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Isolation of Fungal Agents in Some Household Furniture in Owerri, South-East, Nigeria

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ABSTRACT

Background: The study was carried out to isolate fungal species in some household furniture in Owerri, Imo state Nigeria. **Methods**: One hundred and twenty (120) samples were collected randomly from 10 types of household furniture within 12 different homes located in Ikenegbu Owerri. The samples were processed using standard mycological methods for the isolation and identification of fungal agents. **Results**: *Aspergillus niger* species, *Candida albicans*, *Penicillium marneffei* species and *Candida tropicalis* were isolated from the one hundred and twenty (120) samples obtained from the furniture analyzed. The bed swabs yielded the highest number of fungi; 11(91.7%), followed by the kitchen cabinet; 8(66.7%). Wardrobe 2 (16.7%) yielded the least number of fungi, followed by the sitting room upholstery; 3(25%). The fungal species with the highest frequency of occurrence is *Aspergillus niger*; 31(25.8%), while the *Penicillium marneffe*i yielded 1(0.83%), the least frequency of percentage occurrence. **Conclusions**: Moist and damp environmental conditions favour the growth of these fungi, and adequate hygienic measures need to be adopted to ensure that the household furniture are kept dry at all times to prevent fungal colonization.

Keywords: fungi, household furniture, Owerri, Southeast Nigeria

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INTRODUCTION

In every environment, moulds are virtually found and can be detected indoors and outdoors [1]. They are able to colonize diverse substrates including foods and household materials because of their powerful arsenal of hydrolytic enzymes. These fungi can cause a high degree of deterioration when present in/on foods. They can be found indoors where humidity levels are high. Fungus is one of the oldest life forms on the earth and making up approximately 25% of the earth's biomass. Fungi can reproduce either sexually or asexually through the production of large numbers of spores. According to Gorny *et al.* [2] when the conditions are suitable, viable spores germinate to produce hyphae, which grow and spread within or on the substrate, and eventually form a new generation of fungi. Environmental microbes, i.e., fungi and bacteria, are ubiquitous being found in both natural and man-made habitats. In indoor environments, the main source for microbes is usually the outdoor air [3, 4].

Moisture, nutrients and temperature are the most important factors that influence the growth of fungi on building materials. Many of the building materials for homes provide suitable nutrients for mould, helping it to grow. Such materials include paper and paper products, cardboard, ceiling tiles, wood and wood products, dust, paints, wallpaper, insulation materials, drywall, carpet, fabric, and upholstery.

Moulds are filamentous fungi and have a powdery look due to the millions of spores produced by the fungi. Moulds are found in buildings and walls in moisture-damaged homes. Exposure to indoor moulds could pose health risks and cause adverse health effects to the occupants [6]. Linkages between health effects and moisture and mould problems of buildings have been described in literatures, even though the exact mechanisms and the correlation between the causative agents and the symptoms remain poorly understood [1]. The adverse health effects include allergenic reactions, infection, and toxic responses [2]. Many studies have documented an increase in the risk for certain symptoms among occupants of moisture and mould damaged buildings [1, 7]. Microbial concentrations and mycobiota on surfaces may differ from those in the indoor air. Therefore, results obtained from surface sampling cannot directly be associated with the exposure to airborne microbes [10]. Surface sampling is, however, one way to determine whether there is a problem and if so, to locate the source of the bio-contamination. In fact, surface sampling is recommended as a supplement to air sampling as a way of detecting fungi in indoor environments [11]. In addition to outdoor sources, microbes indoors can originate from indoor sources.

These can be the occupants themselves and their activities, as well as indoor plants [12]. Other factors influencing the microbial population include building maintenance, cleanliness, indoor temperature and relative humidity (RH), type of furniture, and carpeting [13]. Microbes may also drift indoors on the clothes of the occupants or in the fur of pets [14].

The type of ventilation affects microbial concentrations in indoor environments. Mechanical ventilation is more efficient than natural ventilation in filtering particles from the intake air and in removing pollutants. This difference is also reflected in microbial concentrations, which in naturally ventilated buildings can be 2 – 7 times higher than in buildings with mechanical ventilation [15]. In general, indoor concentrations of fungi are qualitatively similar and quantitatively lower than those in the ambient air, i.e.,

indoor/outdoor (I/O) fungal concentration ratios are < 1. This is mainly because of ventilation removing particles including fungal spores from the supply air as well as sedimentation processes. Particle removal may take place through filtering in the mechanical ventilation, or through the filtering effect of the building envelope in natural ventilation. Mould spores enter the home through doorways, windows and air conditioning systems. Spores also enter the home through animals, clothing, shoes, bags and people. When mould spores drop where there is excessive moisture in the home, they will start growing. Common problem sites include humidifiers, leaky roofs and pipes, overflowing sinks, bath tubs and plant pots, steam from cooking, wet clothes drying indoors, or flooded area. Many building materials for homes provide suitable nutrients for mould growth. Health effects of mould can vary and the production of allergens or irritants can cause mild allergic reactions and asthma attacks. The production of potentially toxic mycotoxins can cause more severe reactions, and in rare cases death. However, microbes may also grow indoors in building materials and structures. In such a situation, they may be responsible for different harmful effects. They can damage building structures by discolouring and degrading building materials, as well as causing negative aesthetic effects such as dirty appearance and unpleasant odours [19]. Undoubtedly, the main concern about microbial growth in indoor environments is related to the strong link to the adverse health effects in the occupants [20]. It has been estimated that 20% to 40% of homes have mould contamination, and various health effects such as respiratory symptoms, allergic rhinitis, asthma, and hypersensitivity pneumonitis, are associated with mould exposure. Toxicity caused by exposure to metabolites of certain moulds has also been linked to health effects. The aim of the study is to isolate the fungal agents in some household furniture in Owerri municipal Imo State, Nigeria.

MATERIALS AND METHODS

Study Area and Sample Size:

This study was carried out in Owerri, Imo State in South East Nigeria. Owerri is located in the tropical rain forest of the south-east of Nigeria and lies between longitude 5^0 55'-7^0 0 5'E with an average elevation of 15 meters. It has a tropical climate season namely rainy and the dry season. The climate of the area is tropical which means that the daily temperature is at 29 ± 5^0C for most of the year. The annual rainfall is between 217 and 240 with distinct wet and dry season. One hundred and twenty household furniture (bed, table, wooden chair, cushion, cabinet, cupboard, wardrobe, kitchen cabinet, sitting room upholstery and kitchen side stools) were sampled from different sites such as sitting room, kitchen and bedrooms in the different homes which are located in Owerri municipal, Imo State. The swabs were transported to the Department of Medical Laboratory Science Laboratory for processing.

Sample Collection and Processing:

A total of 120 pieces of household furniture within 12 different homes situated in Ikenegbu Owerri were swabbed randomly. The samples were transported to the Imo State University Microbiology Laboratory for processing and identification of fungal agents with the least possible delay.

Media Preparation and Fungal isolation:

The swabs were streaked on the Sabouraud Dextrose Agar which was prepared aseptically according to the manufacturer's instruction and supplemented with Chloramphenicol to inhibit bacterial growth.

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The cultures were incubated at room temperature of about 25^0C for 5 days and were checked daily for obvious growth. The CHROMagar powder was measured accordingly and required volume of water added. The mixture was heated to boil and poured into petri dishes after cooling.

Identification of Fungal isolates:

The growth of fungi on Sabouraud Dextrose Agar was examined critically after 1week based on macroscopic (morphological; obverse and reverse pigmentation) and microscopic examination of the fungal elements in Lactophenol cotton blue (LPCB) mount. Germ tube test was also done to differentiate *Candida albicans* from the non-albicans candida, and other yeasts. Additionally, CHROMagar was used for further identification of the fungal elements especially the yeasts by their different colour pigmentation.

Macroscopic Examination: Morphological (aerial) growth pattern of the fungi and their colour on plates were observed and recorded.

Microscopic Examination:

A drop of lactophenol cotton blue reagent was placed on a glass slide. Fungal elements were picked with a sterilized inoculating needle and teased in the drop of LPCB on the slide. The mixture was covered with a cover slip. It was then focused with x10 and x40 objective lenses of the microscope.

Germ tube test procedure:

A small portion of yeast colony was suspended in 1.5ml of human serum in a test tube. The tube was incubated at 37ºC for 2 hours. A drop of yeast suspension was placed on a glass slide and covered with a cover slip. The slide was read for the presence or absence of germ tubes.

Further Identification of the Fungal **Elements:**

Pure cultures of the fungal isolates were subcultured onto the ChromAgar plate and incubated for 72hours with regular checks at intervals for colour formation and differentiation of the fungi isolated especially the yeasts.

RESULTS

Table 4.1 indicated the different pieces of household furniture from where the swabs were obtained (Beds, Tables, Wooden chairs, Cushion, Cabinets, Cupboards, Wardrobes, Kitchen cabinets, Sitting room, Kitchen side stools) as well as the frequency of occurrence of each isolate from the designated site.

From the results obtained, *Aspergillus niger*, *Candida albicans*, *Penicillium* and *Candida tropicalis* were isolated from the one hundred and twenty (120) swabs obtained from the (10) different pieces of furniture that were sampled.

Using the simple percentage occurrence, the results showed that the beds had the highest number of fungal isolates 11(91.7%), followed by kitchen cabinet 8(66.7%). Wardrobe 2(16.7%) has the least number of fungi isolates, followed by sitting room upholstery 3(25%).

The fungal species with the highest frequency of occurrence is *Aspergillus niger* 31(25.8%) while the *Penicillium marneffei* 1(0.83%) has the least frequency of occurrence. *Candida albicans* was found to occur the most from the bed swabs 5(45.5%).

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Table 4.1: Occurrence of fungal isolates associated with pieces of household furniture

Furniture sampled	No of samples examined	*Aspergillus niger*	*Penicillium marneffei*	*Candida albicans*	*Candida tropicalis*	Total (positive samples)
Bed	12	4 (36.4%)	-	5 (45.5%)	2 (18.2%)	11 (91.7%)
Table	12	2 (40%)	-	3 (60%)	-	5 (41.7%)
Wooden chair	12	3 (42.9%)	-	4 (57.1%)	-	7 (58.3%)
Cushion	12	4 (66.7%)	-	2 (33.3%)	-	6 (50%)
Cabinet	12	4 (66.7%)	1 (16.7%)	1 (16.7%)	-	6 (50%)
Cupboard	12	3 (60%)	-	2 (40%)	-	5 (41.7%)
Wardrobe	12	1 (50%)	-	1 (50%)	-	2 (16.7%)
Kitchen cabinet	12	4 (50%)	-	3 (37.5%)	1 (12.5%)	8 (66.7%)
Sitting room upholstery	12	3 (100%)	-	-	-	3 (25%)
Kitchen side stool	12	3 (42.9%)	-	4 (57.1%)	-	7 (58.3 %)
Total	**120**	**31(25.8%)**	**1(0.83%)**	**25(20.8%)**	**3(2.5%)**	**60(50%)**

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DISCUSSION AND CONCLUSION

Household-furniture-inhabiting fungi are important group of indoor fungi that are able to propagate in almost any home. From the results, *Aspergillus niger*, *Candida albicans*, *Penicillium marneffei* and *Candida tropicalis* were isolated from the one hundred and twenty (120) samples obtained from the twelve (12) different homes that were analyzed. The fungi isolated are found around man and in his environment. The results obtained are in agreement with the report of Portony *et al*. (19), who isolated *Aspergillus* species, *Candida albicans*, *Penicillium* species and non-*albicans Candida* in their similar study. The results further showed that the beds had the highest number of fungal isolates 11(91.7%), followed by kitchen cabinet 8(66.7%). Wardrobe 2(16.7%) yielded the least number of fungi, followed by sitting room upholsteries; 3(25%). The reason for the high number of fungal isolates from the bed furniture may be due to the fact that beds are regularly laid upon. Children after playing might rush to the bed without taking their bathe and some individuals lay on their bed with sweat when they come back from work. This makes room for the fungi which strive well in moist and damp environmental conditions. Dales and Miller (21) carried out a similar study and found that beds were the piece of household furniture with the highest number of fungi which they attributed to sick people lying on the bed, thereby contaminating it. Ayanbimpe *et al*. (22) also reported a high number of fungal isolates from hospital bed furniture. He stated that sick individuals are prone to fungal infections due to the intake or over reliance on broad spectrum antibiotics, thus contaminating the bed with fungi.

The results also revealed that kitchen furniture had a higher prevalence of fungi. This might be due to the fact that the kitchen is always wet, thereby favouring the growth of fungi because they strive well in moist environment.

The present study showed that the wardrobes yielded a total of 2(16.7%) being sampled surface with the least number of fungal isolates. This was followed by the sitting room upholsteries; which yielded 3(25%) isolates. The reason being that the wardrobe is mainly dry all the time and the sitting room kept clean at all times, too. The result is similar to the findings of Dales and Miller, (21) who stated that fungi find it very hard to strive in a dry, less humid and well ventilated environ.

The study further revealed that the fungal species with the highest frequency of occurrence is *Aspergillus niger*; 31(25.8%), while the *Penicillium marneffei* recorded the least frequency of occurrence 1(20.8%). The species of *Aspergillus* isolated may be one of the major causes of fungal allergenic reactions due to its preponderance in our environment. The result also agrees with the study carried out by Obi *et al* (24), which found out that humid environment, especially rains favour the growth of fungal agents and their attendant adverse health effects.

Penicillium marneffei had the lowest frequency of; 1(0.83%) in the household furniture analyzed in this study. This *Penicillium* species is associated with infections including pneumonia especially in immunocompromised individuals. The low frequency at which *Penicillium* species occurred might be as a result of good personal hygiene measures adopted in most of the homes sampled. The result is in agreement with a similar study carried out by Dales and Miller, (21); who stated that, just like *Aspergillus niger*, *Penicillium marneffei* find it very hard to strive in a dry and clean environment.

It can be concluded from this study that moisture and humid environmental

conditions favour the menacing growth of fungi. Adequate measures need to be taken to ensure that the pieces of household furniture are kept dry at all times. The pattern of cleaning the sitting room may also contribute to the prevalence of these fungi on the surfaces of household furniture due to the use of wet rags. This allows fungal aerosols to perch and thrive luxuriantly on these moist surfaces which can infect man thereafter. Moreso, there are adverse health effects of indoor fungi during the rains, as noted by (23) in Anambra state, Nigeria. However, mopping, drying and/or dry-cleaning of the furniture will reduce fungal aerosols and reduce both infection and inhalation by man and these fungal elements.

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