

Comparative aeromycological study of three libraries in Kamptee

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ABSTRACT

The ubiquitous nature of fungal spores makes mycology study crucial. Fungi are the main agent for deterioration, pathogenicity and allergy as well. Their diverse effects require more attention in the research field of mycology. Therefore with these objectives' an atmospheric survey of fungal spores was carried out in three libraries of Kamptee for the period of 1 year (December 2012 to November 2013) using Hi-media air sampler with Rose-Bengal Agar Strips. During study' 26 fungal genera were identified. Maximum fungal genera of all 26 types were isolated from library of S. K. Porwal College, 20 from Kendriya Vidyalaya library, and least 15 were from the library of Bhoyar college of Polytechnic. The maximum CFU/m³/min was calculated from S.K. Porwal College library and it was 5329, followed by 3583 in Kendriya Vidyalaya and least were counted in Bhoyar College of Polytechnic i.e. 1849 CFU/m³/min in sampled year. Dominant fungal species which were isolated from all the three sampling sites were *Aspergillus flavus*, *Aspergillus niger*, *Aspergillus fumigatus*, *Alternaria alternata*, *Cladosporium cladosporoides*, *Cladosporium oxysporum*, *Penicillium citri*, *Rhizopus stolonifer*, *Mucor spp.*, *Syncephalastrum spp.* and *Mycelia sterilia*, *Bispora*, *Monilia*, *Periconia spp.* were isolated from SKPC library only.

Keywords: Aero mycology, Library, Intramural, Hi-media Air Sampler, CFU's.

INTRODUCTION

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. Fungi not only destroy food, fabrics, leather, monuments etc, but also causing many diseases to animal and plants[1]. Fungi are well known allergens [2] as they are omnipresent due to being one of the ample spores releasing organism.

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.

Many previous workers [3-6] carried out Intramural aero mycological studies in libraries by the Petri plate exposure method using Potato Dextrose Agar. The present quantitative and qualitative study was carried out by using Hi-media air sampler with Czapek's Dox agar strips in three libraries of Kamptee. The three libraries chosen in Kamptee were S.K.Porwal College library- the college was established in 1965, Kendriya Vidyalaya library was established in 1997 and Bhoyar College of polytechnic which was established in 2006.

MATERIALS AND METHODS

I- Sampling Sites.

Three libraries were chosen for the study. Site I- S. K .Porwal College Library, Site II- Kendriya Vidyalaya Library, Site III- Bhojar College of Polytechnic Library.

II- Air Sampling.

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 27⁰C for 3-4 days. After incubation, the total colony forming unit per cubic meter per minute was counted by the formula as follows:

$$\text{CFU/M}^3/\text{Min} = \frac{\text{Colonies on Agar Strips} \times 25}{\text{Sampling Time in Minute}}$$

Sub cultures were maintained and fungal species were identified with the help of standard literature [7-11]. 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 Department, Nagpur.

RESULTS AND DISCUSSION

Table – I Total CFU/m³/min and Percentage of Each species Observed in Three libraries.

Sr. No.	Fungal Types	S.K.Porwal Library		Kendriya Vidyalaya Library		Bhojar College of Polytechnic Library	
		SITE I		SITE II		SITE III	
		CFU/m ³ /min	%	CFU/m ³ /min	%	CFU/m ³ /min	%
1	<i>Alternaria sp.</i>	295	5.53	179	4.99	92	4.97
2	<i>Aspergillus sp.</i>	966	18.12	514	14.34	383	20.71
3	<i>Bispora sp.</i>	70	1.31	43	1.36	0	0
4	<i>Candida sp.</i>	545	10.22	499	13.92	109	5.89
5	<i>Chaetomium sp.</i>	170	3.19	90	2.51	18	0.97
6	<i>Cladosporium sp.</i>	177	3.32	160	4.46	261	14.11
7	<i>Cunninghamella sp.</i>	43	0.8	33	0.92	0	0
8	<i>Curvularia sp.</i>	339	6.36	217	6.05	83	4.48
9	<i>Drechslera sp.</i>	107	2	58	1.61	0	0
10	<i>Fusarium sp.</i>	199	3.73	189	5.27	130	7.1
11	<i>Monilia sp.</i>	135	2.53	125	3.48	0	0
12	<i>Mucor Sp.</i>	124	2.32	115	3.2	34	1.83
13	<i>Mycelia sterilia</i>	532	9.98	359	10.01	216	11.68
14	<i>Oospora sp.</i>	140	2.62	185	5.16	0	0
15	<i>Penicillium sp.</i>	406	7.61	253	7.06	175	9.46
16	<i>Periconia sp.</i>	122	2.28	0	0	0	0
17	<i>Phoma sp.</i>	50	1.03	0	0	0	0
18	<i>Rhizopus sp.</i>	186	3.49	151	4.21	168	9.08
19	<i>Saccharomyces sp.</i>	204	3.82	234	6.47	107	5.78
20	<i>Spicaria sp.</i>	32	0.63	0	0	0	0
21	<i>Stachybotrys sp.</i>	43	0.8	29	0.8	10	0.54
22	<i>Syncephalastrum sp.</i>	122	2.28	64	1.78	23	1.24
23	<i>Tetraploa sp.</i>	64	1.2	0	0	0	0
24	<i>Torula sp.</i>	95	1.78	86	2.4	40	2.16
25	<i>Trichoderma sp.</i>	128	2.4	0	0	0	0
26	<i>Trichothecium sp.</i>	35	0.65	0	0	0	0

The total CFU/m³/min calculated from S.K.Porwal College Library was 5329 with maximum 26 fungal genera, total count for Kendriya Vidyalaya library was 3583 with 20 fungal genera. The least CFU/m³/min 1849 with total 15 fungal genera were calculated from Bhojar College of Polytechnic library. *Aspergillus sp.*, *Candida sp.*, and

Mycelia sterilia had maximum colony count in all three libraries, followed by the species of *Penicillium*, *Saccharomyces*, *Curvularia* and *Fusarium*. In Library 3 (B.C.P.L) *Cladosporium* 14.11% where *Rhizopus* contributed 9.08% [Table-1].

Figure I showed that the total concentration of different class of fungi in which Deuteromycetes were more abundant in all three libraries (74 %, 71% and 69% respectively) followed by *Mycelia sterilia* (9%, 10%, 12% respectively). The Zygomycetes and Ascomycetes class contributed 10%, 10.9%, 12% and 7.1%, 9%, 6.8% respectively in all three libraries.

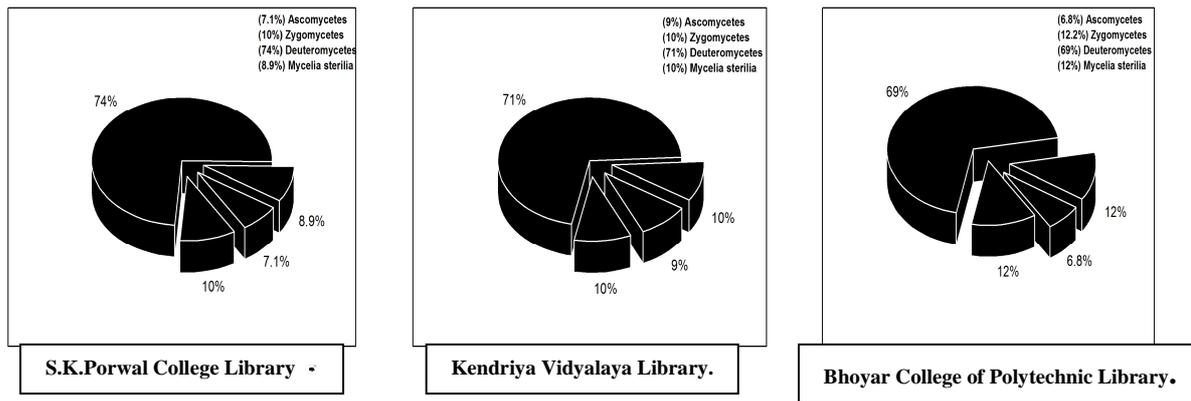


Figure I- Contribution of Different Classes of Fungi.

The Zygomycetes class represented with 4 genera *Cunninghamella*, *Mucor*, *Rhizopus* and *Syncephalastrum* in which *cunninghamella sp* was not found in Bhoyar college of Polytechnic library. The Ascomycetes class was represented by 2 genera (*Chaetomium* and *Saccharomyces*.) and all were found in all libraries [Table-I and Figure-II].

Table-II shows the month wise percentage of Fungal colony count, in which *Aspergillus*, *Candida*, *Cladosporium*, *Curvularia*, *Fusarium*, *Monilia*, *Mycelia sterilia*, *Penicillium*, *Rhizopus*, *Saccharomyces*, And *Trichothecium sp.* were found throughout the year (Dec 2012 to Nov 2013).

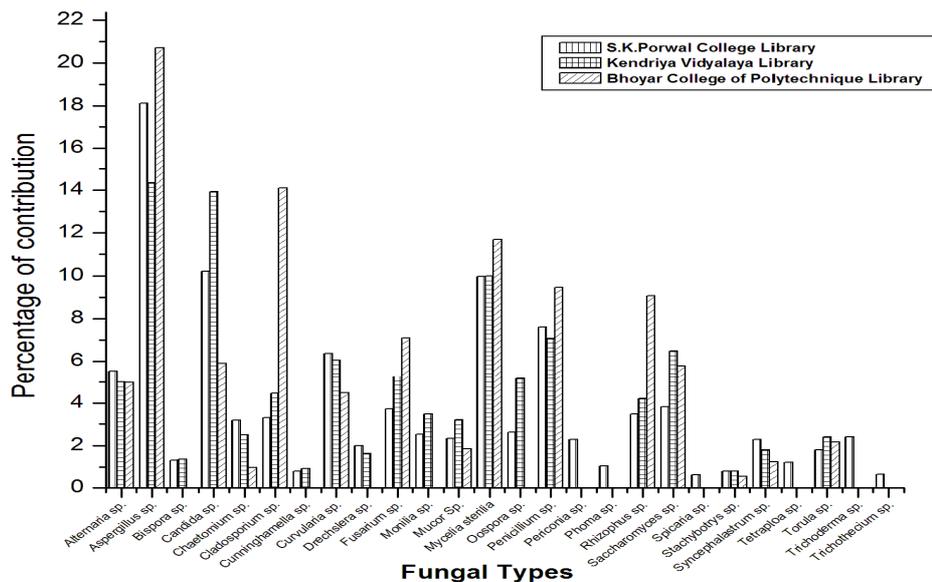


Figure II- Percentage of Occurrence of Fungal Types.

Table-II Month wise % Contribution of Fungal Types.

MONTHS LIBRARIES	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1.S.K.PorwalCollege Library	7.35	8.03	11.9	11.05	5.45	3.87	7.08	7.43	9.16	14.7	7.98	6.0
2. Kendriya Vidyalaya Library	6.36	10.7	14.09	12.41	4.4	3.63	6.42	6.28	7.25	11.39	7.92	9.15
3. Bhoyar College of Polytechnic Library	4.05	7.03	13.52	11.73	8.92	4.15	3.51	7.12	9.15	10.54	9.2	11.08

January, February, March, August, September and November were the most favorable months for the growth of many fungi. The Table II revealed that pre-summer, post-monsoon, and winter were the most favorable seasons for growth and development of fungi. These seasons were represented by the months October, November, December, January, February, March, April. The least diversity and minimum count for fungal colonies was seen in the month of May, followed by April, June, July and December.

The data shows the significant variability in three sampled libraries, with variance of 44042.36, 20805.6, 9924.6 and Standard deviation value of 209.9, 144.2 and 99.6 for S. K. Porwal College Library, Kendriya Vidyalaya Library and Bhoyar College of Polytechnic Library respectively.

Table-III Spearman's rank correlation coefficients critical values between Total Colony Forming Units and Meteorological Variables, $\alpha=0.05$: *S. K. Porwal College Library, **Kendriya Vidyalaya Library, ***Bhoyar College of Polytechnic Library.

Months Meteorological parameter	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Average Temperature	0.287*	0.283*	0.317*	0.337*	-0.275*	-0.306*	-0.391*	-0.370*	0.414*	0.370*	0.317*	0.301*
Relative Humidity	0.283**	0.283**	0.312**	0.331**	-0.271**	-0.312**	-0.380**	-0.361**	0.401**	0.361**	0.312**	0.296**
Total Rainfall	0.291***	0.296***	0.306***	0.32***	-0.283***	-0.317***	-0.401***	-0.353***	0.380***	0.344***	0.331***	0.312***
	0.312*	0.301*	0.429*	0.296*	-0.169*	-0.184*	-0.279*	-0.186*	-0.279*	0.380*	0.536*	0.446*
	0.361**	0.353**	0.414**	0.306**	-0.172**	-0.186**	-0.279**	-0.189**	-0.264**	0.344**	0.503**	0.464**
	0.331***	0.370***	0.464***	0.317***	-0.173***	-0.190***	-0.296***	-0.193***	-0.254***	0.317***	0.446***	0.484***
Total Rainfall	-	-	0.167	-	-	0.186	-	-	0.370	0.243	0.217	-

Spearman's rank correlation analysis was done [Table-III] between Meteorological Factors (Average Temperature, Relative Humidity and Total Rainfall) and Average CFU/m³/min of every month of sampled year. The results were highly significant. It was seen that Average Temperature above 30°C, Relative Humidity at 65%, and Total Rainfall Above 115mm and below 85 mm impacted significantly on fungal diversity and count. No sign was denoted to positive correlation while – denotes negative correlation.

The effect of meteorological factors on airborne micro fungi evaluated based on the correlation coefficient (r) analysis showed that the correlation was found negative between fungal CFU's and temperature for the months of April, May, June and July and positive correlation was found for the remaining months of the year. The negative correlation between fungal CFU's and relative humidity was for the months of April, May, June, July and August. It was confirmed that the meteorological precipitation has direct effect on the fungal spore load in the library environment [12].

Most of the fungal types isolated in this study were similar as studied by other workers [13-14]. Perhaps *Candida*, *Saccharomyces*, *Stachybotrys*, *Syncephalastrum* was isolated first time in all three libraries studied, may due to many small scale industries in Kamptee and surrounding areas of sampled libraries. Whereas *Oospora* was found in two libraries, and *Phoma* in S. K. Porwal college library only.

Aspergillus sp., *Cladosporium sp.*, *Curvularia sp.*, *Penicillium sp.*, *Fusarium sp.* were the most predominant fungi in all type of environment [15-16]. Including all above fungal types, *Candida sp.* and *Saccharomyces sp.* were found dominant in all three libraries environment. The presence of all these fungal types was highly insignificant in health point of concern [17]. The result shows the decreasing concentration and diversity of fungal spores in three libraries that is S.K.Porwal College Library, Kendriya Vidyalaya Library and Bhoyar College of Polytechnic Library respectively. 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[18].

Perhaps Bhojar college of polytechnic library is bigger and number of books are also more than Kendriya Vidyalaya library, still the concentration and diversity was least. It may due to use of air conditioner in library.

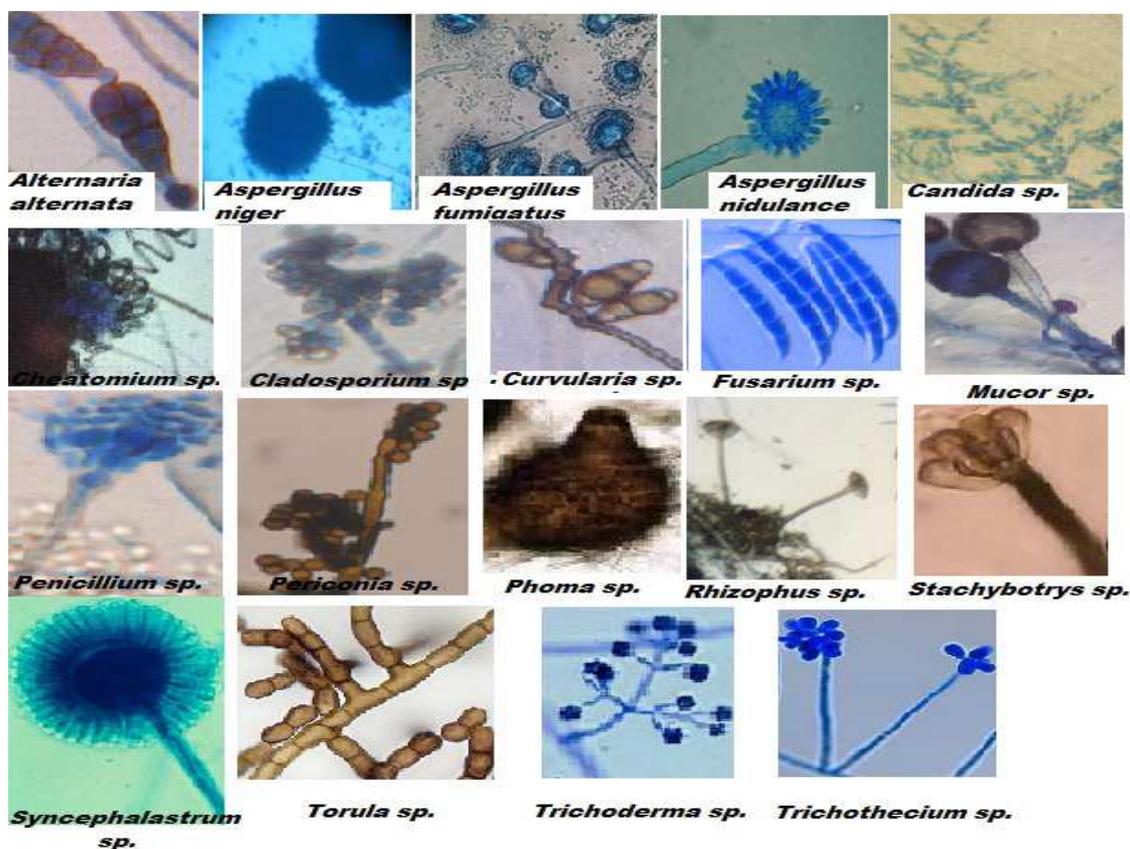


Figure III- Pictures of some fungul species

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