

RESEARCH ARTICLE

Airspora of library in relation to biodeterioration of paper material

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ABSTRACT

Aerobiological investigation were carried out with the help of rotorod air sampler for a period of one year in the ambient air of library. Indoor environment of library comprising various type of air spora including fungi, bacteria, actinomycetes, protozoa and algae. The fungal spore in the atmosphere of library may come from outdoor environment through various sources and its concentration is less as compare to the outdoor environment and some of the fungal spores are supported to degrading the paper material and cause deterioration of paper. The predominant among cellulolytic mycoflora are *Aspergillus sp*, *Chaetomium sp*, *Alternaria sp*, *Cladosporium sp*, *Penicillium sp* and *Trichoderma sp*, etc. besides damage the paper material but also effect on the health of human beings in terms of allergy disorders to sensitive individuals. Fungi associated with books in library and their role in deterioration has been a subject of interest. Books in the library, especially the bound ones offer good substratum for microbial growth as binding glue, clothe covering and paper support the fungal growth to cause deterioration. The present study was carried out find out air borne fungal spores associated with cellulose degrading ability from the ambient air of library.

Keywords: Fungal spores, Cellulose degrading, biodeterioration.

INTRODUCTION

In the abient air of Library consist various types of fungal air spora including fungi, bacteria and actinomycetes which are responsible for biodeterioration of paper material. It has been well-established that biodeterioration of paper material by the activity of Microbes, resulting discoloration, staining and deterioration of valuables in taking place. The Microbial population is very much less inside the library than outdoor environment.

According to Gregory [1] the Microbial concentration of indoor varies greatly with physical and mechanical disturbances. Microbes

in the indoor environment of Library shows variation in quantitative and qualitatively in airspora as they may come from outdoor environment to indoor environment through ventilation, open windows, or originate within books and other paper material in the Library. The analysis of the composition of indoor air of Library, concentration of various types of bio deteriorating micro organizations are giving greater importance [2,3,4,5]. Books in the library especially the bound ones offer good substrate for microbial growth as the binding glue, cloth hemicellulose, pectin, waxes and tannins are support the fungal growth to cause deterioration of paper it easily vulnerable by fungi [4,5,6,7].

The present air spora studies in the Library were carried out to preserve this precious heritage for coming generation. It is extremely essential to work out the fungal flora inside library and their role I deterioration of books and take necessary steps to reduce the losses caused by bio deteriorogens. Knowledge of Aerobiology helps to trace out the organism involved in the process of bio deterioration. Hence, to determine air content of indoor environment of library and their role in bio deterioration of paper material.

In India Vittal and Glory [8] and others reported the role of fungi in deterioration of paper material.

METHODOLOGY

Aerobiological investigations were carried out inside the Ram Manohar Lohiya library building Nanded by operating Rotorod air sampler of Perkins (1957) [9] modified by Harrington [10], This is suitable for short period sampling up to 2 hours. The sampling was carried out for the period of one year, twice in a day in the morning 9.00 Am to 9.30Am and 5.00 Pm to 5.30 Pm in evening. (From 15th March 2011 to 14th March 2012). Air sampler installed in the center of library building equal distance from all section. Library consist of reference section, binding section and book issue section in the hall with a partially closed portion but free air circulate in all sections easily. The slides were prepared and scanned as per the criteria described by earlier workers Tilak and Srinivasulu [11]. Identification of spores type were made on the basis of fungal collection from affected books, comparison with standard slides and photographs, reference books, characteristics and by visual identification. The meteorological parameters

were recorded throughout the period of investigations to correlate with incidence of fungal spores.

RESULTS

The fungal air spora in the ambient air of library revealing 51 spore types out of them 23 spores were suspected to be deteriorating activity. Their percentage contribution was 70.71% to the total airspora. It was observed *Cladosporium* (28.02%) was predominantly in the air content of inside library followed by *Aspergillus* (23.01%), *Penicillium* (0.43%), *Alternaria* (2.01%) *Rhizopus* (0.84%), *Chaetomium*(3.2%), *Trichoderma* (1.2%).These are all proved to be Biodeteriogens. Whereas some fungi Like *Trichothecium* (0.62%) *Humicola* at (0.05%), *Torula* (0.49%), are frequently reported are less number in the air.

Table 1: Percentage contribution of cellulolytic fungi to the total airspora inside the library
(From 15th March, 2011 to 14th March 2012)

S. N.	Spore Type	Percentage contribution of each spore to the total airspora
1.	<i>Alternaria</i>	2.01
2.	<i>Aspergillus</i>	23.01
3.	<i>Botrydiplochia</i>	0.71
4.	<i>Cephalophora</i>	0.32
5.	<i>Cercospora</i>	0.71
6.	<i>Chaetomium</i>	03.2
7.	<i>Cladosporium</i>	28.02
8.	<i>Curvularia</i>	0.62
9.	<i>Didymobotrium</i>	0.71
10.	<i>Drechslera</i>	0.46
11.	<i>Epicoccum</i>	0.24
12.	<i>Fusarium</i>	0.22
13.	<i>Helminthosporium</i>	1.02
14.	<i>Humicola</i>	0.5
15.	<i>Nigrospora</i>	0.31
16.	<i>Phoma</i>	0.43
17.	<i>Penicillium</i>	04.30
18.	<i>Periconia</i>	0.42
19.	<i>Pithomyces</i>	0.26
20.	<i>Rhizopus</i>	0.84
21.	<i>Torula</i>	0.49
22.	<i>Trichothecium</i>	0.62
23.	<i>Trichoderma</i>	01.2
	TOTAL	70.71

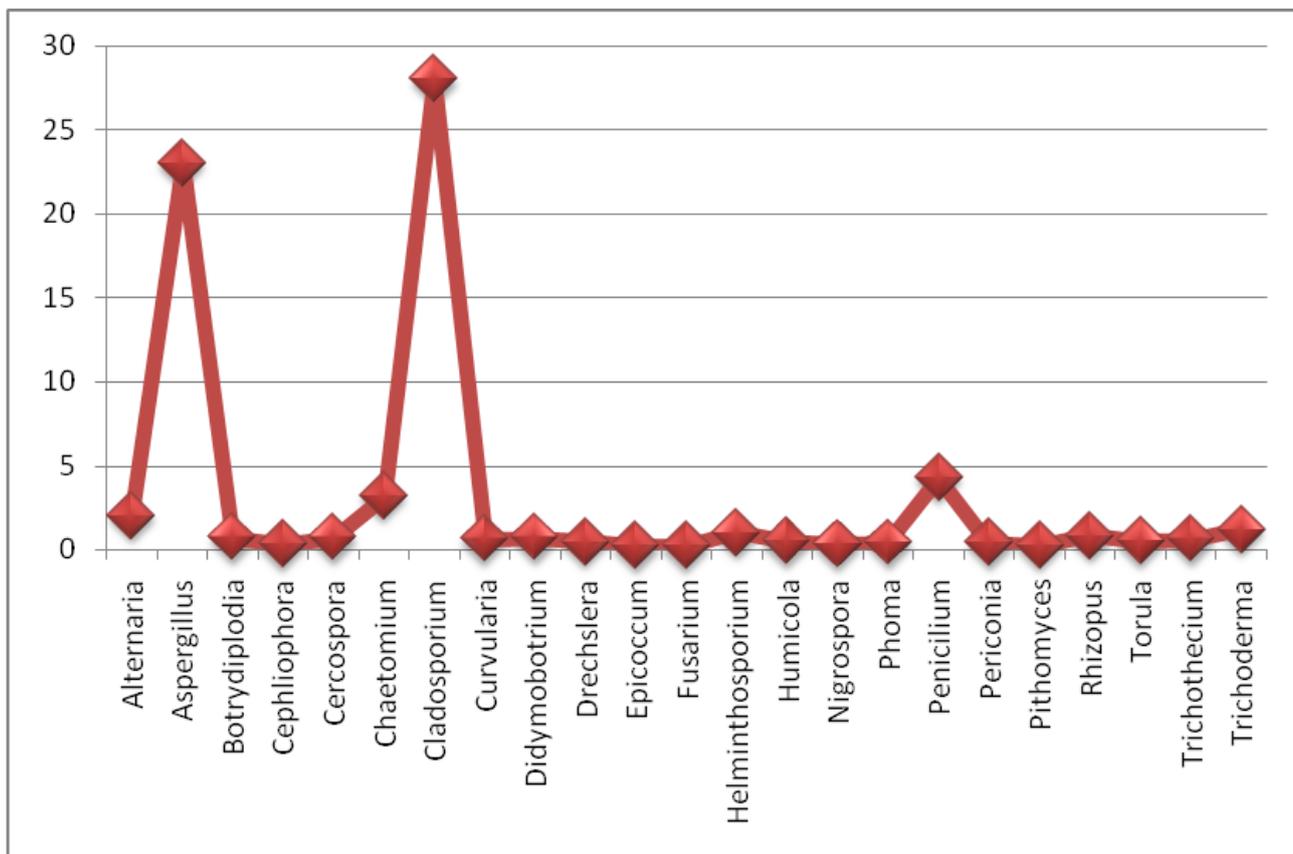


Fig.1: Name of the Cellulolytic Fungi Responsible for Biodeterioration of paper

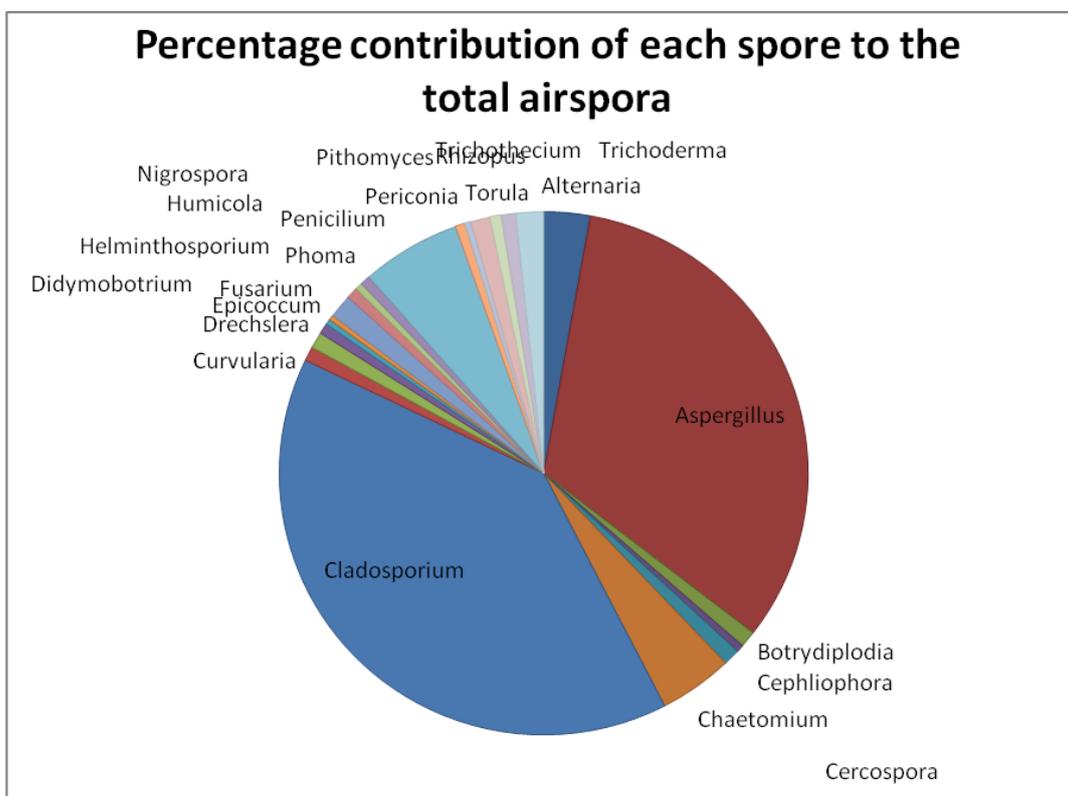


Fig. 2: Incidence of total Fungal spores inside library

In the present study species of *Cladosporium*, *Aspergillus*, *Penicillium* were dominant and frequently recorded among the fungal airspora of library environment. The results are agreed with the findings of earlier workers Vittal and Glory, Agashe and Anuradha [12], Tripathi [13], Tilak and Pillai [14]. Microbes in the air within any single building at any one time depend in the number and kinds of organisms present and the mechanical movements within the closed space. The fungi found in the Library air are primarily in the form of spores and derived from the books where they exist in actively growing condition regarding the deterioration it can be stated that cellulose deterioration does not occur unless certain requirements are fulfilled. The environmental conditions must be favorable for active invasion of the material by the fungi. Cellulolytic fungi are most common organisms responsible for the deterioration of manuscripts, books, papers, journals, periodicals etc., were attacked by several fungi which are air borne fragments of various colors. Nyuksha [15] reported pigments of fungi growing on paper can be seen in between pages of old books. Cellulose is one of the major constituents of which is utilized as a nutrient by many fungi but not all. Cellulolytic fungi have the ability to attack cellulose which is then broken down into glucose molecules and utilized. The articles such as wood craft, papers, fabrics etc., are derived from plant sources made up of cellulose.

The factors responsible for growth and activity of cellulolytic fungi are season weather, human activity and maintenance influence the dispersal of fungi. High humidity encourages the growth and deterioration.

The results obtained in present survey shown a close relation between spore concentration and relative humidity. Solman [16] reported *Penicillium* and *Aspergillus* predominated in indoor during winter. The results agree with these findings, because highest spore catch of *Aspergillus*, *clodosporium* and *Penicillium* found in the month of November with (1050/ m³ of air) (735/ m³ of air) and (680/ m³ of air) to the total air spora respectively. *Aspergillus*, *niger* growth was observed on paper. It was observed *Chaetomium* represented by (3.02%) is known to be colonizer of paper. The cellulose degrading fungi *Trichoderma* (01.2%) has been reported was found to be common on books. The fungal spores cause deterioration of paper material and reduce life of books but also responsible for allergy in sensitive individuals of both users and library workers. In order

to reduce the possible effect of fungi in the indoor environment of library necessary steps such as regular de-dusting of books, cleaning of book racks and floor by employing vacuum cleaner should be under taken, proper ventilation, cleaning and air conditioning will also help in reduce the spore load of fungi. In addition to above measures apply suitable microbiotoxicant low toxic to human and environment and fumigation with ethylene oxide seems to be more suitable [17]. Ultraviolet radiation can be used in the libraries to keep material free from those microorganisms.

The present airspora studies in the library have contributed in understanding the components of the airspora and their co relation with the weather changes and routine activities in the library. The results obtained and the conclusion drawn would serve further as the useful basis of devising a remedial system for the efficient control deterioration and restoration of books and manuscript.

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