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Effects of Municipal Solid Waste on Soil Bacterial From Oke-Ijebu in Akure Metropolis

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ABSTRACT

Soil from dumpsites waste with no proper waste handling method are sources of pathogens to the soil and stream. This in turn may contribute to the emergence of community acquired infections. This study was conducted to obtain an insight into bacteria from dumpsite soil and the nearest stream in Oke Ijebu along Oja Oba road, Akure, Nigeria. Bacteria from the soil of the dumpsites was isolated in a nutrient agar medium plate, representative colonies of the isolates were subjected to further analysis. The bacteria recovered from the sample include: Bacillus anthracis, *Enterobacter* spp, *Staphylococcus* spp, *Pseudomonas aeruginosa, Paenibacillus lantus*, *Shigella sonnei, Salmonella* spp and *Citrobacter* spp were identified. The highest mean bacteria count was from the dump site soil which was 1.013×10^{8} cfu/g while the lowest mean bacteria count was 1.85×10^{5} cfu/g. There is a need for environmental agencies and governments to take appropriate preventive measures to avert potential problems due to dumping of domestic waste near a water body.

Keywords: *Soil, Dumpsites, Domestic waste.*

INTRODUCTION

The soil contains many types of microorganisms such as bacteria, Actinomycetes, fungi and algae which are important because they affect the physical, chemical and biological properties of the soil (Tortora *et a.l*, 2007). Soil is a mixture of broken rocks and minerals, living organisms and decaying organic matter called humus this also includes water and air (Yakowitz, 2008). Organisms in the soil needs air and water to survive, having these essential materials; air, water, and organic matter makes it possible for plants, bacteria, fungi and small animals like earthworm and insects to live in the soil (Sangodoyin, 1993). Microorganisms play an important role on nutritional chains that are important part of the biological balance in life. Where bacteria are essential for the closing of nutrient and geochemical cycles such as the carbon, Nitrogen, Sulphur and phosphorus cycle (Rao and Subba, 1999). Without bacteria and some fungi, soil would not be fertile and organic matter such as straw and leaves would accumulate within a short time. Soil contains varieties of microorganism including bacteria that can be established in any natural environment (Khupe, 2006). Bacteria are the most important and abundant microorganism which is present in surrounding environment. These are very small, unicellular, primitive and non-chlorophyll containing microorganism (Costerton, *et al*., 2015). Soil contains varieties of microorganism including bacteria that can be established in any natural environment. Bacteria are the most important and abundant microorganism which is present in surrounding environment. These are very small, unicellular, primitive and non-chlorophyll containing microorganism (Adegoke,

2001).

The Waste products in dump-site with no paper waste handling method are sources of pathogens to the soil, which in turn contribute to the emergence of community-acquired infections (Tortora *et al*., 2007). Solid waste generation is a growing global issue due to the large increase in solid waste production. This increase in waste quality requires improving and expanding the solid waste management options (Yakowitz, 2008). Landfill disposal is the most commonly used waste management method worldwide (Rabah *et al.*, 2008), physically, chemically, and biological process occur within a conventional landfill to promote the anaerobic degradation of solid waste and result in the production of leachate and landfill gas for a very long time. Waste can be loosely defined as any material that is considered to be of no further use to the owner and is, hence, discarded (Yusuf and Sonibare, 2004). However, most discarded waste can be reused or recycled. Waste can be loosely defined as any material that is considered to be of no further use to the owner and is, hence, discarded (Onuorah *et al*., 2015), one of the principles of most waste management philosophies. What may be of no further use to one person and regarded as waste to be dumped, may be of use to the next person, and is the basis of the rag picking trade, the sifting through of refuse at landfills for recovery and re-sale, a very fundamental historical waste management practice still functioning in many countries, often conducted on a highly organized commercial basis (Azam *et al*., 2003). The developing world is experiencing rapid population growth and a massive shift towards urban population. Human activities create vast amount of various wastes and pollutants (Mark *et al.*, 2000). The release of these materials into the environment sometimes causes serious health problems (Rabah *et al.*, 2008). The level of wastes produced by dense human and domestic animal population often exceeds the local ecosystem's biodegradative capacity, resulting in serious environmental pollution and epidemic outbreaks of disease (Ronald, 1988).

The colifom counts of bacterial of some natural water supplies in Nigeria far exceed the level recommended by the World Health Organization. Surface associated bacterial population in rivers, play an important part in the biodegradation of allochthonous substances such as pollutants derived from human activities (*Costerton et al.*,2005). Therefore, the objective of this study is to investigate the effects of dumpsite on soil microbiota.

MATERIALS AND METHOD

Sample Area

The soil and water samples were collected along Oke-Ijebu Akure, Ondo State Nigeria.

Sterilization of materials

Sampling bottles, beakers, petridishes, test tubes, and conical flasks, (glassware) were washed in water with detergent, rinsed and allowed to dry. They were after sterilized in hot air oven at 160°C for 60 minute (1hr). Media and distilled water were sterilized by autoclaving at 121°C for 15minutes. Workbench was disinfected using 70% ethanol, all the work was done aseptically (near the flame).

Collection of sample

The soil and water samples were collected along Oke-Ijebu Akure, Ondo State. Nigeria. 400 grams of soil sample from a refuse dump site was taken into a plastic container and 1 litre of water sample from stream was collected into a sterilize pre-washed container and appropriately labeled, and were immediately taken to the laboratory for microbiological analysis.

Isolation of bacteria from soil sample

The bacteria was isolated using pour plate method on Nutrient Agar. The petri dishes

was incubated at 37^0C for 24 hours.

Serial dilution method for Soil sample soil

1g of the soil sample was weighed and dispersed in a sterile beaker; 10ml of sterile distilled water was added to dilute the soil sample. 9 test tubes were labeled 10^{-1}–10^{-9} dilution factors 9ml of distilled water was measured into each and then sterilized at 121°C for 15 minute using the autoclave (Olutiola *et al*., 1999).

Pure culture

For reducing microbial population, 1g of soil was dissolved in 10ml of distilled water to make soil suspension. Serial dilution was carried out for getting isolated single colony. In this research, nutrient medium was used for bacterial growth. Nutrient agar was prepared according to the manufacturer's instruction, by dissolving 28g of the powder into 1 liter of distilled water in a conical flask. The conical flask was plugged with cotton wool and covered with aluminum foil. The medium was heated and sterilized in the autoclave at 121ºC for 15 minutes.

Pour plate technique

1ml of the diluted samples were taken from the test tubes 10^{-2} and 10^{-5} and were dispensed into the petri dishes labelled with the same diluted factor and the NA agar was poured into each at 45°C, the plate were rocked and allowed to set(solidify) and incubated for 24 hours (Olutiola *et al*., 1991).

Isolation of different organisms

Isolation was carried out from the 2nd and 5th plate, sterile loop was used to streak the already prepared Salmonella shigella agar, (SSA), Mannitol salt agar (MSA), Eosin methylene blue (EMB) and then incubated for 24 hours at 37°C.

Identification of bacterial isolates

The identification of bacteria was based on biochemical characterization such as sugar fermentation tests, citrate, catalase, indole, methyl red, voges-prauskauer, starch hydrolyses, oxidase etc. was based on colonial appearances, wet mount preparation and the use of staining technique such as lactophenol cotton-blue, ((Ronald, 1988).

RESULTS

Table 1 show the colonial morphology of the bacterial isolates, which is based on form, size, surface, colour, elevation, margin, texture and optical quality. These characteristics aid in identification of bacteria.

Table 1: Colonial morphology of bacteria isolates

SAMPLES	FORM	SIZE	SURFACE	COLOUR	ELEVATION	MARGIN	TEXTURE	OPTICAL QUALITY
Colony 1	Swarming	Large	Rough	Cream	Flat	Lobate	Dry	Translucent
Colony 2	Circular	Small	Dull	Cream	Raised	Entire	Smooth	Opaque
Colony 3	Circular	Large	Rough	Grey	Raised	Entire	Dry	Opaque
Colony 4	Irregular	Large	Dull	White	Raised	Undulate	Smooth	Opaque
Colony 5	Circular	Medium	Dull	Non pigmented	Flat	Entire	Mucoid	Translucent
Colony 6	Circular	Punctiform	Dull	Cream	Convex	Entire	Mucoid	Translucent
Colony 7	Irregular	Small	Glistering	Greenish	Umbonate	Undulate	Dry	Opaque

Table 2 shows the biochemical characteristics of bacteria, these characteristics is base on gram staining reaction, motility, catalase, oxidase, methyl red, Voges Proskauer, citrate, urease, sugar fermentation test (such as Glucose and Lactose) and spore staining. The bacteria identify are *Bacillus anthracis Enterobacter* spp, *Staphylococcus* spp, *Pseudomonas aeruginosa, Paenibacillus lantus Shigella sonnei, Salmonella species and Citrobacter* spp.

Table 2: Biochemical characteristics of isolated bacteria

Probable Organism	Gram Stains	Mo	Cat	Ox	MR	VP	Glu	Lac	Growth on EMB	Spore Staining	Ci	Ur	In
Bacillus anthracis	+R	-	+	+	-	+	NR	NR	+	+C	-	-	+
Paenibacillus lantus	+R	+	+	-	N	+	A	A	+	+T	+	N	-
Shigella sonnei	-R	N	+	N	+	-	NR	NR	+	+C	-	N	-
Pseudomonas spp.	-C	-	+	N	-	+	NR	NR	+	+T	-	-	-
Citrobacter sp.	-R	+	+	-	+	-	+	+	-	_	+	-	+
Pseudomonas spp	-R	+	+	-	+	-	-	-	-	_	-	+	-
Enterobacter sp.	-R	+	+	-	-	+	+	-	-	_	+	-	-
Salmonella sp.	-R	+	+	-	+	-	+	-	-	+	-	-	-
Staphylococcus sp.	+C	-	+	N	-	+	+	-	N	_	-	-	-

KEY: Mo: motility; Cat: catalase; Ox: Oxidase; MR: Methyl Red; VP: VogesProskaeur; Glu: Glucose; Lac: Lactose; EMB: Eosin Methylene Blue; Ci: Citrate; Ur: Urea; In: Indole; –R: Gram negative rod; +R: Gram Positive rod; -C: Gram negative Cocci; +C: Gram Positive cocci; -: Negative reaction; + : Positive reaction; N: Not done.

Table 1.2 shows total bacteria count of the dump sites soil the second replicate had the highest count 1.88×10^5 cfu/g, the mean for the three replicate is 1.85×10^5 cfu/g while the total bacterial count for 10^5 is the third replicate is 1.06×10^7 cfu/g, the mean replicate is 1.013×10^8 cfu/g.

Table 3 : Shows bacterial count from the dump site soil

Sample Code	Total Bacterial Count 10^3	Total Bacterial Count 10^5
R1	184	96
R2	188	102
R3	183	106
MEAN	185	101.333333
SD	7	25.3333333
CV(%)	3.78	25
VAR	7	25.3333333

Keys; VAR : Variance, CV: Coefficient of variation, SD : Standard deviation, R : Replicate

DISCUSSION

In this study, the high counts of both bacteria obtained indicated that the contaminated soil had a high population density than the control soil whose counts showed values that could be easily utilized by the organisms. Also, it may be attributable to the destabilization of the soil ecological balance as a result of the contaminant discharged of refuse and waste products. This result of the mean bacterial count 1.013×10^8 cfu/g from soil sample was in conformity with that of Pal and Lalwani (2011) who reported. All the microbial isolates identified from the soil samples (Table 1.1), have been reported to be associated with wastes and waste biodegradation (Obire *et al.,* 2002). The presence and abundance of species of *Bacillus anthracis* observed in the contaminated soil may not be surprising as these organisms are indigenous to soil environment and are known to persist in such environment (Atlas and Bartha, 2007). However, the presence of *Salmonella* spp and S*higella sonnei Enterobacter , Staphylococcus* sp, *Salmonella* sp and S*higella sonnei* in the contaminated soil may be attributable to feacal contamination. Similar findings were reported Bala (2006) reported the isolation of similar organisms from water sources in Jimeta-Yola that were faecally contaminated. The presence of these organisms is a pointer to possible pollution and may have an effect on the soil ecological balance. These findings were in conformity to that of Johannessen and Boyer (2015).

CONCLUSION

The bacterial analyses of soil samples are important for detecting the presence of microorganisms that might constitute health hazards. This can serve as a guide to monitor and protect our environment in relation to soil within our vicinity. The presence of bacterial species including *Bacillus anthracis Enterobacter sp, Staphylococcus sp, Pseudomonas aeruginosa, Paenibacillus lantus Shigella sonnei, Salmonella sp Citrobacter sp.* May cause severe health hazards like stomach cramps, diarrhea, vomiting, fever, urinary tract infection, pneumonia, hepatic infections, bacteremia, skin and soft tissue and opportunistic infections on burns, wounds and also blood related infections.. Effective and frequent monitoring of refuse is suggested to safeguard the health of the people.

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