MICROBIOME OF ENCLOSED AIR IN SELECTED DORMITORIES IN UNIVERSITY OF PORT HARCOURT

U. Udochukwu[1] F.I. Omeje [2] O.C. Anulude [3] O.K. Ogechi[4]

[1]Department of Bioscience, College of Natural and Applied Sciences, Salem University-Lokoja, Kogi State, Nigeria

[2]Departments of Microbiology, Faculty of Science, Federal University Otuoke, Bayelsa State, Nigeria.

[3]Department of Microbiology, Faculty of Life Science University of Benin, Edo State, Nigeria

[4]Department of Microbiology, Faculty of Life Science University of Port Harcourt, Rivers State, Nigeria

Corresponding Author: Ugueri Udochukwu, Department Of Biosciences, College of Natural and Applied Sciences, Salem University-Lokoja,
P.M.B. 1060 Lokoja, Kogi State, Nigeria
E-mail: udforgod@yahoo.com

ABSTRACT

The presence of bacteria and fungi in indoor air pose a serious problem from the point of view of health protection and environmental engineering. Precise determination of various groups of microorganisms indoors is necessary; both to estimate the health hazard and to create standards for indoor air quality control. Four (4) dormitories were sampled by "the air exposure method", using nutrient agar and Sabouraud Dextrose Agar. This study revealed the general distribution of the microbial indoor air contaminants associated with student's dormitories in the University of Port Harcourt. Dan Etete dormitory had the highest which is as follows; *Micrococcus* spp. (44.4%), *Enterococcus* spp. (47.1%), *Staphylococcus* spp. (50.2%), *Serratia* spp. (46.1%), *Bacillus* spp. (49.3%) *and Kiebsiella* spp. (48.4%). Fungi: - *Aspergillus* spp. (52.3%), *Fusarium* spp. (49.1%), *Altenaria* spp. (50.2%), *Penicillium* spp. (44.2%), *Cladosporium* spp. (48.4%). The number of persons, the type of room and the ventilation systems are believed to be among the factors that affected the indoor airborne microbial rates. Further studies are needed to investigate the antibiotic-resistance patterns of the isolated airborne microorganisms. Implementation of more stringent, frequent and comprehensive disinfection procedures should be applied in all dormitories. Moreover, the number of occupants per room should be reduced to check the spread of air-borne pathogens.

The major public health implication of indoor air is owed to the human risk associated with exposures to indoor air pollution. This may present a greater risk than exposure to atmospheric air contaminants.

Keywords: Health hazard, Air quality, Ventilation systems, Antibiotic-resistance, Dormitories and Pathogens.

{**Citation:** U. Udochukwu, F.I. Omeje, O.C. Anulude, O.K. Ogechi. Microbiome of enclosed air in selected dormitories in University of Port Harcourt. American Journal of Research Communication, 2015, 3(5): 217-224} www.usa-journals.com, ISSN: 2325-4076.

1.0 INTRODUCTION

In recent years, research in this field has increased because of increasing awareness of the variety of health problems potentially caused by airborne microorganisms. An aerosol is a suspension of microorganisms attached to solid and/or liquid particles in the air or gas. Biological aerosols are single microorganisms or clumps of microorganisms attached to solid or liquid particles suspended in the air [1]. The composition of bio aerosol includes, bacteria, yeast, moulds, spores of bacteria and moulds, microbial fragments, toxins, metabolites, viruses, parasites and pollen. Bio aerosols generally range in size from 0.5µm to 50µm in diameter [2]. Microorganisms in bio aerosols may attach to dust particles or may survive as free floating particles surrounded by a coating of dried organic or inorganic material. Location and environmental conditions such as humidity, density and temperature have a great effect on the type of population and amount of microorganisms in enclosed air. Whilst all types of microorganisms can cause problems indoors. Bacteria and fungi are commonly associated with indoor air quality complaints. In any indoor environment, a variety of species will be present at different times and in different micro-environments. In order for airborne disease transmission to occur from microbes in building, there must be a source or reservoir for the microbes: some means for the microbes to multiply and the mechanism for their release and dispersion into indoor air as described by [3]. The major indoor reservoirs are stagnant water or moist interior surfaces. This can accumulate microbes that enter the building in outdoor air and act as amplifiers for bacteria. [4] Observed that fungi can grow in relatively dry environments (example at relative humidity above 75%). Airborne dispersion is relatively easy for microbes found in building ventilation systems (e.g. fungal and bacterial spores) or contaminant carpet. The Northern Territory work health Authority (1993) has stated that measurement of microorganisms in about 1000 CFU (colony forming unit) per cubic meter of air indicates that indoor environment may need to be investigated for microbiological contamination. However, [3] also stated that exceeding this level does not mean that the air is unsafe or hazardous. Merely using a number to represent CFU per cubic meter is an unreliable indicator of the actual hazard posed on airborne microorganisms because of the universal presence of microorganisms. It is critically important to obtain an indication of the ratio groups of organisms present. The information will be of greatest value with periodic testing to provide data for a trend analysis of the microbial groups in a particular site. [5] Further stated that by differentiating these groups of organisms, the likely sources, the risk potential and the need for much action can be established.

2.0 MATERIAL AND METHOD

Indoor air was sampled in dormitories by gravitational (drop plate) method as described by [6], This was done by placing duplicates of open sterile Petri dishes containing already prepared nutrient agar medium and Sabouraud dextrose agar on floor in each room; they were exposed to the air in the rooms for 20minutes in the afternoon. Each of these rooms was originally design for four students apart from Dan Etete which usually have six occupants, but due to lack of accommodation with ever increasing student's population, these rooms (which is 3.65m by 3.65m) now are occupied by a minimum of eight students. Each room have four windows, but over the years due to poor maintenance the windows are sometimes completely without glasses and in some cases the student decided to block it completely which adversely affects the ventilation system. Also some of the windows that have glasses with nets are usually covered with dust (especially during the dry season) due to poor sanitation which prevents cross ventilation and proper aeration of the rooms. The rooms were sampled randomly in each dormitory. Nutrient agar was for the isolation of culturable heterotrophic bacteria while the sabouraud dextrose agar was for fungi isolation. The samples were transported immediately to the laboratory for incubation for 48 hours after 20 minutes of exposure. The bacterial and fungal isolates were purified and identified using various biochemical tests. This study was carried out in four dormitories in the University of Port Harcourt, Rivers State. The dormitories include: Dan Etete, Block B Delta Park, Block A Nelson Mandela and Medical student's dormitory choba campus.

3.0 RESULTS

This study has shown the microbial profile of student's dormitories in the University of Port Harcourt. The tables below show the population of bacteria from four dormitories after 48 hours of incubation on nutrient agar. From (table 1), Dan Etete hostel had the highest bacteria population. From the results, it can be deduced that the microbial load was influenced by the number of occupants as well as the ventilation system of the various dormitories and rooms. Results from the samples obtained from the Dan Etete hall of residence had 142cfu/m^3 for six occupants and 35 cfu/m^3 for one occupant. The result obtained from Dan Etete was on a par with that of other dormitories namely: Medical student's dormitory Choba campus, Block B Delta Park, Block A Nelson Mandela hostel. The same trend was observed for the fungal isolates in (table 2). The relationship between the number of occupants and the microbial load is connected with the fact that humans are partly responsible for the distribution of air borne pathogens. This study has also revealed the general distribution of the microbial indoor air contaminants associated with student's dormitories in the University of Port Harcourt. In Dan Etete dormitory which had the highest bacterial and fungal counts. Bacterial: - *Micrococcus* spp. (44.4%), *Enterococcus* spp. (47.1%), *Staphylococcus* spp. (50.2%), *Serratia* spp. (46.1%), *Bacillus* spp. (49.3%) *and Kiebsiella* spp. (48.4%). Fungi: - *Aspergillus* spp. (52.3%), *Fusarium* spp. (49.1%), *Altenaria* spp. (50.2%), *Penicillium* spp. (44.2%), *Cladosporium* spp. (48.4%). It is known that a mere sneeze and cough in an enclosed room may release microorganisms (about 200miles/hour; 100ms-^{1}) from the mouth and lungs into and around the air, through millions of tiny droplets. These droplets contain living microorganisms and can remain suspended in air for hours or days.

Table 1: Frequency of occurrence of bacteria in the four dormitories (%)

Isolates	Dan Etete Dormitory	Nelson Mandela Dormitory	Delta park Dormitory	Medical student's Dormitory
Micrococcus spp.	44.5	15.1	20.2	10.3
Bacillus spp.	49.3	13.4	25.2	12.1
Enterococcus spp.	47.1	17.3	20.4	15.2
Staphylococcus spp.	50.2	17.1	12.3	20.4
Klebsiella spp.	48.4	23.2	15.1	13.3
Serretia spp.	46.1	17.3	15.4	21.2

Table 2: Frequency of occurrence of fungi in the four dormitories (%)

Isolates	Dan Etete Dormitory	Nelson Mandela Dormitory	Delta park Dormitory	Medical student's Dormitory
Aspergillus spp.	52.3	21.3	14.2	12.2
Fusarium spp.	49.1	23.2	14.6	13.1
Penicillium spp.	44.2	22.4	25.2	12.2
Cladosporium spp.	48.4	10.1	16.1	24.4
Altenaria spp.	50.2	16.3	19.4	14.1

4.0 DISCUSION

From this study; it has been observed that room ventilation also play a role in the distribution of microorganisms. This is therefore a major means of transmission of several diseases which was also reported by [7]. The result from the four hostels sampled, show that the number of colony forming units (cfu)/m^3 varied proportionally to the number of windows in each room. Rooms with lesser ventilation (poor ventilation) system recorded higher CFU values and vice versa. Data presented in this work provide evidence that people occupying or visiting enclosed spaces play a dominating role in the creation of indoor air microbiological environments. It means that all rooms attended by many visitors will be extremely exposed to risk of nigh microbial contamination. This is in conformity with the importance of ventilation. It has been established that surface area and population density of microorganisms are major factors in pathogenesis and dispersion of microorganisms. This study has also revealed the general distribution of the microbial indoor air contaminants associated with students dormitories in the University of Port Harcourt with reference with that of Dan Etete dormitory. Results of this research showed that the most common in schools, are moulds from the genera *Aspergilus* (52.3%). [8], observed that pathogenic organisms represent more than 35% of the total count of bacteria isolated from rooms with *staphylococcus aureus* being found to be the most common organism isolated, representing 50.2%. A similar observation was observed in the study of [9].The common genera of fungi frequently isolated from the hospital air include; *Aspergillus, Alternaria* and *Peniciilium.* The study of [8], also show that *Aspergillus* spp. was found to be the most common fungus isolated in the two hospitals.[10] Found that in schools the most common fungi are: *Peniciilium* sp., *Cladosporium* sp., *Aspergillus* sp. and yeast. [11], isolated some strains of *Aspergillus (A. versicolor)* and *Peniciilium* from the indoor air of some Danish schools. A study in Norwich schools show most commonly occurred moulds belonging to the genera: *Penicillium, Aspergillus, Cladosporium* and *Mucor* [12]. The study of airborne fungal spores is important to understand the dissemination, spread, and movement of the microbes, particularly the pathogenic ones in the atmosphere according to [13]. Thus, it can be posited from this investigation that occupants of these halls of residence are frequently been exposed to health hazards associated with Aspergillus infections. Therefore, students may suffer from (if not controlled) different respiratory diseases. Given any of the above conditions, some researchers recommend indoor and outdoor air tests for comparisons, suggesting that fungi contamination comes from outside the building. However, research indicates that the number of airborne fungi outside buildings is greater than airborne fungi indoors. Most studies indicate that average indoor airborne fungi levels are 25% of the levels outside. Although there are no standards or rules regarding airborne fungi, it is generally agreed that healthy air contains not more than 150cfu/m^3 of air. Nevertheless, certain fungi are considered unsafe at any level like *Aspergillus, Penicillium* and *Stachybotrys*. According to [14], an adult at rest breaths 10 liters (10,000 cubic centimeters) of air each minute. There are a million cubic centimeters per cubic meter of air. If the air contains 520,000 fungi spores per cubic meter then, an adult breathes more than 50 million fungi spores each minute. Indoor air exposure to mycotoxin and allergen producing fungi results in high frequency of health complaints, variant multi-organ and laboratory abnormalities requiring a detailed exposure assessment and clinical evaluation. [15] Clearly noted that only a cautious remediation standard can be applied for buildings and their contents. At the very least, the roof must be repaired, the building air conditioned, the air dehumidified, and its contents either discarded or decontaminated and removed from the premises.

5.0 CONCLUSION

This study has identified six bacterial and five fungal genera as major potential pathogens in indoor air of students' dormitories. The number of persons, the type of room and the ventilation systems are among known factors that affect the indoor airborne microbial compositions. *Staphylococcus, Enterococcus, Micrococcus, Serratia, Bacillus and Klebsiella* are among known bacterial pathogens of public health importance. They have high level of antibiotics resistance. Their presence can lead to severe health problems ranging from various respiratory tract infections to different allergies stimulated by air contaminants. The fungal indoor air contaminants *(Penicillium, Fusarium, Alteraria, Aspergillus and Cladosporium)* are also of major public health concern. They are responsible for major systemic infections mainly through the inhalation of the spore forms of these pathogens.

REFERENCES

1 Downess F.P and K. Ito (2001) Compendium of methods for the microbiological examination of air samples. American Public Health Association Press, Washington D. C (4th ed). p66.

2 Kang Y. J and F.J. Frank (1989). Biological aerosols: a review of airborne contamination and its Measurement in dairy processing plant. *Journal of food protection* 52: 512-524.

3 Burge, H. A and A. Feeley (1991). Indoor air pollution and infectious diseases. In: J. M Samet, D Spengler (ed.), Indoor air pollution: a health perspective. Baltimore, Johns Hopkins University Press.

4 Solomon W. R and H. A Burge (1997). Allergens and Pathogens in Indoor Air Quality. Crc Press Boca Raton.

5 Stuttard E. (1996). Danger in the Air, Article for Property Australia by E. Stuttard, Technical Director. Eml Consulting Service

6 Filipiak M, A. pwtraszewska-pajak, M. Kowska-sekwska., A. Stach., W. Silny. (2004). Outdoor And indoor air microflora of academic building in Poznan.

7 Finland. Michael J. Pelczar., Jr. E, C. S. Chan. R. Noel Krieg.(1990).*Microbiology Concepts and Applications.* McGraw-Hill, New York.

8 Qudiesat, K., K. Abu-Elteen, A. Elkarmi, M. Hamad and M. Abussaud (2009) Assessment of Airborne pathogens in healthcare settings. *African Journal of Microbiology Research,* 3: 066-076

9 Jaffa! , A. A, H. Nsanze, A. Bener, A.S. Ameen, I.M. Banat, A.A. El Mogheth (1997) Hospital Airborne microbial pollution in a desert country. *Environ. Intemat* 23:167-172.

10 Meklin T., T. Husman, A. Vepsalainen, M. Vahteristo, J. Koivisto, J. Halla-Aho, A. Hyvarinen, D. Moschandreas, A. Nevalainen (2000). Moisture damages in schools - symptoms and indoor air Microbes. In: Proceedings of Healthy Buildings, vol 1Finland.

11 Wurtz, H., J. Kildeso, H.W. Meyer, J.B. Nielsen (1999). A pilot study on airborne microorganisms in Danish classrooms. *Proceedings of the 8th International Conference on Indoor Air Quality and Climate,* Edinburgh, Scotland.

12 Jones, A.P. (1999). Indoor air quality and health. Internet *Journal of Atmospheric Environment.* 33.

13 Augustowska, M. and J. Dutkiewicz (2006). Variability of airborne microflora in a hospital ward Within a period of one year. *Ann. Agric. Environ, Med.* 13: 99-106.

14 Laurence, B. M. (1999) Pathogenic Fungi. *Internet Journal on Moulds, pp 1.*

15 Eckardt, J. (1998) Clinical Experience of Diagnosis and Treating Patients with Indoor Fungal Exposure. *Third International Conference on Bio aerosols, Fungi and Mycotoxins,* Eastern NY Occupational and Environmental health Center, London.