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Bacteriological study of air quality in Autonomous University of Puebla-Mexico

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Abstract

The study of air quality today is an essential tool to know how they interact different biotic and abiotic factors and take appropriate action to maintain an optimal balance in terms of environmental health. The aim of this study was bacteriological monitoring air in Autonomous University of Puebla-Mexico, in the area of the treatment plant waste water and bioterio. Bacteriological monitoring air was performed in Autonomous University of Puebla-Mexico for a year, quantified and identifies isolates, and the study of resistance to antibiotics. Bacteriological sampling was performed in the treatment plant and in the bioterio allowed the capture of a total of 8862 and 3460 CFU/m^3 respectively. Were identified Klebsiella (26%), Enterobacter (24%), Enterococci (21%), Proteus (12%), Escherichia (9%) and Citrobacter (8%). With respect to antibiotic resistance test showed greater resistance to bacitracin and vancomycin and in general all isolates were sensitive to ciprofloxacin. The environmental monitoring reflecting the situation at different times of the year, regions and even between intramural or extramural environments, provide relevant information to take appropriate action, influencing the quality improvement in environmental health.

Key words: Air quality, Andersen equipment, bioaerosols, bacteria, antibiotic resistance.

Introduction

The continuous exchange between water, air and land forces us to include into the atmosphere as part of the habitat of the organisms and study there several factors that determine their distribution, wherein the dispersion plays a very important role. It is a fact that only certain organisms the atmosphere will be efficient, and others will be a hostile environment in which only a few can withstand the pressure, so it is considered a selective medium[1].

Several research groups have focused on the study of microorganisms due to its importance in the industrial, medical, recreational and environmental, documenting that various microorganisms and most bacteria are essential to perform various beneficial processes in society, but there are also bacteria that may cause adverse effects indifferentareas[2-4].

Bacteria have intrinsic characteristics that allow their rapid adaptation and continuous evolution. Develop in soil, water and air, but not native ecological latter compartment, the bacteria can be induced to the atmosphere by natural processes such as wind and rain, or even by human activities such as is the case the wastewater treatment plants, waste management facilities, agricultural practices, and other activities that lead to the emission of microbial bioaerosols[5-7].

Thus, we can establish that the atmosphere has no native micro biota, but is a means for rapid dispersion and overall many types of microorganisms. Moreover there is a significant transfer them and their gaseous metabolites between the atmosphere, hydrosphere and lithosphere. Although the atmosphere is a hostile environment for microorganisms in the lower troposphere are a large number from them. The suspended bacteria can remain air borne for long periods and spread via air currents, achieving increase the likelihood of exposure and conditioning adverse public healtheffects[8-10].

Recently in Autonomous University of Puebla-Mexico has increased its enrollment considerably different anthropogenic activities taking place, in addition to a treatment plant wastewater and vivarium which can result in the emission of bio-aerosols, presenting a risk of environmental health. In relation to the above, the aim of this study was bacteriological monitoring air in Autonomous University of Puebla-Mexico.

Material and Methods

The methodology was developed in three stages: bacteriological sampling City University of Puebla-Mexico 19º 00'05" N and 98º 12'97" W, quantification and identification of microorganisms isolated from Andersen equipment function, and study of antibiotic sensitivity of isolates.

Two points were selected for sampling air, distributed generation sources bioaerosols possible: processing plant wastewater and bioterio. From January to December 2011were sampled every third day using bacteriological agar for counting eneralagar and Mac Conkey agar and Eosin Methylene Blue (EMB) for isolation of enterobacteria. During the samplings, air samples were taken with the Andersen six-stage equipment (Model10-709) in each of the two points assigned to a constant flow of 28 liters per minute, the sampling time was 60 seconds.

Samples were suspended in bacteriological agar incubated at 37°C for 24 hours and then quantified with Leica Park field Quebec equipment. Samples suspended in MacConkeyagar and EMB agar incubated at 37°C for 24 hours, the samples were isolated once on the respective media, and were transferred on to Luria Bertani (LB). For identification system was used to galleries API20E of Biomeriux, the inoculation was made directly with the isolation grown in LB broth standing one achmicrotubes 130 ul of culture and incubated at 37°C for 24 hours and the identification is performed using numerical software of the database (Biomeriux www.apiweb.com).

The samples were subjected to antibiotic susceptibility testing by the disk diffusion method (Kirby-Bauer) on Mueller-Hinton agar[11], and antibiotics were evaluated 1ug ciprofloxacin, vancomycin 5mg, 120mg gentamicin, netilmicinbacitracin10 mg and 30mg (Becton Dickinson).

Test was performed Mann-Whitney test to compare the difference between CFU/m^3 medium between the two sampling areas and the ANOVA test with their respective multiple comparison Tukey-Kramer to compare the sensitivity to antibiotics, considering significant when $P<0.05$ (InstatSoftwareV2).

Results and Discussion

Bacteriological sampling was performed in the treatment plant and bioterio, capturing a total of 8862 and 3460 CFU/m^3 respectively, showing significant difference $P<0.05$ (table 1).

The total samples were identified *Klebsiella* (26%), *Enterobacter* (24%), *Enterococci* (21%), *Proteus* (12%), *Escherichia* (9%) and *Citrobacter* (8%). With regard to antibiotic susceptibility testing of isolates obtained showed increased resistance to bacitracin and vancomycin, and in general all isolates were sensitive to ciprofloxacin (table 2). Statistically comparing the activity values between these antibiotics was observed that between ciprofloxacin-vancomycin, ciprofloxacin-bacitracin, gentamicin-bacitracin and bacitracin-netilmicin significant difference exists $P<0.05$.

Discussion: The obtained data in the area of the treatment plant are within the ranges reported ($1x10^2$-$2x10^5$ CFU/m^3) by other research groups, and with respect to the monitor red are abioterio noted the data are below reported levels ($3x10^2$-$14x10^3$ CFU/m^3). With respect to different culturable bacterial genera are presented in this paper and compared with the genera reported frequently in Mexico City (urban area) is presented with 4.9% *Escherichia*, *Enterobacter* 46.4% and *Klebsiella* 1%, *Enterobacter* constantly prevails with the highest percent age in the work reported[12].

Table 1
Total data are presented for each are a sampled per month

Sampling month	Treatment plant CFU/m^3	Bioterio CFU/m^3
January	541	286
February	596	278
March	648	296
April	852	265
May	864	290
June	892	305
July	871	323
August	786	310
September	755	286
October	713	278
November	696	283
December	648	260

The comparison of the total data between the two sampling are as showed significant difference $P<0.05$.

Table-2
Inhibition halos in the different isolated in presence of antibiotics

Genus	Ciprofloxacin (mm)	Vancomycin (mm)	Gentamicin (mm)	Bacitracin (mm)	Netilmicin (mm)
Enterobacter	34.3	23.1	30.7	21.1	32.6
Klebsiella	35.2	23.4	31.0	22.0	31.8
Escherichia	36.3	31.7	33.7	28.7	36.3
Enterococci	32.0	24.5	28.5	22.1	31.0
Citrobacter	34.8	32.0	32.6	23.6	32.0
Proteus	35.9	33.6	31.8	31.6	36.4

(mm): millimeters, Significant differences $P<0.05$ between ciprofloxacin-vancomycin, ciprofloxacin-bacitracin, gentamicin - bacitracin and bacitracin-netilmicin.

The antibiotic sensitivity test allowed us to appreciate the importance of environmental health isolated from showing that in most of the samples monitored is most sensitive to ciprofloxacin, which confirms that the bacterial population has not been in frequent contact with such antibiotic, which is important to note that in a while antibiotics are actively involved in the selection of resistant bacteria without forgetting that the speed with which resistance genes are also contributing to this problem. The selection of resistant organisms can occur during or after treatment with antibiotics, and the residues of these can be set at the temperature for substantial periods of time after treatment[13].

In relation to the data derived in the present investigation we consider that the physicochemical conditions of the atmosphere

do not encourage the growth or survival of micro organisms at most it can only survive for a short period of time. In addition to seasonal variations influence the number of microorganisms present in the atmosphere, as in the case of fungi that are typically more abundant in summer, while bacteria are more abundant in spring and fall due to factors such as temperature, relative humidity and exposure to sunlight, information that supports what is presented in this paper[14].

The major sources of bacteria in the air are caused by man, the most important sewage and animal waste. Degradation and digestion of wastes produces aerosols containing bacteria, some of which may be pathogenic, and the most significant effect on the human population (from the economic view point and the number of affected people), attributed to bioaerosol sextramural source, are the problems of hypersensitivity, including allergicrhinitis, asthma, and some infections. Bioaerosols presence of cell wall components of bacteria, as is the case of the endotoxin of gram-negative and lipoteichoic acids of gram-positive, it represents a health problem. Inhalation of these compounds cause febrile reactions and an intense inflammatory response in exposed individuals[15].

One of the main components responsible for this effect is the endotoxins, a term used to describe the lipopolysaccharide from the outer membrane of Gram-negative bacteria, which produces a toxic effect. Lipid Aoflipo polysaccharide is chemically distinct from other lipids of biological membranes and is responsible for the toxic activity of the molecule. Endotoxins are ubiquitous, given the cosmopolitan nature of Gram-negative and extramural environments found a seasonal pattern in the concentration of endotoxin present in the air, being higher during the summer[16]. However, higher concentrations in the atmosphere have been obtained in occupational environments, such as factories, where they are processed vegetable fibers (such as cotton), plants sewage treatment and even inhospitals[17-21]. As such it is advisable to perform environmental monitoring and environmental monitoring processes and ensure these actions a better quality of life in exposed populations, both intramural and extramural environments[22].

Conclusion

In conclusion, the environmental quality monitoring allow to know the real situation indifferent seasons, regions and even between intramural or extramural environments, providing relevant information to take precautionary measures in the short and medium term, ensuring these actions affect the quality improvement in environmental health.

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