Isolation And Identification Of Airborne Bacteria From Federal University Dutse Lecture Rooms

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Abstract: This study was conducted to isolate and identify bacteria air pathogens in our college lecture rooms using the natural sedimentation technique. The studied areas include political science lecture room III, criminology and security study lecture room III, English lecture room III, environmental management and toxicology lecture room II, mathematics lecture room II, physics lecture room II, postgraduate lecture room and main hall science. A total of 64 samples were collected during the course of this study out of which 56 (87.5 %) showed positive bacterial growth. The isolated bacterial species were identified as Staphylococcus aureus, E. coli, Streptococcus species and Bacillus subtilis. Staphylococcus aureus had the highest percentage occurrence of 51% followed by E. coli (25%) and Streptococcus species (21%) while Bacillus subtilis recorded the least (3%). These pathogens could be linked with several infections such as gastrointestinal tract infections, respiratory tract infections, urinary tract infections and skin disorders. These findings would alert the students, staff and workers to these pathogens and their existence in our lecture rooms.

Keywords: airborne bacteria, bioaerosols, lecture rooms, sedimentation technique

Introduction

Microorganisms are found almost everywhere, and their presence in the air was demonstrated by the work of Lazzaro Splallanzani in 1768 and of Louis Pasteur at the end of the 19th century (Meraj-ul-Haque et al., 2016). However, air is not a natural medium for growth and reproduction of microorganisms, any organism, that airborne contain must have originated from a living or non living source (humans, animals, plants, food, water or soil) (Yaghoub and Elagbash, 2010). Though microorganisms are found in both indoor and outdoor environments, most of the people spend their lives indoors: in houses, industries, offices, colleges, schools, hospitals etc., where they are exposed to many bioaerosols (biological air borne contaminants such as bacteria, viruses, fungi or their byproducts). Exposure to these airborne particles can result in respiratory disorders and other adverse health effects such as infections, hypersensitivity pneumonitis and toxic reactions (Naruka and Gaur 2014; Sheik et al., 2015; Yassin and Almouqat, 2010). In addition, long-term contact of people with bioaerosols can influence a person's mental power and learning ability (Naruka and Gaur, 2014). Different environmental conditions such as temperature, UV light, dryness and humidity, play a role in controlling the growth of airborne particles. Nevertheless the microbes manage to reach new hosts through the air for its survival (Sheik et al., 2015). Poor ventilation, crowded conditions and increase in number of air conditions inside building nowadays can facilitate the spreading and the survival rates of airborne particles and also can increase the chance of people at risk of airborne infections. Among dust particles present in the indoor environment, fungus which reproduce by forming spores, some bacteria especially gram positive bacteria and some viruses can survive for a long time in the air (Sheik et al., 2015; Jacob, 2016).

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Despite the need to monitor bio-aerosol levels in evaluating health risks, differences between automatic techniques and passive sedimentation techniques hamper results comparison. Automated techniques, although they are efficient in quantitative analysis, are of limited use because they require heavy and noisy equipment and need a constant power supply. The passive sedimentation technique is also limited because it does not permit an adequate quantitative analysis, but it is still widely recommended in the literature for use as a microbiological alert (Abe et al., 2012). It is well known that exposure to bioaerosols can cause adverse effect on people and for this reason it is important to check the sanitary conditions of air in the place they live. This research work aims to isolate and identify bacteria in the air of Federal University Dutse lecture rooms, to the best of our knowledge no such study has been attempted till now.

Materials and Methods

Sampling Site

This study was carried out at federal university Dutse. The samples were collected from eight different lecture rooms namely, Political Science lecture room III, CSC lecture room III, English lecture room III, EMT lecture room II, Maths lecture room II, Physics lecture II, PG Lecture room and MHS.

Media Preparation

The media used were prepared according to the manufacturer's instructions.

Sample Collection

Sedimentation Technique which involves the opening of plate with specific culture media was employed for this study (Sekulska, 2007). Prepared plates of nutrient agar were exposed to air for 30mins at different sites in the respective lecture rooms. After sampling, all plates were immediately taken to the microbiology laboratory and incubated at 37ºC for 24 hours for isolation of bacteria. The colonies were sub-cultured onto a new fresh medium in order to obtain pure culture.

Bacterial Identification

Identification of bacterial isolates was done using the standard procedures according to Cheesbrough (2009). Bacterial colonies were initially characterized by morphology and using staining techniques (Gram staining) and identified further by biochemical tests.

Gram Staining

Gram's staining was done to find the reactions of the bacterial isolates to Gram reagents. A smear was prepared and heat fixed. The crystal violet (primary stain) stain was flooded over the fixed culture for 60 seconds, the stain was washed with water. The iodine solution was added onto the smear for 60 seconds, pour off and rinsed with water. A few drops of decolorizer (ethyl alcohol) was added and washed with water immediately after 5 seconds and finally safaranin (Secondary stain) was added for 60 seconds and washed, the smear was allowed to air dry. After drying the slide was mounted under microscope and observed. The stain differentiates bacterial species into two groups; Gram-positive bacteria, which take up crystal violet dye (primary stain) and are stained violet and Gram-negative, which pick up safranin (Secondary stain) are thus stained red after decolourization with alcohol.

Biochemical Test

Biochemical tests such as Catalase, Oxidase, Indole, Methyl Red test (MR), Coagulase, Voges Proskauer (VP), Citrate utilization, were carried out on the isolated bacteria according to cheesbrough (2009).

Result and Discussion

The present study was conducted to isolate and identify airborne bacteria in some selected lecture rooms within the Federal University Dutse. A total of sixty four samples were collected during the course of this study out of which fifty six (87.5 %) were positive while eight (12.5%) showed negative bacterial growth (Table 1). Four bacterial genera were identified from the sampling sites as shown in Table 2. Overall, 124 bacteria were isolated comprising of Staphylococcus aureus, Streptococcus spp, E. coli and Bacillus subtilis (Table 3). Staphylococcus aureus has the highest percentage occurrence of 51% followed by E. coli (25%) and Streptococcus species 21% while Bacillus subtilis recorded the least 3% (Table 3). These pathogens could be linked with several infections such as gastrointestinal tract, respiratory tract, urinary tract and skin disorders.

Table 1: *Number and percentage of positive bacterial samples*

S/N	Sample areas	No. of Samples	No. of Positive Samples	Percentage (%)
1	Political Science lecture room III	8	8	100%
2	CSC lecture room III	8	6	75.0%
3	English lecture room III	8	8	100%
4	EMT lecture room II	8	8	100%
5	Maths lecture room II	8	5	62.5%
6	Physics lecture room II	8	7	87.5%
7	PG Lecture room	8	6	75.0%
8	MHS	8	8	100%
	Total	64	56	87.5%

Table 2: *Isolated Bacteria at various lecture rooms*

Sample areas	Isolated organisms
Political Science lecture room III	Staphylococcus aureus, Streptococcus spp, E. coli
CSS lecture room III	Staphylococcus aureus, Streptococcus spp, E. coli, Bacillus spp
English lecture room III	Staphylococcus aureus, Streptococcus spp, E. coli
EMT lecture room II	Staphylococcus aureus, Streptococcus spp, E. coli, Bacillus spp
Maths lecture room II	Staphylococcus aureus, Streptococcus spp, E. coli
Physics lecture room II	Staphylococcus aureus, Streptococcus spp, E. coli
Postgraduate Lecture room	Staphylococcus aureus, Streptococcus spp, E. coli, Bacillus spp
Main Hall Science	Staphylococcus aureus, Streptococcus spp, E. coli, Bacillus spp

Table 3: *Percentage frequency of occurrences of the isolated bacteria*

Organisms	Frequency of occurence	Percentage (%) of Occurrences
Staphylococcus aureus	63	51
Streptococcus spp	26	21
E. coli	31	25
Bacillus	4	3
Total	124	100

Staphylococcus aureus belong to normal flora of the human skin and nose, it is likely that these organism may be originated from the nose and skin flora of the students and staff of our college. However, this higher incidence of Staphylococcus aureus obtained from this study correlate with several and similar findings of the studies conducted by several researchers. A study conducted by Yaghoub and Elagbash (2010) at Omdurman and El-Rhibat hospital Sudan found that Staphylococcus aureus was the predominant air bacteria isolated from these hospitals. This

study also support the finding of Sheik et al. (2015), in which the occurrence was reported to be 38% in a research conducted to detect the airborne microorganism from a college in Saudi Arabia. This result is also inconformity with the result obtained by Badri et al. (2016), who reported Staphylococcus aureus as the highest bacteria isolated from their study. In the present study Staphylococcus aureus was the dominant isolated organism and this bacterium is a common causative agent of various human diseases, it is responsible for many gastrointestinal tract infections, respiratory tract infections and skin disorders (Yaghoub and Elagbash, 2010). Another pathogen E. coli (25%) which was also isolated is of medical concern. It is one of the most commonly examined Gram-negative bacteria in microbiology. Though it is well known that E. coli inhabits the human bowel as part of normal microbiota, some strains are capable of causing a significant intestinal/diarrheal and extraintestinal infections (Alteri and Mobley, 2012). E. coli is a leading cause of urinary tract infections and intra abdominal infections in which the extent of the disease can range from cystitis to life threatening sepsis (Ejrnaes. 2011). It is well known that E. coli is the most common etiologic agent of urinary tract infections (Alós, 2005). Uropathogenic E. coli (UPEC) infections occur in otherwise healthy individuals and account for more than 90% of uncomplicated urinary tract infections (Warren, 1996). Also the isolation of Streptococcus species 21% is of great concern due to the fact that this bacteria are responsible for many cases of meningitis, endocarditis, bacterial pneumonia and necrotizing fasciilitis. The reasons for high percentage frequency of occurrence of bacteria in this study could be due to low minimal usage of disinfection procedures against airborne pathogens, more number of students attending lecture classes and low degree of hygiene practices.

Conclusion

Using the natural sedimentation technique, 124 bacterial species were isolated in this study. Four genera of the organisms have been isolated comprising of Staphylococcus aureus, Streptococcus spp, E. coli and Bacillus subtilis. And these organisms can cause several infections to the students and staff. In order to develop the quality of indoor air in our lecture room buildings overcrowding has to be avoided, good ventilation systems has to be designed and good hygiene practice must be observed.

Recommendations

Based on the findings of this study, we recommend the followings:

(i) Proper ventilation system should be provided when constructing lecture rooms to allow for movement of air in and out of the building.

(ii) To protect the health of students and staff proper control measures has to be taken to prevent the environmental factors which facilitate the growth and proliferation of pathogenic bacteria in our lecture rooms.

(iii) Disinfection of floors should be performed routinely and dust should be prevented

(iv) Finally, this study focus on the isolation of bacterial airborne pathogens, Future studies may be required to isolate fungal pathogens which could be a good source of air borne pathogens.

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