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Assessment of Bacteria and Fungi in air from College of Applied Medical Sciences (Male) at AD-Dawadmi, Saudi Arabia

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Abstract

This study was conducted to learn the microbial diversity in our college environment so that we can we can develop a database of the microbial load and to have a preliminary idea of the environmental status. A total of 125 samples were collected in duplicate by open plate method from 5 different sites (Microbiology Laboratory, Classrooms, Toilets, Lift and Office rooms) at College of Applied Medical Sciences, Dawadmi was experimentally investigated during Months of October 2014 to February 2015. The number of Bacteria and fungi present in our college environment were studied by exposing Nutrient agar and Sabouraud Dextrose Agar plates for 30 minutes at different sites. The bacteria isolated were; Staphylococcus aureus, Coagulase –ve Staphylococcus, Micrococcus species and Bacillus species. The moulds isolated were Aspergillus fumigatus, Aspergillus niger, Alternaria species and Penicillium species. The yeast belonging to Rhodotorula species was also isolated. The data collected in this study can used for further research. Although microorganisms are present in our college, the amount is within the range (61 - 460 CFU/m^3) which indicates a low level of contamination according to the guidelines by World Health Organization.

Keywords: Bacteria, fungi, moulds, yeasts, faculty of applied medical science, Shaqra University.

Introduction

Most of the people live indoors: in houses, offices, schools, colleges, hospitals etc., *w*here they are exposed to many environmental conditions that effect their health. Microorganisms are normally present in both indoor and outdoor environments. The quantity of microorganisms in a particular area depends upon the presence of water and other nutrient sources in that particular environment where they can develop extensively. Usually microorganisms enter into buildings through the doors, windows, air conditioners and also by people entering from outside. The type of species and amount of organisms present depends on the viscosity, temperature, lighting and food available in that particular environment. Among the microorganisms present in the indoor environment, some species of microorganisms if present beyond the limit can cause serious health problems[1]. So the isolation, identification and measurement of different types of microorganisms especially in indoor environment has become a very hot topic at present and it has attracted everyone's attention in this field[2-4].

Among the indoor microorganisms, some may be pathogenic and could secrete toxic metabolites which can cause allergy and even serious diseases[5]. The amount of fungi after entering from the outdoor environment increases when they have favorable conditions in the indoor environment and can cause health problems not only to those having immunodeficiency but also to healthy people[6]. The main factors helping in growth of and multiplication of both pathogenic and non-pathogenic fungi are temperature, humidity and the hygienic conditions present in the different areas of the building[7]. Actually the favorable conditions that fungus needs is moisture when there is some water leakage from the roof and plumbing, more humidity or dampness. Microorganisms are also present in dust present on surfaces in the rooms which come from outside due to walking, vehicles or from wind. Since a number of students are studying in our college attending both theory and practical sessions they are exposed to a number of pathogenic fungi and bacteria which can affect their health if proper care is not taken.

Various environmental conditions such as UV light, temperature, humidity and dryness, play a major role in controlling the growth of microorganisms from growing in unfavourable environments. But still the microbes manage to reach new hosts through the air for its survival. Among dust particles present in the indoor environment, some bacteria especially which belong to Gram-positive, fungus which have spores and some viruses can survive for several months. Because of the lack of air circulation and increase in number of air conditions inside buildings now days the chance of airborne infections has grown up[8,9]. The studies on indoor air quality in our college have not yet been reported so far. *The aims of this study are the assessment of air microflora (especially bacteria, moulds and yeasts) and determination of the factors responsible for their presence in the rooms.* Microbial assessments in air are not an easy task. The load of microorganisms in the air can be measured by using air sampler method or by using simple settle plate method and by calculating the colony forming units per cubic meter of air (CFU/m^3)[10].

Material and Methods

Sample Collections: The number and type of microorganism's present in indoor air was investigated in College of Applied Medical Sciences for Males at Ad-Dawadmi, Kingdom of Saudi Arabia in selected rooms. The study was conducted during the months of October 2015 to February 2015. A total of 125 samples were collected in duplicate from different sites of the college such as microbiology laboratory, class rooms, toilets, lift and office rooms.

Isolation and identification: The number of Bacteria and fungi present in our college environment were studied by exposing Nutrient agar and Sabouraud Dextrose Agar plates for 30 minutes during the working hours 10 - 12 pm at different sites.. After the exposure and collection, the plates were taken to the Microbiology laboratory and incubated at 37º C for 24 hours for isolation of bacteria and incubated at 28ºC for 5-7 days for isolation of fungi. The total number of bacteria, yeast and moulds in the air samples collected from different sites collected was determined. The total number of colony forming unit (CFU/m^3) was calculated. Then it is converted to organisms per cubic meter air using the standard equation given below[5].

$$\left(\frac{\text{CFU}}{\text{m}^3}\right) = \frac{(\text{no. of colonies on the petriplate}) \cdot 10000/(\text{petriplate surface})}{(\text{petriplate surface}).(\text{petriplate exposure time}).0.2}$$

Identification of bacteria and fungi was done using the standard procedures[11]. The bacterial cultures were identified by usingmicroscopic (using staining techniques), macroscopic characteristics and biochemical reactions. The fungal cultures were identified on the basis of microscopic (using Lactophenol cotton blue staining and wet mounting techniques) and macroscopic characteristics[12].

Results and Discussion

In this study, the microbial concentration of indoor air differs from sampling area to area as shown in table-1 and figure-1.The results show that the average number of highest bacterial concentration of air has been recorded in laboratories (320 CFU/m^3 and average of the lowest bacterial concentration of air has been recorded in office rooms (61 CFU/$m^{3)}$. The average number of highest fungal concentration of air has been recorded in laboratories (460 CFU/$m^{3)}$ and the average of lowest fungal concentration of air has been recorded in office rooms (140 CFU/m^3). The Total of fungal concentration of air was greater than that of the bacterial concentration in all the collection sites.

Table-1
Average number of bacterial and fungal count (CFU/m^3) in air samples

Sampling site	Bacteria (CFU/m^3)	Fungi (CFU/m^3)
Laboratories	320	460
Classrooms	290	340
Toilets	240	280
Lift	180	360
Office rooms	61	140
Total (CFU/m^3)	1091	1580

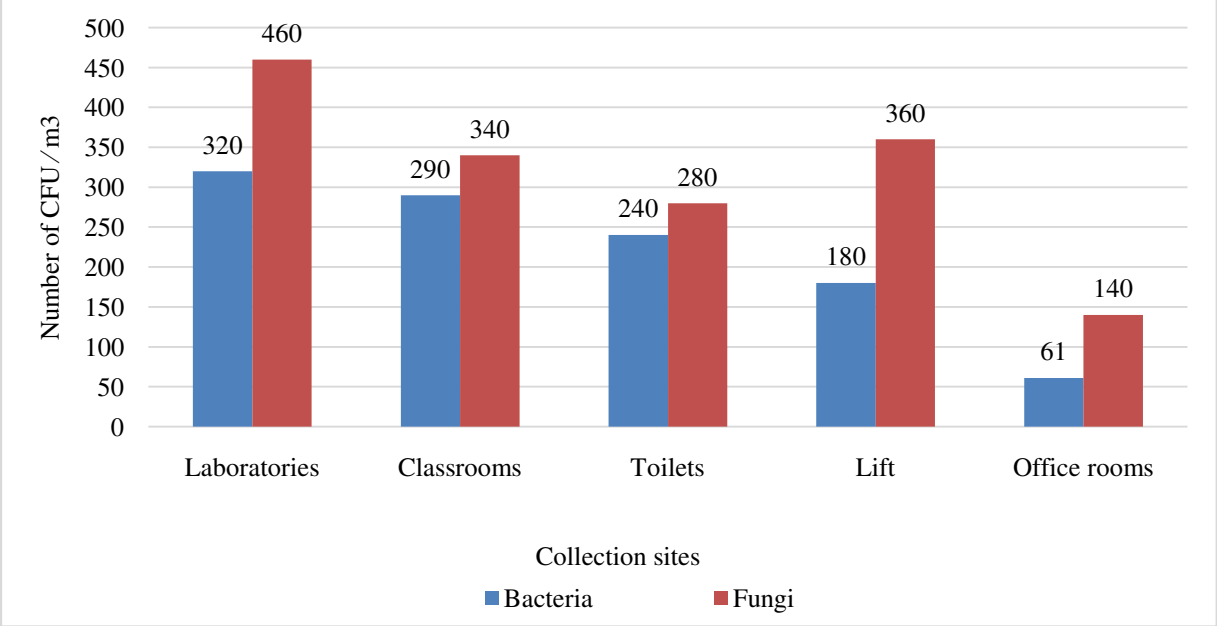

Figure-1
Comparison of average number of bacterial and fungal counts (CFU/m^3)

A total of 69 bacterial isolates belonging to 4 genera are identified in this study as shown in figure-2. Among them 3 isolates belong to Gram positive cocci (*Staphylococcus aureus,* Coagulase negative *Staphylococcus and Micrococcus species*). One isolate was spore forming Gram positive rod belonging to *Bacillus* species. Among them *Staphylococcus species* was dominant, since the percentage frequency of *Staphylococcus aureus* is 38% and Coagulase negative *Staphylococcus* is 26%. But *Bacillus* species and *Micrococcus* species are less frequent with 17% and 19% respectively as shown in the figure-4. We did not isolate any gram negative bacteria in this study. *Micrococcus species* was not found in office rooms. *Bacillus species* was not found in both office rooms and lift.

A total of 97 fungal isolates belonging to 5 genera are identified in this study as shown in figure-3. Among them 4 isolates were filamentous fungi namely *Aspergillus fumigatus, Aspergillus niger, Alternaria species and Penicillium species.* One isolate was yeast belonging to *Rhodotorula species.* Presence of *Aspergillus species, Alternaria species and Penicillium species* were also reported by other workers[13,14]. *Aspergillus fumigatus* is the most dominant species isolated in this study with 40% frequency. Followed by *Aspergillus niger*, *Alternaria species* with 24% and 20% respectively. But *Penicillium species* and *Rhodotorula species* are less frequent with 10% and 6% respectively as shown in the figure-5. *Alternaria species* in lift whereas. *Penicillium species* and *Rhodotorula species* was not found in both lift and office rooms.

Since air does not contain any nutrients and has low moisture content it is not conducive to the growth and survival of micro-organisms but it can act as important medium for carrying and spreading of biological agents. The order of prevalence of air microflora from highest to lowest in microbiology laboratory, classrooms, toilets, lift and office rooms. The results from this study showed that the microbiology laboratory, classrooms and toilets have more percentage of contamination with indoor bacteria and fungi comparing to lift and office rooms. The high rates in Microbiology laboratory is due to handling of microbiological specimens during practical hour's inspite of using disinfection procedures. The reasons for high percentage of bacteria and fungi the toilets are due to improper and low degree of hygiene and cleanness because of minimal usage of disinfection procedures against airborne microorganisms which has given rise to bio-contaminants. Lowest number of airborne bacteria and fungi were recorded in office rooms because of the regular cleaning of the floors properly with disinfectants and using room fresheners frequently. The number of bacteria and fungi is more in classrooms than that of the office rooms because of more number of students attending lecture classes during working hours but there are only few number of persons working in office rooms. The reason for more number of bacterial colonies in lift may be due to the dust coming from outside from the persons using the lift continuously during the working hours. The number of bacterial colonies in air samples from toilets is greater than the lift samples while the number of bacterial colonies in dust samples from toilets is less than the lift samples. The reason is unknown.

In order to safeguard the health of students, staff and workers proper control measures has to be taken to inhibit the environmental factors which favor the growth and proliferation of different bacteria and fungi in indoor environment of the college building[15]. More concentration should be given on maintenance of air conditioners because they can transmit biological agents such as allergen, mycotoxin, volatile organic compounds etc., into the air which can cause health problems. In order to develop the quality of indoor air in the college building first overcrowding has to be avoided and good ventilation systems has to be designed[16]. If the building has more moisture due to cracks in the wall, fungal spores can easily dispersed through the droplets and it can grow and proliferate extensively. Since our college building is new there are no cracks and moisture present in the walls, so there is a little chance of extensive growth of fungi.

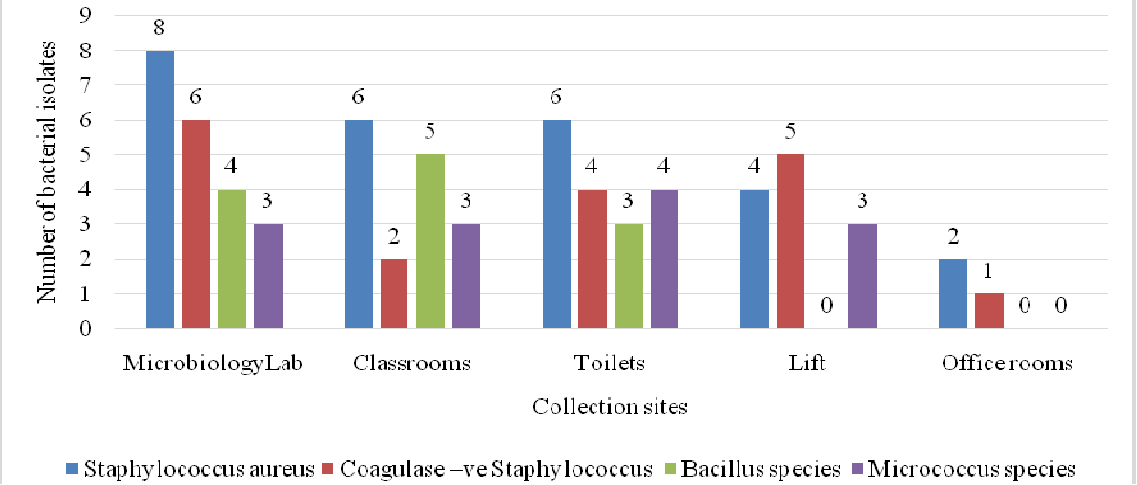

Figure-2
Frequency of different bacterial species isolated from different sites

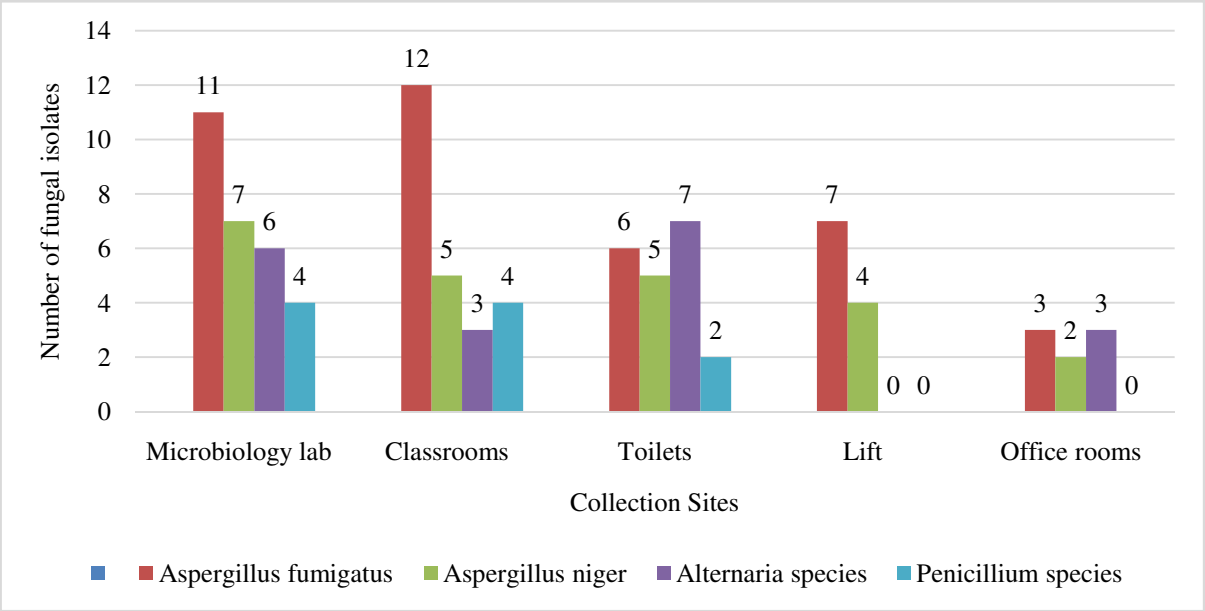

Figure-3
Frequency of different fungal species isolated from different sites

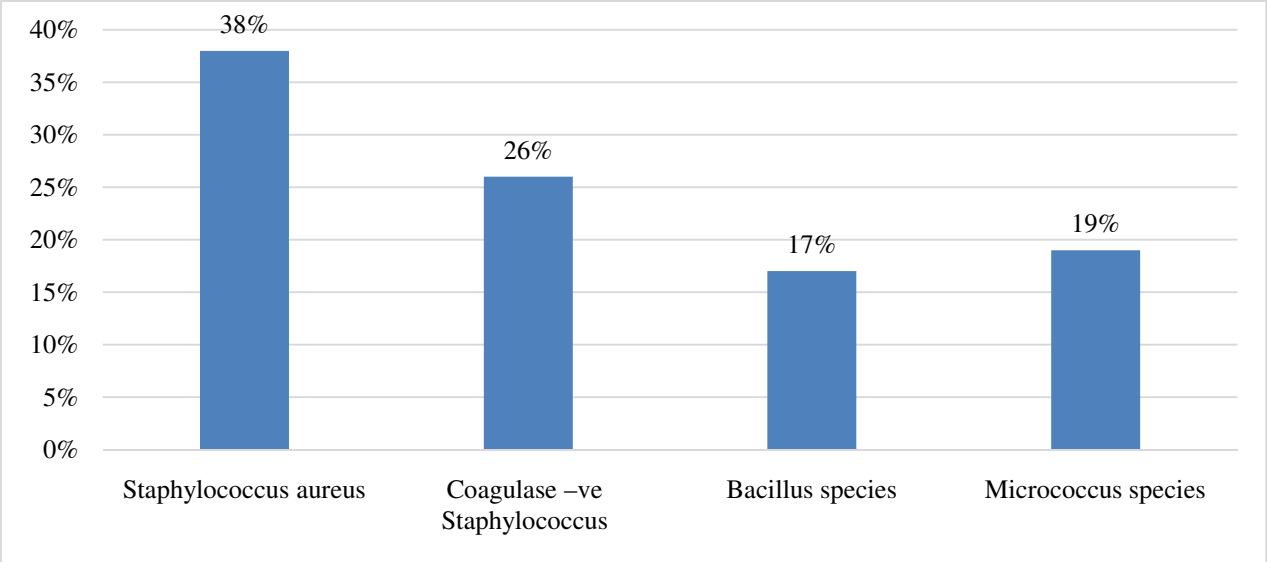

Figure-4
Percentage frequency of bacterial isolates

In our study, *Staphylococcus species, Bacillus species* and *Micrococcus species* were among dominantly isolated bacteria. Since some of the M*icrococcus species* and *Staphylococcus species* belong to normal flora of the human skin, it is likely that these microorganisms may be originated from the skin flora of the staff and students of our college. However, *Staphylococcus aureus* may cause disease through invasion and toxin production such as abscess, pneumonia, diarrhoea and the most feared toxic shock syndrome. *Bacillus species* can survive in the air for longer period of time since it produces spores which are resistant against severe environmental conditions. Many fungal spores have the ability to cause allergies as well as other respiratory diseases and hypersensitivity reactions not only in immunosuppressed patients but also in healthy individuals. The fungi belonging to *Aspergillus species* is found dominant in our study. *Aspergillus species* can cause invasive Aspergillosis and produce mycotoxins which are known to be carcinogens[8]. Other fungal spores also have the ability to cause allergies as well as other respiratory diseases and hypersensitivity reactions not only in immune suppressed patients but also in healthy individuals[17]. Hence, more attention should be given to safeguard indoor environments otherwise the growth of pathogenic microorganisms can cause toxigenic health hazards.

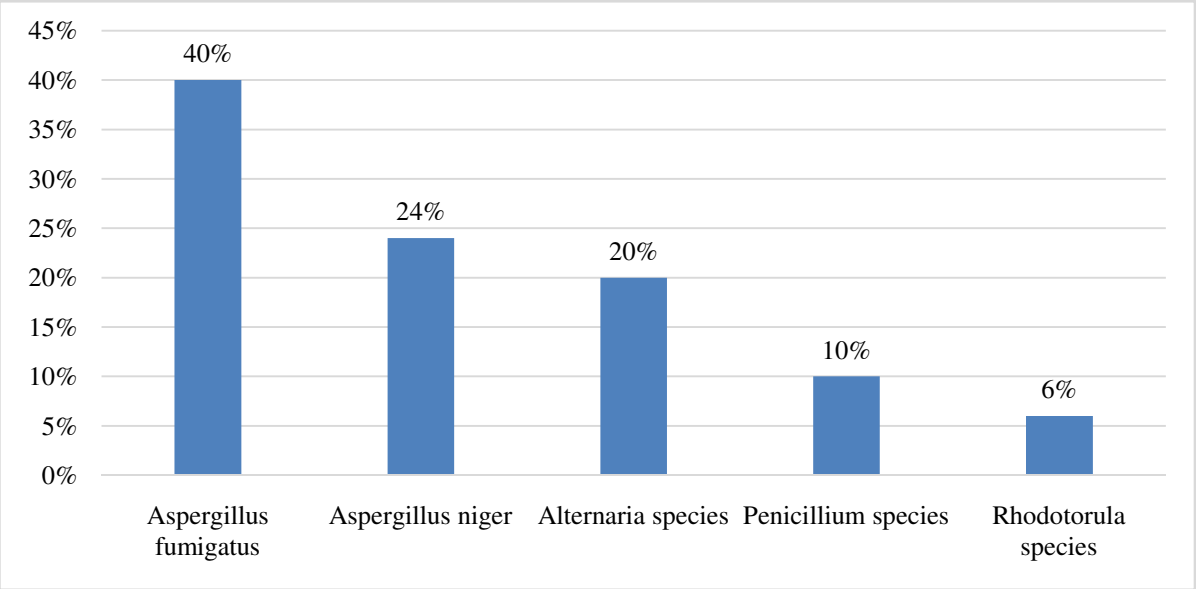

Figure-5
Percentage frequency of fungal isolates

Conclusion

Although microorganisms are present in our college, the amount is within the range (61 - 460 CFU/m^3) which indicates a low level of contamination according to the guidelines established by World Health Organisation[18]. In order to improve quality of indoor air more care should be taken to avoid overcrowding and to have good ventilation. Air conditioner should be maintained regularly. Laboratories and toilets should be cleaning and disinfected daily.

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