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Bacteriological Quality Assessment of Indoor Air of Science Laboratories in Ramat Polytechnic, Maiduguri Borno State

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ABSTRACT

A study on indoor airborne bacteriological contamination in various laboratories of Science Laboratory Technology in Ramat Polytechnic Maiduguri, Borno state, is presented. The present study is aimed at determination of indoor-air bacteriological contamination of SLT laboratories. Investigations were conducted in March, 2016. Air samples were taken twice a day: in the morning (10am) and in the afternoon (4pm). Total numbers of mesophilic aerobic bacteria count (ranged between 1.0×10^2 - 5.3×10^2 cfu/m³) from the air of selected laboratories were determined using Koch sedimentation method. This was determined through sampling using "Settled Plate Technique (SPT)", Petri plates filled with nutrient agar was used in the sample collection. In all of the tested places a multiple growth of bacteria were observed in afternoons than in the morning hours. The predominant bacteria isolated from investigated air samples were: *Escherichia coli* 24(41.37%), *Klebsellia pneumonia* 7(12.07), *Shigella* spp 9 (15.52), and *Staphylococcus* spp 18 (31.03). Among these bacterial isolates the presence of pathogenic and strongly allergenic microorganisms was detected. The current study clearly indicates that there is significant assessment of the indoor airborne bacteria.

Keywords: Indoor air, bacteriological quality, airborne bacteria, open plate technique

INTRODUCTION

The term Indoor Air Quality (IAQ) is refers to the air quality within and around buildings and structures, especially as it relates to the human health and comfort of building occupants (Prescott *et al.*, 1999). IAQ can be affected by microbial contaminants (mold, bacteria), or any mass or energy stressor that can induce adverse health conditions (WHO, 2009). Source control, filtration and the use of ventilation to dilute contaminants are the primary methods for improving indoor air quality in most buildings. Residential units can further improve indoor air quality by routine cleaning of carpets and area rugs (Kalwasinska *et al.*, 2012).

However, bacteria are present on all inanimate surfaces creating ubiquitous sources of possible contamination in the laboratory. Experimental success relies on the ability of a scientist to sterilize work surfaces and equipment as well as prevent contact of sterile instruments and solutions with non-sterile surfaces. Nonetheless, many of these microorganisms are present in the air on minute dust particles, which can remain suspended for long periods, but they may also be dispersed in the very small water droplets of aerosols. Aerosols can be produced from people, through coughing and sneezing, and by many other mechanisms (The World Book Encyclopedia of Science, 1994).

Nevertheless, clean air is a basic requirement of life. The quality of air inside houses, offices, schools, public buildings, health care facilities or other private and public buildings where people spend over 90% of their lives indoors, where they are exposed to some indoor environmental factors (bioaerosol) that influence their health and physical condition (Abdel Hameed and Farag, 1999). Therefore there has been a growing interest in indoor microbial studies in recent years is an essential determinant of healthy life and people's well-being (Ekhaise *et al.*, 2010) The present study is therefore aimed at assessing the airborne bacteria present in the indoor laboratory environment that could possibly cause contamination of culture media and infection of laboratory personals and students as they often make use of the laboratory.

MATERIALS AND METHODS

Study Area

Ramat Polytechnic, Maiduguri is a public higher educational institution established in January 1973 as Government Technical College by the defunct North-Eastern State Government. The Technical College was upgraded and renamed Ramat College of Technology in April 1978 by the then Borno State Government to immortalize the name of the late Head of State, General Murtala Ramat Muhammad. In August 1979, it was again upgraded to the status of a Polytechnic in conformity with the Federal Government initiative to rename all Colleges of Technology in the country to Polytechnic. Ramat Polytechnic, which started by admitting only three hundred students in 1978 has a student population of over fourteen thousand students as at 2013/2014 Academic Session. So far, about forty thousand students have graduated from the Institution with National Diploma, Higher National Diploma, National Certificate in Education in Technical and Business, and Polytechnic Diploma, Certificate and AEO. The study was conducted March, 2016.

Sample collection/ Sampling procedure

Passive monitoring typically employs 'settle plates' also known as sedimentation method was used as sample collection method. In this technique, standard 90 mm diameter petri dishes containing sterile culture media (Nutrient Agar, Blood Agar and MacConkey Agar) were opened and exposed at the six (6) SLT laboratories 15 mins. After which the Petri dishes containing nutrient agar were closed and placed in the incubator at 37°C for possible bacterial growth within 18 to 24 hours (Cheesbrough, 1991).

A total number of 15 plates were exposed at each exposure time; these comprised of 6 Nutrient agar plates (2 in Biology/Microbiology laboratories, 2 in Chemistry laboratories and 1 Physics laboratory, the same number of Blood agar and MacConkey agar plates were used. Thus, this was carried out 2 times in a day (10 am - when the number of students and staff present are minimal and 4 pm - when the day's work is done and students and staff are about leaving the laboratory). The total number of individuals present in the different laboratory at each time of exposure was noted (Baker *et al.*, 2001). All samples were taken in September (before the beginning of the academic year) and October (during academic year). Isolates were identified by their cultural characteristics, morphological appearance and biochemical characteristics as described by many researchers (Koneman *et al.*, 1997). Colony forming unit (CFU) of the bioaerosols (bacteria) were assessed (2 times a day) for three days, taking into consideration the number of individuals present at each exposure time at the sampling sites and the weather conditions at such points.

RESULTS

Table 1: Number of bacterial CFU/m³ air at different sampling time of day at different time of exposure

Investigated rooms	Time of taking samples	Total number of bacteria [cfu/m ³]		
		Day 1	Day 2	Day 3
New Bio. Lab.	Morning	2.7 x 10 ²	3.1 x 10 ²	4.7 x 10 ²
	Afternoon	3.3 x 10 ²	3.7 x 10 ²	5.3 x 10 ²
Old Bio. Lab.	Morning	3.5 x 10 ²	1.1 x 10 ²	1.7 x 10 ²
	Afternoon	4.3 x 10 ²	2.5 x 10 ²	2.3 x 10 ²
New Chem. Lab	Morning	1.1 x 10 ²	1.0 x 10 ²	2.0 x 10 ²
	Afternoon	1.3 x 10 ²	1.5 x 10 ²	2.3 x 10 ²
Old Chem. Lab.	Morning	1.0 x 10 ²	1.3 x 10 ²	1.0 x 10 ²
	Afternoon	2.1 x 10 ²	2.0 x 10 ²	1.3 x 10 ²
Physics Lab.	Morning	1.0 x 10 ²	1.0 x 10 ²	2.0 x 10 ²
	Afternoon	2.3 x 10 ²	1.5 x 10 ²	2.3 x 10 ²

Table 2: Percentage frequency of bacterial isolates from five laboratories analyzed

Type of Bacterial isolates	Percentage frequencies (%)
<i>Escherichia coli</i>	24 (41.37)
<i>Klebsellia pneumonia</i>	7 (12.07)
<i>Shigella</i> spp	9 (15.52)
<i>Staphylococcus</i> spp	18 (31.03)
Total	58 (100)

DISCUSSION

Bacteriological quality assessment of indoor air study is one of the most vital investigations to determine the microbial indoor air contamination. The information on the indoor microbial concentrations of airborne bacteria is necessary both to estimate the health hazard and to create standards for indoor air quality control. The concentrations of bacteria aerosols in the indoor environment of Science laboratories, estimated with the use of the settle plate method, ranged between 1.0×10^2 - 5.3×10^2 cfu/m³

The average level of microbiological air contamination inside investigated university rooms is shown in **Table 1**. The number of bacteria in indoor air of the five SLT laboratories varied greatly in the whole research period. The total number of mesophilic aerobic bacteria in Day 1 ranged from 1.0×10^2 to 1.5×10^2 cfu/m³, in Day 2 it varied from 1.0×10^2 to 3.7×10^2 cfu/m³ and that of Day 1.0 $\times 10^2$ to 5.3×10^2 cfu/m³, respectively.

The study showed that out of total 58 bacterial isolates obtained in the study, *Escherichia coli* has the highest occurrence 24(41.37) followed by *Staphylococcus* spp 18 (31.03), *Shigella* spp 9 (15.52), and *Klebsellia pneumonia* 7 (12.07) has the least. These isolates are commonly found bio aerosols and pathogens in the air. This is because the carriers are commonly present in the area under study. This supports previous studies which state that *Staphylococcus* sp is the frequently commonly found pathogen in air (Kalwasinska *et al.*, 2012).

The new Biology/Microbiology Laboratory had a higher mesophilic bacterial count. This could probably be attributed to the more number of students usually present in Microbiology Laboratory and their various research works, which could introduce more organisms to the indoor air.

In Conclusion, almost all the laboratories of Science Laboratory Technology were contaminated with both gram positive and gram negative bacteria. Thus, attention must be given to control those environmental factors which favor the growth and multiplication of such bacteria in indoor environment of laboratories to safeguard health of students and laboratory technicians and technologists. And also it needs to increase the size and the number of laboratories in Ramat Polytechnic, Maiduguri, so as to make them sufficient for the current and future student population.

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