FUNGAL BIODETERIORATION: A CASE STUDY IN THE ZOOLOGICAL MUSEUM OF THE PUNJAB UNIVERSITY

A. Shabbir, M. A Khan*, A.M. Khan*, M. Iqbal* and F. Ahmad

Department of Mycology and Plant Pathology, University of the Punjab, Lahore 54590 Pakistan
*Department of Zoology, University of the Punjab, Lahore 54590 Pakistan

ABSTRACT

The paper deals with occurrence of fungal deteriogens in indoor air and selected skeletons of pangolin, giraffe and demoiselle crane in zoological museum of Punjab University Lahore. A total of 9 fungal species belonging to 8 different genera were isolated from indoor environment of museum during March-April 2007. *Aspergillus niger* appeared to be the most dominant fungus of indoor environment of the museum with maximum number of colonies on PDA medium. Three species of *Aspergillus* and one species of *Alternaria* were found associated with open skeleton of giraffe. White fluffy mass of fungal groth was even obvious on skeleton joints. Maximum number of fungi (6) was isolated from skeleton of pangolin. Percentage of occurrence of *A. niger* colonies was the highest (40%) on Demoiselle crane after *A. flavus* from giraffe.

Keywords: Biodeterioration, Zoological Museum, Fungi, Punjab University.

INTRODUCTION

The primary goal of museum object conservation is to preserve whatever still exists of the object as nearly as possible in an unchanging stage (Ward, 1986). The preservation and continued use of a museum collection and its associated data depend on an ongoing conservation project. The preventive conservation emphasizes non interventive actions to prevent damage to and minimize deterioration of a museum object. Conservation of a museum object is a shared role between the curator and the conservator. Mutual understanding and respect for each others role and responsibilities to the collection are important. It is the primary responsibility of curator to monitor and assess the condition of the objects (Knapp, 1993). Safety measures and disaster management is very important for the existing museum like in case of our museum. Despite the fact we have comparatively small museum having round about 3000 specimens installed in a single room but all of the present specimens are deteriorating verge owing to lack of proper safety measures. These specimens mostly have been placed in the Zoological Museum since 1963. Biodeteriogens like fungi, bacteria and actinomycetes pose severe threat to museum objects. Microbes get entry into indoor atmosphere through wind currents and settle on various objects. Fungi are major group of biodeteriogens and are responsible for deterioration of various objects including museum items (Diakumaku *et al.* 1995; Bajwa *et al.* 1995). Most of the museum skeletons are infested with fungus due to humidity and the museum stuffed materials (birds and mammals) are also attacked by beetles and other pests for not maintaining properly room isolation system. Mould specimens are going to lose their original structure due to overheating in the Museum. The first step to prevent the infested museum specimens has been taken and studied three most infested specimens to find the infested fungus. Having diagnosed the fungal biodeterioration we will be able to prepare and perform suitable treatment for the museum.

MATERIALS AND METHODS

Analysis of indoor air in the Zoological Museum of Punjab University was done from March-April 2007, using the culture plate exposure method (Gregory, 1973). Three petri dishes (100 mm diameter each) were exposed for 2 min in the indoor environment of museum. These were incubated at 25 $\pm$ 1°C for 7 days. As soon as the fungal growth appeared, sub-culturing was done. Pure cultures were maintained on PDA (Potato Dextrose Agar) and MEA (Malt Extract Agar) media. Tape method was also tried to isolate the fungal biodeteriogens. Three specimens; one bird and two large animals' skeletons were selected on the basis of their deteriorating condition. Sampling material was scratched with the help of sterilized scalpel and attached with the stitching tape from fragile parts of the skeleton. Two broad spectrum fungal media *i.e.*, PDA and MEA were employed for fungal isolation.

RESULTS AND DISCUSSION

Nine species of fungi belonging to 8 genera were isolated from indoor environment of zoological

museum of Punjab University Lahore (Table-9). Isolation from exposed Petri plates resulted in 2 species of *Aspergillus* spp. And one each of *Mucor hemalis, Rhizopus stolonifer, Aspergillus niger, A. flavus, Penicilium* sp., *Alterneria alternata, Cladosporum herbarum, Phoma* sp. and *Monilia* sp. *spergillus niger* was ranked as the most prevalent species significantly with greater percentage of occurrence with a colony count of 23.8% followed by *Rhizopus stolonifer* (16.6%) and *Mucor hemalis* (11.9%). The less common species were *A. flavus* (9.5%), *Alterneria Alternata* (9.5%), *Monilia* sp. (9.5%), *Penicillium* sp. (7.1%), *Phoma* sp. (7.1%) and *Cladosporium herbarum* (2.1%). An earlier study revealed 22 species of fungi belonging to 12 different genera in Barado museum, San Francesco, America (Shah, 1993). The species of *Asperglus* and *alterneria* were major air bond decay agent observed in previous studies. (Gaur, 1980; Nayyera, 1971; Shah, 1995).

Table 1. Indoor aeromycoflora of Zoological Museum of Punjab University during February-March 2007. Data represent the total number of colonies that appeared on 3 PDA plates after 7 days of incubation.

Fungi isolated	Colonies	Percentage occurrence
Mucor hiemalis	5	11.9
Rhizopus stolonifer	7	16.6
Aspergillus flavus	4	9.5
A. niger	11	23.8
Penicillium Spp.	3	7.1
Alternaria alternata	4	9.5
Cladosporium herbarum	1	2.3
Monilia situphila	4	9.5
Phoma Sp.	3	7.1
Total no. of fungal colonies	42	

Table 2: Percentage occurrence of different fungi isolated from skeleton of Giraffe. Data represent the total number of colonies that appeared on 3 PDA plates after 7 days of incubation with 40% of occurrence.

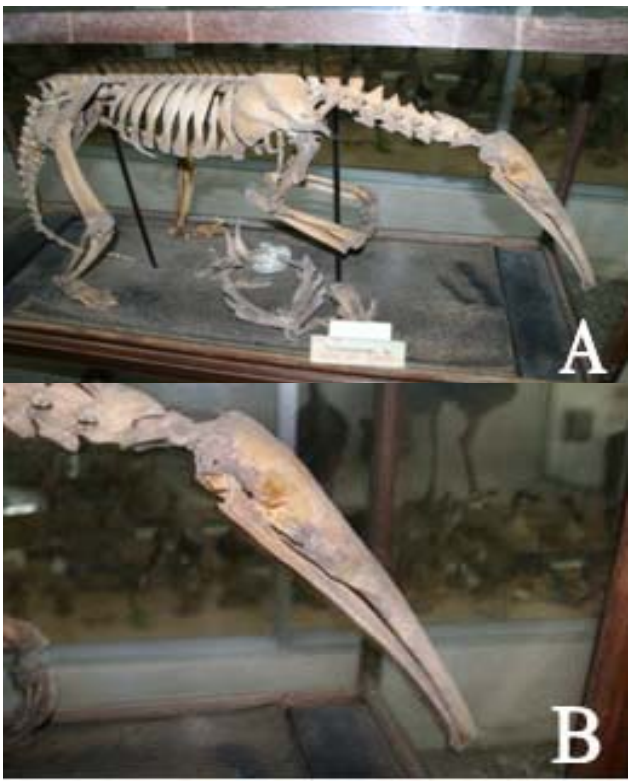
Giraffe		
Fungi isolated	**Colonies**	**Percentage occurrence**
Aspergillus fumigatus	5	50
A. flavus	1	10
A. niger	2	20
Alternaria alternata	2	20
Total no. of fungal colonies	10	

Presence of 3 species of *Aspergillus* and 1 of *Alterneria* was recorded in sampling done on skeleton of Giraffe (Table 2). *Aspergillus flavus* was the most prevalent fungus recorded with total colony count of 50%. Fungi that can grow on suitable substrata play a prominent role in biodeterioration of museum materials (Nair, 1972).

Table 3: Percentage occurrence of different fungi isolated from skeleton of pangolin and demoiselle crane on 2nd March 2007. Data represent the total number of colonies that appeared on 3 PDA plates after 7 days of incubation.

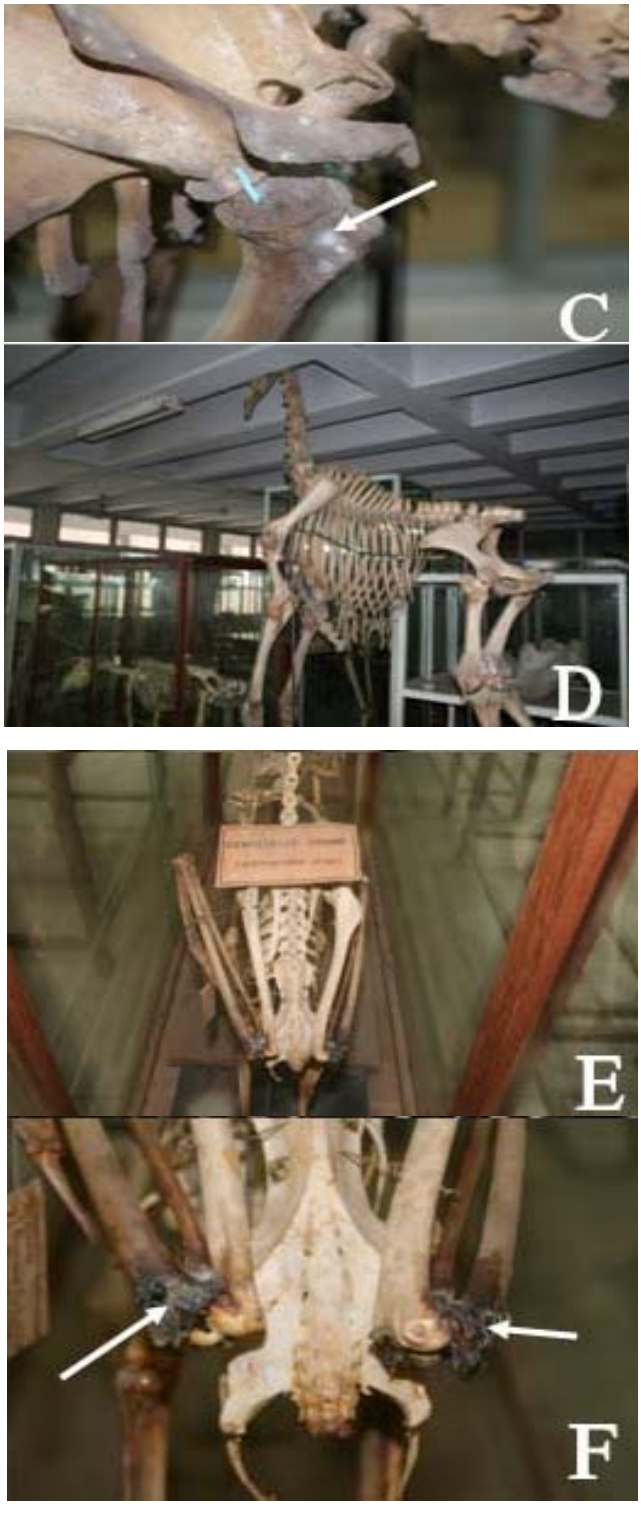
	Pangolin		Demoiselle crane	
Fungi isolated	**Colonies**	**%age occur.**	**Colonies**	**%age occur.**
Rhizopus stolonifer	1	7.1	-	-
Aspergillus flavus	3	21.4	4	26.6
A. niger	2	14.2	6	40
A. fumigatus	5	35.7	2	13.3
Penicillium Spp.	2	14.2	3	20
Alternaria alternata	1	7.1	-	-
Total no. of fungal colonies	14		15	

Fig.1: (A-F): Skeleton of Pangolin in wooden frame (A),



close view of skull (B), Close view of Pectoral girdle showing white mass of fungal growth (C), Skeleton of giraffe without case (D), Skeleton of Demoiselle Crane

(E) and Closer view showing discolouration due to biodeteriogens (F).



Isolation made from the skeleton of pangolin revealed the dominance of *Aspergillus fumigatus*. Other aspergilli included were *A. niger* and *A. flavus.* Fungal flora of demoiselle crane showed the presence of 4 different genera. It was further evident that number of fungi isolated from this skeleton was the least but the maximum in term of number of colonies (Table 3). Other fungi associated with this bird's skeleton were *Penicillium* sp., *Aspergillus flavus* and *Alterneria alternata*. Species of *Aspergillus* and *Alternaria* may be considered as the most common and serious deteriogen as some of their species can survive for 20-30 years. The present study indicates that large numbers of fungi are associated with the Zoological Museum of the Punjab University and there is a need to start a control measures to save this important asset of this old institute.

Acknowledgements: The authors are thankful to Mr. Ehsan Zaidi for formatting this manuscript.

REFERENCES

Bajwa, R., S. Mahmood, J. Z. Naz, (1995). Fungi associated with biodeterioration of building material of Lahore. Biota (1&2): 7-12.

Diakumaku, E, A. A. Gorbushina, W. E. Krumbein, (1995). Black fungi in marble and limestone on aesthetical, chemical and physical problem for conservation of movements. Sci. of Total Environ. 295-304.

Gaur, R., (1980). Aeromycoflora of Merrut II. Fungal spores. J. Palynol., 16: 131-138.

Gregory, P., (1973). The Microbiology of the Atmosphere, Leonord Hill Books, Aylesbury, England, 1973, 2nd edn, p. 377.

Knapp, A. M., (1993). Conserve O Gram. Curatorial Service Division National Park Service Washington, 20013-7127.

Nair, S., (1972). In Biodeterioration of Materials (eds Walters, A. H. and Plas, E. H. H.), Applied Science, London, 2: 401–421.

Nayyera, T., (1971). Hyphomycetes from the air over Lahore. M.Sc thesis, Punjab University Lahore.

Shah, P.A., (1993). Observations on a species of *Sorosporella* (*Deuteromycotina*: *Hyphomycetes*) infecting *Kraussaria angulifera* Krauss (Orthoptera: Acrididae) in the Republic of Mali. *J. Invertebrate Path.* 62 (3): 318.

Shah, M., (1995). Seasonal variation in air mycoflora of commercialized and highly populated areas. Pakistan. J. Pl. Sci., 3(1): 17-24.

Ward, P., (1986). The Nature of Conservation, A Race Against Time. The J. Paul Getty Institute, Santa Monica, Canada.