Study of Indoor Air Quality in a Private University

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***Abstract*: Humans are prominent sources of microbial load which contribute to the presence of pathogens in a particular environment. Airborne biological particles called bioaerosoles are capable of causing diseases and allergies. A study was conducted to monitor the quality of indoor air for presence of potential bacterial pathogens in different departments of a private University. Indoor air sampling was done using Petri plate gravitational settling method from 5 buildings of the University for assessing prevalence of potential pathogenic organisms in air. The count for Gram-positive bacteria in indoor air samples was found to be higher than the Gram-negative bacteria. Antibiotic sensitivity of all isolated bacterial colonies wasdone via disc diffusion test. It was found that all the bacteria isolated were resistant to penicillin and sensitive to tetracycline. Prevalence of antimicrobial resistance among air microorganisms may be a potential health hazard to the individuals in the light of emerging multiple drug resistance among pathogens.**

Keywords*: *air quality, bioaerosoles, airborne diseases, health hazard

I. INTRODUCTION

Airborne biological particles called bio aerosols are capable of causing diseases and allergies. Airborne bacterial infections such as pneumonia and meningitis can prove to be fatal if the bacteria develop resistance to antibiotics which can cause septicemia and may lead to death. Septicemia occurs when a bacterial infection in any part of the body enters the blood stream which can prove to be very dangerous as the bacterial toxins can affect any part of the body [1].

Many airborne bacteria have shown drug resistance which seems to be a potential health hazard. Every year there are many illnesses and deaths due to antibiotic resistance.

Penicillin, the most commonly used drug for treating Gram positive bacterial infections, kills bacteria by preventing new cell wall formation. Without a cell wall, a bacterial cell is vulnerable to outside water and molecular pressures, and quickly dies. Penicillin binds to the transpeptidase by virtue of its highly reactive beta-lactam ring and inhibits the cross-linking of peptidoglycan catalyzed by cell wall transpeptidase.

Bacteria develop resistance to penicillin by any of the three mechanisms like restricting the transport of penicillin to the cell wall or by modifying the target molecule which are enzymes that cross-link the peptidoglycan layer called penicillin binding proteins through mutation or by producing β-lactamase enzymes which break down penicillin.

Emergence and spread of antibiotic resistance has turned out to be a global health threat and is frequently linked with overuse and misuse of clinical and chemotherapeutic agents. Antibiotic resistance has become a very serious problem in the treatment of diseases [2]. When antibiotics fail to work, outcome includes frequent visit to the doctor, hospitalization, repetitive substitute of older ineffective antibiotic, work loss and sometimes, death. For example, NDM-1(New Delhi metallo-ß-lactamase-1) is a gene which provides resistance to bacteria against β lactam antibiotics [3]. It produces carbapenemase, an enzyme that neutralizes the activity of these antibiotics. Resistance to β lactam antibiotics may lead a minor urinary tract infection or a wound infection to severe and fatal bloodstream infection or pneumonia [4].

Ventilation dilutes the concentrations of airborne bacteria and viruses that can cause infectious diseases by its dispersal [5, 6]. The relationship between air changes per hour and infection transmission, in a closed environment or outdoors, is enigmatic [7]. Thus, higher ventilation rates can definitely reduce the prevalence of airborne infectious diseases. Ventilation rates below 10 l/s per person are associated with significantly higher prevalence's of one or more health outcomes or with worse perceived air quality in office environments [8]. Most of us spend the majority of our time in indoor environment be it home, office or school, therefore, it is essential we focus on the indoor air quality and the factors which play a role affecting its quality [9, 10]. A pilot study was conducted to monitor the quality of indoor air for presence of potential bacterial pathogens in different departments of a private University.

II. MATERIALS AND METHODOLOGY

Air samples were collected from 5 buildings of the university by Petri plate gravitational settling method [11]. The Petri plate gravitational settling method was done in triplicates. This method of sampling was chosen owing to its trouble-free methodology and technical feasibility, making use of available resources. The method is based on the adhesive property of media that traps airborne particles onto its surface when plates containing media are exposed face upwards to the atmosphere to collect particles settling by gravity. The exposure time of the petri plates was 10 minutes and after 16 hours of aerobic incubation different bacterial colonies (Fig.1. Bacterial growth) were picked and characterized by Gram staining (Fig.2. Gram positive bacilli, Fig.3. Gram negative bacilli and Fig.4. Gram positive cocci). All isolated bacterial colonies were checked for its antibiotic sensitivity by the disc diffusion test against penicillin and tetracycline (Fig.5. Antibiotic sensitivity via disc diffusion test).

III. RESULT AND DISCUSSION

The study was conducted in five buildings of the University. All the buildings had an average number of 800 persons per day occupancy except in building 1 where the average number of occupants per day was only 350. Building 1 (Architecture Department) was found to have the minimum number of bacterial colonies. Only 4 bacterial colonies were isolated (Table 1: Results of Gram staining). The reason for less bacterial count could be the less population density in the building. Buildings 2 and 3 (Girls Hostel and Mess respectively) had both 8and 10 colonies respectively on the plates exposed in each building. In the hostel and mess, proper aeration, ventilation and regular cleaning activities could be the reason for not obtaining numerous bacterial colonies even though both the buildings had high population density. Buildings 4 and 5(Biotechnology Department and Engineering Department) had the maximum number of bacteria; 40 and 45colonies respectively on the plates exposed in each building. The presence of more bacteria in these departments could be due to the non-functioning of air conditioners and minimum ventilation. The count for Gram-positive bacteria in indoor air samples was found to be higher than the Gram-negative bacteria. All the bacterial colonies isolated were tested for antimicrobial sensitivity. On checking the antibiotic sensitivity, it was found that all bacteria isolated were resistant to penicillin and sensitive to tetracycline.

As human beings are the sources of antibiotic resistant microorganisms in a University environment, increasing the awareness about the reasons of antibiotic resistance and its consequences is the need of the hour.

When a doctor prescribes antibiotics to a patient, most of the time the patient recovers and starts feeling better after initial doses and discontinues the antibiotic often leading to drug resistance [12]. Breathing air having penicillin resistant bacteria can prove to be a menace for human health. Airborne infections having drug resistance will definitely be a lot difficult to treat. Steps must be taken to improve ventilation and air flow to ensure lesser number of air pollutants. Human occupant density influences the level of airborne bacteria [13]. Disinfection methods using phenol/alcohol and NaOCl can also improve the air quality by reducing the total bacterial count [14].

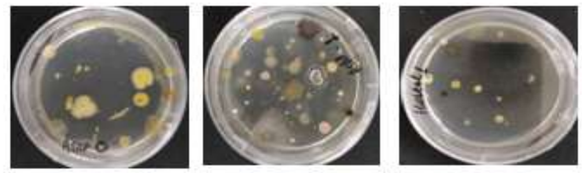

Fig.1. Bacterial Growth

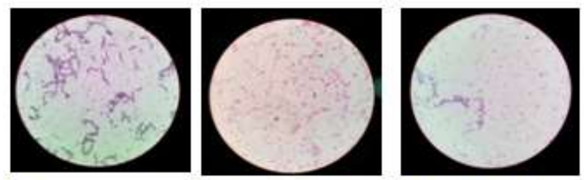

Fig.2. Gram (+) ve bacilli Fig.3. Gram (-) ve bacilli Fig.4. Gram (+) ve cocci

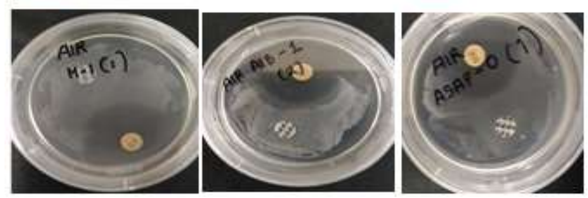

Fig.5. Antibiotic sensitivity via disc diffusion test

Table 1: Results of Gram staining

S. No.	Building Name	No. of Gram Positive Cocci	No. of Gram Positive Bacilli	No. of Gram Negative Bacilli	Total No. of Bacteria
1	Architecture Dept.	4	0	0	4
2	Girls Hostel	1	7	0	8
3	Mess	2	8	0	10
4	Biotechnology Dept.	0	35	5	40
5	Engineering Dept.	0	40	5	45

A preliminary step to curb drug resistance is to increase awareness among staff and students about dosage and usage of antibiotics for treating diseases and the importance of preventing the emergence of drug resistant microorganisms. This pilot study indicates drug resistance of airborne bacteria in the different buildings of the university. In future, we would experiment with more drugs and try to find out if there is multiple drug resistance (MDR). If there is MDR then definitely it is a serious issue which needs immediate attention [15]. The percent relative humidity also plays a role in maintaining the air hygiene of a building [16]. This study did not measure the relative humidity which must also have contributed to the increase or decrease in the number of bacterial colonies isolated from various buildings.

IV. CONCLUSION

Antimicrobial resistance among airborne microorganisms may be a potential health hazard to the individuals in the light of emerging multiple drug resistance among pathogens. Aerosol borne infections like pneumococcal meningitis and meningococcal meningitis may turn out to be fatal if drug resistance to life saving drugs like penicillin is present in these bacteria.

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