



SURVEILLANCE OF AEROMYCOFLORA IN THE POLYTECHNIC LIBRARY AT KAMPTÉE, DIST-NAGPUR (MS)

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ABSTRACT

Air is most vital component of environment without which nobody can survive. One can survive without food for weeks, for a few days without water, but hardly for few minutes without air. Today it is a well established fact that bacteria, viruses, fungi and pollen grains cause air pollution. These biological agents are called as Biopollutant and presence of biopollutant indicates the air quality. The plants, animals and human beings are affected by air-pollution including bio-pollution which is responsible for causing diseases besides being allergic to them. Among the Biopollutant, in India 90% of counts of air-borne biota belongs to fungi.

Fungi are ubiquitous in nature. Hazardous effects of fungi on the health of human, animals and plants can be minimized by monitoring the quality of air for knowing the diversity, abundance and variation according to seasonal changes. The day by day changing atmosphere affects the quality of air, due to change of its biological and non-biological components. A library is a store house of books – books of all kinds. Books are made from paper which is a polymer of cellulose. A binding gum is also used for compiling many papers to form a book. Gum can be synthetic or organic; in both cases it provides nutrients and moisture for growth of fungi.

In order to identify the dominant fungi, an aero mycology investigation has been conducted. The present investigation deals with the isolation of fungal species from indoor environment of library of Bhoyar College of Polytechnic, Kamptee. Sampling of fungal spores catch was carried out in the intramural environment of library for the period of 1 year (December 2013 to November 2014) monthly using Hi-media air sampler with Rose-Bengal Agar Strips. During study 24 fungal genera were recorded with 1050 Colony Forming Units (CFU's) during the study period.

KEYWORDS : Ubiquitous, Hi-media air sampler, Czapek's Dox agar, CFU's, *Aspergillus niger*, *Aspergillus fumigatus*

INTRODUCTION

Atmosphere is rich source of diverse groups of contaminants which may be biological or non biological in origin. Maximum contaminants have hazardous health effects such as allergic reactions, asthma, varied skin diseases, internal organ infection and toxicity as well.

Traditionally, fungi have been defined as eukaryotic, spore-producing, achlorophyllous organisms with absorptive nutrition that generally reproduce both sexually and asexually. Fungi are extremely valuable source of chemicals, including various antibiotics, and also have great potential as biological controls for many serious pests. Fungi are omnipresent, due to being one of the ample spores releasing organism. Fungi can grow on simple to complex substrates and transferred by means of air in greater extents^[1]. Therefore fungal spore percentage should be known to avoid many diseases. Such diseases as can be caused due to inhalation of fungal spores, Toxicity as aspergillosis, allergic asthma, some of saprophytic fungi are opportunistic pathogens which cause skin diseases or any other internal organ diseases. Because of this, they are termed as bio-contaminant^[2]. Many workers do recorded their aero mycological investigation of different libraries time to time^[2-14] and many more.

NAAMP (National Air Quality Monitoring Programme) measures the level of abiotic component of pollution. However, the biotic aspect of pollution is untouched. In the present studies an attempt has been made to measure fungal biopollutant. An aerobiological survey of aero fungi has been done in this work. Aero fungi contribute up to 90% to the air-borne biota in India.^[15]

The present study has been carried out to screen the mycoflora of air inside the library of Kamptee city. The study of indoor aeromycoflora of library and fungi associated with bio-deterioration of books is important not only for conservation of books but also to prevent diseases that they cause in persons working or coming in daily contact with that environment. For preservation of books they should be kept in fungi free atmosphere. For keeping an eye on concentration and diversity, the regular aero mycological survey should be carried out which can help us to specify the preventive measures to avoid adverse effects of fungi. Some species of *Aspergillus*, *Penicillium* genera can cause extreme allergic reaction or respiratory and other related diseases in humans.

Library have volumes of such suitable substrates in the form of old papers, binding fabrics and glue, fragments and pieces of damp deteriorated papers, patches of exudates and excreta of insects, lower

zoonatics and birds, dust, etc. contributed a number of spores by allowing as substrate for harbor. Disturbances caused by physical, mechanical and human activity might induce the movement of the harboring substrates, consequently initiate take off of the spores and diffuse in the air.

However, most of the research done pertained to the deterioration of books. The physical condition from different library structures, such as humidity level, temperature and the presence of organic and inorganic substrates, influence the fungal concentration in their indoor air. Collection of airborne spores can provide valuable information about the indoor air quality in library.^[14,16]

MATERIAL AND METHODS

The present quantitative and qualitative study was carried out in the library of Bhoyar College of Polytechnic which was established in 2006. The sampling was done for a one year from December 2013 to November 2014 monthly.

Air sampling was conducted using Centrifugal Impactor type air sampler (Hi media laboratories Ltd, India LA002) by using Czapek's Dox Agar strips. The sampler was kept at a height of 1 meter above ground and run for 5 minutes. Exposed strips are incubated at 27°C for 3-4 days. After incubation, the total colony forming unit per cubic meter per min. was counted by the formula as follows:

$$\text{CFU's/m}^3/\text{min.} = \frac{\text{Colonies formed on Agar strip}}{\text{Sampling time in minutes}} \times 25$$



Centrifugal Impactor type air sampler (Hi media laboratories Ltd, India La002)

Sub cultures were maintained and fungal species were identified with the help of standard literature^[17-22]. The unidentified spp. cultures were sent to Agharkar Research Institute, Pune for its identification.

The statistical analysis that is Spearman correlation test (r) between total CFU count and Meteorological factors (Average Temperature, Relative Humidity and Total Rainfall) was calculated by using Microsoft Excel-10 and Graphs was made in Microcal origin 6.0; Average Temperature and Relative Humidity was recorded using Ambient Weather WS-07 Thermo- Hygrometer display, Total Rainfall data were collected from Regional Meteorological Centre, Nagpur.

TABLE: 1 Meteorological data of sampling period

| Sr. No. | Month and Sampling year | Max. Temp. (in °C) | Min. Temp. (in °C) | Average Temp. (in °C) | Average relative Humidity (in %) | Average Rain fall (in mm) |
|---------|-------------------------|--------------------|--------------------|-----------------------|----------------------------------|---------------------------|
| 1 | December2013 | 28 | 12 | 20 | 56 | 18 |
| 2 | January2014 | 28.6 | 12.4 | 20.5 | 59 | 10.2 |
| 3 | February2014 | 32.1 | 15 | 23.55 | 58 | 12.3 |
| 4 | March2014 | 36.3 | 19 | 27.65 | 55 | 17.8 |

Spearman Correlations

| | | B | Max. Temp. | Min. Temp. | Ave. Temp. | R. Humidity | Rainfall |
|-----------|----------------|----------|------------|------------|------------|-------------|----------|
| B | Spearman Corr. | 1 | -0.32632 | 0.43082 | -0.03333 | 0.44834 | 0.52189 |
| B | Sig. | -- | 0.30058 | 0.16206 | 0.91809 | 0.1438 | 0.08179 |
| Max.Temp. | Spearman Corr. | -0.32632 | 1 | 0.54991 | 0.85614 | -0.5289 | -0.11208 |
| Max.Temp. | Sig. | 0.30058 | -- | 0.06398 | 3.79E-04 | 0.07705 | 0.72874 |
| Min.Temp. | Spearman Corr. | 0.43082 | 0.54991 | 1 | 0.84063 | 0.0979 | 0.46154 |
| Min.Temp. | Sig. | 0.16206 | 0.06398 | -- | 6.16E-04 | 0.76212 | 0.13095 |
| Ave.Temp. | Spearman Corr. | -0.03333 | 0.85614 | 0.84063 | 1 | -0.20666 | 0.17513 |
| Ave.Temp. | Sig. | 0.91809 | 3.79E-04 | 6.16E-04 | -- | 0.5193 | 0.58616 |
| Humidity | Spearman Corr. | 0.44834 | -0.5289 | 0.0979 | -0.20666 | 1 | 0.58042 |
| Humidity | Sig. | 0.1438 | 0.07705 | 0.76212 | 0.5193 | -- | 0.04786 |
| Rainfall | Spearman Corr. | 0.52189 | -0.11208 | 0.46154 | 0.17513 | 0.58042 | 1 |
| Rainfall | Sig. | 0.08179 | 0.72874 | 0.13095 | 0.58616 | 0.04786 | -- |

2-tailed test of significance was used.

RESULTS AND DISCUSSIONS

Table 2 showed the concentration, diversity and count of aero fungal flora observed in intramural environment of Bhoyar College of Polytechnic library for a one year sampling period i.e. from December 2013 to November 2014. All together 1050 CFU/m³/min were counted during the study period. Total 24 species belonging to 17 genera were observed. *Aspergillus* represented by 4 species while *Alternaria*, *Cladosporium*, *Rhizopus* and *Penicillium* by 2 species.

Aspergillus niger and *Rhizopus nigricans* contributed most i.e. 93.75 CFU/m³/min and least contribution was shown by *Phoma* spp. i.e. 12.5 CFU/m³/min and only observed in post monsoon season i.e. in the month of September and October.

In the month of April, May and June minimum count was recorded because during this period average temperature was highest side and Percentage relative humidity at lower side and it showed direct correlation with fungal count.

July to November months was noticed as favorable months for enhancement of fungal aerospora due to moderate temperature and average percentage relative humidity at higher side. In January only 43.75 CFU/m³/min was observed as compared to December month count which was 75 CFU/m³/min and showed enhancement in the month of February may be due to the transition period of season with average temperature of 23°C which was suitable for growing/incubation of the fungi.

TABLE 2 :- Showing CFUs/m³/min of recorded fungal species from Bhoyar College of Polytechnic Library from Dec 2013 – Nov 2014

| Fungal species Name | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Total |
|----------------------------|------|------|------|-----|-----|-----|------|------|------|------|------|------|-------|
| Ascomycetes | | | | | | | | | | | | | |
| <i>Emericella nidulans</i> | 6.25 | 0 | 0 | 0 | 0 | 0 | 0 | 12.5 | 12.5 | 6.25 | 12.5 | 6.25 | 56.25 |
| Zygomycetes | | | | | | | | | | | | | |
| <i>Mucor</i> sp. | 0 | 6.25 | 6.25 | 0 | 0 | 0 | 6.25 | 6.25 | 0 | 0 | 6.25 | 6.25 | 37.5 |

| | | | | | | |
|----|---------------|------|------|-------|-------|-------|
| 5 | April2014 | 40.2 | 23.9 | 32.05 | 48 | 13.2 |
| 6 | May2014 | 42.6 | 27.9 | 35.25 | 51 | 16.3 |
| 7 | June2014 | 37.8 | 26.3 | 32.05 | 67 | 172.2 |
| 8 | July2014 | 32 | 25 | 28.5 | 77 | 271 |
| 9 | August2014 | 30.4 | 23.6 | 27 | 80 | 291.6 |
| 10 | September2014 | 35 | 29 | 32 | 53 | 176.9 |
| 11 | October2014 | 35 | 30 | 32.5 | 68.37 | 58.3 |
| 12 | November2014 | 33 | 28 | 30.5 | 67.71 | 19.6 |

*Source: Regional Meteorological Department, Nagpur.

Descriptive statistics

| | N | Mean | SD | Sum | Min | Max |
|-----------|----|----------|----------|---------|-------|-------|
| B | 12 | 87.5625 | 49.56104 | 1050.75 | 31.25 | 187.5 |
| Max.Temp. | 12 | 34.25 | 4.47325 | 411 | 28 | 42.6 |
| Min.Temp. | 12 | 22.675 | 6.48188 | 272.1 | 12 | 30 |
| Ave.Temp. | 12 | 28.4625 | 4.9242 | 341.55 | 20 | 35.25 |
| Humidity | 12 | 61.67333 | 10.24207 | 740.08 | 48 | 80 |
| Rainfall | 12 | 89.78333 | 107.7896 | 1077.4 | 10.2 | 291.6 |

Spearman Correlations

| | | B | Max. Temp. | Min. Temp. | Ave. Temp. | R. Humidity | Rainfall |
|-----------|----------------|----------|------------|------------|------------|-------------|----------|
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| Ave.Temp. | Spearman Corr. | -0.03333 | 0.85614 | 0.84063 | 1 | -0.20666 | 0.17513 |
| Ave.Temp. | Sig. | 0.91809 | 3.79E-04 | 6.16E-04 | -- | 0.5193 | 0.58616 |
| Humidity | Spearman Corr. | 0.44834 | -0.5289 | 0.0979 | -0.20666 | 1 | 0.58042 |
| Humidity | Sig. | 0.1438 | 0.07705 | 0.76212 | 0.5193 | -- | 0.04786 |
| Rainfall | Spearman Corr. | 0.52189 | -0.11208 | 0.46154 | 0.17513 | 0.58042 | 1 |
| Rainfall | Sig. | 0.08179 | 0.72874 | 0.13095 | 0.58616 | 0.04786 | -- |

2-tailed test of significance was used.

Microorganisms are responsible for biodegradation of storage materials, equipment, library materials, painting etc. More than 80 genera of fungi have been associated with the most commonly identified belonging to three distinctive fungal groups, *Ascomycetes*, *Basidiomycetes* and *Deuteromycetes*.^[23] The main types of allergic spores are *Aspergillus*, *Cladosporium*, & *Penicillium*. The clinical investigation has provided the significance and utility of treatment is preventing the effect of aeroallergens to sensitive individual.^[24-25] Therefore, it is a need of trained aero mycologist and clinicians

The data were subjected to the Statistical analysis. A close observation throughout a year and Statistical analysis of paired t- test leads us to significant results. The fungal spore count is less as compared to other libraries in Kamptee^[2] It may due to the age of library, library area, available number of books in library, number of people used to visit the library, frequent cleanliness, and proper ventilation systems of the library. Perhaps Bhoyar College of polytechnic library is bigger and numbers of books are also more, still the concentration and diversity was least. It may due to use of air conditioner in library and due to maintaining of Library etiquette.

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|-------------------------------------|-----------|--------------|--------------|-------------|-----------|--------------|--------------|--------------|--------------|------------|--------------|--------------|-------------|-------------|-------------|
| <i>Rhizopus nigricans</i> | 12.5 | 6.25 | 12.5 | 6.25 | 12.5 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 93.75 |
| <i>Rhizopus solani</i> | 6.25 | 0 | 6.25 | 6.25 | 6.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| <i>Cunninghamella sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 12.5 | 0 | 6.25 | 0 | 0 | 0 | 25 |
| Deuteromycetes | | | | | | | | | | | | | | | |
| <i>Alternaria alternata</i> | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 75 |
| <i>Alternaria brassicicola</i> | 6.25 | 0 | 6.25 | 6.25 | 0 | 0 | 0 | 6.25 | 6.25 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 43.75 |
| <i>Aspergillus flavus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 12.5 | 6.25 | 6.25 | 6.25 | 18.75 |
| <i>Aspergillus fumigatus</i> | 6.25 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 12.5 | 12.5 | 6.25 | 6.25 | 6.25 | 50 |
| <i>Aspergillus niger</i> | 12.5 | 12.5 | 6.25 | 12.5 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 93.75 |
| <i>Aspergillus terreus</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 31.25 |
| <i>Cladosporium cladosporioides</i> | 6.25 | 6.25 | 12.5 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 0 | 6.25 | 12.5 | 6.25 | 6.25 | 6.25 | 81.25 |
| <i>Cladosporium herbarum</i> | 6.25 | 0 | 6.25 | 0 | 0 | 0 | 0 | 12.5 | 12.5 | 18.75 | 18.75 | 6.25 | 6.25 | 6.25 | 81.25 |
| <i>Curvularia lunata</i> | 0 | 0 | 6.25 | 6.25 | 0 | 6.25 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 37.5 |
| <i>Fusarium oxysporum</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 12.5 | 6.25 | 6.25 | 6.25 | 6.25 | 31.25 |
| <i>Geotrichum sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 12.5 | 6.25 | 6.25 | 6.25 | 37.5 |
| <i>Helminthosporium sp.</i> | 0 | 0 | 6.25 | 6.25 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 31.25 |
| <i>Nigrospora oryzae</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 25 |
| <i>Penicillium chrysogenum</i> | 6.25 | 0 | 0 | 0 | 6.25 | 0 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 43.75 |
| <i>Penicillium digitatum</i> | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 12.5 | 6.25 | 6.25 | 50 |
| <i>Phoma sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 0 | 0 | 0 | 12.5 |
| <i>Sporotrichum sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 12.5 | 6.25 | 0 | 0 | 0 | 25 |
| <i>Torula sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 6.25 | 25 |
| <i>Trichoderma sp.</i> | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6.25 | 6.25 | 6.25 | 0 | 0 | 0 | 18.75 |
| TOTAL | 75 | 43.75 | 81.25 | 62.5 | 50 | 31.25 | 31.25 | 93.75 | 112.5 | 150 | 187.5 | 131.2 | 1050 | 1050 | 1050 |

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