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Microbiological assessment of waste dump site at Obo market, Obong Ntak, Etim Ekpo LGA, Akwa Ibom State

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Abstract
The aim of the study was to carry out microbiological assessment of the microorganisms associated with waste dumpsite. A total of six samples of waste were collected from different dumpsite in Obo market at Etim Ekpo local Government Area and were examined for their microbiology and physiochemical properties using standard laboratory techniques. A total of eleven (11) microorganisms were isolated from soil samples, eight (8) were bacteria isolates, while three (3) were fungal isolates. The bacterial isolates were identified to be *Escherchia coli, Staphyloccus aureus, Bacillus subtilis, klepsiella species, Bacillus cereus, Micrococcus species, Actinomyces* israeli and Enterobacter aerogenes while the fungal species were Penicillium *notatum, Aspergillus niger and mucor species*. Enumeration of total heterotrophic and total coliform bacteria and fungi isolation, characterization and identification of these isolates were all done using standard microbiological techniques. This shows that the soil in that area contains a lot of bacteria and chemical pollutant that exceeded recommended standard. The total coliform count ranged from 3.2×10^4 to 6.1×10^2 while total heterotrophic bacterial and fungal count ranged from 2.6×10^4 4.3×10^2cfu/g and 2.0×10^4 to 3.1×10^2cfu/g respectively. Municipal and industrial waste in the market contribute to the high contents of bacteria and chemical pollutant that exceed the recommended standard of 20% municipal waste, 15% commercial waste and 30% mineral oil and heavy metals respectively. This was achieved when the population was multiplied by the waste generation per head/day ×365days in the recommended standard hence these constitute a public health issue.

Keywords: Microbiological assessment, Waste dumpsite, Etim Ekpo

Introduction

Wastes are unwanted or unusable materials which are discarded after primary use, or is worthless, defective and of no use. With urban industrialization, social development and population increase, solid waste production are growing rapidly, posing serious problems in production industries and domestic homes. Most human activities generates waste (Brunner and Rechberger, 2014) [1]. Despite that, the production of waste remains a major source of concern as it has always been since pre historic period (Chandler *et al*. 1997) [2]. In recent times, the rate and quantity of waste generation have been on the increase. As the volume of waste increases so also do the variety of the microbes increases (Vergara and Tchobanoglous (2012) [5]. Unlike the pre_ historic period where wastes were merely a source nuisance that needed to be disposed of, proper management was not a major issues as the population was small and vast amount of land was available to the population at that time. In those days, the environment easily absorbed the volume of waste produced without any form of degradation (Tchobanoglous *et al*.1993) [7].

A waste is said to be hazardous if it is infectious meaning containing viable microorganism or their toxins which are known or suspected to cause disease in animals or humans (Williams, P. T, 2005) [9]. Waste disposal poses threat to both man, animals and the soil. Chemical hazards and aetiologic agents might be dispersed in the environment through water and wind (Trung, D.N., and Kumar, S. 2005). Poisonous plants, insects, animal, and indigenous pathogens are biologic hazards that might be encountered at the waste site. These waste materials are packed with a tremendous source of energy and nutrients (protein, carbohydrate, lipids etc.) which serves as food source to a diverse class of microorganism (Chen *et al*. 2001) [1].

The health problem associated with dump siteb are related to their emission which usually involve persistent organic pollutants such as lead, heavy metals and Volatile organic Compounds like Benzene, Ethylene glycol, Formaldehyde, Toulene etc. The actual health risk depends on the practices followed and on the type of waste at each dump site, as well as the environmental and social conditions of the area (Vergara and Tchobanoglous, 2012) [5]. Uncontrolled disposal of harzardous and health care waste as well as manual on site treatment and disposal of waste by informal workers result in important increases of health risks and the negative environmental impact (Guisti, 2009).

There is therefore the need to isolate, characterize, and identify the types of bacteria, and fungi associated with waste dump sites. Hence this study was carried out to assess the potential health hazards that could result from indiscriminate dumping of waste around the residential areas.

Material and Methods

Study Area

This study was conducted in Etim Ekpo, Akwa Ibom state, south-south region of Nigeria. Etim ekpo has a population size of about 305, 21 (Census report, 2006) and is seen by many as fast growing city both economically and population wise. The city lies between latitude 5.5 and 6.0 and longtitude 6.0 and 6.5 of the Green which mendian. It is located in the rain forest belt with elevation of less than two feet above sea level. With its status as a developing capital city,it is surrounded by several sub-urban and rural communities. The maximum temperature experienced is between 26-28 degree Celcius and annual rainfall of about 362-365mm.

Sample size and sample collection

A total of 6 samples were collected across three dumpsites during the period of this study. At each sampling station, the surface debris was removed and subsurface soil, dug to a depth of about 5cm was scooped from one foot square area into sterile duplicate sampling containers and appriopriately labeled. Size samples two from each site was collected from each visit.

Method

Physiochemical properties of the samples and the physical properties of the soil samples that were analysed include the p^H, temperature and acidity.

Chemical Properties

The chemical properties that were analysed include, chemical oxygen demand (COD) Biochemical oxygen Demand (BOD), Total Dissolved solid (TDS), Dissolved oxygen (DO)etc.

Heavy Metals

The heavy metals were analyzed using atomic absorption spectroscopy (AAS). They includes Zn-Zinc, cd-cadmium, mg- magnesium, cr-chromium, Hg-mercury etc.

Isolation of bacteria from waste samples

Serial dilution techniques were used for the isolation of bacteria and fungi. For each sample 1g of sample was thoroughly mixed in 10ml of sterile normal saline (the stock).Sample were vigorously mixed during dilution to assist in dislodging the bacteria from the soil particles. Sterile distilled water was labeled sequentially starting from stock and 10^{-1} to 10^{-4}. One ml from the stock will be transformed to the 10 dilution test tube using a sterile pipette. One ml from 10^{-1} dilution was transferred to 10^{-2} tube for each succeeding step then from the 10^{-2} to the $10^{3,}$ then, from the 10^3 to the 10^4 (Paul and Clark, 1988). From the dilution of 10^{-4} and 10^{-5} of each soil sample, one ml aliquot was transferred aseptically onto freshly prepared nutrient agar plates. The inoculated plate were inverted and incubated at 37 °C for 24-48hrs after which the plates were examined for growth. The discrete colonies which develop were counted and the average counts for duplicate cultures recorded as total viable aerobic heterotrophic bacteria in the sample. Similarly, from dilution of 10^{-3} of each soil sample, 0.1ml aliquot were transferred aseptically unto freshy prepared sabouraud's dextrose agar plates for isolation of fungi (Harrgan and McCance 1990). The inoculum was spread with a sterile bent glass rod. The inoculated plates were inverted and incubated 28 °C (room temperature) for 5 to 7 days. The colonies which developed were counted and the average count for duplicate recorded as total viable fungi in the sample.

Purification of isolates.

Pure culture of bacteria were obtained by aseptically streaking representative colonies of different morphological types which appeared on the cultured plates onto freshly prepared nutrients agar plates which were incubated at 28^0c for 24hrs.Discretes bacteria colonies which developed were sub cultured on nutrients agar slant and incubated at 28^0C for 24hrs.This will serve as pure streaked cultures for subsequent characterization test. The pure cultures were identified on the basis of their cultural, morphological and physiological characteristics in accordance with method described by Chessbrough.

Result

Microbial Count

The microbial counts of the soil sample from different locations at the waste dumpsites in obo market is presented in table 4.1. The total coliform count ranges from 3.3×10^{-6}-6.1×10^{-5}cfu while total heterotrophic bacterial and fungal counts ranged from 2.6×10^2cfu/g-4.3×10^2cfu/g and 2.0×10^4-3.1×10^4cfu/g respectively.

Table 1: Heterotrophic bacterial and fungal TCC, THBC, and THFC

Samples (Dump Waste	TCC	THBC	THFC
A	3.1×10^4	2.3×10^4	2.2×10^4
B	5.3×10^2	3.1×10^4	2.1×10^4
C	6.2×10^2	4.2×10^4	2.2×10^4

Key: TCC: Total Coliform Counts, THBC: Total Heterotrophic Bacteria Count. THFC: Total heterotrophic Fungal Count.

Characterization and Identification of Microbial Isolates

The microbial isolates were characterized and identified by colonial morphology, microscopic examination and biochemical tests using taxonomic scheme Bergeys manual of determinative bacteriology. The results obtained from the microbiological analysis of the soil reveals the presence of Bacillus cereus, Micrococcus species, Actinomycetes, Enterobacter aerogenes, Vibro cholera, staphylococcus aureus, Klebsiella species, Escherichia coli and Bacillus

subtilis

Table 2: Characterisation of Fungal Isolates from water samples

Water samples	Pigment morphology	Hyphae Septate	Reproductive Structure	Probable Organisms
A	Greenish blue colony	Septate	Longerected single corudiospores	Penicillium notatum
B	Brownish powdery colony	Septate	Rough and Dark	Aspergillus
C	White cotton wool like colony	Non -septate	Smooth conidiospore	Mucor sp

Discussion

The microbiological and physiochemical analysis of waste dumpsite in popular Obo market revealed the presence of coliform organisms mainly of human origin as clearly seen from the soil sample. Higher counts were prevalent in station C commonly associated with the residents and other inhabitants in the area.

The common Salmonella typhi and Yersinia species obtained by the bacterialogical study of the rural and urban areas were not encountered within the duration of this work. During the course of this research work, it was observed that the physical condition of the soil contributed to the poor crop yield. A total of eleven (11) microorganisms were isolated from the soil samples, eight (8) bacteria isolates and three (3) fungi isolates. The bacteria isolates were Staphylococcus, E.coli, klebsiella, Actinomycetes, Bacillus, cereus, B. Subtillis, Micrococcus species and Enterobacter acrogens while the fungal species were: Penicillum species, Mucor species and Aspergilus species. The result showed that the bacteria in the waste dump site are mainly from the waste dumps scattered in the area and the coliform is mainly from the human origin. Microorganisms need an environment with the PH range between 6.0-9.0 and in this work, the PH range from 7.02-7.31 gave the microorganism the ability to survive in the soil. The presence of heavy metal like Mn-magnesium, Zu-Zinc, fe, iron, k-pottassium, Mg-magnesium, cu-copper, found in the soil sample are from wastes, from industries, petrochemicals, etc. and littering of metals from garbage and the waste dump. The metal concentration and distribution is a function of particle size, sanity and organic contents. The level of heavy metals according to environmental contamination by heavy metals like copper, iron, lead awaken great concern because they constitute a health hazard to man and other wild life when accumulated within the biological system like the soil, which often constitute industrial influence. Copper can also cause gastrointestinal irritation and corrosion in the liver and kidney.

The chemical analysis of the soil showed higher level of some toxic elements like Mercury, Lead, Chromium, Cadmium and Arsenic which indicated chemical pollution. Bio-accumulation of these metals by plant could be very detrimental to health if they are consumed by man in some cases could lead to death.

Conclusion

The microbiological analysis of waste dump site in Obo market revealed that the soil in that rural area contains bacteriological and chemical pollutant which exceed the interventional standard recommended by world health organization (WHO), American public health association (APHA) and Federal environmental protection agency (FEPA) of 20% municipal waste, 15%commercial waste and 30% mineral and heavy metals when we multiply the number of waste generation per day × 365 days (WHO, 2007) [8]. This informed the suggestion that government should set up monitoring team to go round all the dumping sites to ensure proper sanitation and destruction of waste in the Local Government and the State to prevent disease outbreak

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