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Microbiological Assessment of Soil from Dumpsites in Joseph Ayo Babalola University

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***Abstract*: This study investigated the microbiological assessment of two dumpsites in Joseph Ayo Babalola University (JABU). Dumpsites are a prime source of environmental pollution that constitutes a habitat for vector and other nuisance organisms capable of transmitting or causing diseases. The aim of the research is to isolate and identify the microorganisms present in soil from various dumpsites in JABU. A total of 3 soil samples was collected on different locations from each site labelled A-C. The isolates that were obtained were identified and characterized using staining techniques and biochemical tests. The total bacterial count for S1 ranged from 10.2 x 10^3 cfu/g to 20.1 x10^3 cfu/g while the count for S2 ranged from 5.4 x 10^3 cfu/g to 9.4 x10^3 cfu/g. The total fungal count for S1 ranged from 4 x 10^3 SFU/g to 8 x 10^3 SFU/g while the count for S2 ranged from 2 x 10^3 SFU/g to 6 x 10^3 SFU/g. Eight Gram negative bacterial isolates (*E. coli, Klebsiella, Proteus, Salmonella, Serratia, Enterobacter, Micrococcus and Pseudomonas*) and two isolates positive (*Bacillus subtilis and Staphylococcus epidermidis*) to Gram staining were obtained. A total of 9 fungal isolates (*Aspergillus fumigatus, A. flavus, A. niger, Mucor, Cladosporium, Rhizopus stolonifer, Rhizopus oryzae Fusarium, and Penicillium)* were obtained. From these experimental results, it was shown that pathogenic microorganisms were discovered to be present in soil samples from various dumpsites.**

***Keywords*: microbiological, assessment, soils, dumpsites.**

1. Introduction

Wastes are materials produced by our everyday activities (consumption, recreation, manufacturing, and living) that are undesired and no longer useful to us, according to Ayilara *et al.* (2020). According to Ugwu *et al*. (2017), These are the substances that are created as a result of regular business activities and that we are in charge of producing, discarding, or discharging. Because of the steadily rising amount of solid waste produced, pollution is a serious problem.

These wastes can have a severe influence on the ecosystem if they are not properly disposed of and managed. In the metropolitan state, trash is dumped both on authorized and unapproved disposal sites. Composition of these dump site are generated from hospital, residential, commercial, market etc. (Naveen, and Sivapullaiah, 2020).

As stated by Grobler *et al.* (2022), garbage workers gather and dispose of generated waste along roadside, near residential areas, or in a government-approved dumpsite. In general, bacteria and fungus are the most prevalent types of organisms in solid waste (Sumbodo *et al*., 2021). The components of the waste act as a substrate for the development of these bacteria. They proliferate and thrive on these wastes by using the many components that make up the solid waste. The environment has become more polluted as a result of various popular waste disposal methods used in some nations, such as dumps, landfills, and incinerators.

Residential, commercial, and industrial are the three main sources of generation for municipal solid trash, respectively (Grobler *et al.,* 2022). Soil microorganisms, particularly fungi and bacteria, are responsible for the breakdown and transformation of biodegradable (organic) elements found in waste (Baye *et al*., 2021). Untreated solid wastes should never be disposed of improperly since it endangers both human health and the environment.

Refuse dumps are places on land where materials that are leftover from different activities and sources are disposed of, according to Baye *et al*. (2021). These locations offer plentiful supplies of microorganisms, the majority of which are pathogenic. Despite the difficulties associated with surviving in the atmosphere, such as prolonged UV light exposure and low moisture content level, many microorganisms can continue to be viable even after spending long periods of time aloft (Sumbodo *et al.,* 2021).

The purpose of this study is to determine the microbial load of the microorganisms present in selected dump site present in this institution as well as to determine if they are pathogenic or not. The aim of this study is to assess the microorganisms present in soil samples collected from selected dumpsites in Joseph Ayo Babalola University.

2. Materials and Methods

A. Sampling Site

The two sites selected for this study are situated in Joseph Ayo Babalola University, Ikeji-Arakeji, Osun State. The first sampling site (S1) is located at the University's Staff Quarter (7.4195°N, 4.9665°E) while the second site (S2) is situated along the University's Medical Centre (7.4163°N, 4.9723°W).

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The soil sample used in this study was aseptically obtained from two (2) separate dumpsites inside Joseph Ayo Babalola University in Osun State; and these dumpsites were designated as Sample A (SA) and Sample B (SB). Each sampling point's surface debris was meticulously removed using a sterile trowel during the collection of samples from the corresponding dumpsites, and the subsurface was scooped with a second sterile trowel to a depth of 10 cm (Sunday and Babajide, 2020). The samples were taken at three separate locations within ten metres of each dump site, and after that, they were marked, placed into separate sterile polyethene bags, and brought to Joseph Ayo Babalola University's Microbiology Laboratory for analysis.

B. Total Heterotrophic Microbial Count

Ten folds serial dilution of samples were prepared by dissolving 1 gram of the soil samples into 9 ml of sterile distilled in a test tube. The procedure was repeated progressively to get the 10^{-6} dilution. One ml each of 10^{-3} and 10^{-4} dilutions were pipetted into separate sterile petri dishes. Cooled, molten nutrient agar, Macconkey agar and potatoe dextroxe agar for was then aseptically poured into each of the Petri-dishes containing the samples. The dishes were swirled gently to mix the content properly and then allowed to set before incubating in inverted position at 37 °C for 24 hours for bacterial growth and 37 °C for 72 hours for fungi growth. The plates were examined for colonies which were counted using colony counter and was recorded (Fawole and Osho, 2007).

C. Isolation of Organisms and Preparation of Pure Cultures

For isolation and preparation of pure cultures for bacteria, distinct colonies were selected from the plates and sub-cultured unto sterile nutrient agar by streaking method. The plates were then incubated in inverted position at 37 °C for 24 hours. Pure isolates were obtained and transferred unto agar slant aseptically and serve as culture stock for subsequent characterization test. It was then stored in the refrigerator at 4 °C.

For fungi, distinct hyphae were picked using sterile cork-borer and sub-cultured unto a sterile potatoe dextrose agar. The plates were then incubated in inverted position at 37 °C for 4 days. The sub-cultured fungal isolates were identified on the basis of their morphological and microscopic features. Their microscopic attributes were examined using the wet mount technique. Both Methylene blue and distilled water were used respectively as mount ants. The microscopic structures observed were recorded and compared.

D. Identification and Characterization of Bacterial Isolates

Bacterial colonies were sub-cultured on freshly prepared nutrient agar plates and incubated at 35°C for 24 h to obtain pure cultures. The colonial characteristics of the sub-cultured bacterial colonies were recorded. The bacterial isolates were further identified by gram staining and biochemical characterization tests such as catalase, indole, oxidase, motility, methyl-red, Voges-Proskauer, and citrate utilization.

3. Results

Table 1 shows the heterotrophic bacteria count and heterotrophic fungi count of microorganisms isolated from sampling site A. The value for the bacteria isolates ranged from 10.2 X 10^3 to 20.1 X 10^3 CFU/g while the value for fungi count ranged from 4 X 10^3 to 8 X 10^3 SFU/g. Table 2 shows the heterotrophic bacteria count and heterotrophic fungi count of microorganisms isolated from sampling site B. The value for the bacterial isolates ranged from 5.4 X 10^3 to 9.4 X 10^3CFU/g while the value for fungi count ranged from 2 X 10^3 to 6 X 10^3 SFU/g.

Table 1
Sampling Site A

Point	Bacterial count (CFU/g)	Fungi count (SFU/g)
A	13.2 X 10^3	5 X 10^3
B	10.2 X 10^3	4 X 10^3
C	20.1 X 10^3	8 X 10^3

Table 2
Sampling Site B

Point	Bacterial count (CFU/g)	Fungi count (SFU/g)
A	5.4 X 10^3	4 X 10^3
B	6.8 X 10^3	2 X 10^3
C	9.4 X 10^3	6 X 10^3

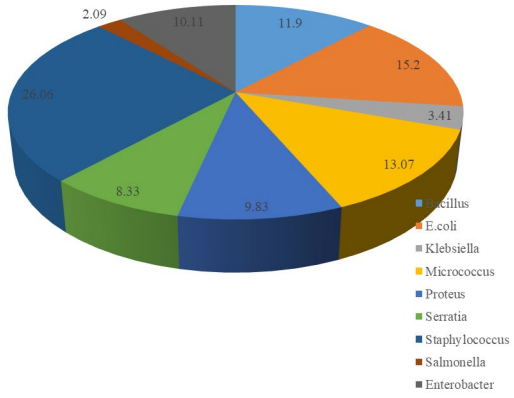

Fig. 1. Frequency of bacteria isolated on S1

Keys:
S1: Dumpsite situated at the University's Staff Quarters

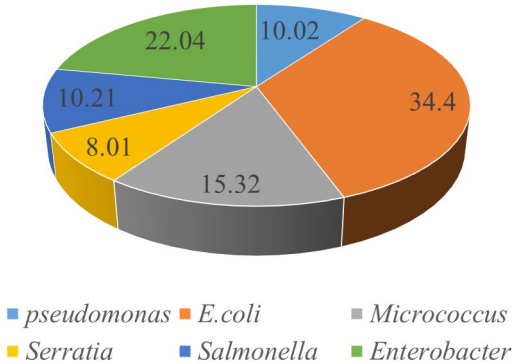

Fig. 2. Frequency of bacteria isolated on S2

Keys:
S2: Dumpsite situated behind the University's Clinic

A total of Ten (10) bacteria isolates was isolated from the two

sampling sites, Two (2) were gram positive while Eight (8) were gram negative. On the first sampling site, *Staphylococcus aureus* had the highest occurrence frequency (26.06%), while *Salmonella enteritidis* had the lowest (2.09%) as shown on Figure 1. On the second sampling site, *E.coli* had the highest level of occurrence (34.4%) while *Serratia marcescens* had the lowest (8.01%) as shown on Figure 2.

Similarly, a total of Ten (10) fungi isolates were isolated from the sampling sites. *Mucor mucedo* was found to be dominant on the first sampling site (S1) with a percentage value of 46.41% while *Cladosporium herbarum* had the least value of 10.23% (Figure 3). *Aspergillus niger* was found to be dominant on the second site (S2) with a percentage value of 31.52% while *Cladosporium herbarum* had the least value of 2.06% (Figure 4).

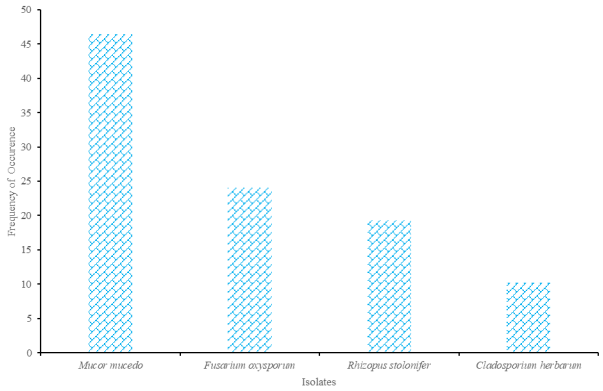

Fig. 3. Frequency of fungi isolated on S1

Keys:
S1: Dumpsite situated behind the University's Staff Quarter

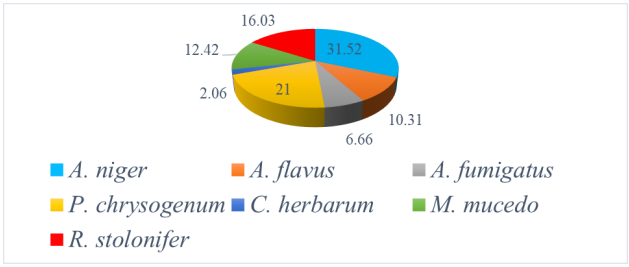

Fig. 4. Frequency of fungi isolated on S2

Keys:
S2: Dumpsite situated behind the University's Medical Centre

4. Discussion

The bacterial count ranged from 5.4 x 10^3CFU/g to 20.1 x 10^3CFU/g for the two-sample site. While the fungal count ranged from 2 x 10^3SFU/g to 8 x 10^3SFU/g for the two-sample site. The difference in microbial counts observed in the dumpsite soils may be attributed to a difference in nutrient concentration. This agrees with Akingbile (2012), who stated that the quantity and quality of nutrients available in the soil determines the total microbial count in such location.

Isolation of bacteria species *Bacillus sp, Enterobacter sp, Escherichia coli, Klebsiella sp, Micrococcus sp, Pseudomonas sp, Staphylococcus sp, Salmonella sp, Streptococcus spp,* and fungi isolates *Aspergillus niger, Mucor spp, Penicillium spp* corresponds with the report of Elenwo *et al*. (2022), Fakorede *et. al.* (2018), Chetan *et al*. (2017) and Williams and Hakam 2015, who also reported these isolates were present in soil from dumpsites. According to Fakorede *et al.* (2018) the isolation of this microorganisms is an indication that they are not only ubiquitous in nature, but also populates the soil hence, increased nutritional value of soil. The results of Adeyeba and Akinbo's studies (2003) are consistent with the possibly pathogenic bacteria agents discovered in this investigation. There was evidence of both human and animal faeces mixed in with the trash at the dumpsite due to the presence of *E. coli* and *Enterobacter* sp. The majority of the isolated bacteria and fungi species are pathogenic and have been shown to be etiological agent of man and animal diseases. Fungi, especially *Aspergillus spp* secrete mycotoxins that are poisonous to health when contacted (Fakorede *et al*., 2018). Food- and water-borne illnesses like typhoid, diarrhoea, and gastroenteritis could spread as a result of this (Elenwo *et al.*, 2022).

Of the isolated microorganism in this study, only *Micrococcus spp, E. coli, Klebsiella spp* and *proteus spp* were isolated from all the stations. This agrees with the report of Chetan *et al.* (2017) who reported some of these organisms. According to Chetan *et al.* (2017) isolation of these microorganisms has shown that seasonal influence can affect microbial proliferation.

5. Conclusion

The presence of coliforms particularly indicator organisms and the abundance of Mycotoxin-producing fungi indicate the poor health condition of dumpsite soils. This could pose serious risks to the health of people living close to these sites. Diseases including typhoid, diarrhoea, and gastroenteritis that are transmitted by food and water might break out when E. coli is present.

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