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MICROBIOLOGICAL ANALYSIS OF SOLID WASTE IN TWO OPEN DUMPSITES AT GWAGWALADA AREA COUNCIL OF ABUJA, NIGERIA

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ABSTRACT

Waste disposal has become an acute problem in numerous urban centers in Nigeria. The waste disposal option in many Nigerian cities is predominantly open dumping and unsanitary landfilling. Open dump site are often cited within or close to residential neighbourhood thus becoming a public threat. Waste can contaminate surface water, ground water, soil and air through this disposal option and can pose serious public health challenges. This paper presents the physical characteristics of waste and the microbiological analysis of waste in two open dumpsites at Kutunku and Angwa-dodo areas of Gwagwalada Area Council of Federal Capital Territory Abuja. Characterization of waste was done by separating waste in the two dumpsites into distinctive components eg food waste, leaves, paper, glass, metal, etc. and then weighing separately. In the microbiological analysis, waste samples were collected from 8 open dumpsites, 4 samples were collected each from Kutunku and Angwa-dodo areas. The collected waste samples were subjected microbiological analysis using standard laboratory techniques. The result shows that the 26.07 % solid waste generated in Kutunku is composed of food waste, while that of Angwa-dodo is 33.3 %. Other components of the waste include bottle and glass, plastic bags, tin and metal, old clothes, leather and electronic waste. The bacteria identified were *Escherichia coliform, Streptococci feacalis, Salmonella, Shigella, Nitrobacteria, Clostrdia, Klebsiella and Staphylococcus aureus, Aspergillus, Rhizopus,* and *Salmonella.* The fungi identified were *Aspergillus niger, mucor* species and *Rhizopus.* The pathogenic microorganisms found in the solid waste at Kutunku are higher than those found in waste at Angwa-dodo and were above Federal ministry of environment standard. The results showed that open dumping is a public threat and should be discouraged. Proper disposal of waste in landfill site will reduce and eliminate adverse impact on human health and the environment.

Keywords: *Open dumpsites, Solid Waste & Microorganisms, Gwagwalada*

INTRODUCTION

Open dumping approach as solid waste disposal method is a primitive stage of solid waste management in many developing countries. It is the disposal of waste in an uncontrolled and uncovered site with minimal or no structural design (Marianna and Alessandra, 2009). It is one of the most poorly rendered services by municipal authorities in developing countries as the systems applied are unscientific, outdated and in-efficient (Foday *et al*, 2013). Solid waste disposal sites are found both within and on the outskirts of urban cities in Nigeria. These dump sites are common in developing countries due to low budget available for waste disposal. Nigeria is witnessing an unprecedented growth of cities in recent time. The country's high population figure has series of implications for every aspect of people socio-economic and cultural life style, with the pressure in urban population, existing facilities such as water, electricity, road, educational institutions and housing become inadequate and solid waste generation and disposal take unprecedented precarious dimension. (Omole and Alakinde, 2013).

Open dumpsite are sources of environmental and health hazards to people living in the vicinity of such dumps (Foday *et al.*, 2013). Waste in dumpsites can emit greenhouse gases, like methane, toxic leachates pollute subsurface and surface waters and enhance risk of disease transmission to nearby residents. These dumpsites make very uneconomically use of space,

allow free access to animals and flies and often produce unpleasant and hazardous smoke from slow-burning fires (SANDEC 2008).Pathogenic microorganisms and harmful chemicals in solid waste can be introduced into the environment when the waste is not properly managed and disposed (Wai-Ogosu, 2004; Ogbonna *et al*, 2006).The problem of solid waste disposal is a major concern in Nigeria because the amount of solid waste generated is always on the increase due to increase in population and some socio-economic factors.Thus, the objective of the study was to analyse the microorganisms found in solid waste in open dumpsites within Gwagwalada Area Council of Abuja.

The study seeks to analyze the microbiological content of open dump sites within Gwagwalada Area Council, Abuja Nigeria. The objectives of the study are; to identify the physical characteristics of waste being disposed of at the dumpsites and to examine the micro biological content of wastes from Kutunku and Angwa-dodo dumpsites

Study Area and Methodology

Gwagwalada is one of the six local government area councils of the Federal Capital Territory of Nigeria, together with Abaji, Kuje, Bwari, and Kwali; and the Abuja Municipal Area Council (AMAC). Gwagwalada is also the name of the main town in the Local Government Area, which has an area of 1,043 km2 and a population of 158,618 at the 2006 census. Before the creation of Federal Capital Territory, Gwagwalada was under the Kwali District of the former Abuja emirate now Suleja emirate. Gwagwalada Area Council was created on 15th October, 1984. Its official population figure of 158,618 people at the 2006 census. The relocation of the seat of government from Lagos to Abuja in 1992 and the recent demolition of illegal structures within the Federal City Center brought a massive influx of people into the Area Council being one of the fastest growing urban centers in the FCT.

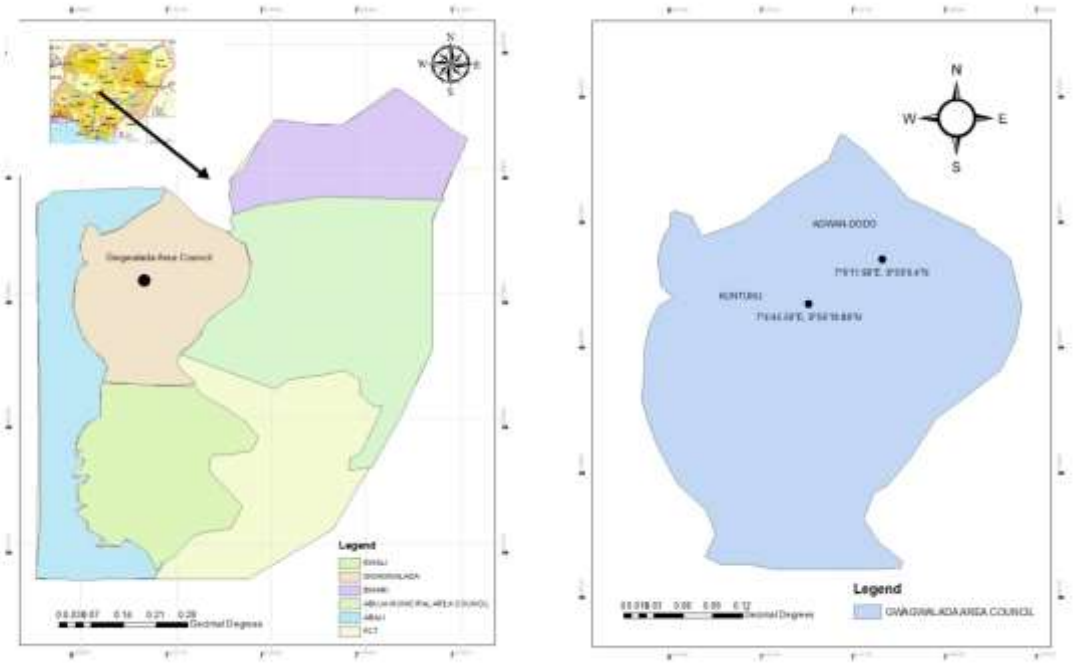

Fig 1: Map of the Study Area
Source: University of Abuja GIS Lab

MATERIALS AND METHODS

Physical Characteristics of Waste

This was done by taken a known sample of waste (say 10 kg), separating them into distinctive components eg food waste, leaves, paper, glass, metal, etc. and then weighing of individual component was done, when added the total weight must tally with the original quantity taken**.**

Cultivation and Enumeration of Bacteria and Fungi

Waste samples were collected from eight (8) dump sites 4 from Kutunku and 4 from Angwa-dodo areas within Gwagwalada Area Council of Abuja. Waste microbial isolates were estimated by waste dilution plate count

method. From each sample 1 g of waste was dissolved in 9 ml of distilled water and serial dilutions were prepared for each sample. Diluted samples were transferred to sterile Petri dishes and then general and differential media Potato dextrose agar ;(PDA), salmonella / shigellaagar ;(SSA,) Cled agar, Eosin Methylene Blue agar; (EMB), Nutrient agar; (NA) containing chloramphenicol (250 g) were also introduced into the petri dishes and incubated in an incubator at 25.5 ºC for seven days for fungal isolates and forty-eight (48) hours for bacteria isolates. After incubation discrete colonies of culture on nutrient agar and potato dextrose agar plates were counted and the unit expressed in cfu/100 ml. In order to determine the identity of bacteria isolates results were compared with standard references of Bergey's manual of Determinative bacteriology (Buchanan and Gibbsons 1974). The fungi isolates were examined microscopically using the need mount techniques, their identification was performed using the scheme of Larone (1986).

RESULTS AND DISCUSSION

Physical Characteristics of Solid Waste at Dumpsites

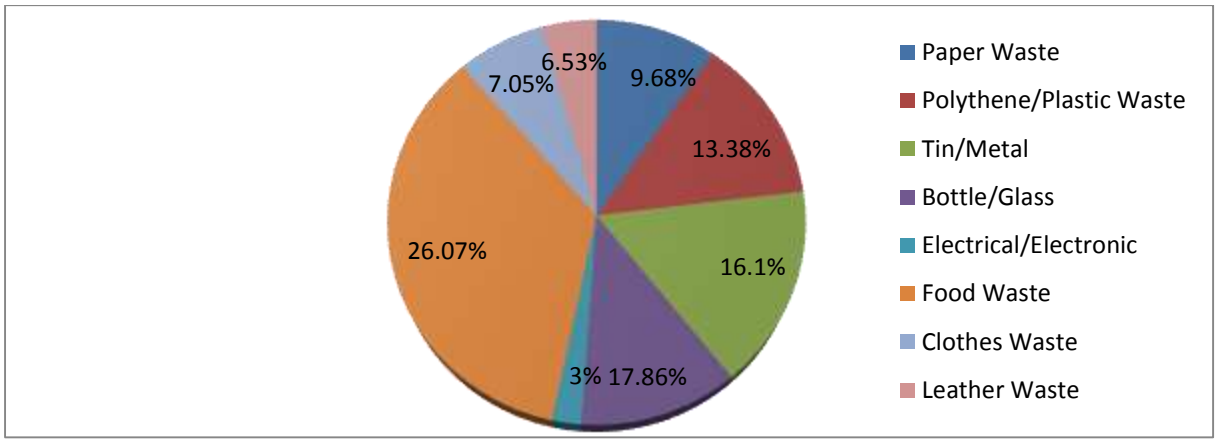

Fig 2: Physical characteristics of Solid Waste Generated from Kutunku dumpsite

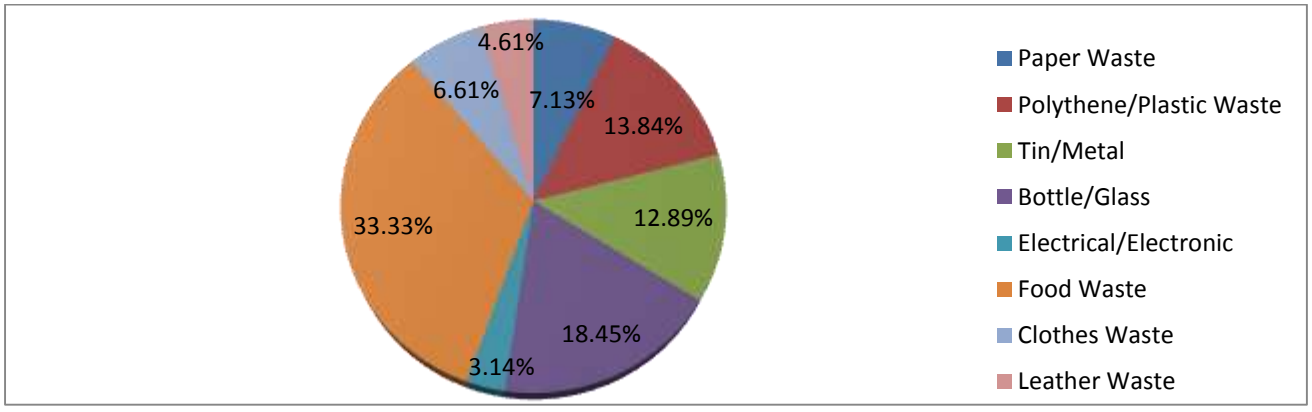

Fig 3 Physical characteristics of Solid Waste from Angwa-Dodo dumpsite

The pie charts above show the characteristics of solid waste generated in the study site, Kutunku and Agwan-dodo respectively in percentage(s). The result shows that the solid waste generated in Kutunku is composed of food waste (26.07 %), bottles and glass waste (17.86 %), tin/metal waste (16.1 %), polythene/plastic waste (13.38 %), clothes waste (7.05 %), Electrical/Electronics (3 %), Leather waste (6.53 %) and paper waste (9.68 %) respectively while that of Agwan-dodo is bottle and glass waste (18.45 %), food waste (33.33 %), tin/metal waste (12.89 %), Electrical/Electronics (3.14 %), Leather waste (4.61 %) polythene waste (13.84 %), clothes waste (3.14 %),and paper waste (7.13 %) respectively.

Table 1: Identifying the bacteria present in the waste at the dumpsites

S/N	MICROBIAL SPECIE	KUTUNKU LAT. 8 56 19.86N LNG. 07 04 45.59E	METHODOLOGY	FEDERAL MINISTRY OF ENVIRONMENT (FME) LIMIT (mg/kg)
1.	TOTAL *COLIFORM* (CFU/100ml)	$2.0X10^7$	MEMBRANE FILTER	400
2.	TOTAL HETEROTROPHIC BACTERIA (CFU/100ml)	$6.8X10^5$	POUR PLATE	NOT STATED (NS)
3.	TOTAL HETEROTROPHIC FUNGI (CFU/100ml)	$6.6X10^2$	POUR PLATE	NS
4.	FAECAL *COLIFORM* (CFU/100ml)	$3.1X10^6$	MEMBRANE FILTER	200
5.	FAECAL *STREPTOCOCCI* (CFU/100ml)	$2.6X10^6$	MEMBRANE FILTER	0.0
6.	HYDROCARBON UTILIZING BACTERIA (CFU/100ml)	$6.3X10^2$	POUR PLATE	NS
7.	HYDROCARBON UTILIZING FUNGI (CFU/100ml)	$7.6X10^5$	POUR PLATE	NS
8.	*ASPERGILLUS* (CFU/100ml)	$2.5 X 10^5$	POUR PLATE	NS
9.	*RHIZOPUS* (CFU/100ml)	$2.8 X 10^3$	POUR PLATE	NS
10.	*MUCOR MUCEDOR* (CFU/100ml)	$5.9 X 10^4$	POUR PLATE	NS
11.	YEAST (CFU/100ml)	$9.1 X 10^4$	POUR PLATE	NS
12.	*SALMONELLA* (CFU/100ml)	$1.2 X 10^2$	POUR PLATE	NS
13.	*SHIGELLA* (CFU/100ml)	$2.1 X10^2$	POUR PLATE	NS
14.	*E.COLI* (CFU/100ml)	$3.0 X 10^7$	POUR PLATE	200
15.	*PSEUDOMONAS* (CFU/100ml)	$5.0 X 10^6$	POUR PLATE	NS
16.	*KLEBSIELLA* (CFU/100ml)	$2.5 X 10^2$	POUR PLATE	NS
17.	*STAPHILOCOCCUS* (CFU/100ml)	$4.4 X 10^6$	POUR PLATE	NS
18.	*NITROBACTER* (CFU/100ml)	$4.1 X 10^5$	POUR PLATE	NS
19.	*CLOSTRIDIA* (CFU/100ml)	$2.8 X 10^3$	POUR PLATE	NS

Table 2: MICROBIAL BACTERIAL ISOLATES OF WASTE SAMPLES IN KUTUNKU

S/N	MICROBIAL SPECIE	ANG. DODO LAT. 8 56 36.45N LNG. 07 05 55.22E	METHODOLOGY	FEDERAL MINISTRY OF ENVIRONMENT (FME) LIMIT (Mg/Kg)
1)	TOTAL *COLIFORM* (CFU/100ml)	$16.0 X10^7$	MEMBRANE FILTER	400
2)	TOTAL HETEROTROPHIC BACTERIA (CFU/100ml)	$2.5X10^5$	POUR PLATE	NOT STATED (NS)
3)	TOTAL HETEROTROPHIC FUNGI (CFU/100ml)	$2.5X10^2$	POUR PLATE	NS
4)	FAECAL *COLIFORM* (CFU/100ml)	$3.0X10^6$	MEMBRANE FILTER	200
5)	*FAECAL STREPTOCOCCI* (CFU/100ml)	$3.0X10^6$	MEMBRANE FILTER	0.0
6)	HYDROCARBON UTILIZING BACTERIA (CFU/100ml)	$3.3X10^3$	POUR PLATE	NS
7)	HYDROCARBON UTILIZING FUNGI (CFU/100ml)	$5.9X10^5$	POUR PLATE	NS
8)	*ASPERGILLUS* (CFU/100ml)	$2.5 X 10^5$	POUR PLATE	NS
9)	*RHIZOPUS* (CFU/100ml)	$1.8 X 10^3$	POUR PLATE	NS
10)	*MUCOR MUCEDOR* (CFU/100ml)	$4.3 X 10^4$	POUR PLTE	NS
11)	YEAST (CFU/100ml)	$6.2 X 10^4$	POUR PLATE	NS
12)	*SALMONELLA* (CFU/100ml)	$1.0 X10^5$	POUR PLATE	NS
13)	*SHIGELLA* (CFU/100ml)	$1.5 X 10^5$	POUR PLATE	NS
14)	*E. COLI* (CFU/100ml)	$3.0 X 10^2$	POUR PLATE	200
15)	*PSEUDOMONAS* (CFU/100ml)	$4.7 X 10^6$	POUR PLATE	NS
16)	*KLEBSIELLA* (CFU/100ml)	$0.5 X 10^2$	POUR PLATE	NS
17)	*STAPHILOCOCCUS* (CFU/100ml)	$3.0 X 10^6$	POUR PLATE	NS
18)	*NITROBACTER* (CFU/100ml)	$3.7 X 10^5$	POUR PLATE	NS
19)	*CLOSTRIDIA*(CFU/100ml)	$1.8 X 10^3$	POUR PLATE	NS

Table 2: MICROBIAL BACTERIAL ISOLATES OF WASTE SAMPLES IN ANGWA-DODO

The laboratory result showed that the bacteria and fungi level of waste in Kutunku and Agwan-dodo are high, this is in agreement with the results of Chetan *et al* (2017), study on microbial counts at different dumpsite at Udupi, India and Atalia *et al*, (2015) research work at Ahmedaba, India. All the bacteria and fungi (Total coliform, total heterotrophic bacteria, total heterotrophic fungi) level found on the study site are higher than the Federal Ministry of Environment standard/Limit of 400 mg/kg for Faecal Coliform and *Escherichia.coli* standard/limit of 200mg/kg. Bacteria and fungi level of waste in Kutunku is higher than that of Agwan-dodo, this implies that there will be serious health challenge being posed to the inhabitant of the study area if these wastes contaminate the water used for domestic activities. Waste is said to be hazardous if it contain microorganism or toxins which are known or suspected to cause disease in human and animal (Yakowitz, 1998). Waste disposal poses threat to man, animal and the soil. Furthermore, some of the bacteria and fungi detected might not pose a serious threat such as Total Heterotrophic, hydrocarbon utilizing bacteria and fungi, mucor mucedor, yeast, *Pseudomonas*, *nitrobacter and clostridia* (because their limits were not stated). The presence of these bacteria and fungi is also associated with waste biodegradation, if properly harnessed can be used in the future treatment plant in Nigeria in accelerating the bioconversion of waste compost into organic fertilizer for use in gardening, agriculture and horticulture (Obire *et al*., 2002). Bacteria and fungi also have one health implication or the other if it comes in contact with water, air and body system of the inhabitant. The bacteria that might be of serious threat are; Total Coliform, Faecal *Coliform*, (bacterial gastro enteritis, diarrhoea) Faecal *Steptococci*, *(*infections of external ear, sore throat, skin lesions), *Rhizopus* (dysentery), *Salmonella* (typhoid fever) *Aspergillus (*aspergillosis*)* (Cairncross and Feachem 1993)

CONCLUSION

The findings of this study have shown that Total Coliform, Faecal *Coliform*, Faecal *Steptococci, Aspergillus, Rhizopus, Salmonella* were prevalent in wastes at the dumpsites at Kutunku and Angwa-dodo areas of Gwagwalada Area Council, Abuja, Nigeria where extracted waste samples were used for this study. The study has also shown that all the bacteria and fungi found on the study site carry lots of diseases, this implies that there will be serious health challenge being posed to the inhabitant of the study area if these waste contaminate the water used for domestic activities. The presence of these parasitic microorganisms present in wastes at the dumpsites at Gwagwalada Area Council, Abuja, Nigeria supports the earlier observations that parasitic infections constitute a major public health problem in the country. The data obtained from this study provides information on the various diseases associated with wastes at dumpsites in Gwagwalada Area Council, Abuja, Nigeria. The study also provides data for understanding the vectors; disease carriers and of the physical composition of waste at the dumpsites in Gwagwalada Area Council, Abuja, Nigeria.

Recommendation

It is recommended that waste authorities should provide appropriate funding for solid waste programs, including waste collection, evacuation of waste and disposal facilities, recycling and training programs, designation and planning of safe sanitary landfills. At the household level, it is recommended that they should adopt the 4Rs'; Reduce the consumption of materials that generate large amount of waste, Reuse and Recycle materials instead of throwing them away and Recover energy from waste that cannot be recycled. Sanitary landfilling is a better option to open dumping.

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