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Biodegradation of Polythene by Fungi Isolated from Waste Disposal Areas in Gusau Metropolis

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Abstract: Indiscriminate disposal of polyethylene materials have become a regular practice among developing nations of Africa, especially in Nigeria. This has resulted in environmental pollution. Their accumulation can be hazardous and can cause various environmental problems. This work was aimed at studying the biodegradation of polythene by fungi 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 Potato dextrose agar for the growth of fungi. A total 7 fungi were isolated from different areas. The fungal count in hospital ranged from 2×10^{-2} -39 $\times 10^{-2}$ cfu/mL, roadsides ranged from 3×10^{-2} - 70×10^{-2} cfu/mL, petrol pump ranged from 3×10^{-2} - 100×10^{-2} cfu/mL, and waste disposal areas ranged from 2×10^{-2} - 50×10^{-2} cfu/mL. The fungal species associated with the polythene materials were identified as, *Aspergillus flavus, Aspergillus fumigatus, Aspergillus nidulans, Aspergillus lentulus, Aspergillus niger, Trichoderma harzianum, Histoplasma capsulatum*. The fungal 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. Efficacy of the fungi in degradation of polythene were analyzed using liquid culture method. Among the fungal species *Aspergillus flavus* degraded at 66.6%, *Aspergillus fumigatus* degraded 44.4% of polythene in a period of 2 months. This work reveals that the *Aspergillus flavus* and *Aspergillus fumigatus* posses greater potential to degrade polythene when compared with other fungi. The use of genetically engineered organisms should be adopted so that they can produce upgraded metabolic enzymes to degrade polythene.

Keywords: Biodegradation, Fungi, Polythene, Waste disposal, Soil.

Research Paper

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1. INTRODUCTION

Polyethylene is a linear hydrocarbon polymer made from long chains of ethylene monomers (C_2H_4). Its general formula is CnH_2n, where 'n' signifies the number of carbon atoms (Kale *et al.,* 2015). Polyethylene finds applications in many areas, such as transportation, agriculture, and manufacturing, because of its strength, stability, chemical resistance, and durability (Sharma and Nandy, 2015). However, these same features also make polyethylene one of the most enduring and troublesome pollutants in today's world.

The polyethylene group represents a significant portion of plastics that cause environmental issues in developing countries. It is estimated that between 500 billion and 1 trillion plastic bags are used globally each year. Polythene is particularly strong and resistant to natural decay, often taking up to 1,000 years to break down in the environment. As it deteriorates under sunlight, it fragments into smaller, sometimes toxic particles that can contaminate soil and water. Animals, especially marine creatures, often ingest these microplastics, which can then enter the food chain, posing serious ecological and health risks (Denuncio, 2011). Every year, about 25 million tons of synthetic plastics accumulate along coastlines and in land habitats (Cooper, 2011). According to the Greenpeace International Report (2014), global polythene production reaches roughly 100 million tonnes each year, a staggering figure with significant environmental

consequences. A 2019 report by the United Nations highlighted that about 13 million tonnes of polythene end up in oceans annually. If trends continue, an estimated 26 billion tonnes of polythene waste could be produced, with 12 billion tonnes accumulating in various ecosystems by 2050 (ONU, 2019; Geyer, 2017). Polythene alone makes up nearly 64% of plastic materials used in packaging and bottling, and it is often discarded after just a single brief use (Sudhakar *et al*., 2008). Commonly used plastics include polyethylene (in low, medium, high, and linear low-density forms), polyethylene terephthalate (PET), nylon, polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), and polyurethane (PUR) (Bhardway *et al*., 2012). Among these, polythene (PE) is especially resistant to degradation due to its hydrophobic properties and long-chain carbon structure, making it chemically stable and environmentally persistent (Ghatge, 2020).

While some strategies such as landfilling, incineration, and recycling have been used to manage polyethylene waste, these methods are not sustainable. Landfilling causes long-term soil pollution and loss of fertility, with polythene often staying intact in soil for centuries (Kumar *et al*., 2013). Incineration releases toxic gases like carbon dioxide, furans, and dioxins, which pose health risks to humans by causing respiratory diseases and increasing cancer chances while also contributing to global warming (Fatimah *et al*., 2017). Dioxins, in particular, disrupt endocrine systems, raising serious public health concerns. Countries such as Colombia, Mexico, Bolivia, Brazil, India, and the United States have employed various physical and chemical methods to manage polythene waste, which have somewhat reduced its accumulation (Gomez *et al.,* 2016). However, these traditional methods have created new problems, notably the generation of secondary toxic waste that threatens ecosystems and living organisms (Kang *et al.,* 2020; Rodríguez *et al.,* 2020). This situation has increased interest in safer alternatives, especially biological methods that use microorganisms to break down polyethylene into simpler and less harmful substances (Yoshida *et al.,* 2016).

In Nigeria, one visible form of plastic pollution is the widespread use and careless disposal of polyethylene-based “pure water” sachets, commonly used for packaging drinking water (Temitope *et al*., 2015). Due to poor waste management practices and a lack of environmental awareness, these sachets clutter streets, gutters, and public areas in urban and rural communities. They contribute significantly to blocked drainage systems, hindering water flow and often causing localized flooding during the rainy season (Odusanya *et al.,* 2013; Temitope *et al.,* 2015). The visible pollution, along with its long-term environmental impact, highlights the urgent need for more sustainable solutions and increased scientific focus on degradation methods (Zheng *et al.,* 2005; Skariyachan and Banu, 2007).

In the past decade, studies worldwide have shown that certain microbial strains can break down synthetic polymers, including polyethylene. For instance, *Ideonella sakaiensis* was identified as a bacterium capable of decomposing PET (Yoshida *et al*., 2016), while fungal strains such as Aspergillus and Penicillium have shown some success in degrading polythene (Skariyachan *et al.,* 2016). Other research has looked at the use of mixed microbial communities tailored to polluted environments for more effective biodegradation (Chandra *et al*., 2019). Despite these developments, there has been limited research in West Africa especially Nigeria where local conditions and microbial populations might affect polyethylene degradation efficiency.

Priyanka and Tiwari (2011) made a current research on biodegradation of polythene by five different types of soil sample collected from different sources. The five-soil sample (A, B, C, D, E) were indigenous to locations: (A) Medicinal Garden soil, (B) Sewage Water Soil, (C) Energy Park soil, (D) Sludge Area soil, (E) Agricultural Soil, respectively. In this research, the Polythene bags were cut in small strips, thoroughly rinsed with tap water and then distilled water, the strips were dried under room temperature and the initial weight of the strips were taken. Polythene bags were incubated in the container, containing selected soil samples, after a specific period, films were removed from the soil, and was rinsed with tap water and then immersed in distilled water, until it remained clear and dried in oven, after which the final weight was measured. Various species of bacteria and fungi such as *Bacillus subtilis, Aspergillus niger, Aspergillus nidulan, Aspergillus flavus, Aspergillus glaucus, Penicillum species, Pseudomonas* sp*., Staphylococcus aureus., Streptococcus lactis, Proteus vulgaris, Micrococcus* sp. were found to degrade polythene efficiently. The active enzymes produced by the bacteria and fungi caused weight loss in the sample of polythene. This study evidence that the degradation rate is faster in the laboratory condition because individual microorganism inoculated with sample which may help in the degradation of polythene.

Usha *et al*., (2011) carried out biodegradation on polythene in India and the polythene was analyzed 2, 4 and 6 months of incubation in liquid culture method. Pour plate method was adopted using the starch casein agar for actinomycetes, nutrient agar for bacteria and sabouraud dextrose agar for fungi. The microbial species associated with the polythene materials were identified as *Pseudomonas* sp*, Bacillus* sp*, Staphylococcus* sp*, Aspergillus nidulans, Aspergillus flavus and Streptomyces* sp. among the bacteria *Pseudomonas* sp degrade 37.09% of polythene in 6-month period. Among the fungal species *Aspergillus flavus* degrade 20.96% of polythene and *Streptomyces* species 46.16% of

polythene. This work reveals that the *Streptomyces* sp possess greater potential to degrade polythene when compare with other bacteria and fungi.

This study aims to investigate the potential of indigenous microorganisms to biodegrade polyethylene waste. Specifically, the research focuses on the isolation and identification of fungal strains from polythene-contaminated environments in Gusau Metropolis, Zamfara State, Nigeria, and the evaluation of their ability to degrade polyethylene under controlled laboratory conditions.

The scope of the study includes microbiological sampling from various environments such as waste disposal sites, hospitals, petrol stations, and roadsides to capture a wide range of fungal species potentially adapted to plastic-rich conditions. Laboratory methods including fungal culturing, identification, and screening using mineral salt medium were employed to assess the capability of the isolated fungi to utilize polyethylene as their sole carbon and nitrogen source. The findings aim to contribute to sustainable bioremediation strategies using native fungal species for managing plastic pollution in low-resource settings.

The novelty of this approach is its focus on native microbes that may have developed mechanisms to utilize polyethylene as a carbon source due to long-term exposure. By emphasizing the potential of these organisms for bioremediation, the research hopes to aid in the development of cost-effective and environmentally friendly solutions to plastic pollution, particularly in low-income areas where waste management systems are still developing.

2. MATERIALS AND METHODS

2.1 Study Area:

This research was carried out in Gusau, Zamfara State. Gusau is a capital city and local government area located in North West, of Nigeria. Zamfara State is located at 12.1281°N, and on longitude 6.7825° E, Gusau covers a total land mass of approximately 3469 square kilometers. It is located on the Sokoto River in the savanna region of Nigeria. The river provides access to water supplies during the dry season. It serves as a major industrial center of northern Nigeria. Industries in the city include textile manufacturing, groundnut and tobacco processing, and cotton ginning. The city is active in mining the deposits of gold and diamonds in the surrounding countryside. The city is part of the Hausa- Fulani cultural region of northern Nigeria. It has a substantial Muslim population and contains numerous mosques and Muslim organizations.

2.2 Sample Collection

2.2.1 Soil Sample Collection

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

2.3 Sample Preparation

2.3.1 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 then passed through a 2mm stainless sieve to remove debris, it was then stored in a labeled container until analyzed.

2.3.2 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 were 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.

2.4 Determination of Microbiological Parameters

2.4.1 Serial Dilution

Ten folds serial dilution of the sample were 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 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.

2.5 Isolation of Fungi

2.5.1 Total Fungal Count

This was carried out using spread plate method according to the description of Cheesebrough (2006). Potato Dextrose Agar (PDA) 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 it was aseptically dispensed into the petri-dish. Streptomycin was added to inhibit the growth of bacteria. 0.1ml of the appropriate tenfold of serial dilution (10^{-2}) of the sample was inoculated into each of the PDA plate. The inoculated plates were incubated at 37°C for 3-7days after which the isolates were sub-cultured and each colony that developed were counted and stored in a sterile Potato Dextrose agar slant for characterization and identification.

2.6 Characterization and Identification of the Fungal Isolates

Colony morphology and cellular morphology were carried out to characterize and identify the fungi as

described by Cheesbrough (2006). They were identified as to the description of Sarah *et al.,* (2016).

2.6.1 Colony Morphology and Cellular Morphology

The colony morphology determination was based on the color, elevation, margin and shape while the cellular morphology determination was based on the shape and arrangement of the cells.

2.7 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 fungi culture was maintained as 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. RESULT

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

S/N	Location	Sample ID	Total Fungi count(cfu/ml) (10^{-2})
1	Roadsides	Damba	4
		Nassarawa	70
		Sabongida	12
		Birnin ruwa	3
		Tudun wada	42
2	Petrol pump	Rahim	3
		Samsin	40
		Ama Zuma	8
		Huberal	100
		Nipco	10
3	Hospital	Shagari	7
		Dr. Karima	18
		King Fahad	2
		Yariman Bakura	3
		FMC	39
4	Waste disposal areas	Samaru	18
		Sabon gari	50
		Sabon gida	2
		Bayan NTA	27
		Unguwar Shado	2

Table 2: The colonial and microscopic characteristics of the mold isolates

Isolates	Colonial characteristics	Microscopic characteristics	Suspected organism
1	Colonies are granular, flat, often with radial grooves, yellow at first but quickly becoming bright to dark yellow-green with age.	Conidial heads are typically radiate, later splitting to form loose columns, (300µm-400µ in diameter) biserate but having some head with phalides borne directly on the vesicle.	*Aspergillus flavus*
2	Colonies consist of a compact white or yellow basal felt covered by a dense layer of dark brown to black conidial head.	Conidial heads are large (up to 3mm by 15-20µm in diameter), globose, dark brown, becoming radiate and tending to split into several loose columns with age.	*Aspergillus niger*
3	Colonies are typically blue-green with suede-like surface consisting of a dense felt of conidiophores.	Conidial heads are typically columnar (up to 400 X 50 µm but often much shorter and smaller) and uniserate.	*Aspergillus fumigatus*

4	Colony color can range from white, green, or yellow.	Conidial head are globose to subglobose, typically 3-5µm in diameter.	*Trichoderma harzianum*
5	Colonies are slow growing, white or buff-brown suede-like to cottony with a pale yellow-brown reverse.	Microscopic morphology shows the presence of characteristic large, rounded, single celled, tuberculate macro conidia formed on short, hyaline, undifferentiated conidiophores.	*Histoplasma capsulatum*
6	Colonies are suede-like to floccose, white with interspersed grey-green patches of conidia.	Conidial heads are short, columnar and uniserate.	*Aspergillus lentulus*
7	Colonies are usually fast growing, white, yellow, yellow-brown, brown to black or shades of green, mostly consisting of a dense felt of erect conidiophores.	Conidia are one celled, smooth or rough walled, hyaline or pigmented, are produced in long dry chains which may be divergent in compact columns.	*Aspergillus nidulan*

Table 3: Frequency of occurrence of fungal isolates in various waste disposal sites

S/N	Organism	Hospital	Roadside	Petrol pump	Waste disposal area	Total	Frequency%
1	*Aspergillus flavus*	3	2	2	4	11	39.2
2	*Aspergillus fumigatus*	3	4	3	1	11	39.2
3	*Aspergillus niger*	0	2	0	0	2	7.1
4	*Aspergillus lentulus*	0	0	1	0	1	3.5
5	*Aspergillus nidulans*	0	0	1	0	1	3.5
6	*Trichoderma harzianum*	1	0	0	0	1	3.5
7	*Histoplasma capsulatum*	0	1	0	0	1	3.5
	Total	**7**	**9**	**7**	**5**	**28**	**100**

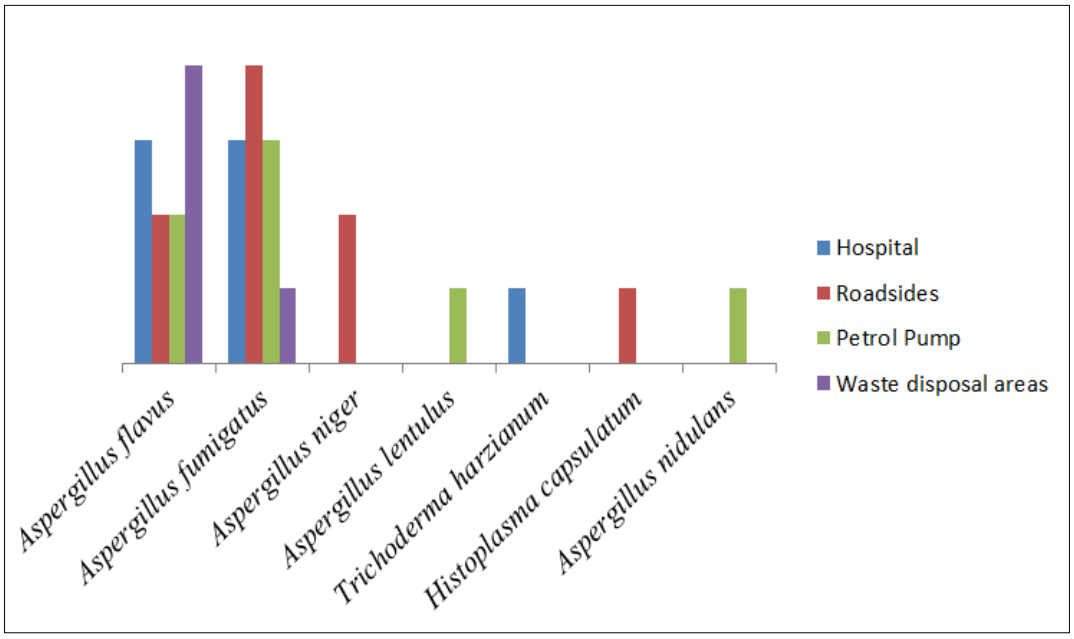

Fig. 1: Bar chart representing the frequency of occurrence of fungi isolated from various waste disposal sites

Table 4: The fungal 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	*Aspergillus lentulus*	0.010	0.010	0.010	0.009	0.007	0.007	0.005	50
2	*Aspergillus fumigatus*	0.009	0.009	0.009	0.008	0.007	0.007	0.005	44.4
3	*Aspergillus nidulans*	0.015	0.015	0.015	0.015	0.013	0.013	0.012	20
4	*Trichoderma harzianum*	0.010	0.010	0.010	0.009	0.009	0.009	0.007	30
5	*Aspergillus niger*	0.011	0.011	0.011	0.009	0.007	0.007	0.005	54.5
6	*Aspergillus flavus*	0.006	0.005	0.005	0.003	0.003	0.003	0.002	66.6

7	*Histoplasma capsulatum*	0.012	0.009	0.009	0.007	0.005	0.005	0.007	41.6

4. DISCUSSION

The total fungal count in hospital ranged from 2×10^{-2} -39×10^{-2} cfu/mL, roadsides ranged from 3×10^{-2} - 70×10^{-2} cfu/mL, petrol pump ranged from 3×10^{-2} - 100×10^{-2} cfu/mL, and waste disposal areas ranged from 2×10^{-2} - 50×10^{-2} cfu/mL (Table 1). This high fungal population in petrol pump may be as a result of the high organic carbon and organic content of the polyethylene dump site soils. This is similar to the findings of Usman *et al.* (2019), who stated the heterotrophic population of fungi in polythene in Katsina at the range of 1.60×10^7 - 85×10^7 cfu/mL, it agrees with Monica *et al*. (2022), who reported the population of fungi in Tanzania ranged from 1×10^4 - 86×10^4 cfu/mL. but disagrees with the findings of Usha *et al.* (2011), who stated that the fungal count in India ranged from 44.32×10^2 - 35.62×10^2 cfu/mL. The molds isolated were: *Aspergillus fumigatus, Aspergillus flavus, Aspergillus niger, Aspergillus nidulans, Aspergillus lentulus, Trichoderma harzianum, and Histoplasma capsulatum* (Table 2). This work is similar to the findings of Usha *et al.* (2011), who stated that the fungal species associated with the polythene materials were identified as, *Aspergillus nidulans, Aspergillus flavus and Streptomyces sp.* It is also similar to the findings of Ayeni *et al*. (2022), who also reported that the fungal species associated with polythene degradation were *Aspergillus flavus, Aspergillus nidulans, Aspergillus fumigatus, Penicillium chrysogenum, Mucor mucedo, Eurotium repens, and Rhizopus*. It corresponds with the findings of Saira *et al.,* (2022), who recorded the isolated fungal species as *Aspergillus Niger, Aspergillus flavus, Penicillium,* white rot, and brown rot fungi. These fungi use various mechanisms such as metabolic or enzymatic and microbial organization that convert the complex material into a simpler one with the release of carbon dioxide. It is based on two methods: growth and catabolism. In this step, organic compounds are fully degraded (demineralized) Saira *et al.,* (2022), the biodegradation mechanism involves a number of microorganisms, including fungi, (Siracusa *et al.,* 2008). The rate of degradation of contaminants is also based on the contaminant concentration and the quantity of "biocatalyst." In brief, fungi are able to degrade complex polythene and thus prove themselves potent agents for biodegradation (Siracusa *et al.,* 2008).

The occurrence of fungal isolates indicated that *Aspergillus flavus* had a percentage of 39.2%, (Table 3) and was isolated from Doctor karima hospital, FMC, Rahim petrol pump station, NIPCO petrol pump station, Sabongida roadside, Shagari hospital, Bayan NTA waste disposal area, Amazuma petrol pump station and Nassarawa roadside. *Aspergillus flavus* is a saprophytic soil fungus that infects and contaminates preharvest and post-harvest seed crops with the carcinogenic secondary metabolite aflatoxin. The fungus is also an opportunistic animal and human pathogen causing aspergillosis. It is specie that is known for its ability to degrade complex organic matter. *A. flavus* is involved in the degradation of various organic pollutants such polycyclic aromatic hydrocarbons (PAHs) and heavy metals. *A. flavus* can grow in a wide range of temperatures (12-40℃) and pH levels (3-9). It is commonly found in the soil, decaying organic matter, and contaminated water. It is the most predominant because of its adaptability in the waste disposal sites.

Aspergillus fumigatus also had the highest frequency of occurrence 11(39.2%), (Table 3). *Aspergillus fumigatus* 39.2%, occurred in Nassarawa roadside, Amazuma petrol pump station, NIPCO petrol pump station, Unguwar shado waste disposal area, Yariman bakura hospital, Rahim petrol pump station, Tudunwada roadside and Shagari hospital. This is because they are commonly found in the soil, decaying organic matter, which are normally found in waste disposal areas and contaminated water (Koutny *et al.*, 2009). *Aspergillus fumigatus* is one of the most ubiquitous of the airborne saprophytic fungi. Humans and animals constantly inhale numerous conidia of this fungus. It also plays an essential role in recycling environmental carbon and nitrogen. It natural ecological niche is soil. Where it survives and grows on organic debris. *A. fumigatus* can grow in a wide range of temperatures (12-40℃) and pH levels (3-9). One reason for the prevalence of *A. fumigatus* as the main clinical cause of aspergillosis is the exceedingly high abundance of the species, with the average human inhaling hundreds of airborne conidia daily.

Aspergillus niger had the occurrence of 2(7.1%), (Table 3) and was isolated from Sabongida roadside and Brinin ruwa roadside. *Aspergillus niger,* is a filamentous fungus growing aerobically on organic matter. In nature, it is found in soil and litter, in compost and on decaying plant material (Reiss *et al.*, 2016). *A. niger* is able to grow in the wide temperature range of 6–47°C with a relatively high temperature optimum at 35–37°C. The water activity limit for growth is 0.88, which is relatively high compared with other *Aspergillus* species. It is able to grow over an extremely wide pH range: 1.4–9.8. These abilities and the profuse production of conidiophores, which are distributed via the air, secure the ubiquitous occurrence of the species, with a higher frequency in warm and humid places (Rippel-Baldes *et al.*, 2015). It is generally regarded as a non-pathogenic fungus widely distributed in nature. Humans are exposed to its spores every day without disease becoming apparent. It has been able to colonize the human body as an opportunistic invader and in almost all these cases the patients have a history of severe illness or immunosuppressive treatment (Schuster *et al.,* 2002).

Aspergillus nidulans had the occurrence of 1(3.5%), (Table 3) and occurred in Huberal petrol pump station. It is typical a soil fungus, it also causes diseases in human and animals (Peng *et al*., 2018).

Aspergillus lentulus had the occurrence of 1(3.5%), (Table 3) and it occurred in Huberal petrol pump station. It is widely distributed in the soil and a causative agent of invasive aspergillosis in immunosuppressed patient (Geyer *et al.*, 2017).

Histoplasma capsulatum had the occurrence of 1(3.5%), (Table 3) and was isolated from Brinin ruwa roadside. *Histoplasma capsulatum,* it is a specie which can be mold or yeast that can cause pulmonary and disseminated histoplasmosis and is distributed worldwide except Antarctica and most often associated with river valleys. However, the Mississipi-ohio river valley in the USA is recognized as the endemic region. Environmental isolation of the fungus has been made from soil enriched with excreta from chicken and bats. It can be found in soil or on vegetation contaminated by bird droppings. It exhibits thermal dimorphism growing in living tissue or in culture at 37℃ as a budding yeast-like fungus and in soil or culture at temperature below 30℃ as a mold (Gray *et al.,* 2009).

Trichoderma harzianum had the occurrence of 1(3.5%) (Table 3) and it occurred in FMC. *Trichoderma harzianum* is a bio control agent tremendously utilized in the management of fungal diseases as they have mycoparasitic properties (Shen *et al.*, 2015). *Trichoderma harzianum* well known bio-agent is ubiquitous which can be found in the soil and is endophytic symbiont in nature (Khan *et al.*, 2017).

The finding indicated that *Aspergillus flavus* and *Aspergillus fumigatus* were more predominant organism isolated from various disposal sites. This is because they are saprophytic fungus and are normally found in waste disposal areas and contaminated water and the least were *Aspergillus niger, Aspergillus lentulus, Aspergillus nidulans, Trichoderma harzianum, Histoplasma capsulatum.* (Fig 1).

The fungal degradation of polythene bags from different locations in Gusau metropolis (Table 4). *Aspergillus flavus* showed higher degrading capability when compared to other fungi. This is due to the production of metabolites such as citric acid, gluconic acid, and oxalic acid which are hypothesized to aid the breakdown of polythene (Shah *et al.,* 2014). This agrees with Saira *et al*., (2022), who reported that *Aspergillus flavus* showed higher degrading capability of polythene when compared to other fungal isolates followed by *Aspergillus niger*.

5. CONCLUSION

The isolated microbes were native to the site of polyethylene disposal and they showed some degradability in natural conditions. The most predominant mold is *Aspergillus flavus* and *Aspergillus fumigatus* and the least were *Aspergillus lentulus, Aspergillus nidulans, Aspergillus niger, Trichoderma harzianum, Histoplasma capsulatum. Aspergillus flavus* and *Aspergillus fumigatus* had higher capability of degradation when compared to other organisms**.** This finding suggests 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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