identification of the fungal spores was done on the basis of microscopic examination and with the help of available literature (Bernett, 1960; Larone, 2002; Ellis, 1976).

Fig. 1: The study area (source: www.mapsofindia.com)

The conversion factor of this sampler is 5. Hence, if the total number of one spore type from the catches is 14, then total number of these spore types per meter of the air is 14×5 = 70 (Tilak, 1982). This number is the total number of spore/m^3 of the air at that particular site and height at that time.

RESULT AND DISCUSSION

The air mycoflora of a particular region is influenced by topography and meteorological parameter of the concerned area.

A total 23 different fungal spore types (Table 1) have been identified during the study in which *Aspergillus, Penicillium, Mucor* and *Rhizopus* are reported human pathogen. The yearly total no. of fungal spores was found 5465 m^3 during the March 07 to Feb.08. The dominant fungal spores were of *Fusarium* sp. (7.04%), followed by *Alternaria* sp. (6.86%), *Rhizopus* sp. (6.77%) and *Aspergillus fumigates* (6.31%) (Fig. 2). For the year August '07 is the month of highest incidence 895 m^3 (16.37%) of fungal spores (Fig. 7) and the minimum number of fungal spore were observed during the month of March and June '07 with 225 m^3 (4.11%) of fungal spores. Figure 3-6 show month wise contribution and seasonal variation (in term of no. of fungal spore) of four major spores contributors during the study, i.e., *Alternaria* sp., *Aspergillus* sp., *Fusarium* sp. And *Rhizopus* sp.

Figure 3 shows seasonal variation of *Alternaria*. *Alternaria* found throughout the year with max in August '07 and min in May '07 and Jan.'08. Figure 4 shows seasonal variation of *Aspergillus*. *Aspergillus* found max in August' 07 and absent in April, May and June '07. Figure 5 shows seasonal variation of *Fusarium*. *Fusarium* found throughout the year with max in August'07 and min in Feb.'08. Figure 6 shows seasonal variation of *Rhizopus*. *Rhizopus* found max in July '07 and absent in May '07.

These all figures show great variation of presence of fungal spores in atmosphere. Hot and dry months show less number of spores, whereas months of rainy seasons show max. number of spores due to wet condition, humidity, presence of plenty of organic food.

Table 1: Air borne fungal spores and their percentage contribution during March 2007 – Feb. 2008

Spore type	% contribution during the study
Alternaria sp.	6.86
Aspergillus fumigatus sp.	6.31
Cercospora sp.	5.67
Chaetomium sp.	2.74
Circinella sp.	4.84
Cladosporium sp.	5.67
Colletotrichum sp.	2.19
Cucurbiotaria sp.	3.11
Curvularia sp	5.67
Drechslera sp.	3.84
Fussarilla sp.	3.20
Fusarium sp.	7.04
Helmenthosporium sp.	3.01
Mucor sp.	2.92
Nigrospora sp.	1.09
Penicilium sp.	3.20
Pestalotia sp	3.01
Pyricularia sp.	4.39
Rhizopus sps.	6.77
Sclerospora sp.	5.94
Torulla sps.	3.75
Trichoderma sp.	1.55
Xylaria sp.	4.20
Unidentified	2.92
Total	100.0

Major spore (in number) contributors during the March 2007-Feb. 2008

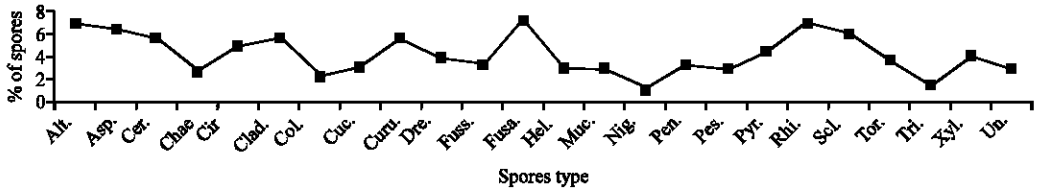

Fig. 2: Annual percentage contribution of spores during March 2007-Feb. 2008

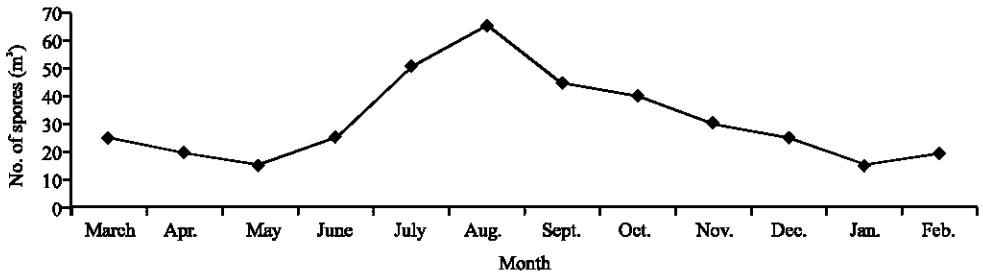

Fig. 3: *Alternaria* sp.

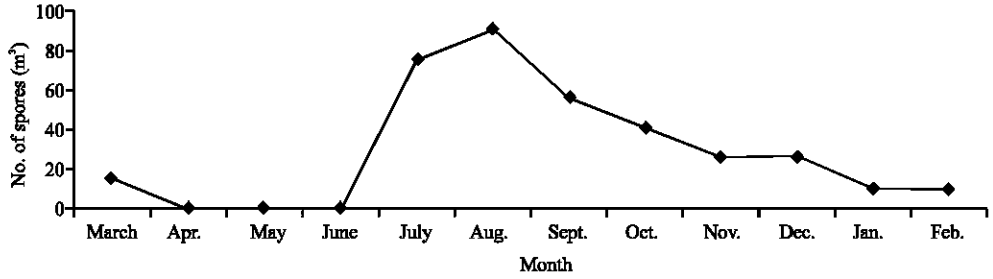

Fig. 4: *Aspergillus* sp.

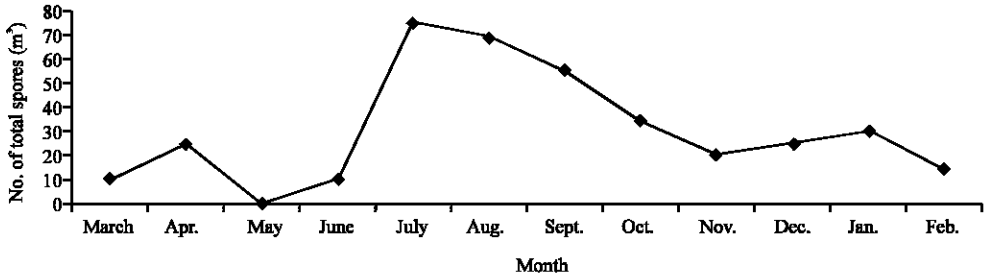

Fig. 5: *Fusarium* sp.

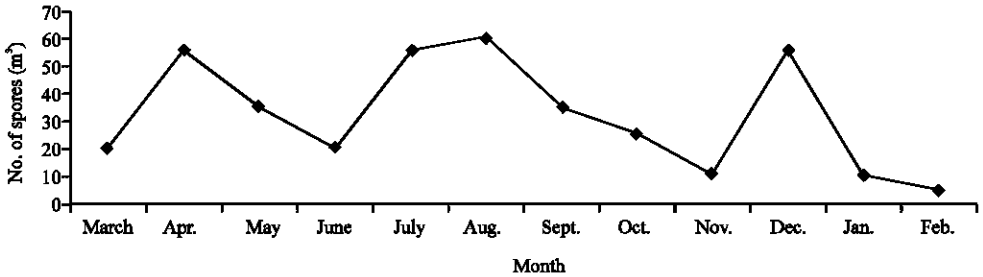

Fig. 6: *Rhizopus* sp.

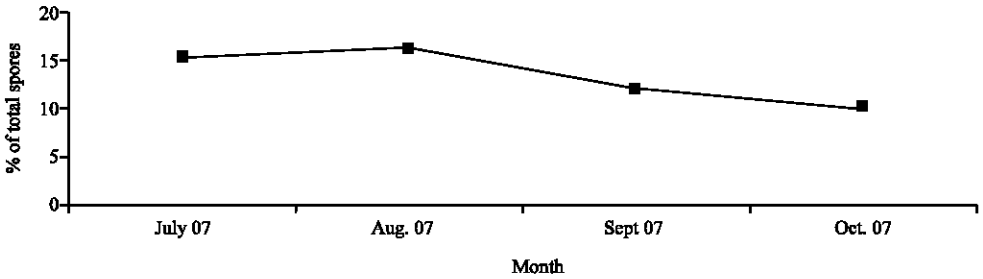

Fig. 7: Some months of higher spore concentration

In previous study Raha and Bhattacharya (1997) reported 16 genera from residential area of West Bengal where *Cladosporium* (23.61%) occupied the first rank. Hazarika *et al.* (2008) reported 32 fungal spores and observed maximum concentration of fungal spore in bamboo-storage site and July, September and October are the months of highest incidence whereas, August is the month

of highest incidence in this study. Mishra *et al.* (2008) reported 13 genera from atmosphere of Obra town where *Aspergillus* (21.61%) is most dominant which contradict the present study where *Fusarium* (7.04%) is dominant. Afzal and Mehdi (2002) reported 21 genera from atmosphere of Karanchi where *Aspergillus* is most dominant followed by *Alternaria*. Mangala *et al.* (2006) reported *Alternaria* in highest number from Miramar beach area Goa.

These all result of previous studies show that occurrence and distribution of fungal spores in the atmosphere variable, it's depend on meteorological factor and nature of the particular place. Each result mentioned above contradicts to other. So, we are unable to predict the air borne fungal spores of a particular place on the basis of previous study.

The prevalence of *Fusarium* in all the seasons is due to its pathogenic as well as saprophytic nature in the soil. Despite plant pathogenic relationship the fungus is highly cellulolytic in nature. *Alternaria* is another pathogenic fungus sporulate in winter crops. The hot and humid climate particularly the rainy season has been found most suitable for the sporulation of *Asprgillus* and *Rhizopus* species.

CONCLUSIONS

Since, there are changes in meteorological conditions each year therefore present investigation of one year is not sufficient to analyze air-borne mycoflora with that of trends of seasonal variation. Although, frequent precipitation in rainy season is an important factor for the spores fall and their germination in hot and wet conditions prevailing in and around Korba town. The season representing mostly saprophytic group of fungi such as *Aspergillus fumigates*, *Penicillium* sp., *Chaetomium* sp., *Cladosporium* sp. But, the higher percentage of fungal propagules is obtained in rainy season because of the availability of organic substrate either living or dead and humid atmosphere. The abundance of organic matter in rainy season provide opportunity to both the groups i.e., saprophytic and plant pathogenic fungi. During present investigation no area specific fungi could be identified. However, *Drechslera* sp., *Xylaria* sp. are obtained as common representative of forest fungi.

The present study is of one year provides a preliminary information on different groups of fungi. The regular monitoring of fungal spores may provide better knowledge for specific group of fungi causing various types of heath disorder in human being. Therefore, it necessitates carrying out regular air monitoring of bio-particles in Korba which is almost environmentally sick. R.V. Shukla helped to identify the fungal spores.

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