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Incidence of deteriorating fungi in the air inside the college libraries of Wardha city

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ABSTRACT

Fungi, a specialized group of microorganisms are dangerous agents inside library which are not only responsible for paper deterioration and ageing of books in the library but also significantly affect health of the library staff. The deterioration of library material by microorganisms has attracted attention in recent years. Efforts have been made towards reduction of these losses by finding out the conditions, causes and weather conditions, which incidentally contribute to the deterioration of library books and other materials. The role of fungal agents in deterioration is due to their hydrolytic enzyme activity. The cellulytic activities cause maximum damage to paper. Investigations by the exposed culture plate method helped in determining the composition and percentage contribution of the various constituents of airspora inside library. Isolated fungi were identified and classified on the basis of their characters with the help of authentic literature. It was observed that the deteriorating activity of fungi changed with respect to the paper type. The fungi observed in the study includes Aspergillus niger, A. flavus, A. fumigatus, A. spp., Alternaria alternata, Alternaria spp., Curvularia spp., Fusarium spp., Rhizopus spp., Penicillium spp., Chaetomium spp., Helminthosporium spp., Geotrichum spp., Drechslera spp. Fungi like Aspergillus niger, Chaetomium, Penicillium, Rhizopus and Alternaria were also isolated from the books in the libraries.

Key words: Aeromycoflora, *Aspergillus spp.*, College library, Book deteriorating fungi, Hydrolytic enzyme activity.

INTRODUCTION

Fungal spores, pollen grains, and some bacteria are among the most prevalent airborne particles which form the major components of our environment and also act as biopollutants. The available literature shows that airspora studies have been done almost exclusively in outdoor

environments [1]. However, a human exposure also occurs to a significant extent indoors. The present research considers few specific indoor environments namely, libraries since there has been little planned scientific study with respect to the air spora of libraries. Extensive study has been carried out on the aspect outside India. In India such work was carried out in past by many workers [2-6]. Recently only few records were seen highlighting indoor aerospora [7-10].

Biodeterioration of library materials is a worldwide problem and it causes great damage especially to unique manuscripts and books stored in the libraries [11]. In this study we intend to discuss one of the biological factors as a main external group of factors that influence library materials. Fungal spores are an important component of the bioaerosol. There are about 80,000 species most of which are cosmopolitan in origin. The biological features of the fungi i.e. their ease of dispersion makes fungi one of the chief agents of contamination of any type of substrate including cellulose materials in the books of library. Many are pathogenic to human beings causing allergic problems including asthma due to differential deposition in the respiratory system. It also causes the skin infection like Dermatophytosis or ring worm infection or tinea is by far the most common disease in human beings [12]. These fungi along with bacteria are responsible for the deterioration of the materials in the library. The activity of different environmental factors may cause some changes in physical and chemical properties of library collections and most of the time it has been seen these conditions are conducive for the growth of microbes hence, accelerating the deterioration process. In addition to internal causes for the deterioration of paper in books, due to its acidity, external agents are also a major threat to manuscripts [11, 13].

MATERIALS AND METHODS

Isolation of aeromycoflora from the two different college libraries was carried out for every month from May 2010 to Oct 2010 by using the exposed culture plate method. The petridish culture plate method was used for determination of total number of colonies recorded in the entire sampling period. The sites were sampled every month with petriplates of 10cm diameter containing two different media viz; Czapek Dox Agar (CZA) and Potato Dextrose Agar (PDA) with dissolved streptomycin to exclude bacterial colonies. These petriplates were exposed for 10 min. and then incubated at 28 ± 1°C. for 4-5 days and were regularly examined. After few days the petriplates were observed for number and distribution of fungal colonies on agar plates and recorded in the notebook for total number of fungal colonies present. These fungal colonies were isolated and cultured on appropriate media for identification and further studies. For species identification, specimen microscopic slides were prepared using glycerin jelly as mounting media and lactophenol cotton blue as the standard stain. Record of temperature, humidity etc. were also maintained. The fungal species were identified using the available literature. Percentage frequency and percentage contribution of individual species were calculated as per the standard formula:

$$\% \ Frequency = \frac{No.of \ observations \ in \ which \ colony \ appear}{Total \ no.of \ observations \ recorded} \times 100$$

$$\% \ Contribution = \frac{Total \ no.of \ colonies \ of \ one \ species}{Total \ no.of \ colonies \ of \ all \ species} \times 100$$

Temperature (°C) and Relative Humidity (%) were recorded in the libraries during the sampling period using a Hygrometer. (Table- I)

RESULTS AND DISCUSSION

The present aeromycological investigation was undertaken to study the indoor aeromycoflora of two different libraries. The results of aeromycoflora during entire sampling period showed that the indoor library atmosphere was never free from fungal spores. A total of 10 types of fungal species were identified up to generic level some of them are identified up to species level and the rest which are not identified were grouped under unidentified fungal types (Table-II). The isolated and identified fungal species were *Aspergillus niger, A. flavus, A. fumigatus, Aspergillus spp., Alternaria alternata, Alternaria spp., Curvularia spp., Fusarium spp., Rhizopus spp., Penicillium spp., Chaetomium spp., Helminthosporium spp., Geotrichum spp., Drechslera spp.* The monthly variation pattern revealed that *Aspergillus spp.* were dominant in both the libraries during entire sampling period followed by *Alternaria spp., Penicillium spp., Curvularia spp., Rhizopus spp., Chaetomium spp.* etc. One of the reason might be because these spores have the capability to multiply faster than the rest. Along with the petriplates exposure method the fungi were also isolated from the books in libraries. Species of *Aspergillus, Penicillium, Alternaria, Chaetomium* and *Rhizopus* had contaminated the books. This further proves that the above mentioned fungi were prominently present both in the air as well as the books. During the six month survey, the total number of fungal colonies encountered was 259 and 296 from first (I) and second (II) library respectively and the fungal species which has not identified were grouped under unidentified fungi their number was about 86 and 103 from first (I) and second (II) library respectively. *Aspergillus fumigatus* and *Aspergillus niger* dominated the airspora and exhibited the highest concentration 33 and 58 from first (I) and second (II) library respectively. Maximum fungal species were found in the month of August(54), September(65), October(49) and August(53), September(66), October(57) from first (I) and second (II) library respectively and least in the months of May(23), July(24) and May(30), June(45), July(45) from first (I) and second (II) library respectively. Month wise trend of species richness is depicted in Figure 1. Among the various species encountered, *Aspergillus fumigatus* and *Aspergillus niger* was the principal fungi with a contribution of 12.74% and 19.59% of the total fungal flora in first (I) and second (II) library respectively which is followed by *Curvularia, Penicillium, Alternaria spp.* etc. (Figure 2)

Table I: Average temperature and relative humidity recorded from two libraries

Months	Temperature (°C)		Humidity (%)	
	I	II	I	II
May	40.3	39.8	38	40
June	33.3	32.6	68	72
July	31.8	27.4	77	86
August	33.1	30.9	72	76
September	32.1	32.1	67	65
October	30.4	28.6	75	78

I = B.D. College of Engineering, II = J.B. College of Science.

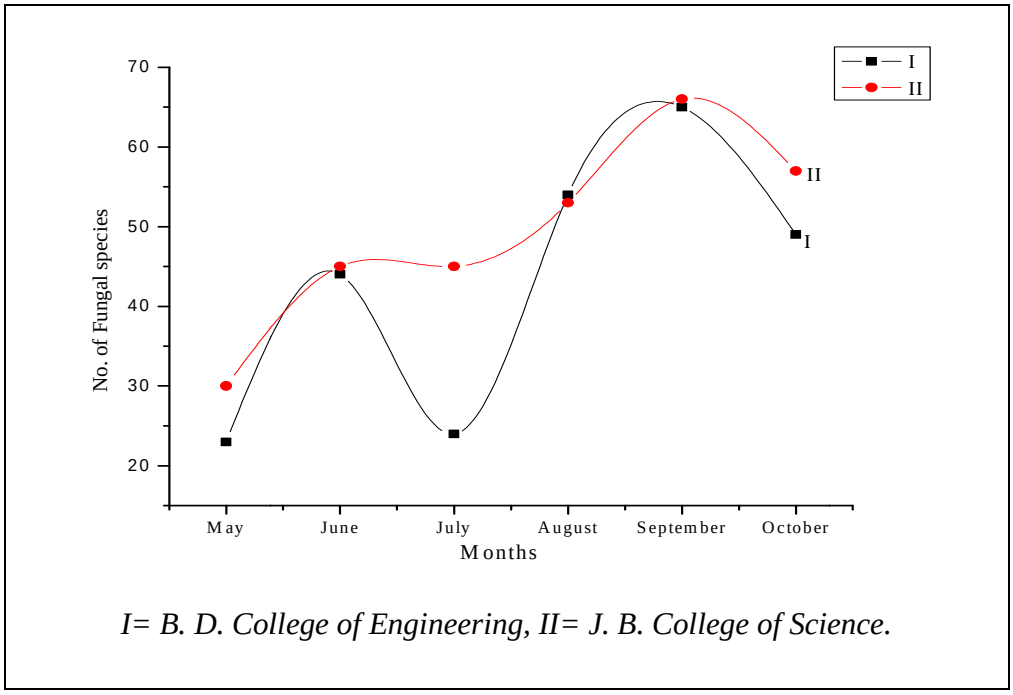
The awareness of microbial deterioration of library materials came only after Nineteenth century [14]. The first scientific study, which discusses microbial deterioration of papers, comes from

France, 1917 [15]. The history of insect cause deterioration of library materials exceeds 1000 years, while knowledge of microbial deterioration of library materials is only about 90 years old [11].

Table II: Monthly distribution, number of colonies, % frequency and % contribution of Aeromycoflora isolated from two different college libraries of Wardha City

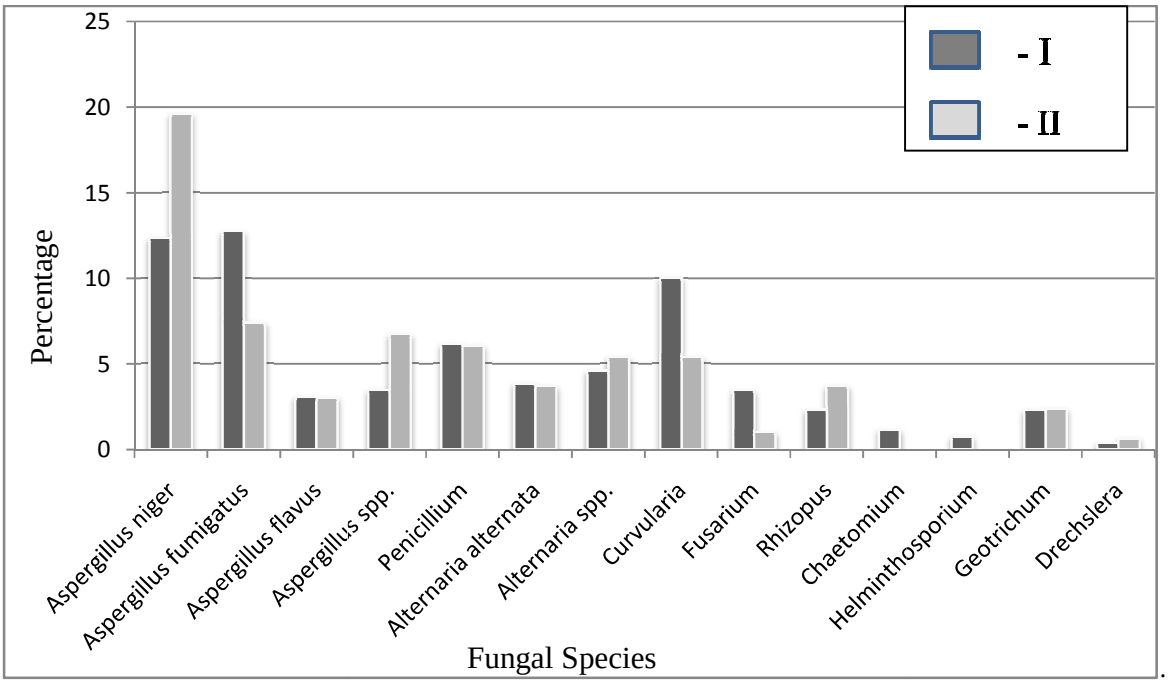
Fungal types	Libraries	Months						Fungal colonies	% Frequency	Total %
		May	Jun	Jul	Aug	Sep	Oct			
Aspergillus niger	I II	12 20	06 18	03 06	03 09	02 05	06 0	32 58	100.00 83.33	12.35 19.59
Aspergillus fumigatus	I II	03 04	0 0	06 12	09 0	12 0	03 06	33 22	66.66 33.33	12.74 7.43
Aspergillus flavus	I II	0 0	02 01	01 03	04 05	01 0	0 0	08 09	66.66 50.00	3.08 3.04
Aspergillus spp.	I II	01 0	0 0	0 0	01 03	02 09	05 08	09 20	66.66 50.00	3.47 6.75
Penicillium spp.	I II	0 0	09 03	0 0	02 06	04 06	01 03	16 18	66.66 66.66	6.17 6.08
Alternaria alternata	I II	0 02	03 0	0 0	0 0	03 03	04 06	10 11	50.00 50.00	3.86 3.71
Alternaria spp.	I II	0 0	06 0	0 03	0 0	03 04	03 09	12 16	50.00 50.00	4.63 5.40
Curvularia spp.	I II	0 0	0 0	0 01	06 03	15 09	05 03	26 16	50.00 66.66	10.03 5.40
Fusarium spp.	I II	0 0	0 0	0 0	0 0	03 03	06 0	09 03	33.33 16.66	3.47 1.01
Rhizopus spp.	I II	0 0	0 03	01 0	01 03	04 05	0 0	06 11	50.00 50.00	2.31 3.71
Chaetomium spp.	I II	0 0	0 0	0 0	03 0	0 0	0 0	03 0	16.66 00.00	1.15 0
Helminthosporium spp.	I II	0 0	0 0	0 0	0 0	02 0	0 0	02 0	16.66 00.00	0.77 0
Geotrichum spp.	I II	0 01	0 0	0 0	06 03	0 03	0 0	06 07	16.66 50.00	2.31 2.36
Drechslera spp.	I II	0 0	0 0	0 0	01 0	0 02	0 0	01 02	16.66 16.66	0.38 0.67
Unidentified Fungi	I II	07 03	18 20	13 20	18 21	14 17	16 22	86 103	100.00 100.00	33.20 34.79
Total	I II	23 30	44 45	24 45	54 53	65 66	49 57	259 296	--	--

I= B.D. College of Engineering, II= J.B. College of Science.



I= B. D. College of Engineering, II= J. B. College of Science.

Figure 1- Monthwise species richness



I= B.D. College of Engineering, II= J.B. College of Science.

Figure 2- Percentage contribution of Fungal species

CONCLUSION

Aspergillus spp., Curvularia spp., Penicillium spp., Rhizopus spp., and *Alternaria spp.* are the most frequently isolated fungi. These genera cause the decay of stored products in libraries. In this study we intended to survey the extent of fungal contamination of library materials as one of the main external factors that influences library material. The libraries under study are from the Wardha city which has a tropical climate. One of the basic aspect lacking is the monitoring and maintenance of temperature and humidity between 18 to 22°C. and 55% respectively. These conditions make the libraries very vulnerable to fungi and fungal spores which can thrive well. Since in our study, libraries also show a high prevalence of species of *Aspergillus, Cuvularia, Rhizopus, Penicillium and Aternaria*, their presence as contaminating agents on studied manuscripts, are not un-expected.

Among all different methods used for fungal isolation, maintained culture of isolated fungi was most sensitive than direct microscopic examination and was also more reliable than macroscopic inspection. So it could be recommended that culture should be used for routine inspections especially in libraries containing old and valuable archival materials. Bearing in mind that fungi have been isolated from a great number of books, activity of fungi and deterioration of manuscripts are a real hazard to library materials. For prevention of damage and preserving library collections, environmental conditions should be adjusted in a way that fungal growth dimishes [16]. The optimum temperature for this purpose should be between 18 to 22°C. and humidity should be adjusted below 55% [16]. Therefore, sanitary measures should be considered during the construction of library buildings in order to prevent exposure to fungi and to minimize fungal growth [16]. Along with these activities, various methods of disinfection such as chemical methods and radiation should be considered for elimination of contaminating fungi [17-19].

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REFERENCES

[1] T Sreeramulu and A Ramalingam, *Ind. J. Agric. Sci*., **1967**, 36, 112-132.
[2] ST Tilak and DB Vishwe, *Biovigyanam,* **1975**, 1, 187-190.
[3] ST Tilak and OJ Chakre, *IV Int.Conf.Palynol.1976-77.Lucknow*, **1978**, 181-182.
[4] M Babu, Aerobiological studies at Aurangabad, Ph. D. Thesis, Marathwada University Aurangabad, **1983.**
[5] ST Tilak and SG Pillai, *Ind.J.Aerobiol*, **1988,** 1(2), 92-94.
[6] A Sinha, MK Singh and R Kumar, *Ind.J.Aerobiol.Vol,* **1998**, 11(1and2), 19-23.
[7] KS Verma and Srivastava, *Advances in Pollen spore research.* **2004**, 22, 93-94.
[8] KL Tiwari, *Flora and fauna,* **2005**, 2, 195-196.
[9] Pillai, G Shanta, Patil, B Mukundraj, *Ind. J. aerobiol*, **2007**, 20 (I and II), 63-65.
[10] Patil, B Mukundraj, SA Kamble, Pillai, G Shanta, *Bionanofrontire. Science Day Special issue*, **2009**, 85-86.
[11] B Zyska, *Int. Bio-deterioration and Bio-degradation,* **1993**, 40, 43-51.

[12] S Madhavi, MV Rama Rao and K Jyothsna, *Scholars Research Library Journal, Annals of Biological Research*, **2011**, 2(3), 88-93.
[13] CJ Wessel, *I. Deterioration band Preservation of Library Materials*, The University of Chicago Press, Chicago, **1970**, 39-84.
[14] A Orlita, *Int. Bio-deterioration Bulletin*, **1977**, 13, 45-47.
[15] P See, *Int. Bio-deterioration and Bio-degradation*, **1919**, 40, 43-51.
[16] MLE Florian, *Leather Conservation News*, **1994**, 10, 1-28.
[17] MW Ballard and NS Baer, *Restaurato***, 1986,** 7, 143-68.
[18] JH Haines and AK Stuart *J. American Inst. Conserv*, **1986,** 25, 49-55.
[19] M Adamo, M Brizzi, G Magaudda and G Martinelli, *Restaurator*, **2001,** 22, 107-31.