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Assessing Dust for Potential Pathogenic Fungi in Office Floors

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Abstract
Dust formation occurs as a result of separating lighter particles from the heavier ones by means of an upward directed stream of airborne organic and inorganic particulate matter that originates from a multiplicity of indoor and outdoor sources. The aim of this study was to determine the types of potential pathogenic fungi in dust in office floors. Dust samples were obtained from forty offices in three Departments and the College Administrative block. The samples were obtained from carpeted and uncarpeted offices. One gram of each sample was weighed and suspended in 10ml of sterile distilled water. One ml of the 1 in 10 diluted samples was inoculated onto Sabouraud dextrose agar with and without chloramphenicol and incubated at 37^0C at room temperature for seven days. The plates were examined every other day for 7 days. Identification was based on macroscopic and microscopic morphology and physiological tests. Out of the 40 samples collected in this study, 37(92.5%) harboured potential pathogenic fungal agents. *Aspergillus* species was the most encountered isolates 35(87.5%) while *Rhizopus* species was the least encountered 2(5.0%) isolate. Most of the *Aspergillus* species 23/35(65.7%) were from tiled floors while *Rhizopus* species 2(100%) were isolated from carpeted floors only. There was significant association between floor types and isolate distribution. Fungi were isolated from most of the locations in the study. There was no significant association between sample locations and isolates distribution ($\chi^2 = 4.0$, p = 0.13). The dust samples from the offices harboured fungal species which are potential opportunistic mycosis agents.

Key words: Fungi, dust, office floors, microbial dispersal

Introduction

All around the world, life style changes have resulted in a shift from open air environment to air tight, energy efficient environments at home and work places, where people spend a substantial portion of their time (Molhave, 2011; Chao *et al*., 2003). Dust formation occurs as a result of separating lighter particles from the heavier ones by means of an upward directed stream of airborne organic and inorganic particulate matter that originate from a multiplicity of indoor and outdoor sources. Conditions such as; increasing air humidity, decreased ventilation and increased moisture level leads to the proliferation of fungi (Ruest, 2004). These fungal elements may cause severe illness as a result of indoor mould exposure including pulmonary, immunologic, neurologic and oncologic disorders (Kuhn and Ghannoum, 2003).

Dust formation occurs as a result of the ongoing elutriation of airborne organic and inorganic particulate matter that originates from a multiplicity of indoors and outdoors sources. In recent years, the quality of indoor air has been the subject of several studies. Conditions such as, increasing air humidity, decreased ventilation and increased moisture level subsequently increase the proliferation of fungi and bacteria (Ruest, 2004). These fungal elements may cause severe illness such as; pulmonary, immunologic, neurologic and oncologic disorder through exposure to indoor moulds (Kuhn and Ghannoun, 2003).

The origin of fungi in the floor and surface dust of buildings include deposition of species that originated from outdoor air, microbiota shed from humans, pets, pests, growth on materials and tracked in soil (Adams, 2013; Dunn, 2013; Hospodsky *et al*., 2012). It remains unclear whether floor dust acts simply as a fungal depository of these sources, or if a functioning microbial ecology exist.

The water activity of the substrate controls fungal growth. Water activity is the ratio of the vapor pressure of water in the substrate to the vapor pressure of free water (Flannigan, 1993; Miller, 1992). Optimal water activity for fungal growth ranges from 0.65 to 0.99. Because each fungus has its own optimal water activity, the type of fungi found in building materials depends on the moisture content and composition of the materials. Household dust is a useful tool for the assessment of air quality in indoor environments (Li *et al*., 2010). The aim of this study was to determine the profile of potential pathogenic fungi in various office floors in the College of Medical Sciences.

Materials and methods

The study was a cross-sectional study which ran for 7 months, between May to December, 2019. Samples of office dust were obtained from carpeted and tiled offices. A total of forty offices were sampled in the College of Medical Sciences, University of Calabar, Nigeria. Samples were collected using new carpet brush and new plastic collector which were surface sterilized before each collection by washing with 70%v/v ethanol. Each dust sample was collected into a new sterile dispensing envelope and appropriately labeled. A square meter of the carpeted and uncarpeted floors was sampled by brushing in multiple directions such that the available dust could be practically collected. The samples were transported to the Laboratory for analysis.

Culture

One gram of each sample was weighed and suspended in 10ml of sterile distilled water. From the above suspension, 1ml was then diluted to 10^{1}. Then, 1ml of the diluted sample was inoculated onto Sabouraud Dextrose agar with and without chloramphenicol ($16\mu gml^{-1}$) in duplicates, incubated at room temperature at 37^{0}C for one week. Cultures were examined every other day for growth up to 4 weeks before discarding as negative (Hass et al., 2010).

Pure cultures of every isolate were prepared before performing any physiological test. This was done by sub-culturing individual isolates onto fresh SDA plates and incubating at room temperature (25-28°C) for 3 to 7 days. Fungal isolates were identified by colonial morphology, lactophenol cotton blue preparation and Riddle's slide culture (Ogba *et al*., 2016; Procop and Robert, 1998).

Data analysis

Data obtained from the study was analyzed using the statistical package for social sciences (SPSS) 20.0. Descriptive statistics was carried out. The frequency was calculated for categorical variables and interaction between specific categorical variables was tested for significance using the Chi square. A p-value of ≤ 0.05 was considered statistically significant.

Results

Table 1 shows the number of samples collected per sample site. Thirty percent of the samples were obtained from Old College block, while 15.0% of the samples were obtained from the College Administrative block. Table 2 shows the distribution of fungal types in the sample sites. Only two fungal species were isolated in the study. *Aspergillus* species was more prevalent (94.6%) than *Rhizopus* species *(*5.4%). Table 3 shows the types of fungal isolates by sample location. Out of the 35 *Aspergillus* species isolated, (31.4%) were from Biochemistry Department followed by 25.7% in Physiology and Anatomy Departments respectively. The least number of isolates were from College Administrative block 17.1%. There was no significant association between sample locations and isolates distribution ($\chi^2 = 4.0$, $p = 0.13$). Table 4 shows the distribution of isolates by floor type. Out of the 40 offices sampled, 8 floors had rug carpet while 32 floors were tiled. Most of the *Aspergillus* species 23/35(65.7%) were from tiled floors while *Rhizopus* species 2(100%) were isolated from carpeted floors only. There was significant association between floor types and isolate distribution.

Table 1: Sample sites and number of samples collected

Sample sites	No. (%) of samples collected per site
Physiology Department	12(30.0)
Anatomy Department	11(27.5)
Biochemistry Department	11(27.5)
College Admin. Block	6(15.0)
Total	40

Table 2 Distribution of fungal types in the study

Types of isolates	No. (%) of isolates
Aspergillus species	35(94.6)
Rhizopus species	2(5.4)
Total	37

Table 3 Distribution of fungal types by sample locations

Sample sites	No. (%) of *Aspergillus* species	No. (%) of *Rhizopus* species	Total	Statistics
Physiology Dept.	9(27.5)	1(50.0)	10	
Anatomy Dept.	9(27.5)	1(50.0)	10	$\chi^2 = 4.0$
Biochemistry Dept.	11(31.4)	0(0.0)	11	$p = 0.13$
College Admin Block	6(17.1)	0(0.0	6	
Total	35(94.6)	2(5.4)	37	

Table 4 Distribution of fungal isolates by floor types

Floor types	No. (%) of *Aspergillus* species	No. (%) of *Rhizopus* species	Total	Statistics
Carpeted floor (n = 8)	12(34.2)	2(100)	14(37.8)	
Tiled floor (n = 32)	23(65.7)	0(0.0)	23(62.2)	$\chi^2 = 8.6$ $p = 0.05$
Total	35(94.6)	2(5.4)	37(92.5)	

Discussion

The study aimed to isolate pathogenic fungi in household dust. This study recorded a fungal prevalence of 92.5% in the various locations. This finding is lower than the 100% prevalence reported by Abu-Saeed *et al.* (2012) from offices, hostels and Laboratories in Usmanu Danfodio University, Sokoto, Nigeria. However, the 92.5% prevalence was higher than the 14.0% reported by Barberan *et al.* (2015) in Eastern USA.

Aspergillus species was the most encountered isolate (94.6%) in this study. This is similar to the work of Abu-Saeed *et al.* (2012) who reported 100% *Aspergillus* species. *Rhizopus* species 2(5.4%) was the least encountered isolate in this study. The 5.4% in this study differ from the 50% prevalence for *Rhizopus* species by Abu-Saeed and Colleagues (2012). This may be due to the various locations sampled. In this study only offices were sampled while Abu-Saeed and Colleagues sampled offices, hostels and Laboratories.

Fungi were isolated from most of the locations in the study. There was no significant association between sample locations and isolates distribution ($\chi^2 = 4.0$, $p = 0.13$). This depicts that fungi are ubiquitous in nature.

Although the number of carpeted floors sampled was 8/40(20.0%), isolates from carpeted floors seem to be higher 14(37.8%) than those from tiled floors 23(62.2%). *Rhizopus* species was only isolated from carpeted floors. This may be due to the fact that *Rhizopus* species requires high moisture conditions for growth (Bullerman, 2003). The tiled floors could have lacked moisture and as such unable to provide suitable environment for *Rhizopus* species.

Conclusion

The dust samples from the offices harboured fungal species which are potential opportunistic mycosis agents.

Recommendation

There is need to completely remove rug carpets from office floors and also improve on the sanitation of office floors and the environs. This will reduce the occurrence of potential fungal pathogens and in turn break transmission of the fungi.

Conflict of interest declaration

None declared

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