Spatial and seasonal assessment of bioaerosols associated with municipal solid wastes in Yenagoa metropolis

Abstract

The proliferation of microbes in dumpsites includes putrefying bioaerosols fouling the air quality. This study assessed the bioaerosols of 6 Municipal solid wastes dumpsites, with regard to microbes suspended in the air using the sedimentation or settle plate method. Aseptically prepared Nutrient agar, Sabouraud Dextrose agar and MacConkey agar were partially opened and suspended in platforms of the dumpsite for 30 minutes. Afterward the samples were incubated in-situ. Results for total heterotrophic bacteria ranged from 49-73 cfu/30 minutes for dry season, and 44-51 cfu/30 minute for wet season. Total fungi ranged from 24-37 and 17-37 cfu/30 minutes for dry and wet seasons respectively. Meanwhile the levels of enterobacteriaceae ranged from 22-43 and 20-31 cfu/30 minutes in dry and wet seasons respectively. The control station indicated the lowest level of microbes compared to all assessed stations. The two stations in the central dumpsite indicated the highest levels of microbial densities. Notwithstanding, bacteria densities were relatively higher in dry season compared to wet season, but the reversed was the case for fungal densities. Result confirmed that the proliferation of bioaerosol due to anthropogenic activities associated to putrefying bacteria from unsanitary disposal of waste streams.

Keywords: bioaerosols, microbes, waste stream, anthropogenic activities

Introduction

The problems posed by poor handling of municipal solid waste have become a global threat to biodiversity and key resources of the ecosystem. In most developing nations, policies put in place to regulate the reduction, reuse and recycling waste streams are ineffective.1 Due to urbanization and industrialization the magnitude of waste stream in most metropolises have become worrisome.2 For instance, in Nigeria, the daily magnitude of waste stream is estimated to be in the range of 0.44-0.66 kg/capital/day, culminating to of 25 million tons per annum.4 In addition, the desire for contemporary technologies may have incurred some toxic waste that find their way to the ecosystem.5

Piles of unattended waste stream undergo physical, chemical and biological transformation that emits toxic aerosol that infringes on ambient air quality. For instance, foul odour is produce when biomass are acted upon by putre-fying bacteria.6 As documented in literature, due to atmospheric mobility the dispersal and the transmission of pathogenic bioaerosols to the ecosystem have become inevitable.7 Dumpsite bioaerosol of microbial origin have been reported as a major source of air pollution.3 This research therefore seeks to assess the spatial and seasonal level of bioaerosol associated with municipal solid waste dumpsites in Yenagoa metropolis.

Materials and method

Media preparation technique

The microbial enumeration of the dumpsite aerosol was carried out based on standard protocol,6,10 using the settle plate culture or sedimentation technique as describe by Ambroze et al.8. The total of aerobic microbial count was determined using Nutrient Agar for bacterial, Sabouraud dextrose agar for fungi and Mc Conkey agar for enterobacteriaceae. The nutrient agar was fortified with 50μg/ml of Ketoconazole, while the Sabouraud dextrose agar was fortified with 100μg/ml tetracycline.

Sampling technique and laboratory analysis

Aseptically prepared media in Petri dishes containing 20ml of the aforementioned culture media (in triplicates), were suspended on a pegged makeshift 4ft wooden platforms and exposed for 30 minutes. The sampling was carried out in 7 sampling stations (LA-LF), and a control station (LX). The petri dishes were closed after duration of exposure, and transported to the laboratory for incubation. The bacteria and coliforms were incubated at 37°C for 24hours, while fungi were incubated at 28±2°C for 72 hours. The enumeration of the microbial species were carried out with the aid of a Quebec colony counter, and expressed as cfu/30 minutes.

Result and discussion

Figure 1 presents results of the spatial and seasonal distribution of bacterial aerosols. Results showed that bacterial bioaerosols ranged from 40–73 cfu/30 minutes, with lowest values in the control station (LX). Based on seasonal variation, higher bacterial counts were reported in dry season compared to wet season. Furthermore, lowest bacterial count was reported in the month of May at station LD, highest bacterial count was reported in the month of November at station LF (Figure 1).

Figure 2 presents the spatial and seasonal variation of fungal count. Results showed that the spatial variation of fungal count which ranged from 23–47 cfu/30 minutes, with the control station having the lowest value. Based on seasonal variation, higher fungi count was reported in wet season compared to dry season. This was in contrast compared the trend of bacterial count (Figure 1). Notwithstanding, highest and lowest fungi count was reported in the months of July and January respectively. Results of the seasonal and spatial variation of enterobacteriaceae associated with the dumpsite is presented in Figure 3. Result showed that the spatial distribution of enterobacteria count ranged from 20–43 cfu/30 minutes, with lowest count in the control station. In addition, higher enteric bacteria count were reported in dry season compared to wet season. Highest and lowest enteric bacteria count was reported in the months of March and July respectively (Figure 3).
Comparatively, the studies of Ambrose et al.\textsuperscript{8} in Uyo Metropolis, reported bacterial count ranging from 16 - 64 cfu/15 minutes, 1 - 39 cfu/15 minutes for coliforms and; 13 - 77 cfu/15 minutes fungi. A recent study on microbial assessment of soil isolated from dumpsite in Yenagoa Metropolis by Angaye et al. (2018), showed the following microbial ranges; for bacteria (9.30-20.5 X10\textsuperscript{6} cfu/g in dry season, and 5.43-13.41 X 10\textsuperscript{6} cfu/g in wet season), fungi (16.63 - 28.56 and 10.51-20.70 X10\textsuperscript{4} cfu/g), and enterobacteriaceae (14.27- 27.90 dry season and 10.30 – 21.40 X 10\textsuperscript{4} cfu/g in wet season). They reported higher bacterial count in dry season, which was in contrast to higher fungal in wet season. Furthermore, predominant bacterial species were; Bacillus spp., E. coli, Pseudomonas spp and Staphylococcus spp; while fungal isolates includes Aspergillus spp., Penicillium spp., Rhizopus spp., and Saccharomyces spp.

**Conclusion**

This research investigated the spatial and seasonal diversities bioaerosols associated with MSWs dumpsites in Yenagoa metropolis. Results showed that there are pathogenic microbes fouling air quality and public health. Consequently, aseptic disposal and containment of waste stream have become necessary, in order to mitigate adverse health effects that may arise from poor handling of waste. In addition, dumping or sighting of waste dumpsite close to public places, and effective legislations and polices should be enacted to reduce, reuse and recycle waste stream.

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None.

**Conflict of interest**

The authors declare that there is no conflict of interest.

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