23

Investigation of Physicochemical Analysis and Microbiological Characteristics of Leachate – Contaminated Groundwater in Asaba Metropolis

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Abstract

The effects of landfill waste disposal system on some aspects of the environment (soil, leachate, surface and groundwater) were investigated using changes in microbial populations and physicochemical properties as parameters. Two sides of landfills (abandoned and active) in Asaba (Delta State) were assessed using conventional methods in line with distance from the landfill, while controls were taken at 5000m away but within the same area. Total heterotrophic bacterial counts of (aerobic and anaerobic) were significantly higher at 0m of the abandoned landfill compared to 50m, 100m and control groundwater samples while the values of other microbial groups analyzed were not significantly different in groundwater samples. The microbial groups involved were total coliforms, total phosphate solubilizing bacterial, total actinomycetes, total fungal and total nitrate reducing bacterial counts. At the active landfill, microbial counts were significantly different at each sampling point as counts decreased from 0m through 50m to 100m away. DO, COD, TSS, TDS and microbial metabolizable nutrients (NO_3, CO_3 and SO_4) were significantly higher in the active landfill water samples but decreasing in the same order of 0m, 50m and 100m away. Other physicochemical properties were not significant. All the metals determined had their highest concentrations at the abandoned landfill sites with values being non-significantly different with regards to distance. The reverse was the case in the active landfill site. These metals include Zn, Ni, Cu, Cr, Pb, Cd, and Mg. Values of Ca, Na, and K were also in the same

direction. Similar observations in the groundwater samples but with very significantly lower values except in the case of microbial counts where aerobic organisms were virtually absent. In the leachate analysis, high metallic ions concentrations were observed with low microbial counts too. Distance also influenced both the microbial counts and metallic ion concentrations especially in the active landfill site. The other physicochemical parameters analyzed also showed higher values in the leachate than in groundwater samples. The study showed significant influence of leachate spread and percolation as there were gradual differences in the values of parameters measured concentrated within the 0m and 50m distances during the study. Conclusively, landfill impacted negatively on groundwater qualities as distance playing significant roles too. This means that domestic water supply should not be sourced close to such waste disposal systems.
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Keywords: Leachate, Dumpsite, microorganism, physicochemical, solid waste, waste management

The wastes that are generated in cities and municipals are normally disposed in different locations. Landfill, and open dumpsites had been old and common methods of solid waste management practice and one of the easiest and cheapest methods for waste disposal in many parts of the world and Nigeria in particularly, Longeand Balogun 2010, Jhamnani and Singh 2009. They are normally located away from residential in disused quarries; mining's or excavated pits away from human residence, or along surface water bank (Abdul-salam 2009). Historically wastes are disposed of unscientifically and indiscriminately leading to the development of many waste dumpsites around with little or no regulation. Solid wastes are regarded as those wastes that do not contain hazardous materials originated from residences, industries, commercial institutions, etc (Slomczynska and Slomczynska 2004, Ministry of Environment and Forests MOEF 2008). Solid wastes generated are inventible and landfilling and open dumpsites (land and Bank of rivers) are common method of managing these wastes in many developing countries like Nigeria (Alimbaet al.,2012).Modern landfill facilities have not been practicing or found in Nigerians municipal dumpsites, so also pre-sorting and sorting out of solid wastes into degradable and non-degradable and recyclable materials, lining up of the dumpsite are not in vogue in Nigeria waste management strategy. Most Nigerians dumpsites are located near residence, source of drinking water and besides river banks that are not designated for specific waste rather all forms of wastes. Improper and poor management of municipal dumpsites have created a number of adverse environmental impacts among all are clogging of water way, windblown litters, fly-ash, attraction of rodents, vermiform, (Abdul-salam 2009). It also has been reported that landfill release hazardous chemicals, microbial contaminated liquid and gases into the environment and these constitute public and environmental health issues known and unknown to people in many countries (Oyasi 2003) one of the major pollution problems caused by the solid wastes to land is leachate. Leachate is a liquid that is generated when water or another liquid come in contact with solid wastes as defined by Peter et al., (2002). It could be also being produced as result of aerobic and anaerobic degradation of organic and inorganic materials by consortia microorganisms and water. These leachates also have distinguishing characteristics in that they are highly variables and contain significantly elevated concentrations of undesirable materials derived from the wastes. Researchers have shown that leachates from the open dumpsites/landfills may also contain potentially toxic metals and bio-load of microorganisms. These may find their way into the environment and consequently enter food chain through plants, animals and fishes in the aquatic environment, (Dosumu et al., 2003, Peter et al., 2002). The concentration of wastes may drastically change overtime due to chemical degradation and microbiological decay (acidiogens, acetogens and methanogens) of organic matter present. Consequently the physical characteristics of leachate varies considerably depending on the age of waste and landfill may continue to produce contaminated leachate and this process may last for 20 to 50 years which can pose significant environmental impact when released untreated into the environment(Peter et al., 2002).Due to increase of population and development of industries, open river dumpsite leachate problems become increasingly due to release of persistent organic pollutants, heavy metals in higher concentration and these can cause oxidative stress by formation of free radicals, (Henry 2008). Leachate has potential to contaminate ground and surface water and has a substantial risk to natural environment and to the health of residents who use these water resources for drinking and other domestic purposes. Although the soil and other materials do naturally purify most of the water as it strains through an aquifers but once the leachate enters the water bodies it introduces pollutants into the food webs through bioaccumulation, changes in the biotic diversity and introduction of persistent organic compounds (POC) into the aquatic environments(Mor et al., 2006, Ogundiran and Afolabi 2008). It is apparently difficult and expensive to clean up the contaminated water. Exposure to toxic substances to unsuspecting populace and those residing near contaminated dumpsite have led to series of human health disorder which include cholera, typhoid, dermatitis, enteric fever, organ dysfunction, agonistic and antagonistic effect, neurobehavioral disorder, and nauseating, environmental aesthetic dent etc. Leachate composition varies widely with different sites and environmental conditions also depend on the nature of the deposited solid wastes, soil and other physical parameters (temperature, moisture available, oxygen, rainfall, PH), operational factors of the water, land fill chemicals and microbiological activities. These contaminants have been reported to possibly cause growth retardation and haematological abnormalities in man, animal and plant (Butt and Ghaffer 2012), Palmer et al., 2005, Ogundiran and Afolabi 2008).Contamination of groundwater is a serious environmental problem throughout the world as it affects water resources.

Materials and Methods

Physicochemical parameters in the leachate and water samples from Asaba dumping site near airport and Asaba housing estate in Delta state is represented in the tables below. Leachate samples from the actual leachate percolating the soil in about four meters feet trench excavated from different sites; active and abandoned site in triplicate. Total of six grab samples were taken from different points at different meters designated 0meter, 50 meter, 100meter (0 m, 50 m, 100 m) were collected in 5L polythene bottles covered with aluminum foils. A few drops of concentrated nitric acid were added to the leachate samples collected for heavy metals analysis to preserve the samples, the samples were then transported to laboratory stored at 4^0C and analyzed within 48hours. 0 m is the collection point of the leachate close to the residence in both sites (active and abandoned sites). A random sampling method was used to collect the groundwater samples from residential borehole well close to the dumping site from both sides. Ground water samples of totally six were collected within 100meters from the sampling locations assigned 0 m, 50 m, 100 m. water was collected from bore ells were pumped for 5 minutes before sampling. These samples were collected in pre-clean polypropylene container of 2L capacity after rinsing with the sample and preserve airtight to avoid evaporation store at 4^0C before proceeding for analysis. A sterile McCartney bottle was used to collect the samples meant for microbial analysis.

Laboratory Analysis

Physicochemical and heavy metal analysis of leachate and water Samples

The parameters were selected as a result of their pertinent importance in municipal dumpsite leachates composition and their pollution ability on groundwater resources in particular. The physicochemical parameter including pH, electric conductivity, total dissolved solid (TDS) were analyzed in-situ using pH portable field kits Hanna instrument (HI 19820), A digital multi-parameter Hanna instrument (HI 9813) was used to measure conductivity and TDS. The analysis was based on the equipment manufacturer guide. Chemical oxygen demand (COD) was determined by trimetric/dichromate oxidation method as described by (APHA 1998). Other analyses were conducted to ascertain the quality of the leachate and water samples taken from various points using standard methods for the examination of water and waste water (APHA 1998). Heavy metals were determined using Unicam Atomic Adsorption Spectrophotometer (Model 9391/959). The microbial population of total heterotrophic bacteria (THB), total fungi of the leachate and water samples were enumerated using serial dilution and spread plate methods of Pepper and Gerba(2012). About 0.1 m of water and leachate samples were serially diluted in sterile distilled water and aliquots of the dilution were plated onto Nutrient Agar and sabrouad Agar and they were incubated inverted at 30^0C for 5-7 days for fungi. The colonies formed on the plates were enumerated and expressed on colony forming units (cfu)/ml. Isolation/Enumeration of

Anaerobic Bacteria, aliquots (1.0ml) from 10^{-4} and10^{-5} dilutions of the samples were inoculated into Reinforced Clostridial agar and nutrient agar respectively using pour plate technique of Harley and Prescott, (2000), the inoculated plates were incubated in an anaerobic jar at room temperature for 2-5 days. Colonies that develop from the plates after incubation were counted.Isolation and enumeration of total coliform count was done using standard plate countmethod (Eja*et al*., 2005). 1ml of each water sample was aseptically pipetted into 9ml dilution blank. It was then diluted 10-fold up to 10^{-5}; 1ml each from 10^{-4} and 10^{-5} was used to seed sterile Petri dishes in duplicates, molten MacConkey agar at 45°C was aseptically poured into the seeded plate and swirled. Inoculated plates were incubated at 37°C for 18-24 hours. Viable colonies were counted. Membrane filtration technique of Prescott and Harley (2008) was also employed in the isolation of coliforms. in Isolation/Enumeration of Actinomycetes from water samples, spread plate technique of Eja *et al*., (2005) was used. 1.0ml of inoculum from dilutions of 10^{-4} and 10^{-5} of the samples was used to seed sterile Petri dishes in duplicate and sterile molten acidified starch nitrate agar at 45°C was poured into the seeded plates and swirled properly. Plates were left on the work bench to set before incubating at ambient temperature for4-14 days. Emerging colonies were counted. In Isolation/Enumeration of Nitrate Reducing Bacteria, aliquot (1.0ml) from 10^{-4} and10^{-5} dilutions of the samples was inoculated into nitrate agar using pour plate method of Harley and Prescott (2000), the inoculated plates were incubated at 28±2°C for 18-24 hours after which viable colonies were counted. Microbial isolates were enumerated in duplicate plates using the method of Harley and Prescott (2000) and Etok et al., (2004). Plates with colonies between the range of 25-250 colonies were used while those above or below this range were discarded. The pure bacterial strains were identified on the basis of their morphological and biochemical tests and the pure isolates were subjected to various morphological and biochemical characterization tests such as colour, shape, elevation, consistency and margin. The identity of bacteria isolates, results were compared using standard references of bergey's manual of Determinative Bacteriology 2nd edition (Buchanan and Gibbons 1974)

Result

Microbial Loads Observed According to Group Water (Bore Hole) (Log_{10}cfu/ml)

Table 1

	Distance of Ground water bore hole from active site (m)				**Distance of Ground water bore hole from abandoned site (m)**			
Parameter	**0**	**50**	**100**	**Control**	**0**	**50**	**100**	**Control**
THBC$^+$	4.53	4.36	3.26	3.23	5.63	4.64	3.57	3.28
THBC$^-$	3.30	3.34	2.34	3.08	3.53	3.43	3.32	3.15
TCC	3.23	3.11	3.26	2.41	3.43	3.36	2.23	3.15
TPSBC	3.00	3.08	2.01	2.26	3.23	3.15	2.08	2.28
TAC	3.00	3.04	2.15	2.20	3.48	3.49	2.41	2.23
TFFC	2.26	2.23	2.18	4.53	2.38	2.32	2.26	4.56
TNRBC	2.08	2.23	2.06	3.28	3.00	2.38	2.20	3.32

Table 2	**Distance of Group Load in Leachate from old Landfill (m)**			**Distance of Group Load in Leachate from Active Landfill (m)**		
Parameter	**0**	**50**	**100**	**0**	**50**	**100**
THBC$^+$	1.32	1.38	1.43	3.26	2.15	2.08
THBC$^-$	1.45	1.46	1.41	2.45	2.41	1.38
TCC	1.32	1.26	1.15	2.36	1.32	1.26
TPSBC	0.60	0.85	1.11	1.41	0.90	1.04
TAC	0.60	0.78	0.70	0.90	0.78	0.60
TFC	0.70	0.78	0.85	1.04	0.70	0.48
TNRBC	0.30	0.30	0.60	0.00	0.00	0.30

Microbial Group Loads in Leachate (Log10Cfuml-1

Figures followed by different alphabets are significantly different while those followed by the same alphabets are not significantly different (<0.05).

Table 3

Physicochemical Parameters of Groundwater Samples of the various Study Locations							
Distance of Ground water from abandoned landfill (m)				Distance of Ground water from active landfill (m)			
Parameter:	50	100	Control	50	100	Control	Femenv. Limit Drinking Water
Temperature:C	32.9a	32.3b	24c	31.3a	31.3a	25.0b	<40
pH	7.8a	7.3b	6.8c	6.3a	7.1b	7.2b	6.5-8.5
Salinity(%)	10.5a	10.1a	N	3.2a	3.2a	ND	0
Turbidity(NTU)	4.5a	4.1a	4.0b	3.4	3.2a	3a	5
DO(mgl-^{1})	52.3a	65.6b	0.8c	49.56a	46.7b	0.6c	7.5
BOD(ppm-^{1})	5.0a	4.6b	16c	4.4a	4.3a	13b	
COD(mgl-^{1})	3.1a	2.8b	15.3c	23.43a	22.62a	12b	
Chloride (mg^{1})	5.2a	5.0a	4.8b	5.4a	5.3a	1.2b	250
Nitrate (mg^{1})	0.3a	0.22b	0.02c	2.3a	2.1a	ND	
Sulphate(mgl^{1})	0.23a	0.14b	0.01a	0.52a	0.48b	ND	500
TDS (ppm-^{1})	9500a	9000b	320c	4990a	4280b	250c	-
TSS (ppm-^{1})	4600a	4180b	18.9c	650a	540b	11c	-
Conductivity(Us/cm)	280a	230b	0.03c	230a	210c	NS	1000
Carbonate (mg^{1})	85.5a	83.6a	29.3b	130a	120.2b	18.5c	200

Figures followed by different alphabets are significantly different while those followed by the same alphabets are not significantly different (<0.05).

Table 4: Metallic Content of Groundwater Samples of the various Study Locations

	Distance of Ground water from Abandoned Landfill (m)			Distance of Ground water from Active Landfill (m)			
Parameters	**50**	**100**	**Control**	**50**	**100**	**Control**	**FEMENV. LIMIT DRINKING WATER**
Chromium (mgl^{-1})	0.05a	0.03a	ND	0.02a	0.02a	ND	-
Lead (mgl^{-1})	0.03a	0.02a	ND	0.02a	0.01b	ND	<0.1
Cadmium (mgl^{-1})	0.75a	0.54b	ND	0.04a	0.02b	ND	0.01
Nickel (mgl^{-1})	0.08a	0.09a	0.03c	0.08a	0.06b	0.01	0.05
Copper (mgl^{-1})	174a	172a	0.02b	1.2a	1.12b	ND	-
Zinc (mgl^{-1})	1.21a	1.20a	0.1b	0.56a	0.51b	0.02c	<1
Calcium (mgl^{-1})	0.12a	0.28b	-	0.05a	0.04b	-	150
Potassium (mgl^{-1})	42.4a	38.6b	0.06c	13.5a	13.2b	0.04c	-
Sodium (mgl^{-1})	20.45a	20.3a		3.2a	2.9b		-
Magnesium (mgl-1)	280a	270b	1.31c	21.1a	21a	0.84b	50

Figures followed by different alphabets are significantly different while those followed by the same alphabets are not significantly different (<0.05).

Table 5 Metallic Ion Content of Leachate Samples of the Various Study Locations

	Distance of Leachate Sample from Abandoned Landfill (m)			Distance of Leachate Sample from Active Landfill (m)		
Parameters	**0**	**50**	**100**	**0**	**50**	**100**
Potassium (mgl^{-1}	49.5a	38.4b	28.3c	18.4a	13b	12b
Sodium (mgl^{-1})	75.3a	63.4b	56.4c	37.0a	28.4b	27.3c
Magnesium (mgl^{-1})	185a	154b	130c	120a	110b	100c
Copper (mgl^{-1})	84.5a	73.5b	65.6c	11.4a	9.2b	9.1b
Chromium (mgl^{-1})	0.12	0.09	0.08	0.04	0.03	0.02
Zinc (mgl^{-1})	1.42a	1.28b	1.14c	0.38a	0.34a	0.28b
Lead (mgl^{-1})	0.05	0.04	0.04	0.02	0.01	0.01
Cadmium (mgl^{-1})	1.52a	1.21b	1.10c	0.15	0.13	0.11
Nickel (mgl^{-1})	0.34a	0.30a	0.22b	0.1a	0.07b	0.04b
Calcium (mgl^{-1})	0.8a	0.59b	0.32c	0.12	0.1	0.1

Figures followed by different alphabets are significantly different while those followed by the same alphabets are not significantly different (<0.05).

Biochemical Characteristics of Bacteria Isolated from Leachates and Water

TABLE 6: Characteristic and Identification of Aerobic Bacteria from Landfill and Boreholes

S/N	Coagulase	Gram Reaction	Shapes	Motility	Catalase	Methyl Red	Voges Proskauer	Indole	Oxidase	Citrate Utilization	Nitrate Reduction	H_2S Production	Urease Production	Starch Hydrolization	Spore Production	Glucose	Sucrose	Manitol	Linsotol	Xylose	Fructose	Arabinose	Maltose	PROBABLE ORGANISM
1	+	+	C	-	+	-	+	-	-	-	+	-	-	-	-	A	A	A	A	-	-	-	A	*Staphylococcus aureus*
2	-	+	C	-	+	+	-	-	-	-	-	-	+	-	-	-	A	-	-	-	A	-	-	*Micrococcus luteus*
3	+	+	R	+	+	+	+	-	-	-	+	-	+	-	+	A	-	A	-	A	-	-	A	*Bacillus spp*
4	-	+	R	+	+	+	-	-	+	+	+	-	-	-	-	A	A	A		A	AG	-	A	*Alcaligenes autrophus*
5	-	-	R	+	+	+	+	-	-	+	+	-	+	-	+	AG	-	-		A		-	A	*Proteus penneri*
6	-	-	R	-	+	-	-	-	-	+	+	-	+	-	-	AG	AG	AG	AG	AG	AG	AG	AG	*Klebsiella plant*

																								icola
7	+	+	R	+	-	+	-	-	-	-	+	+	+	+	+	A	A	A	A	A	AG	-	A	*Streptococci spp*
8	-	-	R	+	+	+	-	+	-	-	+	-	-	+	-	AG	AG	AG		AG		AG	AG	*Escherichia coli*
9	-	-	R	+	+	-	-	+	+	-	+	-	-	+	+	A	-	-	A	-	A	-	A	*Vibrio spp*
10	-	-	R	+	+	+	-	-	+	+			-		-	AG	-	AG	AG	A		AG	A	*Salmonella spp*
11	-	-	R	-	+	+	-	+	-	-	+	-	-		-	AG	-	AG					AG	*Shigella spp*
12	-	-	R	+	+	+	-	-	-	+	+	-	+		-	AG	A	AG		-		AG	AG	*Citrobacter spp*
13	ND	-	R	-	-	-	+	-	+	+	+	-	-	-	-	A	A	AG		-		-	AG	*Serratia marcescens*
14		-	C	-	+	+	ND		+		+	ND			-	AG	+	+	-	-			A	*Neisseria lactanica*
15	ND	+	PL	+	+	+	-	-	-		+		ND		-	AG	A	-					A	*Chromatiumspp*

TABLE 6A: Characteristic and Identification of Anaerobic Bacteria from Landfill and Boreholes

S/N	Gram Reaction	Shapes	Spore Production	Motility	Coagulase	Catalase	Methyl red	Voges Proskauer	Indole	Oxidase Production	Citrate Utilization	Nitrate Reduction	H_2S Production	Urease Production	Starch Hydrolization	Glucose	Sucrose	Manitol	Xylose	Fructose	Arabinose	Maltose	PROBABLE ORGANISM
1	+	R	+	+	-	-	-		-	-	-	+		-	+	AG	AG	AG	AG	AG	AG	AG	*Clostridium perfingens*
2	+	R	+	+	-	-	-		+	-	-	-	-	+		-	-						*Clostridium tetani*
3	+	R	-	+		+		+	-	-	-	-	-			A	-	-	-	AG	-	A	*Listeria monocytogenes*
4		R		-		-			-	+		+	+		+	AG	AG	AG	AG		AG	AG	*Bacteroides buccae*
5		R				-		-	-	-		-			+	AG	AG	-	-			A	*Actinomyces bovis*

Biochemical Characteristics of Bacteria Isolated from Leachates and Water

S/N	Gram Reaction	Shapes	Spore Production	Motility	Coagulase	Catalase	Methyl red	Voges Proskauer	Indole	Oxidase Production	Citrate Utilization	Nitrate Reduction	H_2S Production	Urease Production	Starch Hydrolization	Glucose	Sucrose	Manitol	Xylose	Fructose	Arabinose	Maltose	PROBABLE ORGANISM
1	+	C	+	-		+						+			+								*Streptomyces albus*
2	+	C	+	-		+						+			+								*Streptomyces griseus*
3	+	R	+									-			+			-	-				*Actinomyces bovis*

Characteristic And Identification Of Coliforms From Landfill And Boreholes

S/N	Gram Reaction	Shapes	Spore Production	Motility	Coagulase	Catalase	Methyl red	Voges Proskauer	Indole	Oxidase Production	Citrate Utilization	Nitrate Reduction	H_2S Production	Urease Production	Starch Hydrolization	Glucose	Sucrose	Manitol	Xylose	Fructose	Arabinose	Maltose	PROBABLE ORGANISM
1	-	R	-	-	-	+	-	-	-	-	+	+	-	+	-	AG	AG	AG	AG	AG	AG	AG	*Klebsiella planticola*
2	+	R	+	+	+	-	+	-	-	-	-	+	+	+	+	A	A	A	A	AG	-	A	*Streptococci spp*
3	-	R	-	+	-	+	+	-	+	-	-	+	-	-	+	AG	AG	AG	AG		AG	AG	*Escherichia coli*
4	-	R	-	+	-	+	+	-	-	-	+	+	-	+		AG	A	AG	-		AG	AG	*Citrobacter spp*
5	+	C	-	-		-	ND	ND					ND			A	A	A	A	AG	-	A	*Enterococcus faecalis*

Characteristic and Identification of Fungal Species Isolated from Landfill and Boreholes

S/N	Colour	Type of	Nature Hyph	SpeciVegetatistructu	Asexual	SpeciReproduct Structu	Conidi Rea	Vesis shap	Probab Organis
1.	Greyi gree	Filament	Septa	-	Foot conidiChlamydospo	Sporodachia	-	-	Aspergill Fumigut
2.	Green Yello	-	SeptatMultinucled Branch	-					
3.	White	Filament	No-septa Rhizo		Glob		Bear Sporangi	-	Mucsp
4.	Greyi	Filament	No-septa Rhizo		Ov		Bear Sporangi	-	Rhizopsp
5.	Blac	Filament	No- septa Foot		Globose	Smooth wall conidiopho			Aspergill nig
6.	Yellowi brow repad growl colo	Filament	No- septa Foot		Acrope branched chai	Shoconidiopho	-	-	Cladosporisp

Discussion and Conclusions

The study on effects of landfills on the physico-chemical and microbial spectrum of groundwater of parts of Delta Sate was carried out in section. This discussion was therefore done in sections in accordance with the study carried out. From the table above, observations showed that the active landfill had more effects than the abandoned one. This is because higher values were observed in the active landfills than the abandoned one, which had lower values. The above observation showed that bores water near the abandoned landfill had lower values than those nearer to the active landfill. This could be attributed to the presence of metabolizable substances in the active landfill where fresh wastes were constantly brought in. The substances produced during the metabolism percolated down through the soil to the ground water table. The values in table three are being significantly different ($p<0.05$) among the sample for the parameters. Nwaugo*et al* (2009) working on water sources in Ishiagu observed a similar situation. Fatta *et al* (1999) working on ground water in Athens, Greece reported that the soil particles adsorbed some of the physico-chemical parameters and did not allow some of them to reach the ground water table. All the metals had higher concentrations at the time of analyses and some metals which were not even found in the control borehole. Though the values vary in ranges and are being significantly different ($P<0.05$) among all the sampling points. Again, observations also showed the influence of distance in this contamination. The physico-chemical parameters measured showed that borehole water nearest the landfills were more contaminated than those further away while the control sample was cleaner than others (50m and 100m). This also follows the principle of diffusion. There was decrease of contaminants as distance increased away from the pollution source. Microbiological analysis of the ground water showed lower microbial loads than were observed in the leachate. This could be attributed to oxygen tension based on the depth of the boreholes; only a few micro-organisms were reported with the anaerobic total heterotrophic bacteria being the highest. This was the major physiological group of micro-organisms found in the abandoned landfill. Only three microbial groups – total heterotrophic bacteria (aerobic) and the coliforms were found in the active landfill. This agrees with the earlier suggestions that the availability of metabolizable nutrients influenced the presence of the microbial groups. This was coupled with the oxygen tension as the microbial groups which were not observed required oxygen for survival and growth. Others absent in ground water could therefore be tied to nutrient availability and oxygen tension. The above suggestion could be accepted as the situation changed extensively during the rainy season which had much mixing at the time of the analyses. More microbial groups were observed with higher numbers. This created the opportunity for many micro-organisms which could have been filtered off or die before reaching the ground water to survive and reach the water easily. In the same vein, more nutrients were accumulated in the ground water in the rainy season because of the ease of percolation using the saturated soil water. This saturation ensured easy percolation and easy contamination of the ground water by both the nutrients and the organisms. Furthermore, the control had only $THBC^-$ without other groups. This observation showed the much contaminative effect of the landfills in ground water. It was observed that whether abandoned or active, landfills contaminate ground water. However, this contamination is more in active landfills than in abandoned ones. The leachate physico-chemical parameters showed values above that of ground water. The leachate had high BOD, low DO with high conductivity too. Generally, more or higher values were recorded in the active landfills than the abandoned one. The continuous release of materials from the freshly deposited wastes in the active landfill caused the high values observed. Observations in the BOD and DO show that high BOD and less DO were reported. This also tallies with the earlier observation of up word moment of water during the rainy season. This rise caused the solubilization of wastes into the leachate. This observation follows the same trends with the metallic ions which were higher in the leachate during the rainy season. Again, Cr, Pb, Cd and Cu were all very low in the control soil leachate than the leachate. This further goes to establish the negative impact of the landfills on leachate. This observation could further be the cause of ground water contamination. This is because it is the soil leachate that reaches the ground water table for contamination. This therefore accounts for the positive correlation between the ground water quality and the leachate quality observed in this study.

Analyses of the results indicate that much of the substances in the abandoned landfill had been leached out or metabolized hence the low values recorded. This is unlike the results obtained in the active landfills with fresh and constant supply of wastes resulting in increased release of various substances to the leachate.The values of chemical elements and metallic ions in the leachates vary in ranges and are being significantly different ($P<0.05$) among all the sampling points. Like other samples earlier explained, distance also influenced the values obtained. Samples from the 0m were higher and more impacted than those from 50m and 100m away while the control samples were the least affected. This further indicates the negative or adverse impact of landfills on leachates but shows that the effects diminish with distance away. This means that the landfill effect is proportionally or directly related to the distance from the landfill. Assessment of the various microbial groups indicates higher microbial diversity and loads away from the landfill site in the leachates. It also shows that the active landfill had higher microbial diversity and loads than the abandoned one. This had already been attributed to the variety of microbial metalizeable substances in the active landfill which had been exhausted in the abandoned landfill. On the other hand, the low microbial diversity and load could be attributed to the survival of the fittest. The breakdown of the leachate components is dependent on microbial activities, which in turn is oxygen dependent. The low microbial spectrum in abandoned site leachate therefore keeps the leachate intact with very little microbial activities. Generally, results obtained from this study showed interesting variations. It was evident that leachate had more microbial loads, than the ground water. This could be expected as Pelzcar et *al* (2005) and Nwaugo *et al*. (2008). This was because only very few obligate anaerobes could survive in the ground water with its very minimal oxygen tension. Again, the soil profile had acted as filter for the ground water and did not allow micro-organisms to percolate to the ground water table. The water (ground) contained only small amounts of these metals as secondary sources because of distance and diffusion.

Observation in this work showed that the bacterial species in the leachate and water were *Klebsiella planticola, Streptococcus Pseudomonas aerugmosa, Alcaligenes autrophus, Bacillus* species and *P. putida.* Other organisms also observed were *Streptomyces, Actinomyces, Micrococcus citrobacta, Serriatia, Chromatium*and*Proteus* species were also observed. The fungi were *Apsergillus, Mucor, Clodosporium, Rhizopus* and *Candida* species etc. Alcamo (2001), Al-Mutani (2009) Brady &Weils (2008) and Eja*et al*(2010) have stated that land fill wastes support several microbial growth systems. It is even more appropriate to state here that the diversity of wastes deposited at the landfill site also contains these various organisms and supported the growth of others too. The observation of diverse micro-organisms at the site is one thing but the other issue is that more micro-organisms were reported in the active landfill site. This remains the main feature following the continuous inflow of wastes to the active site. The microbial utilizable nutrients in the abandoned landfill had been exhausted and so could not support high microbial spectrum. Hallawella (2005) and Khajuria (2010) had earlier stated that landfill sites are polluted sites and could serve as sources of pathogenic organisms to man. They further stated that the construction of boreholes or other domestic water sources near landfill should be discouraged. The WHO standard for potable water quality states that no coliform should be found in domestic water as this indicated feacal pollution of the water. This study therefore advocates the location of landfills in areas remote from human water supply sources. There is therefore the need to treat the water obtained near landfills before use as such water is not potable both in terms of the physico-chemical parameters and the biological aspects.

Conclusion

Landfills are sites set aside for the disposal of waste materials by burial and it is one of the oldest forms of waste treatment thus, proper measures should be put in place to ensure that wastes are properly disposed and leachates are covered to prevent their percolation to the ground water. This study has revealed that microorganisms are prevalent in landfill leachates as well as groundwater. These microorganisms are higher at the edge and decrease with distance. The result also showed that the physicochemical parameters such as pH, temperature, DO, Salinity etc favors the proliferation of THB more than other microbial groups. Solid waste disposal is considered as one of the main environmental problem in parts of Delta State today. The appropriate design and operation aspects of these landfills are not well considered to protect the aquifer from contamination by leachate. All the bacterial genera reported in this study have been reported by Chesbrough (2005) as potential pathogens that are capable of causing diseases, pose health risk to the inhabitants of this settlements where landfill is sited.

References

Abdul-Salam, N. (2009). Assessment of heavy metal pollution in dumpsites in Ilorin metropolis *Ethiopian. Journal of Environmental Studies and Management. 2(2), 92-99.*

Alcamo, O. T. (2001) "*Fundamentals of Microbiology"* Sixth Edition, Cambridge University Press Inc. 226-234

Alimba C. G, Bakare A.A, and Latunji C.A, (2012). Municipal landfill leachate induced chromosome aberration in rat bone marrow cells. *Afr J Biotech*. 2053-2057

Al-Mutairi, S. O. (2009). "*Production of Compost from Municipal Solid Waste in Riyadh City"* M.Sc Thesis College of Food Science and Agriculture, King Saud University, Saudi Arabia

Brady, N. C. and Weils, R. R. (2008).*The Nature and Properties of Soils* (14th Edition) Prentice Hall, New Jersey, Pp.190-980

Buchannan, R. E. and Gibbons, N. E. (2000). Bergey's manual of determination bacteriology. 8th edition. The Wihams and Wiekins Company, Baltimore.

Butt, I and Ghaffer, A. (2012). Ground water quality assessment near Mehmood Boti landfill, Lattore, Pakistan. *Asian Journal of Social Science and Humanities 1(2), 13-22.*

Cheesbrough, M. (2005). *District Laboratory Practice in Tropical Countries.* Part 2. Cambrige University Press. pp 146-155.

Dosumu, O. O., Salami, N., and Adekola, F. A. (2003). Comparative study of trace elements levels bulletin of the chemical society of Ethiopia. 17(1): 107-112.

Eja, E.M.; Alobi, N.O.; Ikpeme, E.M.; Ogri, O.R. and Inyang, A.O, (2010). Environmental and Public Health related assessment of solid waste Management in Uyo, Akwa Ibom State, Nigeria. *World Journal of Applied Science and Technology*. 2(1): 110-123.

Etok, C. A., Udo, S. M. and Eja, M. E (2004). *General Microbiology Practical Manual.*Abison printing press, Calabar, Nigeria.

Fatta D., Papadopoulos A. and Loizidou M. (1999).A Study on the Landfill Leachate and its Impact on the Groundwater Quality of the Greater Area.Athens, Greece.*Kluwer Academic Publishers,* 175–190.

Harley, J. P. and Prescott, L. M. (2000).*Laboratory Exercises in Microbiology (5th edition) McGraw Hill Publisher*. New York.

Henry, J. R. (2008). An overview of phytoremediation of lead and mercury. Washington DC. NNEMS Reports. P. 3-9.

Hellawella, J. M. (2005). Biological Indicators of Freshwater Pollution and Environmental Management London, Elsevier Applied Science Publishers.

Holt, J.G., Kreig, N.R., Sneath, P.H.A., Stanley, J.T. and Williams, S.T. (1994).*Bergeys Manual of Determinative Bacteriology*. (9th edition) Williams and Wilkins Publishers, Baltimore USA.

Jhamnani, B. and Snigh, S. K. (2009).Ground water contamination due to Bhalabiwa landfill site in New Delhi. *Int'l Journal of Environmental Science and Engineering* (1), 121-5.

Khajuria, S. (2010). Estimation of Municipal Solid Waste Generation and Landfill in Asian Developing Countries. *Journal of Environmental Biology, 31*(5): 649-654.

Longe, E.O and Balogun, M.R (2010).Ground water quality assessment near municipal landfill, Lagos, Nigeria Research Journal And Applied Science and Engineering Technology.2(1)39-44

Ministry of Environment and Forests (MOEF) 2008. 6TH Environmental report Card of Bangalore

Mor, S., Ravindra, K., Dahiya, R. P. and Chandra, A. (2006). Leachate characterization and assessment of ground pollution near municipal solid waste landfill site environmental monitoring and assessment. 1(2): 10-13.

Nwaugo, V.O., Chima, G.N., Elekwa, I. and Inyang, C. U (2009) Evaluation of surface water quality in heavy metal mining area of Ishiagu, South Eastern Nigeria.*Journal of Science Engineering and Technology*. 16(2); 8781 – 8794

Palmer, S.R, Dunstan, F.D, Fielder. H,Fone, D.L, and Higgs, G., (2005). Effect of leachate on ground water and heavy metal toxicity of leachate from municipal dumpsites. *Environ. Health perspective,* 113, 1362-1365

Pelczar, M, Chan EI.S and Kriegi N .R (2003) Microbiology of the soil and atmosphere; concepts and applications in microbiology McGraw Hills, Inc. U.S.A. 772-873

Pepper, I. L. and Gerba, C. P. (2005).Environmental micro-biological. A laboratory manual. Second edition, Elseuei academic press.

Peter, K., Morton, A. B., Alex, P. R., Anna, L. and Thomas, H. C. (2002). Present long term composition of municipal solid waste leachate. A review, critical review in environmental science and technology. 32(4), 297-336.

Prescott, L. M., Harley, J. P., and Klein, D. A. (2008). Microbiology.7th edition. McGraw-Hill companies Inc, New York. pp. 113-114

Ogundiran, O. O., and Afolabi, J. A. (2008). Assessment of physicochemical parameters and heavy metals toxicity of leachates from municipal solid waste open dumpsite. *Int'l Journal of Environmental Science Technology, 5(2): 243-250.*

Oyasi P. (2006). Microbiological and physicochemical characteristics of the soil of water collection site in Port Harcourt city, Nigeria. *Nigeria Journal of Soil Science*. 16: 162-167

Slomczynska, B. and Slomczynski, T. (2004). Physiochemical and toxicology characteristics of leachate from MSW landfills *Polish. Journal of Environmental Studies, 13: 627-637.*