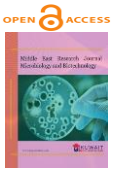

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# Decomposition of Polythene by Bacteria Isolated from Waste Disposal Sites in Gusau City

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**Abstract:** The accumulation of polythene can be hazardous and can cause various environmental problems. This work was aimed at studying the biodegradation of polythene by bacteria isolated from waste disposal areas in North West, (Zamfara state) Nigeria. A total of twenty soil samples were collected from four different locations, such as waste disposal areas, hospitals, roadsides, and petrol pumps station. Spread plate method was carried out on Nutrient agar for the growth of bacteria. A total of 13 bacteria were isolated from different areas. The total bacteria count in hospital ranged from $80 \times 10^{-4}$ - $248 \times 10^{-4}$ cfu/mL, roadsides ranged from $116 \times 10^{-4}$ - $208 \times 10^{-4}$ cfu/mL, petrol pump ranged from $88 \times 10^{-4}$ - $184 \times 10^{-4}$ cfu/mL and waste disposal areas ranged from $116 \times 10^{-4}$ - $264 \times 10^{-4}$ cfu/mL. The microbial species associated with the polythene materials were identified as *Pseudomonas sp, Bacillus sp, Staphylococcus aureus, Providencia stuartii, Clostridium perfringes, Corynebacterium diphtheria, Listeria monocytogen.* The bacteria isolates were screened for polyethylene degradation using mineral salt medium containing polyethylene as sole source of carbon and nitrogen for their ability to degrade polyethylene for the period of 2 months. The efficacy of the microbes in the degradation of polythene were analyzed using liquid culture method, among the bacteria *Pseudomonas aeruginosa* degraded 75% of polythene, *Bacillus subtilis* 71.4% in a period of 2 months.

**Keywords:** Biodegradation, Bacteria, Polythene, Gusau, Waste Disposal.

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**Research Paper**

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## 1. INTRODUCTION

Polythene plays an important role in the packaging of goods, food material, medicine and garbage bags etc. but its degradation is becoming a great threat and a vital cause of environmental pollution. (Guari *et al*, 2016). It finds a wide range of applications in humans' daily use because of its easy processing for various products such as carrying food articles, packaging textiles, manufacturing laboratory instruments, and automotive components (Arutchelvi *et al.*, 2008). Polythene constitutes 64% of the total synthetic plastic as it is being used in huge quantities for the manufacture of bottles, carry bags, disposable articles, garbage containers, margarine tubs, milk jugs, and water pipes. Annually 500 billion to 1 trillion polythene bags are being used routinely all over the world. The worldwide utility of polyethylene is expanding at a rate of 12% per annum and approximately 140 million tons of synthetic polymers are produced worldwide each year (Vatseldutt and Anbuselvi, 2014). Subsequently, the huge amount of polyethylene accumulated in the environment and their disposal evokes a big ecological issue. It is strong and highly durable and takes up to 1000 years for natural degradation in the environment.

Polythenes in large amounts accumulate in the environment and thus create environmental issues. On the contrary, they cause environmental pollution by accumulating in the environment this takes place because of their stable nature (Hemashenpagam *et al.*, 2013). Worldwide utilization of polyethylene is increasing at a rate of 12% per annum and approximately 140 million tons of synthetic polymers are produced each year (Shimao, 2001). It takes a thousand years for their efficient degradation. Huge amounts of polythene accumulate in the environment, so their disposal creates a big problem in terms of ecology. Polythene causes global warming and pollution not only as a major issue of waste disposal but also releases dioxides and $CO_2$ while burning (Venkatesh *et al.*, 2021). Accumulation of polythene wastes in the environment is posing an ever-

increasing ecological threat throughout the globe (Shilpa *et al*., 2022). Some possible methods for this purpose are biodegradation and biorecycling (Yang *et al.*, 2005).

Furthermore, polythene is degraded by sunlight into smaller toxic parts contaminating soil and water where they can be accidentally ingested by animals and thereby enter the food chain especially in the marine biota (Denuncio *et al.*, 2011). Every year 25 million tons of synthetic plastics are being accumulated in the sea coasts and terrestrial environment (Cooper, *et al.*, 2010). Biodegradation is a process which includes microorganisms like bacteria and fungi that can degrade the polythene and therefore the process of Biodegradation is an upcoming trend in this field of degradation (Gu *et al*,2000). This method of biodegradation by microbial enzymes increases the rate of degradation of polythene without causing any harm to the environment (Bhardwaj *et al*, 2012).

Guari *et al.,* (2016) carried out biodegradation of polythene in India. Soil samples were collected from different areas of Dehradun and brought to the laboratory, preserved under laboratory conditions for further use. Polythene samples of different densities such as 10 micron and 40 micron were purchased from local market of Dehradun. A total of 15 bacteria were recovered from different areas. Further Screening of polythene degrading microorganism was done by zone of clearance method out of 15 bacteria only 3 showed the positive results and identified to be *Staphylococcus* sp, *Pseudomonas* sp., *and Bacillus* sp. Three isolates and one consortium were used for degradation of 10 and 40 micron polythene. *Bacillus sp*. showed 42.5% followed by *Staphylococcus* sp. 20%, *Pseudomonas* sp. 7.5 % and consortium 5% during degradation by weight loss in 40 days. *Bacillus* sp may act as solution for the problem caused by polythene in nature. Hence from this study, it can be speculated that microbes have enough potential to degrade plastic in due course of time.

The primary purpose of this research is to explore the potential of bacteria isolated from waste disposal sites in Gusau City for the degradation of polyethylene. With the growing environmental concerns due to the accumulation of non-degradable polythene waste, the study aims to identify microorganisms that can effectively break down polythene and assess their degradation capacity. The research seeks to provide an eco-friendly and sustainable solution to the global challenge of polythene waste disposal by investigating the biodegradation capabilities of local bacterial strains.

The scope of this research includes: Collecting soil samples from waste disposal sites in Gusau City and isolating bacteria capable of degrading polythene. Screening and identifying bacteria with the ability to break down polythene. Investigating the degradation efficiency of the identified bacterial strains by measuring the weight loss of polythene over time.

The research focuses on bacteria isolated from waste disposal sites in Gusau City, making it one of the first studies to investigate the biodegradation potential of local microbial communities in this region. The study also examines the degradation potential of bacterial strains on different types of polythene allowing for a comprehensive understanding of microbial degradation under varied conditions.

By focusing on natural, microbial-based degradation methods, the study contributes to the growing body of knowledge on sustainable waste management and the development of biotechnological solutions to environmental pollution caused by polythene waste.

## 2. MATERIALS AND METHODS

### 2.1 Sample Collection

#### 2.1.1 Soil sample collection

A total of twenty soil samples were collected from four different locations, such as waste disposal areas, hospitals, roadsides, and petrol pump stations. The topsoil was cleared using a shovel and the soil was collected at a depth of 10cm transferred in a sterile container and then transported to the laboratory.

### 2.2 Sample Preparation

#### 2.2.1 Soil Sample Preparation

The soil sample was collected from various sites, it was air-dried for seven days in a well-ventilated laboratory, after which it was homogenized by grinding and then passed through a 2mm stainless sieve to remove debris, it was then stored in a labeled container until analyzed.

#### 2.2.2 Polythene Bag Sample Preparation

Polythene bags were collected aseptically from waste disposal areas, hospitals, roadsides, petrol pumps surrounding and transferred into a sterile polythene bag, and transported to the microbiology laboratory then each of the polythene bags was washed with 70% ethanol and rinsed with water and allowed to air dry in microbiology laboratory then it was cut into strips and weighed to ascertain its initial weight.

### 2.3 Determination of Microbiological Parameters

#### 2.3.1 Serial Dilution

Tenfold serial dilution of the sample was made as described by Cheesebrough (2006). One gram of soil sample was transferred into a test tube containing 9ml of distilled water and it was serially diluted. This was continuously repeated until the tenth tube ($10^{-10}$). Diluent $10^{-4}$ was aseptically transferred into the nutrient agar plate using the spread plate method. A glass rod was used to evenly spread the sample on the plates. The plates were incubated at 37°C for 24 hours.

### 2.4 Total Bacteria Count

This was carried out according to Cheesebrough (2006). Nutrient agar was weighed and

prepared according to the manufacturer's instruction. It was sterilized in an autoclave at 121°C for 15 minutes, allowed to cool then aseptically dispensed in a petri-dish. 0.1ml of the appropriate ten folds serial dilution was used for the spread plate method. Diluent four ($10^{-4}$) of the sample was inoculated into each of the nutrient agar plate. A glass rod was used to evenly spread the sample on the plates. The inoculated plates were incubated at 37°C for 24 hours after which the bacterial colonies that developed were counted and the results were recorded.

### 2.5 Characterization and Identification of the Isolates

Each colony was sub cultured and stored on a sterile Nutrient agar slant for characterization and identification.

### Bacterial Isolation

Bacteria isolates were characterized based on their morphological and biochemical characteristics according to Cheesebrough (2006). The tests carried out were: catalase, urease, triple sugar iron (TSI), coagulase, indole, citrate, methyl red, and voges proskauer.

### 2.6 Microbial Degradation of Polythene

The method of Ariba *et al.*, (2015), was employed for microbial degradation of polythene. The Mineral Salt Media was prepared by $NaNO_3$ 0.1 g, $MgSO_4.7H_20$ 0.1g, $K_2HPO_4$ 0.2 g, KCl 1g, $FeSO_4.6H_2O$ 0.02g, and the mixture was added into a conical flask, 200 mL of water was added and heated to dissolve the media, 10 mL was transferred into twenty different test tubes and allowed to cool. A loopful of microbial culture was inoculated into the Mineral Salt Medium. The sterile pre-weighed polythene bags were aseptically transferred into the Mineral Salt Medium. One test tube containing the polythene bag pieces without bacterial culture was maintained as a control. These test tubes were incubated at 37°C for 60 days and were constantly monitored. Forceps was used to carefully remove the polythene bags from the culture. This was done at 10 days interval during the period of incubation. The collected pieces were washed thoroughly with distilled water and ethanol. The pieces were dried in a desiccator and weighed for final weight. The data was recorded. The same procedure was repeated for all the treated samples. The weight loss of polyethylene was calculated in comparison to controls using the following equation: initial weight – final weight ÷ initial weight × 100

## 3. RESULTS

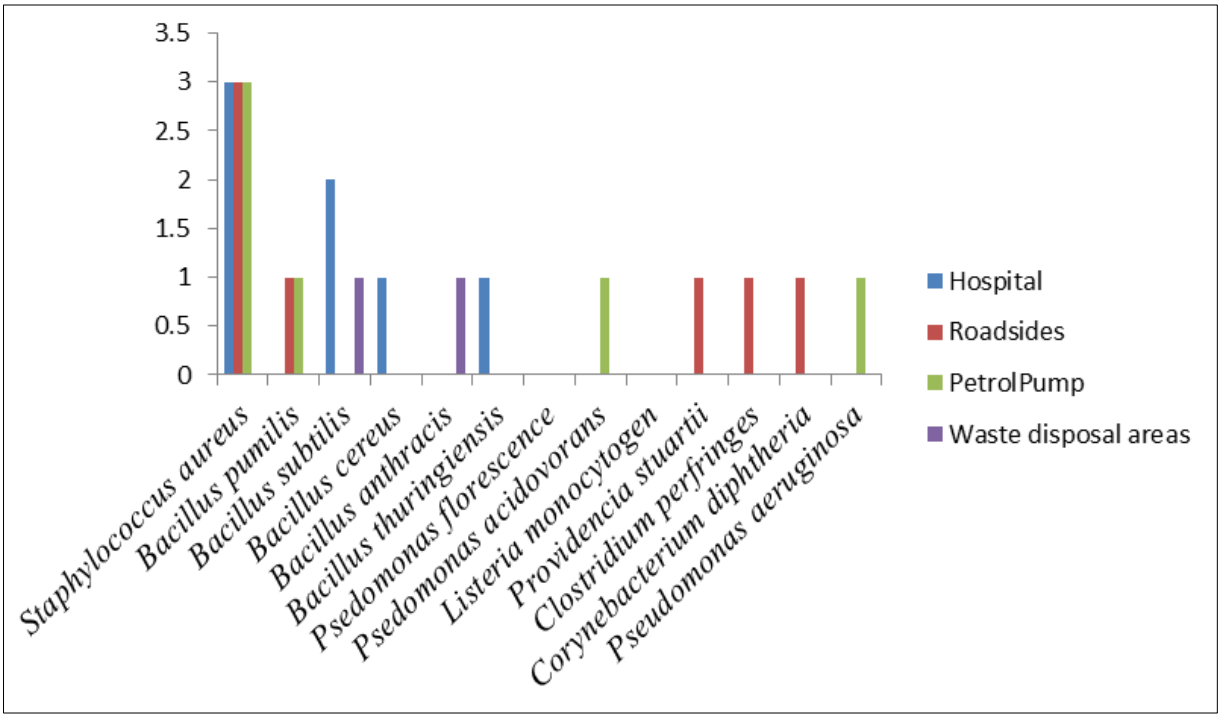


**Fig. 1: Bar chart representing the frequency of occurrence of bacteria isolated from various waste disposal sites**

**Table 1: Total bacterial count of soil and polythene bag from various waste disposal sites**

| S/N | Location | Sample ID | Total Bacteria count(cfu/ml) ($10^{-2}$) |
|---|---|---|---|
| 1 | Roadsides | Damba | 208 |
| | | Nassarawa | 116 |
| | | Sabongida | 172 |
| | | Birnin ruwa | 129 |
| | | Tudun wada | 148 |

| S/N | Location | Sample ID | Total Bacteria count(cfu/ml) ($10^{-2}$) |
|---|---|---|---|
| 2 | Petrolpump | Rahim | 184 |
| | | Samsin | 96 |
| | | Ama Zuma | 120 |
| | | Huberal | 140 |
| | | Nipco | 88 |
| 3 | Hospital | Shagari | 80 |
| | | Dr. Karima | 248 |
| | | King Fahad | 176 |
| | | Yariman Bakura | 200 |
| | | FMC | 180 |
| 4 | Waste disposal areas | Samaru | 116 |
| | | Sabon gari | 192 |
| | | Sabon gida | 232 |
| | | Bayan NTA | 264 |
| | | Unguwar Shado | 120 |

**Table 2: Morphological and Biochemical characteristics of bacteria isolates from soil and polythene bags of various waste sites**

| Isolates | Gram stain | Indole | Methyl Red | Voges proskauer | Catalase | Coagulase | Urease | Citrate | Hydrogen Sulfide | Lactose | Gas Formation | Probable id entity of ba cteria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | + | - | - | + | + | + | + | + | + | - | - | *Bacillus pumilis* |
| 2 | - | + | + | - | + | + | + | + | - | - | + | *Providencia stuartii* |
| 3 | + | - | + | - | + | + | - | + | + | - | + | *Corynebacterium diphtheria* |
| 4 | + | - | + | + | + | + | + | + | - | + | - | *Staphylococcus aureus* |
| 5 | + | - | - | + | + | - | + | + | - | - | - | *Bacillus cereus* |
| 6 | - | - | - | - | + | + | + | + | + | - | + | *Pseudomonas florescence* |
| 7 | + | - | - | + | + | - | - | + | - | - | - | *Bacillus subtilis* |
| 8 | + | + | - | + | - | + | - | + | + | - | - | *Clostridium perfringes* |
| 9 | - | - | + | - | + | - | - | + | - | + | - | *Pseudomonas acidovorans* |
| 10 | + | - | + | + | + | - | - | + | - | - | - | *Listeria monocytogens* |
| 11 | + | - | + | + | - | + | - | + | + | - | + | *Bacillus thuringiensis* |
| 12 | - | - | - | - | + | + | - | + | - | + | - | *Pseudomonas aeruginosa* |
| 13 | + | - | + | + | + | + | - | + | - | + | - | *Bacillus anthracis* |

**Table 3: Frequency of occurrence of bacteria isolated from various waste disposal sites**

| S/N | Organism | Hospital | Roadside | Petrol pump | Waste disposal area | Total | Frequency% |
|---|---|---|---|---|---|---|---|
| 1 | *Staphylococcus aureus* | 3 | 3 | 3 | 0 | 9 | 37.5 |
| 2 | *Bacillus pumilis* | 0 | 1 | 1 | 0 | 2 | 8.3 |
| 3 | *Bacillus subtilis* | 2 | 0 | 0 | 1 | 3 | 12.5 |
| 4 | *Bacillus cereus* | 1 | 0 | 0 | 0 | 1 | 4.2 |
| 5 | *Bacillus anthracis* | 0 | 0 | 0 | 1 | 1 | 4.2 |
| 6 | *Bacillus thuringiensis* | 1 | 0 | 0 | 0 | 1 | 4.2 |
| 7 | *Pseudomonas florescence* | 0 | 0 | 0 | 1 | 1 | 4.2 |
| 8 | *Pseudomonas acidovorans* | 0 | 0 | 1 | 0 | 1 | 4.2 |
| 9 | *Listeria monocytogen* | 0 | 0 | 0 | 1 | 1 | 4.2 |
| 10 | *Providencia stuartii* | 0 | 1 | 0 | 0 | 1 | 4.2 |
| 11 | *Clostridium perfringes* | 0 | 0 | 0 | 1 | 1 | 4.2 |
| 12 | *Corynebacterium diphtheriae* | 0 | 1 | 0 | 0 | 1 | 4.2 |
| 13 | *Pseudomonas aeruginosa* | 0 | 0 | 1 | 0 | 1 | 4.2 |
| | Total | 7 | 6 | 6 | 5 | 24 | 100 |

**Table 4: The bacterial degradation of polythene bags from different locations in Gusau metropolis within the period of 60 days**

| S/N | Isolates | Initial weight(g) | Day 10 | Day 20 | Day 30 | Day 40 | Day 50 | Final weight | %of weight loss |
|---|---|---|---|---|---|---|---|---|---|
| 1 | *Bacillus thuringiensis* | 0.014 | 0.013 | 0.013 | 0.012 | 0.011 | 0.011 | 0.010 | 28.5 |
| 2 | *Pseudomonas acidovorans* | 0.010 | 0.009 | 0.009 | 0.008 | 0.007 | 0.007 | 0.006 | 40 |
| 3 | *Providencia stuartii* | 0.010 | 0.010 | 0.010 | 0.009 | 0.008 | 0.008 | 0.005 | 50 |
| 4 | *Bacillus anthracis* | 0.012 | 0.011 | 0.011 | 0.010 | 0.009 | 0.009 | 0.008 | 33.3 |
| 5 | *Listeria monocytogens* | 0.011 | 0.011 | 0.011 | 0.009 | 0.007 | 0.007 | 0.005 | 54.5 |
| 6 | *Staphylococcus aureus* | 0.016 | 0.015 | 0.015 | 0.014 | 0.013 | 0.013 | 0.011 | 31.2 |
| 7 | *Bacillus cereus* | 0.010 | 0.010 | 0.010 | 0.008 | 0.008 | 0.008 | 0.006 | 40 |
| 8 | *Corynebacterium diphtheriae* | 0.007 | 0.006 | 0.006 | 0.005 | 0.005 | 0.005 | 0.005 | 28.5 |
| 9 | *Clostridium perfringes* | 0.007 | 0.007 | 0.007 | 0.006 | 0.005 | 0.005 | 0.005 | 28.5 |
| 10 | *Pseudomonas aeruginosa* | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.002 | 0.001 | 75 |
| 11 | *Bacillus subtilis* | 0.007 | 0.006 | 0.006 | 0.004 | 0.004 | 0.004 | 0.002 | 71.4 |
| 12 | *Bacillus pumilis* | 0.006 | 0.006 | 0.006 | 0.005 | 0.004 | 0.004 | 0.003 | 50 |
| 13 | *Pseudomonas florescence* | 0.007 | 0.006 | 0.006 | 0.004 | 0.003 | 0.003 | 0.002 | 71.4 |

## 4. DISCUSSION

Microorganisms play a vital role in biological decomposition of materials, including synthetic polymers in natural environments. In this research, sampling was carried out in four different points such as hospitals, roadsides, petrol pumps station and waste disposal areas. The total bacteria count in hospital ranged from $80 \times 10^{-4}$ - $248 \times 10^{-4}$ cfu/mL, roadsides ranged from $116 \times 10^{-4}$ - $208 \times 10^{-4}$ cfu/mL, petrol pump ranged from $88 \times 10^{-4}$ - $184 \times 10^{-4}$ cfu/mL and waste disposal areas ranged from $116 \times 10^{-4}$ - $284 \times 10^{-4}$ cfu/mL (Table 1). The microbial population in hospital may be as a result of the increased availability of biodegradable organic and inorganic substrates from the variety of municipal wastes continuously being dumped at these sites. This disagrees with the findings of Usha *et al.* (2011), who reported the heterotrophic population of microbes in polythene in India and recorded bacterial counts at the range of 62.71x10 - 56.52 x 10 cfu/mL , and similar to the findings of Ayeni *et al.* (2022), who reported the Mean microbial count in Abuja at the range of $82\times 10^{7}$ to $137\times 10^{7}$ cfu/mL, it disagrees with the findings of Monica *et al*., (2022), who stated that population of bacteria in Tanzania ranged from $1 \times 10^{5}$ to $1.21 \times 10^{5}$ cfu/mL.

The organisms isolated were: *Staphylococcus aureus, Bacillus spp, Pseudomonas spp, Corynebacterium diphtheria, Providencia stuartii, Listeria monocytogen, and Clostridium perfringes* (Table 2). This is similar to the findings of Priyanka and Archana (2011), who reported the bacterial isolates from various waste sites to be *Pseudomonas, Bacillus subtilis, Staphylococcus aureus, Streptococcus lactis, Proteus vulgaris and Micrococcus luteus* and also similar to the findings of Usha *et al.*, (2011), who reported that the microbial species associated with the polythene materials were identified as *Pseudomonas sp, Bacillus sp, Staphylococcus sp*. It is also similar to the findings of Beatrice *et al.*, (2022) who reported that most of the bacterial isolated were *Proteus sp., Pseudomonas sp., Bacillus sp., Micrococcus sp., E. coli, Enterobacter sp., and Serratia sp*. This indicates that the recovered bacterial isolates are widely distributed in the solid waste impacted soils.

The occurrence of bacterial isolates from the soil are *Staphylococcus aureus* had a percentage of 37.5%, (Table 3) which was isolated from Yariman Bakura hospital, Tudunwada roadsides, Huberal petrol pump station ,Amazuma petrol pump station, Samson petrol pump station, Brininruwa roadside. This organism is predominant in various waste sites because it is an environmental organism. It can be transferred to carcasses during slaughter and further processing of the carcass which are done in soil (Wendland *et al.*, 2013). *Staphylococcus* exist in air, dust, sewage, water, milk, food and environmental surfaces. *Staphylococcus aureus* is a bacterium that can thrive in various environmental conditions, and it can be found in various environments such as human skin and mucous membrane, soil, water, animal habitat, food processing environments and healthcare settings. It is also known to cause infection in humans such as food poisoning. *Bacillus subtilis* had an occurrence of 3(12.5%), (Table 3) and occurred in Shagari hospital, Unguwar shado waste disposal area and Federal medical center (FMC). *Bacillus subtilis* is often referred to as a 'soil dweller'. It is known for its ability to form endospores, allowing it to survive extreme environment. It can be found in the soil and also in gastrointestinal tract of animals. *B. subtilis* can be isolated from many environments such as terrestrial and aquatic, making it seem that this species is ubiquitous and broadly adapted to grow in diverse settings within the biosphere. However, like all members of the genus *Bacillus, B. subtilis* can form highly resistant dormant endospores in response to nutrient deprivation and other environmental stresses.

*Bacillus pumilis* had an occurrence of 2(8.3%), (Table 3) and was found in Damba roadside, and Rahim petrol pump station. It can be found in the soil, water and

gastrointestinal tracts of animals, and it's known for its ability to degrade organic matter.

*Bacillus thuringiensis* had an occurrence of 1(4.2%), (Table3) and it occurred in King Fahad hospital. *Bacillus thuringiensis* is one of the most useful organism with potential for soil health improvement (Geoderma, 2019). It contributes to organic matter decomposition and nutrient cycling. This organism also serves as a biofertilizer and has the ability to solubilize phosphates, produce plant growth, promoting substances and improve soil structure. *B. thuringiensis* enhances soil carbon and reduces greenhouse gas emission (Geoderma, 2019).

*Clostridium perfringes* had an occurrence of 1(4.2%), (Table 3) was isolated from Bayan NTA waste disposal area. It's an anaerobic bacterium found in the soil, water and its known to cause food poisoning and gas gangrene in humans, it can also cause soil-borne disease in plants, such as root rot and damping off. This organism can immobilize nitrogen, making it unavailable to the soil. *C. perfringes*'s ability to degrade polythene bags is attributed to its production of enzymes such as lipases, esterases, and polymerases, which breaks down the polythene polymer chain (Ryan, 2013).

*Bacillus cereus* had an occurrence of 1(4.2%), (Table 3) and was isolated from Doctor Karima hospital. *Bacillus cereus* group species are endemic soil bacteria that occupy diverse ecological habitats (Ehling *et al.*, 2005; Jensen *et al.*, 2003). Due to the formation of heat, UV, acid, and desiccation-resistant endospores, the bacteria can persist in a dormant state, making it difficult to elucidate their primary ecological niches. In addition to soil, the species have been isolated from fresh and stored foods, invertebrates, and plants (Hoton *et al.*, 2009). Some reports suggest that the *B. cereus* group species do not germinate and grow in nonsterile soils unless a nutrient source, such as decomposing plants, insects, or animals is present (Freker *et al.*, 2011). *B. cereus* can contribute to soil erosion and nutrient loss. It produces enterotoxins that contaminate soil and water.

*Bacillus anthracis* had an occurrence of 1(4.2%), (Table 3). It occurred in sabon gari waste disposal area. *Bacillus anthracis* are spore forming bacterium, which causes anthrax, a serious and often fatal disease of grazing animals and occasionally humans. *B. anthracis* spores are stable for long periods in soil and grazing animals are their readily available host. This organism can degrade certain organic matter but this is not its primary role. Instead it can survive for long period in soil and animal products, allowing it to persist as a pathogen (Mock and Fouet 2001).

*Pseudomonas aeruginosa* had an occurrence of 1(4.2%), (Table 3) and occurred in Huberal petrol pump station. *Pseudomonas aeruginosa* is an aquatic and soil bacterium that can infect a range of organisms, including plants (Rahme *et al.*, 2000). This organism can produce exo polysaccaharides, which help improve soil structure and water holding capacity (Bikaris, 2013). *Pseudomonas* spp are known to secrete biosurfactants such as rhamnolipids, which can increase the hydrophilicity of hydrophobic surfaces, including polythene, thereby promoting the adhesion of bacterial cells and the subsequent degradation of polythene (Kosaric *et al.*, 2010).

*Pseudomonas florescence* had an occurrence of 1(4.2%), (Table 3) and was isolated from Unguwar shado waste disposal area. *Pseudomonas florescence* is an aerobic bacterium found in the soil and gastrointestinal tracts of animals and it produces extracellular enzymes that break down carbohydrate, protein and lipid. It is generally regarded as plant commensals and has been studied for their bio control and plant growth promotion properties (Haas and Defago, 2005). It's well known as a producer of secondary metabolites with antimicrobial activity, such as the polyketides pyoluteorin and 2,4-diacetylphloroglucinol, which may be vital for the bacterium to fend off competitors in the soil and plant environment, and are also key targets for exploitation in the biological control of plant diseases.

*Pseudomonas acidovorans* had an occurrence of 1(4.2%), (Table 3) and was isolated from Rahim petrol pump station. *Pseudomonas acidovorans* this is an aerobic bacterium found in the soil and water and it's known for its ability to degrade various organic acids, including citrate, succinate, and malate.

*Listeria monocytogen* had an occurrence of 1(4.2%), (Table 3) and occurred in Samaru waste disposal area. Li*steria monocytogen* is the causative agent of the food-borne life threatening disease listeriosis. This pathogenic bacterium received much attention in the endeavor of deciphering the cellular mechanisms that underlie the onset of infection and its ability to adapt to the food processing environment. Although information is available on the presence of *L. monocytogenes* in many environmental niches including soil, water, plants, foodstuff and animals, understanding the ecology of *L. monocytogenes* in outdoor environments has received less attention. Soil is an environmental niche of pivotal importance in the transmission of this bacterium to plants and animals. Soil composition, microbial communities and macro fauna are extrinsic edaphic factors that direct the fate of *L. monocytogenes* in the soil environment (Vivant *et al.*, 2013).

*Corynebacterium diphtheria* had an occurrence of 1(4.2%), (Table 3) and was isolated from Nassarawa roadside. It is found in the soil, water and respiratory tract of animals. It causes diphtheria in humans, a serious disease that affects the respiratory and nervous system.

*Providencia stuartii* had an occurrence of 1(4.2%) (Table 3) and was isolated from Damba roadside. *Providencia stuartii*, are ubiquitous in the environment, and are also known to cause nosocomial infections. It is facultative anaerobic bacterium found in the soil. It is the most common *Providencia* species capable of causing human infections. Currently *P. stuartii* is involved in high incidence of urinary tract infections in catheterized patient. This findings disagrees with the findings of Beatrice *et al*., (2022), who reported that *Proteus* sp. had the highest frequency (33.3 %), *Providencia* sp. (29.63 %), *Pseudomonas* sp. (16.67 %), *Bacillus* sp. (9.26 %), *Micrococcus* sp. (5.56 %), *Escherichia coli* (1.85 %), *Enterobacter* sp. (1.85 %), and *Serratia* sp. (1.85 %).

The findings indicated that *Staphylococcus* was more predominant in various disposal sites and this is because *Staphylococcus aureus* are environmental organism and the least were *Bacillus* spp, *Listeria monocytogen, Providencia stuartii, Clostridium perfringes, Corynebacterium diphtheria* and *Pseudomonas aeruginosa spp* (Fig 1).

The microbial degradation of polythene bags from different locations in Gusau metropolis (Table 4). *Pseudomonas aeruginosa* had the highest degradation rate when compared to other bacteria with the percentage of 75%. This is because *Pseudomonas* spp are known to secrete biosurfactants such as rhamnolipids, which can increase the hydrophilicity of hydrophobic surfaces, including polythene, thereby promoting the adhesion of bacterial cells and the subsequent degradation of polythene (Kosaric *et al.*, 2010; Ghrib, 2015). Members of the genus *Pseudomonas* inhabit a wide variety of environments, which is reflected in their versatile metabolic capacity and broad potential for adaptation to fluctuating environmental conditions. This agrees with the findings of Usha *et al*., (2011), who stated that the *bacterial* specie *Pseudomonas* degraded 37.09% of polythene and 28.42% of plastics in 6 months incubation period. Therefore, *Pseudomonas* spp have the highest degrading capability of polythene when compared to other bacterial species. This is also in accordance with the findings of Guari *et al.*, (2016), who stated that a total of 15 bacteria were recovered from different sites and after screening 3 of them showed positive results and are identified as *Pseudomonas* spp, *Staphylococcus* spp and *Bacillus* spp. It contradicts the findings of Suchi *et al*,. (2021), who stated that the weight loss in low density polyethylene (LDPE) sheet by *Ralstonia* sp. and *Bacillus* sp. was 39.2% and 18.9% respectively. It also disagrees with the findings of Vatsel and Anbuselvi (2014), who reported that different strains were recovered and were identified as *E.coli*, *Staphylococcus*, *Pseudomonas*, *Klebsiella* and *Staphylococcus* species and the minimum degradation was found to be by *Pseudomonas* species. *Staphylococcus* showed 52% degradation and *Pseudomonas* showed 11% degradation by weight loss. Previous studies have reported that the bacterial isolates obtained from the dumpsites were efficient degraders and utilizers of organic waste components, and they were used as sole sources of carbon and energy (Emmanuel *et al.*, 2017).

## 5. CONCLUSION

The isolated microbes were native to the site of polyethylene disposal and they showed some degradability in natural conditions. The most predominant organism for the bacteria is *Staphylococcus aureus* and the least were *Bacillus pumilis, Listeria monocytogen, Providencia stuartii, Pseudomonas acidovorans, Bacillus thuringiensis, Clostridium perfringes, Bacillus cereus, Bacillus anthracis, Pseudomonas aeruginosa, Pseudomonas florescence, Corynebacterium diphtheria* and *Bacillus subtilis*. *Pseudomonas aeruginosa*, and *Bacillus subtilis*, had higher capability of degradation when compared to other organisms. *Pseudomonas aeruginosa* and *Bacillus subtilis*, had higher capability of degradation when compared to other organisms. This finding suggest that microorganism from waste disposal site have adapted to utilize polythene as the carbon source providing a potential biological solution for mitigating plastic pollution.

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