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RESEARCH ARTICLE

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Fungi associated with carpets and floor dust samples as an indicator for indoor air quality

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ABSTRACT

This research was conducted to isolate fungi from carpets and floor dust samples as an indicator of indoor air quality. Dust samples from offices, laboratories and common rooms of Usmanu Danfodio University were collected by use of sterile plastic container and analysed. The fungi isolated includes Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus, Mucor racemosus, Mucor hiematis ,Rhizopus stolonifer ,Scopulariopsis spp ,Trichoderma spp and Wallemia spp. with Aspergillus niger having the highest percentage frequency of occurrence(100%) while Aspergillus ustus had the least percentage frequency of occurrence(8.3%). However, The total mean fungal concentration count was $1.39x10^{2}$cfu/g with a standard deviation of $6.78x10^{1}$cfu/g. Conclusively, fungi are present in dust samples and they include both pathogenic and saprophytic species. Thus attention should be given to indoor air quality by improvement in hygienic practices.

Keywords: Fungi, Floor dust, Percentage frequency, Indoor air quality.

INTRODUCTION

Indoor air is made up of numerous airborne particles including molds, bacteria allergens and dusts. In a typical indoor environments such as Home, School and Workplace. The particle level are mostly influenced by the occupant activities, internal maintenance practices, quality of the interior maintenance and external air that is brought into the facility by the ventilation system [6].

Molds are form of fungi that can be found indoors and outdoors. They are brought indoors through shoes clothes, pets, and the outside air [6]. Thus, a few dozen to several hundreds fungal spores per cubic meter can be found indoors mostly comprising of mold spores and various allergens in carpet dust, furnishings and flooring. This could frequently trigger asthma and other respiratory problems in man as a result of airborne exposure to the host [1]. However, it is important to note that growth of fungi and other microorganism cannot occur in carpet or on any other surface without nutrient source and water which might be caused as a result of flooding, roof leak, plumbing leaks, damp basement or moisture condensation on cold surfaces . With the presence of this factor, their growth is encouraged and they become a problem. These common sources of indoor moisture causes the fungal growth[1].

Studies of indoor air quality is a fairly new scientific discipline and the impact of interior particulate levels is now been researched. Some researchers believe that interior furnishings may play a role in these airborne particles. Although, porous surfaces on carpets have also been examined as a possible source for the introduction of indoor particles that affects the environmental condition [6].

A reasonable goal in this research is to identify fungi associated with the floor dust so as not to allow indoor growth of these organisms especially in the environment occupied by people with respiratory problems such as asthma, pneumonia, other related airborne health problems and healthy individuals.

MATERIALS AND METHODS

Sample Collection

Dust samples were obtained from six(6) carpeted old buildings, two(2) carpeted new buildings, two(2) uncarpeted new building and two(2) uncarpeted old buildings in Usmanu Danfodio University Sokoto and analysed. A square meter of each carpet or floor samples was surface sampled by brushing in multiple directions into a sterile polythene bags by use of new brush and was appropriately labeled.

Sample Processing and Analysis

Dust samples were weighed(1 gm) and suspended in a sterile distilled water.1ml from the above suspension was then diluted tenfold(10^1) and 1ml of the diluted sample was inoculated into Potato Dextrose Agar with a pipette and incubated at room temperature for 7-14 days[4].

Identification of Samples

The macroscopic identification of fungi was carried out to check for the colour and its appearances while the microscopic examination was carried out by taking a portion of the culture and fixing it on a clean glass slide and a drop of lacto phenol cotton blue was added using a sterile inoculating needle and covered with a clean coverslip.It was viewed under the microscope using x10 and x40 objectives. Identification was based on colonial and cellular morphology of the fungi as they appear in the mycology atlas for identification[4].

RESULTS

Table 1: Mean fungal colony count from the Floor Dust Samples at Specific Sites

Sample Sites	Designation	Fungal load (cfu/g)
1	H.O.D Microbiology Office	1.5×10^2
2	H.O.U Zoology Office	8.0×10^1
3	H.O.U Botany Office	9.5×10^1
4	Dean of Science Office	5.5×10^1
5	Computer Room Bursary Department	1.6×10^2
6	I.B.B Centre, Common Room	1.8×10^2
7	Dean of PG School's Office	1.1×10^2
8	Deputy Dean of PG School's Office	1.0×10^2
9	MCB (300 level) Laboratory	2.7×10^2
10	MCB (400 level) Laboratory	1.2×10^2
11	New Male Hostel Common Room 1	8.5×10^1
12	New Male Hostel Common Room 2	2.6×10^2
Total Colony Count		1.67×10^3
Average Colony Count		1.39×10^2
Standard deviation		6.78×10^1

Key : H.O.D= Head of Department, H.O.U = Head of Unit, IBB= Ibrahim Badamasi Babangida, PG= Post Graduate, MCB = Microbiology.

Table 2: Percentage frequency of occurrence of the fungal isolates at the sample sites

Fungi Identified	Total number of Sample sites	Number of sites present	% frequency of occurrence
Aspergillus niger	12	12	100
Aspergillus flavus	12	11	91.7
Aspergillus fumigatus	12	4	33.3
Aspergillus ustus	12	1	8.3
Mucor racemosus	12	8	66.7
Mucor hiemalis	12	2	16.7
Rhizopus stolonifer	12	5	41.7
Scopuloriopsis spp	12	1	8.3
Wallemia spp	12	3	25
Trichoderma spp	12	3	25

Table 3: Characteristics of Sample Sites and its degree of fungal Contamination

Sample Sites	Characteristics	Fungi Isolated	Degree of Contamination(%)
i	Old Building Carpeted	*A.niger, A.flavus*	20
ii	Old building Carpeted	*A.niger, A.flavus, A.fumigatus*	30
iii	Old Building Carpeted	*A. niger, A.flavus, M.racemosus*	30
iv	Old Building Carpeted	*A. niger, A.fumigatus,M.racemosus R. stolonifer*	40
v	Old Building Carpeted	*Wallemia* spp, *M. hiemalis, A.niger A.flavus*	40
vi	Old Building Carpeted	*A.niger, A.flavus, A. ustus*	30
vii	New Building Carpeted	*A.niger, A.flavus, A.fumigatus, M.racemosus, R.stolonifer, M. hiemalis*	60
viii	New Building Carpeted	*A.niger, A.flavus, A. fumigatus, M.racemosus, R.stolonifer*	50
ix	Old Building Uncarpeted	*A.niger, A.flavus, M.racemosus R.stolonifer, Scopulariopsis* spp *Trichoderma* spp, *Wallemia* spp	70
x	Old Building Uncarpeted	*A.niger, A.flavus, M.racemosus, Trichoderma* spp, *R. stolonifer*	50
xi	New Building Uncarpeted	*A.niger, A.flavus, M.racemosus Trichoderma* spp	40
xii	New Building Uncarpeted	*A.niger, A.flavus, M. racemosus Wallemia* spp	40

DISCUSSION

From the results obtained, a total of ten (10) fungal species were isolated from twelve (12) dust samples obtained from the twelve(12) indoor environments that were analysed. Table 1 indicated the different locations where the samples were obtained as well as the fungal load of each of the designated venue. It however showed that the sample site ix (MCB LAB 300 level) had the highest fungal load of 2.7 x 10^2cfu/g, which might be as a result of the characteristics of the building which is an uncarpeted old building. However, the least fungal count was recorded in the sample site iv which is the Deans Office that is an old building but carpeted. The total colony count per gram of the dust sample was 1.67x10^3cfu/g, and the total average colony count was 1.39x10^2cfu/g while the standard deviation is 6.78x10^1cfu/g. Table 2 indicates the percentage frequency of occurrence of each of the fungal specie as they were isolated from the sample sites in regards to the total sample sites .The fungal specie with the highest frequency of occurrence is *Aspergillus niger*(100%) that was isolated from the whole sample sites that were analysed while the organism with the least percentage frequency of occurrence is *Aspergillus ustus* (8.3%) that was only isolated from sample site vi(IBB Centre, Common Room). The results shown in table 3 reflects the level of contaminations and the characteristics of the floors respectively (either carpeted or uncarpeted as well as the relative age of the building as either new or old). It is worthy of note that in sites vii (Dean of PG Schools Office) & viii (Deputy Deans Office) which is less than a year old the fungal concentration is high as compared to some old building. The reason is that the sample sites vii & viii are located within area of high water activity and that the fungal spores continue to infiltrate during construction processes and after the construction was, completed, the spores continue to enter the building through air current, open doors and windows, heating ventilation and air conditioning system [3]. Another comparison is that of site ii, iii & xi as both sides show similar values respectively as the degree of the contamination in the three sites are 30%, 30% and 40% respectively even though their features are different. Both sites however are places with high foot traffic. The assumption is that the presence of carpet in site ii and iii is a factor for the fungal population by trapping and harboring dust which may not be completely removed by routine sweeping[5].Sample sites ix and xii are within similar range of concentration but different level of contamination. Both sites are of high foot traffic also, which is as a result of daily activity with different people that accounts for the high concentration on both site.

Aspergillus spp were the most isolated fungi from the dust samples. With *Aspergillus flavus*,and *Aspergillus niger* having the highest percentage frequency of occurrence. The two fungi are the most ubiquitous along with *Aspergillus fumigatus*.The three species of *Aspergillus* are classified as a hazard class [2]they are known to cause invasive Aspergillosis and produce mycotoxin which are known carcinogens[3].*Mucor racemosus ,Mucor hiemalis* and *Rhizopus stolonifer* are known to cause more of opportunistic diseases [7] all of which are detrimental to human health.

CONCLUSION

From the study it can be concluded that the dust samples from carpets and floors of indoor environments harbor fungi of different species. There are also indications that the indoor air qualities are influenced by the nature of the fungi species present in the dust sample.It can be said that a good percentage of the fungi isolated may have adverse health effect on occupants of such indoor environments.

Recommendations

1. There is the need therefore to pay adequate attention to general indoor environments since they possess infectious and toxigenic health hazard.
2. Awareness programme to be established to the rural/urban populace on the effect of dust accumulation/inhalation.

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