Sinop University
Positive Science International
e-ISSN: 3108-3862

Positive Science International, 2(1), 27-42
Research Article, Year: 2026
DOI: 10.71340/psi.1866014

Microbial Analysis, Physicochemical Content and Insect Vectors Associated with Selected Dumpsites in Ijebu-Ode, Nigeria

Adewole SEBIOMO[1*]

[1*] *Department of Biological Sciences, Tai Solarin Federal University of Education Ijagun, Nigeria*

Article Info

Research article
Received: *18.01.2026*
Accepted: *10.03.2026*
Published: *30.06.2026*
Corresponding Author*: *Adewole SEBIOMO*
sebiomoadewole6@gmail.com
0000-0002-3930-0022

Keywords

Insect
Bacteria
Fungi
Viabe counts

Abstract

This study analyzed the types of insect vectors in dumpsite locations and the microorganisms associated with the insect vectors and dumpsites. The heavy metal and physicochemical content of the soil samples were also determined. Bacteria and fungi were isolated from the soils, housefly and cockroaches collected from the dumpsites. Atomic absorption spectrophotometer was used to determine the mineral content of the soil samples. Bacterial and fungal counts were also determined using the Quebec colony counter. Dehydrogenase, phosphatase, catalase, urease and peroxidase activities were estimated. Of the ten bacterial species identified *Pseudomonas aeruginosa* had the highest frequency of 20.3% while *Streptococcal faecalis* had the least percentage frequency of 3.1%. Seven fungal genera were identified. They include; *Aspergillus niger*, *Trichoderma* spp., *Penicillium* spp. the enzyme activities in this work increased significantly ($P \leq 0.05$) after analysis of dumpsite soils. Peroxidase and catalase activities of dumpsite soils were higher compared to their control soil samples. The Na, Fe, Zn, Cu, Pd and Cd contents of the dump site soil samples were more than what was obtained in the control soil samples. However, the Ca, Mg, K contents of the control soil samples were significantly higher than those of the dump site soils. Fe had the highest value of 33.57±10.22 mg/kg compared to the other soil samples.

Nijerya'nın Ijebu-Ode Bölgesinde Seçilmiş Çöp Depolama Alanlarıyla İlişkili Mikrobiyal Analiz, Fizikokimyasal Bileşim ve Böcek Vektörleri

Makale Bilgisi

Araştırma makalesi
Başvuru: *18.01.2026*
Kabul: *10.03.2026*
Yayın: *30.06.2026*
Sorumlu Yazar*:
Adewole SEBIOMO
sebiomoadewole6@gmail.com
0000-0002-3930-0022

Anahtar Kelimeler

Böcek
Bakteri
Mantar
Canlı sayımı

Özet

Bu çalışmada, çöp depolama alanlarında bulunan böcek vektörlerinin türleri ile bu böcek vektörleri ve depolama alanlarıyla ilişkili mikroorganizmalar incelenmiştir. Ayrıca, toprak örneklerinin ağır metal ve fiziko-kimyasal içerikleri de belirlenmiştir. Çöp depolama alanlarından toplanan toprak, ev sineği ve hamamböceği örneklerinden bakteri ve mantarlar izole edilmiştir. Toprak örneklerinin mineral içeriklerinin belirlenmesinde atomik absorpsiyon spektrofotometresi kullanılmıştır. Bakteri ve mantar sayımları ise Quebec koloni sayacı kullanılarak gerçekleştirilmiştir. Dehidrogenaz, fosfataz, katalaz, üreaz ve peroksidaz enzim aktiviteleri değerlendirilmiştir. Tanımlanan on bakteri türü arasında, %20,3'lük görülme sıklığı ile *Pseudomonas aeruginosa* en yüksek orana sahip olurken, %3,1'lik görülme sıklığı ile *Streptococcus faecalis* en düşük orana sahip olmuştur. Yedi mantar cinsi tanımlanmıştır. Bunlar arasında *Aspergillus niger*, *Trichoderma* spp. ve *Penicillium* spp. yer almaktadır. Çalışmada incelenen çöp depolama alanı topraklarında, analizler sonrasında enzim aktivitelerinde anlamlı düzeyde artış ($P \leq 0,05$) gözlenmiştir. Depolama alanı topraklarının peroksidaz ve katalaz aktiviteleri, kontrol toprak örneklerine kıyasla daha yüksek bulunmuştur. Çöp depolama alanı topraklarında belirlenen Na, Fe, Zn, Cu, Pb ve Cd içerikleri, kontrol topraklarında elde edilen değerlerden daha yüksek bulunmuştur. Buna karşın, kontrol topraklarının Ca, Mg ve K içerikleri, depolama alanı topraklarına göre anlamlı derecede daha yüksek olarak belirlenmiştir. İncelenen elementler arasında Fe, 33,57 ± 10,22 mg/kg değeri ile en yüksek konsantrasyona sahip olmuştur.

Research Article

To cite this article:
Sebiomo, A. (2026). Microbial Analysis, Physicochemical Content and Insect Vectors Associated with Selected Dumpsites in Ijebu-Ode, Nigeria, Positive Science International, 2(1), 27-42, https://doi.org/10.71340/psi.1866014

1. Introduction

Wastes are usually disposed at selected locations or recycled for other uses. In times past, wastes have not shown any important environmental impact due to the recycling processes occuring in the soil. The rise in population of man and industries, resulted in the increased rate at which waste is generated resulting in significant environmental changes. Due to poor waste management technologies in many underdeveloped nations [1], environmental pollution, disease causing organisms, toxins, heavy metals, toxic gaseous emissions, and other dangerous pollutants have increased. These wastes are usually generated from agriculture, industries and other anthropogenic activities. The production of waste in Nigeria is more than two hundred and fifty thousand tons every year. It is produced more in the urban areas compared to the rural areas [2]. The quantity of wastes and dumpsites in Nigeria have increased drastically due to unprecedented rise in human population, construction, businesses and manufacturing industries [3]. When wastes accumulate, they negatively impact the quality of the soil in that environment. Unchecked rise in waste products affects the capacity of soils to naturally handle the waste. When pollution occurs soil microflora and soil fauna are impacted. Fluctuations in pH, temperature, electrical conductivity and microbial populations, are some of the factors which show the impact of pollutants in the environments [4].

Accumulation of waste can be attributed to the rise in population when people move from the rural areas to the cities. Waste dumpsites is a breeding ground for rodents, mosquitoes, flies and pathogenic microorganisms [5]. In most developing countries wastes are usually deposited on roads without proper care for waste disposal. Improper management of solid wastes results in land degradation, water pollution and air pollution. Proliferation of dump sites usually reduces the soil quality and which usually results in decrease of vegetation abundance. Important sources of heavy metals in dump sites are wastes from industries, ashes from incinerators, wastes from mines and dangerous substances from households such as dyes, paints, batteries, inks, etc. [6]. This causes adverse effects on human and animal health as well as the soil fertility and soil quality. Accumulation of wastes in dump site gives rise to exponential multiplication of bacteria and fungi which in turn degrades the substances that are biodegradable [5]. A lot of households in Nigeria rely on groundwater for their daily activities. Dumpsites can pollute groundwater by via a mixture of industrial wastes [7]. Biodegradable wastes in dump sites decays and then smells generating methane gas which, increases the greenhouse effect. Burning wastes is discouraged because plastic releases substances which are toxic and dangerous such as dioxins. Biodegradable wate can acts as breeding grounds for disease transmitting insects and rodents, which transmits diseases such as cholera, diarrhoea, dysentery and typhoid fever.

Dumpsites are a common occurrence in Ijebu ode local Government of Ogun state, Nigeria. A lot of pathogenic microorganisms and insect vectors which spread these microbes are usually associated with these dumpsites. The wastes sometimes end up in soils useful for agriculture via erosion and then resulting in contamination of rivers and drinking water supplies. The dumpsites are of primary health concern because of the spread of pathogenic microorganisms. On the other hand, accumulation of wastes could result in increase in microbial load which enables the conversion of organic matter to inorganic matter which in turn supplies plant nutrients. Consequent upon accumulation of wastes in the dumpsites there is usually a resultant accumulation of minerals and heavy metals in soils after biodegradation of the wastes. Hence the aim of this study is to determine the microbial activities, physicochemical content, and insects associated with the dumpsite soils via the following objectives; (1) Isolation and identification of microorganisms associated with dumpsite soils, (2) Determination of the urease, phosphatase, dehydrogenase, peroxidase and catalase activities in dumpsite soils, (3) Analysis of the pH, electrical conductivity, organic carbon, nitrogen, phosphorus, calcium, magnesium, potassium, sodium, iron. zinc, copper, lead and cadmium content of dumpsite soil samples, (4) Identification of insects associated with the dumpsites, (5) Isolation of the microorganisms associated with these insects.

2. Materials and Methods

2.1. Sampling Location

This work was conducted in Ijebu ode local government, Ogun state, Nigeria. The research location occurred between longitude 3.180 E and latitude 6.470 N in Nigeria. The area is a rain forest region that has both dry and wet seasons. The annual rainfall is always high with values in the range of 1575-2340

2.2. Sample Collection

A total of 30 soil samples was collected from ten different dump sites in Ijebu Ode local government Ogun state. Soil samples, approximately 100 g each, were collected from the selected dumpsites using soil auger at a depth of 5 cm, thus ensuring minimal disturbance to the soil structure. Control soil samples were collected from distance located at least 150 meters away from the dump site to assess baseline conditions. The collected soil samples were carefully transferred into black polythene bags, labelled accordingly, and transported to Biochemistry laboratory, Institute of Agricultural Research and Training, Moor Plantation, Apata, Ibadan, Oyo state, for further analysis. All samples were analyzed within 24 h of collection and stored in a cool, dry place prior to examination. A composite sampling technique was employed to ensure representative samples from each site. Four locations were chosen in a grid format to facilitate comprehensive analysis.

In addition to the samples from the dump sites.

2.3. Collection of Insects

- Sticky traps: The cockroaches were trapped using sticky traps. It was made with plywood. The plywood is 60 cm long, 40 cm wide and two cm thick. The plywood was coated on the surface with grease and placed at the dumpsite so that the insects were caught when they approached it.
- Water traps: They were designed with plastic buckets (5 litres in volume). The buckets were filled with water and detergents were introduced into the water to reduce surface tension and enhance wetting of the insects [8].
- **Sweep net:** They were used for catching the houseflies in this study. They were made using mosquito nets. Metal rods were used to form the rim and a wooden handle was added. Twenty sweeps were carried out at a dumpsite between 8.00am and l0.00am in the morning for a better catch.
- **Hand picking:** Cockroaches were also handpicked. Samples were collected in the morning between 8-10 am.

2.4. Microbial Enumeration and Identification

Twenty-eight grams of Nutrient Agar powder was weighed on the Mettler balance and dispensed into 1000ml of distilled water contained in the conical flask. It was dissolved and then distributed into macCartney bottles before it was sterilized in autoclave set at 121°C for 15 minutes. 55g of macConkey Agar was weighed on analytical meter balance and dissolved in 1000ml of distilled water in clean and dry conical flasks. It was dissolved and then distributed into macCartney bottles before it was sterilized in autoclave set at 121°C for 15 minutes. Thirty-nine grams of Potato Dextrose Agar was weighed on analytical meter balance and dissolved in 1000ml of distilled water in a clean and dry conical flask. It was dissolved and then distributed into macCartney bottles before it was sterilized in autoclave set at 121°C for 15 minutes. Nine milliliters of distilled water were pipetted into a clean test-tube and were covered with cotton wool and foil then placed in autoclave at 121°C for 15 minutes to produce sterile water. After this 1 gram each of soil sample was weighed into test-tube containing 9 ml of sterile distilled water and serially dilute them into 5 test-tube.

Pour plate method was used to dispense the inoculum into the culture plates. The plates were then allowed to cool and set. Each sample were duplicated and the plates were incubated at 37°c for 24-48 hrs. Nutrient Agar and MacConkey agar while the Potato Dextrose Agar was incubated at 28°c-30°c. All the plates were incubated invertedly. After bacteria and fungi emerged from plates, they were sub-cultured continuously until pure cultures were achieved. Quebec colony counter was then used to count bacteria and fungi in culture plates containing 15-150 colonies per plate and then the colony forming units per gram (cfu/g) was calculated. Pure culture of bacteria isolated was identified on the basis of their morphological and biochemical characteristic. The organisms were subsequently characterized according to the taxonomic scheme of Buchanon and Gibbon, (1974) while fungi were identified base on morphological and cultural characteristics.

2.5. Phosphatase Activity

Two grams of soil sample was extracted with 20ml sodium carbonate buffer at pH 6.0. The suspension obtained was centrifuged at 5000 rpm in a high speed Gerber centrifuge (Gallenkamp model) at 5ºC for 30 min. The supernatant obtained at the end of 30 min centrifugation was decanted into 30 ml centrifuge stoppered bottle and stored in a deep freezer at -20ºC prior to analysis. One ml of enzyme extract of sample was pipetted into 50 ml test tube. five ml of disodium-p-nitrophenol phosphate was added, mixed thoroughly by shaking to obtain a homogenous solution and left to stay for 5 minutes in order to yield the yellowish colouration. A standard solution of phosphatase enzyme was prepared from stock phosphatase solution and treated similarly like the sample above. The absorbance of the yellowish colour solution and standard solution was measured as change in 60s (1 min) at wavelength of 475nm. One unit of phosphatase activity was estimated as the quantity of enzyme which catalysed 0.01 absorbance change in one min at wavelength of 475 nm.

$$\text{Phenol } (\mu g\ g^{-1}\ dwt\ h^{-1}) = \frac{C \times 100}{dwt \times t \times 10}$$

C = phenol concentration (μg phenol ml^{-1}) filtrate

dwt = dry weight of 1g moist soil

t = the incubation time hours,

100 is the total volume of the soil suspension in millitres

10 is the weight of the soil used in the test.

2.6. Soil Urease Activity

Urease activity was determined using the method of and Teicher [9]. After incubation of soil with urea and citrate buffer addition urease activity was measured using a colorimeter. Prior to incubation, toluene was added.

2.7. Dehydrogenase Activity

The method of Kumar *et al.* [10] was adopted in this study to determine the dehydrogenase activity of soil samples. Five grams of the soil samples treated with Dimethylammonium acetate and Nicosulfuron+Atrazine and non-treated soil samples were dispensed into 250 mL conical flask. TTC-glucose solution (1 mL) and Tris buffer (2.5 mL) solution were added to the herbicide-treated soil samples. One mL of distilled water was then added into the control flasks. The pH was adjusted to 7 using 1.0 N HCl and the flasks were swirled gently to mix the contents. The mixtures were incubated at 30 °C for 24 hours. After incubation, the soil samples were treated with methanol and transferred into a funnel and then sieved with Whatman No 42 filter paper placed on 100 mL graduated cylinder. Additional amounts of methanol were passed through the soil until 50 mL of methanol, containing the formazan, was collected in the graduated cylinder. The red methanolic solutions of the formazan were determined using a UV/Vis Spectrophotometer.

2.8. Peroxidase Activity

Peroxidase activity was measured using the method of Burns [11]. Peroxidase activity in soil samples was measured using the spectrophotometer. Pyrogallol was then used as substrate. A suspension containing 0.1 g of fresh soil to which 25 ml of 50 mMsodium acetate buffer at pH 5 was then homogenized for 1 minute. The activity of the peroxidase enzyme was measured by adding 1 mL of soil suspension to two hundred and fifty microlitre of substrate solution. The substrate and buffer, soil suspension and buffer were then prepared. The buffer was used as blank. Five microlitre of 0.3% hydrogen peroxide was dispensed to each sample and the controls. The prepared samples were incubated at 20°C (in the dark) for four hours. Peroxidase activity was then determined in the spectrophotometer at a wavelength of 460 nm. The activity of enzyme peroxidase was then calculated and values were expressed in μmol/g soil/h [15].

2.9. Catalase Activity

Catalase activity was determined using the method described by Vijayakumar *et al.* [17]. Residual H_2O_2 was titrated with $KMnO_4$ [16]. One gram of soil sample was dispensed into 5 mL distilled water with 1 mL of 3% hydrogen peroxide solution. The resultant solution was then shaken vigorously and five mililitres of 1.5 mol/L H_2SO_4 was latter added. The resulting solution was then filtered. Titration was done using 0.05 mol/L $KMnO_4$. One enzyme unit was calculated as the amount of enzyme that catalysed the consumption of 1 μmol of H_2O_2 per g soil per hour [17].

2.10. Mineral, pH and Electrical Conductivity Analysis

The method described by Blakmore *et al.* [18] was used to determine the mineral contents of the vegetables. Concentrations of minerals (Na, K, Ca, Fe and Zn) in the samples were estimated using the atomic absorption spectrophotometer. Sample extract and standard solutions were introduced into the atomic absorption spectrophotometer. The concentrations of the minerals were then calculated. Cadmium (Cd), Lead (Pb), Hexavalent Chromium (Cr^{+6}) and Mercury (Hg) were analyzed, in air dried soil samples obtained from polluted auto mechanic workshop sites after the soils have been homogenized, by using the atomic absorption spectrophotometer. The pH and electrical conductivity (EC) of the samples were determined using pre-calibrated pH and conductivity meter.

2.11. Statistical Analysis

The version 20 of the statistical package for social sciences (SPSS) software was used to analyze data from the microbial count, soil nutrient content, soil microbial respiration and soil biomass carbon. Duncan's tests and the One-Way ANOVA were used to test statistical differences between the various treatment groups. Continuous data are presented as Mean ± standard deviation and were considered statistically significant when the p-values were less than 0.05.

3. Results

Table 1 shows the dominance of *Clostridium* spp. (Bacteria), *Enterobacter melanogenicum* (Bacteria), *Fusarium* spp. and *Aspergillus* spp. (Fungi) in majority of the soil samples analyzed.

Table 1. Bacteria and fungi obtained from dumpsite soil samples

Soil Samples	Bacteria	Fungi
CONTROL	*Streptococcus aureus*	*Fusarium* spp.,
SOFAARI1	S. *pyogenes, Enterobacter melanogenicum, Bacillus* spp., *Clostridium* spp.	*Aspergillus* spp., *Fusarium acacia*
SOFAARI2	*Psedomonas aeruginosa, Escherichia coli, Staphylococcus aureus, Bacillus* spp., *Acinetobacter* spp.	*Fusarium poliferatum, Mucor mucedo*
SOFAAR13	*Salmonella typhi, S. saprophyticuss, P. putida*	*Mucor racemosus, Penicillum chrysogenum*
SO1TONR1	*E. melanogenicum, S. pyogenes, E. coli, Acinetobacter* spp.	*Penicillum* spp., *Aspergillus nodulans*
SOITONRI2	*Clostridium spp., Bacillus* spp*., S. aureus, Klebsiella pneumonia*	*Saccharomyces* spp., *Fusarium oxysporum*
SOITONRI3	*Salmonella* spp*., P. aeruginosa, S. aureus, Bacillus* spp.	*Mucor* spp., *Penicillum chrysogenum, Aspergillus* spp.
SOSABOO1	*Clostridum* spp., *S. pyogenes, E. melanogenicum, Salmonella typhi*	*ochraceus, Penicillum* spp*., Fusarium acacia*
SOSABOO2	*P. aeruginosa, E. coli, S. aureus*	*Saccharomyces* spp., *Mucor mucedo*
SOSABOO3	*Bacillus* spp., *S. saprophyticus, K. pneumonia*	*nodulans, Fusarium proliferatum*
	S. pyogenes, Clostridium spp., *E. coli*	*Fusarium oxysporum, Saccharomyces* spp., *Aspergillus* spp.

The following are soil samples obtained from Faari; SOFAARI1, SOFAARI2, SOFAARI3, Itorin; SO1TONR1, SO1TONR2, SO1TONR3 and Sabo; SOSABOO1, SOSABOO2, SOSABOO3

Contained in Table 2 are ten genera of bacteria namely *Acinetobacter* spp., *Pseudomonas aeruginosa*, *Escherichia coli* and *Streptococcus faecalis.* Of the ten bacterial species identified *P. aeruginosa* was consistently isolated in all the samples collected. It recorded a percentage frequency of 21.3% while *S. faecalis* were the least with a percentage frequency of 4.1%.

Table 2. Bacterial Isolates obtained from Dumpsites and their Percentage Occurrence in Soil Samples

Bacterial isolates	Percentage occurrence
Acinetobacter spp.	18.6
S. faecalis	4.1

P. aeruginosa	21.3
Serratia spp.	8.9
B. subtilis	15.8
S. aureus	8.6
Escherichia coli	3.9

The results presented in Table 3 shows the fungi isolated from the dumpsites. Seven fungal genera were identified these includes *Aspergillus niger*, *Trichoderma viride Penicillium notatum*., *A. niger* recorded the highest occurrence with a percentage frequency of 25.44% while *Fusarium* spp. recorded the percentage frequency of 9.10%.

Table 3. Fungal isolates from dumpsites and their percentage occurrence in soil samples

Fungi isolates	% Frequency of occurrence
A. niger	25.44
T. viride	10.70
P. notatum	17.90
F. oxysporum	10.10
Mucor mucorales	22.0
Saccharomyces cerevisiae	13.00
Rhizopus stolonifer	12.20

Table 4 shows the enzymatic activities of the soil samples. Dehydrogenase and urease (21.97± 11.00 mg/g and 98.90± 15.93 mg/g) had the highest activities at Faari and Itorin respectively. In this study enzyme activities increased significantly compared to the control.

Table 4. Enzyme Activities of Soil Samples

Parameters	Control	Faari	Itorin	Sabo
Urease (mg/g)	8.50±0.00	70.77±29.88	98.90±15.93	59.73±7.0
Acid Phosphatase	1.70±00	1.95±0.05	0.98±0.42	0.98±0.12
Alk. Phosphatase	1.60±0,00	0.70±0.30	1.03±0.57	0.76±0.42
Dehydrogenase (mg/g)	5.20±0,00	21.97±11.00	12.93±0.96	11.50±5.0
Peroxidase(µmol/h/g)	0.38±0.04	5.09±0.60	1.30±0.69	1.40±0.20
Catalase(µmol/h/g)	<0.01	0.03±0.01	0.0±0.01	0.04±0.01

Presented in Table 5 are the microbial counts of the soil obtain from the dumpsite. There was significant difference ($p \leq 0.05$) in the actinomycetes counts. The highest count of $8.94 \pm 0.88 \times 10^2$ was obtain at the Itonri dumpsite. The lowest actinomycetes count of $6.17 \pm 0.58 \times 10^2$ cfu/g was obtained from the control soil samples. The actinomycetes counts ranged from 6.17 ± 0.58 to $3.85 \pm 1.45 \times 10^2$ cfu/g. There was significant difference ($p \leq 0.05$) in the bacteria count. The highest count value of 3.85 ± 1.45 10^2 cfu/g was obtained at the Faari dumpsites. The lowest fungi count of $2.95 \pm 0.58 \times 10^2$

cfu/g was obtained from the control soil sample the fungi counts ranged from 2.95 ± 0.58 to 3.85 ± 1.45 ×10^2 cfu/g. There were significant differences (p≤0.05) in the bacterial counts. The highest count value of 5.19 ± 1.15 ×10^2 cfu/g was obtained at the Sabo dumpsite. The lowest bacteria count of 3.11 ± 0.57×10^2 cfu/g was obtained from the control soil sample. The bacteria counts ranged from 3.11 ± 0.57 ×10^2 cfu/g to 5.19 ± 1.15 ×10^2 cfu/g. The bacterial count value of 4.23 ± 0.88 ×10^2 cfu/g obtained at Itonri dumpsite was significantly higher than what was obtained at the other sampling points. The lowest coliform count of 2.16 ± 0.57 ×10^2 cfu/g was recorded in the control soil sample. The coliform count ranged from 2.16 ± 0.57 to 4.22 ± 0.88 ×10^2 cfu/g.

Table 5. Microbial Counts of Dumpsite Soils

	TAC (cfu/g ×10^2)	TFC (cfu/g ×10^2)	TBC (cfu/g ×10^2)	TCC (cfu/g ×10^2)
CONTROL	6.17±0.58^a	2.95±0.58^a	3.11±0.570^j	2.16±0.57^a
SOFAARI1	7.63±1.55^d	3.74±1.87^e	3.39±0.88^a	3.23±1.15^c
SOFAARI2	8.47±1.45^j	3.55±1.15^c	3.89±1.15^e	3.72±1.45^g
SOFAAR13	7.71±1.15^e	3.85±1.45^d	3.49±1.45^c	3.37±1.15^d
SO1TONR1	7.20±1.15^d	3.85±1.45^e	3.17±1.45^a	3.05±1.45^b
SOITONRI2	8.94±0.88^k	3.76±1.15^e	5.34±1.45^i	4.23±0.88^k
SOITONRI3	7.81±1.45^f	3.52±0.88^{cd}	3.56±1.73^d	3.49±1.45^f
SOSABOO1	7.55±1.45^c	3.35±1.76^c	3.37±1.45^b	3.49±1.45^f
SOSABOO2	8.31±1.45^i	3.16±1.45^b	5.19±1.15^h	4.11±1.15^j
SOSABOO3	8.15±1.45^g	3.06±1.15^{ab}	5.04±1.15^f	3.86±1.45^h

The following are soil samples obtained from Faari; SOFAARI1, SOFAARI2, SOFAARI3, Itorin; SO1TONR1, SO1TONR2, SO1TONR3 and Sabo; SOSABOO1, SOSABOO2, SOSABOO3. TAC= Total Actinomycetes count, TFC= Total Fungal Count, TBC= Total Bacterial Count, TCC= Total Coliform Count

The result presented in Table 6 shows the physical and chemical characteristics of the soil samples obtained from the dumpsites. The soils of the dumpsites and control all recorded acidic pH values. The highest pH value of 6.33 recorded at Itorin, Sabo and control dumpsites while the lowest pH value of 5.80 was obtained at Faari. Nitrogen content was highest in the samples from the dumpsites (0.24 ± 0.00%) compared to the control. However, the lowest Total Nitrogen concentration (0.10 ± 0.00%) was obtained in the control. Phosphorus showed similar trends comparable to that of the soil nitrogen. It recorded the highest concentration (7.94 ± 3.96%) at Faari. The lowest concentration of 3.30 ± 0.00% was recorded in the control soil samples. Samples from the various sampling point had high amount of sand compared to clay and slit. Samples obtained from Sabo recorded the highest amount of sand (85.93 ± 4.11%), while soil samples obtained from Sabo recorded the lowest amount of sand (74.20±4.127%). There were significant differences (p ≤ 0.05) in the mineral and heavy metal content of soil samples. The Na, Fe, Zn, Cu, Pd and Cd contents of the dump site soil samples were significantly higher than their control soil samples. However the Ca, Mg, K contents of the control soil samples were significantly higher than those of the dump site soils. Fe had the highest value of 33.57 ± 10.22 mg/kg compared to the other soil samples.

Table 6. Physicochemical Properties of Dumpsite Soils

Parameters	Control	Faari	Itorin	Sabo
Ph	7.27±0.25	5.80±0.18	6.33±0.25	7.23±0.35
Electrical conductivity (µS/cm)	23.38±0.7	69.30±5.23	87.10±5.74	39.70±3.12
Total organic carbon (%)	0.73±0.00	4.82±0.87	2.80±1.32	2.14±0.25
Nitrogen (%)	0.16±0.00	1.33±0.16	0.24±0.00	0.13±0.6
Phosphorus (%)	3.33±0.00	7.94±3.96	6.67±3.49	4.70±3.75
Sand (%)	88.62±0.0	74.20±4.12	75.80±11.54	88.93±4.67
Silt (%)	7.00±0.00	9.30±1.90	10.03±4.24	4.97±1.37
Clay(%)	4.00±0.00	19.53±4.55	16.20±7.36	9.807±3.31
Ca (meq/100g)	2.80±0.00	1.55±0.64	1.10±0.70	0.90±0.51
Mg (meq/100g)	2.90±0.00	0.77±0.13	0.57±0.22	0.47±0.21
K (meq/100g)	0.90±0.00	0.45±0.12	0.29±0±15	0.33±0.06
Na (meq/100g)	0.40±0.00	0.35±0.16	0.33±0.10	0.23±0.06
Fe (mg/kg)	0.90±0.00	33.57±10.23	17.14±3.08	10.63±6.45
Zn (mg/kg)	0.12±0.00	2.53±1.03	0.85±0.24	0.70±0.36
Cu (mg/kg)	0.02±0.00	0.70±0.27	0.29±0.23	0.30±0.00
Pb (mg/kg)	<0.01	0.87±0.14	0.14±0.06	0.05±0.01
Cd (mg/kg)	ND	0.06±0.05	0.03±0.01	ND

In Table 7, the cockroaches obtained from Sabo recorded the highest (TVC), (TBC), (TYC) and (TMC). ($6.35 \pm 0.01\times10^3$ cfu/g, $4.45 \pm 0.01\times10^3$cfu/g, $3.05 \pm 0.02\times10^3$, $1.40 \pm 0.01\times10^3$ cfu/g, $1.54 \pm 0.01\times10^3$ cfu/gestectively). The TVC($5.88 \pm 0.04\times10^3$ cfu/g) of cockroaches obtained from Faari recorded the lowest counts of $5.88 \pm 0.04 \times10^3$ cfu/g compared to Itonri ($6.25 \pm 0.01\times10^3$ cfu/g) and Sabo ($6.35 \pm 0.01\times10^3$ cfu/g). The TBC of cockroaches obtained from IJELE also recorded the lowest TBC value of $3.20 \pm 0.05\times10^3$ cfu/g. There was significant ($p \leq 0.05$) difference in the TVC, TBC, TFC and TMC value.

Table 7. Viable Counts of Microorganisms Obtained from Cockroaches

LOCATION	TVC×10^3 cfu/g	TBC×10^3 cfu/g	TFC×10^3 cfu/g	TYC×10^3 cfu/g	TMC×10^3 cfu/g
ITONRI	$6.25{\pm}0.01^b$	$3.55{\pm}0.01^b$	$2.88{\pm}0.44^a$	$1.32{\pm}0.01^b$	$1.43{\pm}0.01^b$
FAARI	$5.88{\pm}0.04^a$	$3.20{\pm}0.05^a$	$2.77{\pm}0.47^a$	$1.20{\pm}0.03^a$	$1.34{\pm}0.23^a$
SABO	$6.35{\pm}0.01^c$	$4.45{\pm}0.01^c$	$3.05{\pm}0.02^b$	$1.40{\pm}0.01^c$	$1.54{\pm}0.01^c$

This results in Table 8 indicates the presence of bacteria in the cockroach samples obtained from the selected dumpsites. Pathogenic bacteria such as *S. aureus, S. typhi, K. pneumonia, E. coli* and *S. pyogenes* were identified. The other isolated bacteria include *Puesdomonas aureginosa, Actinetobacter calcoceticus, Puesdomonas maltophilia, Serratia marcescens, Bacillius* spp., *Yersinia enterocolitica, Salmonella typhi, Clostridium* spp., *Listeria monocytogenes* and *Enterobacter melangenicum.*

Table 8. The Bacteria Isolated from Cockroaches

FAARI	ITONRI	SABO
P. aeruginosa	*S. marcescens*	*S. pyogenes*
Streptococcus spp.	*Bacillius* spp.	*E. coli*
K. pneumonia	*Y. enterocolitica*	*P. maltophilia*
A. calcoceticus	*S. typhi*	*L. monocytogenes*
P. maltophilia	*Clostridium* spp.	*E. melangenicum*
E. coli	*S. pyogenes*	
	P aeruginosa	

In Table 9, *Aspergillus* spp. and *Fusarium* spp. which include *Aspergillus niger, Aspergillus terreus, Aspergillus cereus, Aspergillus fumigatus, Fusarium compactium, Fusarium oxysporium* were commonly isolated from all the cockroach samples collected from the dumpsites.

Table 9. The Fungi Isolated from Cockroaches

FAARI	ITONRI	SABO
A. niger	*F. compactium*	*A. terreus*
S. cerevisae	*P. oxalicum*	*A. flavus*
A. cereus	*A. niger*	*F. oxysporium*
A. tamari	*A. terreus*	*A. fumigatus*
P. oxalicum	*S. cerevisae*	*S. cerevisae*
Fusarium oxyporium		*Trichoderma haraium*

The bacteria isolated from housefly collected from dumpsites (Table 10) include; *Salmonella typhi, Escherichia coli, Actinetobacter calcoceticus, Yersinia enterocolitica, Staphylococcus aureus, Proteus* spp., *Kieblesiella pneumonia, Puesdomonas maltophilia, Serratia marcescens, Streptococcus pyogenes, Pseudomonas aeruginosa, Enterobacter melangenicum, Listeria monocytogenes, Clostridium* spp. *and Bacillius* spp.

Table10. The Bacteria Isolated from Houseflies Obtained from Different Dumpsites.

FAARI	ITORIN	SABO
S. typhi	*E. coli*	*A. calcoceticus*
Y. enterocolitica	*S. aureus*	*S. aureus*
Proteus spp.	*K. pneumonia*	*P. maltophilia*
S. marcescens	*A. calcoceticus*	*S. pyogenes*
P. aeruginosa	*P. maltophilia*	*E. coli*
S. pyogenes		*E. melangenicum*
		L. monocytogenes,
		Clostridium spp.
		Bacillius spp.

In Table 11, *Aspergillus niger, Trichoderma harzianum, Aspergillus fumigates, Fusarium compacticum, Penicillum oxalicum, Aspergillus tarrus, Saccharomyces cerevisae, Fusarium oxysporium and Aspergillus cereus* were obtained from housefly obtained from all the dumpsites examined in this study.

Table 11. The Fungi Isolated from Houseflies Obtained from Different Dumpsites.

FAARI	ITONRIN	SABO
F. compacticum,	*A. niger*	*T. harzianum*
P. oxalicum	*P. oxalicum*	*A. fumigatus*
A. terreus	*A. cereus*	*A. niger*
S. cerevisae	*A. tamari*	*F. oxysporium*
A. niger	*F. oxysporium*	

4. Discussion

The dumpsites that were analysed in this study were found to be at varying decomposing stages. This shows the poor sanitary condition in the locality. The most important challenge to environmental health arose from accumulated municipal solid waste and human excreta. The analysis of waste dumpsite in Ijebu Ode showed that coliform organisms mainly of human origin were prevalent in the soil samples. In this study pathogenic bacteria (i.e. *Salmonella typhi*) and fungi (i.e. *Aspergillus fumigatus*) were isolated from the cockroaches and houseflies examined in this study. This indicates a possible spread of diseases if the insects are not eliminating and the dumpsites cleared of refuse.

The bacterial activity in the dumpsites could be due to putrefaction and increased decomposition of organic matter in the vicinity of the dumpsites. *Escherichia coli*, an indicator of fecal pollution, was obtained in dumpsite soils analysed in this study. *Enterobacter melanogenicum* was also found to be predominant in all dumpsite soil samples. Ekundayo *et al.* [28] reported that seven (7) different species of bacteria were isolated (*Clostridium* sp., *Bacillus* spp., *Staphylococcus aureus*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli* and *Salmonella* spp.) in their study. The work of Nireti *et al*. [29] also correlated with the results in this study. They isolated *Escherichia coli*, *Klebsiella* spp., *Pseudomonas* spp., *Staphylococcus aureus* and *Streptococcus* spp., and fungi isolates *Aspergillus niger*, *Mucor* spp., *Penicilluim* spp. and *Saccharomyces* spp. *Fusarium oxysporum* and *Penicillum* spp. were in all dumpsite soils compared to the control. The work of Obueh *et al*. [19] reported the isolation microorganisms that were also isolated in this study. In their study, seven bacterial species were isolated. *F. oxysporum* has been shown to be pathogenic in plants. However, *Penicillum* spp., have antibacterial activities. *Streptococcus pyogenes* and *S. aureus* were also predominant in the dumpsite soils. These two have been implicated in bacterial infection in man (blood). *P. aeruginosa* and *Acinetobacter* spp. had the highest frequency of occurrence of 20.3% and 15.6% respectively. The following fungal genera were the most predominantly. Isolated: *A. niger*, *Tricoderma* spp., *Penicillum* spp., *Aspergillus niger* had the highest percentage frequency of 22.4%. *A. niger* have been shown to produce Aflatoxins in the substrates where the grow. The urease, Acid phosphatase, Alkaline phosphatase, dehydrogenase, peroxidase and catalase activities were more prominent in dumpisite soils compared to the control. The increased microbial activities in the dumpsite soil is indicative of rise in biodegradation rates. Obueh *et al.* [19] also reported that the pH values in their work ranged from 5.26 ± 0.03 to 6.87 ± 0.04. Permissible pH limit recommended by WHO [20] is 6.5-8.5. Ibiam *et al.* [21] stated that the excessive amounts of phosphate in the well water, will result in the multiplication of algae and latter result in slime production, which negatively impacts the quality of water.

Several physicochemical characteristics of the waste dump soil were assessed in this study. Ohaeri *et al*. [30] reported that the dumpsites analysed in their study yielded the following pH results: Umuchima (7.11), Eziobodo dumpsite (7.08), and Girls Hostel (6.97). Ohaeri *et al*. [30] further stated that a number of variables pertaining to the breakdown and interaction of waste products with the environment may be responsible for the higher pH values found in the dumpsite soils. Paper goods, yard debris, and food scraps are examples of organic waste items that break down over time. In this study there were no significant differences ($P \geq 0.05$) in the pH values obtained in this study.

The organic carbon, total nitrogen and available phosphorus levels were significantly higher than control. The accumulation of organic carbon in the dumpsites might be as a result of excessive combustion that is carried out constantly on the dump sites. Ohaeri *et al*. [30] corroborated the results obtained in this study. They discorvered that the organic carbon values in dump site soils were higher than control values. In this study the Na, Fe, Zn, Cu, Pd and Cd contents of the dump site soil samples were significantly higher than their control soil samples. The increased values of heavy metals occurred as a result of the excessive accumulation of waste materials that contained heavy metals. The Ca, Mg, K contents of the control soil samples were significantly higher than those of the dump site soils. Bhalla *et al*. [22] opined that heavy metals pollution of boreholes and wells occurs as a result of infiltration of the landfill leachate through the water.

Taofeek *et al*. [31] reported that in all the investigated soils, concentrations of Fe were the highest followed by Mn. This is similar to the results obtained in this study where Fe had the highest value. Odu *et al.* [23], stated that water that contains high amounts of chromium will result in allergic dermatitis and cancer. It could also cause cancer in the human body [24]. Udofia *et al*. [25] reported lead poisoning could retard brain development and the ability to learn in children.

The bacteria and fungi isolated from houseflies and cockroaches obtained from the dumpsite soil samples are pathogenic and could spread from the insects to man and animals after contact with food or open wound. Samuel *et al.* [26] were able to isolate *Aspergillus flavus, A. niger, Penicillium* spp., and *Fusarium* spp. in their work. They also reported that the average temperature obtained from the dumpsite was 270C and the average pH obtained was 7.7. Abba *et al.* [8] reported that nine insect species were collected from refuse dumps studied. They further stated that the species of insect were different in the refuse dumps analysed. *M. domestica, Anopheles* spp. and *P. americana* were collected and examined.

5. Conclusion

The viable counts of bacteria, fungi and actinomycetes were highest in dumpsite soils. The microbial activities were in the dumpsite soils were higher compared to the control showing higher degradation rates in the dumpsite soils. Pathogenic bacteria and fungi were consistently isolated from the insects and dumpsite soils. This however shows high possibility for the outbreak of bacterial or fungal infections in areas located close to the dumpsite soils.

Acknowledgements

Funding/Financial Disclosure The authors have no received any financial support for the research, authorship, or publication of this study.

Ethics Committee Approval and Permissions The work does not require ethics committee approval and any private permission.

Conflict of Interests The authors stated that there is no conflict of interest in this article.

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