Microbiology Research Journal International

Volume 34, Issue 6, Page 20-24, 2024; Article no.MRJI.115987
ISSN: 2456-7043, NLM ID: 101726596
(Past name: British Microbiology Research Journal, Past ISSN: 2231-0886, NLM ID: 101608140)

Assessment of the Bacteriological Properties of Indoor Dust in some Classrooms of Delta State University of Science and Technology, Ozoro

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.9734/mrji/2024/v34i61449

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/115987

Original Research Article

Received: 13/02/2024
Accepted: 17/04/2024
Published: 25/05/2024

ABSTRACT

The bacteriological properties of indoor dust in some classrooms of the Delta State University of Science, Ozoro was examined with a view to identify any possible source of pollution of classroom indoor air quality; measurement of microbial load of classroom dust sample and to compare findings of selected locations as a means to determine high air polluted areas. This was done by the collection of dust samples from classrooms table and chair surfaces. It was observed that the amount of bacteria available in classrooms differ based on activities in and around the classrooms. Bacteria isolates indicated the presence of pathogen associated with disease such as *Bacillus sp;*

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Cite as: *Orogu J.O., Ehwarieme, D.A., Okinedo, J.I., Eze E.M., & Okobia U.B. (2024). Assessment of the Bacteriological Properties of Indoor Dust in some Classrooms of Delta State University of Science and Technology, Ozoro. Microbiology Research Journal International, 34(6), 20–24. https://doi.org/10.9734/mrji/2024/v34i61449*

Staphylococcus sp; Micrococcus sp. of indoor air pollution exist and this is identified as open dump practice birthing more microbial cells which are transported through air and poor sanitation practice around and within the classrooms. Contamination of sample was observed for dust at different locations with the bacteria count seen to be higher at sample C ($1.8x10^2$cfu/m^3) and lower in sample D ($0.2x10^2$cfu/m^3). *Staphylococcus sp* dominated all the locations that were analyzed while *Micrococcus sp.* only occurred in site C. This is because poor environmental sanitation is observed at certain classrooms in addition to shattered classroom windows given an ease of access of dust flow indoor. It can be concluded that only a minimal sources of indoor air pollution exist and hence only a small amount of bacteria is present. In spite of this, prevalence of such practices is likely to promote the growth of more microbial cells.

Keywords: Assessment; bacteriological; classrooms; dust; indoor; properties.

1. INTRODUCTION

Dust is a solid material or particle that is typically less than 100 µm and in the form of fine powder. It is frequently discovered on the ground, on the surface of things, or blown about by mechanical or natural forces [1]. It is discharged from a variety of human endeavors, such as commercial, industrial, municipal, and agricultural operations. As a major source of heavy metal contamination in the urban environment, dust has currently received little attention [2]. But dust—which includes aerosols that are frequently responsible for interior air pollution—as well as vehicle exhaust, sinking airborne particles, house dust, soil dust, and soil dust all significantly contribute to pollution in the urban environment.

Microorganisms and other hazardous organic and inorganic contaminants have been found in dust in metropolitan areas. These microorganisms have been linked to a number of stationary and mobile sources, including automotive exhaust, airborne particles that sink, dust from houses and soil, and aerosols carried by the air and water [3]. Microorganisms from dust can land on food, beverages, and indoor appliance surfaces, posing a health danger to nearby residents. A person can become infected through ingesting from contaminated hands, hand-to-mouth transmission from adult behavioral patterns, or individual physiological differences. The air found inside buildings is referred to as indoor air. The air quality is often altered through to increased levels of microbes in air dispersed from unsanitary environment and/or other human activities. The most common genera of bacteria found in indoor air are *Staphylococci, Bacilli, and Clostridium* [4].

According to a 2015 study by Akpofure on the evaluation of indoor air quality in certain homes, air contaminants were found in indoor air samples at extremely dangerous levels. *Bacillus sp., B. subtilis, B. cereus, Streptococcus sp., Bacillus sp.,* and *Micrococcus sp.* were among the germs identified in the isolates of bacterium genera. Research has indicated that dust possesses the ability to harbor microorganisms, which may contribute to their existence on domestic surfaces after being adhered to and carried by dust particles. Since students spend the majority of their time indoors and come into touch with classroom surfaces frequently, this is caused by crammed classrooms and the proximity of sources of release, such as waste dumps, which can lead to ingestion and inhalation [5]. As reported by Abulede et al. [6] there are significant effects of weather on the pollutants, especially temperature. Another study by Oguntoke et al. [7] revealed rural dwellers to be exposed to poor air quality with the concentrations of the five monitored gases significantly higher than the permissible limits.

The World Health Organization estimates that about two million people die prematurely every year as a result of air pollution, while many more suffer from breathing ailments heart disease, lung infections and even cancer [8]. People's exposure to air pollution is determined by the concentrations of pollutants in the environment and the time individuals spend in the polluted environments. According to Shittu et al. [9], the factors that can have a negative effect on health and comfort ranges are chemical and biological pollutants. Biological pollutants are of immerse important because most of these microorganisms are pathogenic. The information on the microbial concentrations of airborne bacteria is necessary both to estimate the health hazard and to create standards for air-quality control [4].

This study is necessary to determine any potential sources of indoor air pollution in classrooms, measure the microbial load of a

sample of dust, and compare the results of selected locations to identify high air polluted areas because there is a dearth of information on classroom dust and related microorganisms.

2. MATERIALS AND METHODS

2.1 Study Area

Ozoro is a community in Delta state situated at Latitude: 5.5383 and Longitude: 6.2161. it is the headquarters of Isoko North Local Government Area of Delta State serving as the administrative units of the Isoko regions in Delta State Nigeria. It boosts an estimated population of 13,411 [10] inhabitants and land mass of 1.136km^2. It is home to both municipal and industrial activities. Aside these, it is often subjected to frequent flooding which helps in dispersing pollutants over a large area. Ozoro falls within the southern tropical evergreen forest zone and characterized by two climatic seasons. Ozoro is home to a tertiary institution constituted large amount of classroom. Location of these classrooms and academic activities may play a role in the prevalence of the transport and deposition of dust contaminating microorganisms.

2.2 Sample Collection and Preparation

Sixteen dust samples (four samples per classroom) were obtained through the use of a hand brush and a sample can from classroom table and chair surfaces. This was done for different days until a quantifiable amount of indoor dust is obtained and labeled accordingly. The indoor dusts were transported carefully to the laboratory for analysis.

3. METHODS

3.1 Culturing and Enumeration of Bacteria in Air Samples

1g of representative dust samples were weighed and diluted with 9ml sterilized distilled water in sterilized test tubes to make serial dilutions of 10^{-1} to 10^{-9}. 0.1ml aliquot from the 5th serial dilutions (mostly low concentration for bacteria) were collected and pour on already prepared nutrient agar plates. These plates were hence Incubate at 37^{o}C for 24 hours before colonies were enumerated using colony counter.

3.2 Isolation, Characterization and Identification of Bacteria in the Air Samples

Pure cultures of bacteria were obtained by aseptically streaking representative colonies of different morphological types, which appeared on the cultured plates onto freshly prepared Nutrient agar plates and MacConkey agar plates and incubated at 37^{o}C for 24 hours. These serve as pure stock cultures for characterization and identification.

3. RESULTS AND DISCUSSION

3.1 Results

Average results of microbial load in indoor classroom dust is represented below;

3.1 Bacterial Count

The bacteria count ranges from 0.2 x 10^2cfu/m^3 to 1.8 x 10^2cfu/m^3

Table 1. Average results of measured bacteria count

Classroom	Bacteria Count
A (cfu/m^3)	0.8 x 10^2
B (cfu/m^3)	1.7 x 10^2
C (cfu/m^3)	1.8 x 10^{2*}
D (cfu/m^3)	0.2 x 10^2

3.2 Discussions

The result obtained for microbial assessment of indoor classroom dust showed the presence of bacteria in classroom furniture's. It was observed that the amount of bacteria available in dust differ for various classrooms with the presence of isolated bacteria such as *Bacillus sp; Staphylococcus sp; Micrococcus sp.* The presence of these microbes in classrooms can be attributed to promoting factors including humidity and temperature. Also, the presence of unhygienic practice can be observed also to cause its presence and spread around classroom tables and chair in addition to open dumping practices in and around the classroom. From the study, it was observed that the bacterial load for the dust samples showed that the bacterial counts varied depending on hygiene of the classrooms. This is because poor environmental sanitation is observed at certain classrooms in addition to shattered classroom windows given an ease of access of dust flow

Table 2. Bacteria isolate from classrooms

Bacteria Isolates	A	B	C	D
Strains	*Bacillus sp; Staphylococcus sp;*	*Bacillus sp; Staphylococcus sp; Micrococcus sp*	*Bacillus sp; Staphylococcus sp;*	*Staphylococcus sp;*

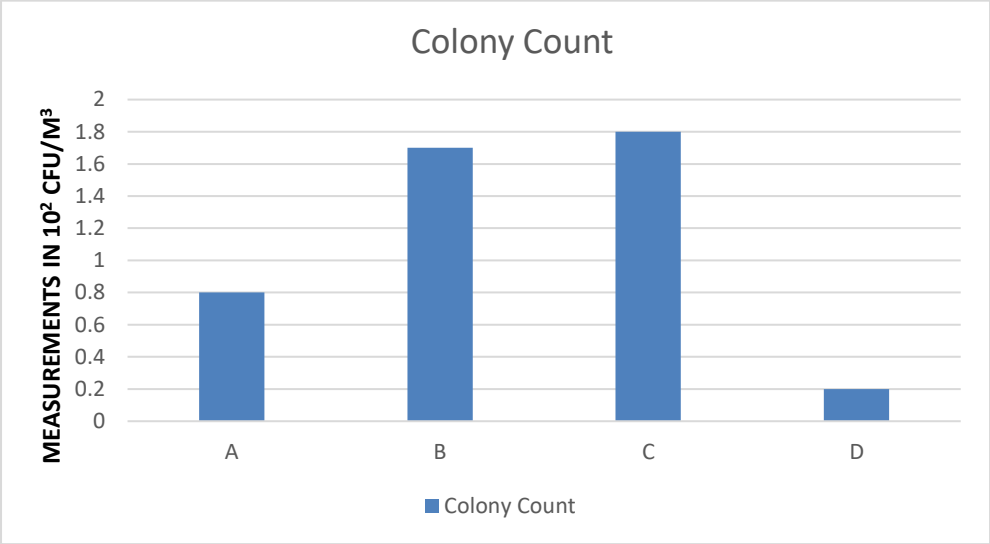

Fig. 1. Average result of bacteria count for different classrooms

indoor. It is also as a result of poor cleaning practices especially with the absence of sanitizing materials. This result is similar to findings by Sharif et al. (2019) with high microbial count in indoor dust in learning center. It is clear from the results obtained in this study that bacterial load increased at a favorable temperature.

5. CONCLUSION AND RECOMMENDATIONS

The results obtained on microbial load reveals the presence of bacteria in indoor classroom dust although in small amount, promoting by wing transport, unhygienic practice and favored by likely environmental condition. It is however important to maintain reduced environmental pollutions to minimize the levels of microbes in classrooms. It can be concluded that only a minimal sources of indoor air pollution exist and hence only a small amount of bacteria is present. In spite of this, prevalence of such practices is likely to promote the growth of more microbial cells.

It is recommended that the following mitigating measures are adopted to minimize pollutant levels and exposure risk; Classroom conditions which give rise to inflow of dust should be avoided by proper maintenance of classroom windows as a means to minimize indoor microbial presence. Good sanitation practices should be actively done around and within classrooms through the use of active cleaning agents such as disinfectants. Waste litter around municipal classrooms should be prevented through awareness campaign in addition to proper hygiene practice.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/115987