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# Effect of Medical Wastes on Physico-chemical Properties of Soil Ecosystem at Selected Hospital Dumpsites in Owerri Municipal

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***ABSTRACT***
*Low and Middle-Income countries (LMIC) with poor waste disposal system is at risk of surrounding soil contamination. There is paucity of studies evaluating the influence of medical waste dumpsite on the environment which may have adverse effects on plants, animals, and human health. The aim of the study is to access the effect MWD on the physicochemical properties of soils around HCFs in Owerri Municipal of Imo State in Nigeria. The physicochemical parameters of the soil were assessed using standard laboratory methods. The results were evaluated using SPSS 23. Three sites were randomly selected among the public and the private HCF and compared with a control. Soil samples were collected from 0-15 cm depth (Top soil) and 15-30 cm depths (Sub soil) from the selected sites. The soil samples physicochemical properties were analysed. The results showed variations in soil properties in comparison with the control indicating the impact of MWD on the soil at the different sites. The results showed that the soils were sandy loam in texture. The pH of soil in the study site ranged from strong to slightly acidic in reaction. The results for microbial analysis indicated a proliferation of bacteria organisms at the MW dumpsites. There is a significant effect of medical waste disposal (MWD) practices on the physico-chemical properties of the soil in selected hospitals in Owerri. In conclusion it is evident that soil in HCF dumpsites are heavily loaded with pathogenic micro-organism, which could pose a direct danger to the health of people, animal and plants. It is important HCFs to adhere to appropriate medical waste disposal practices.*

***Keywords:*** *Medical waste, Physicochemical, Dumpsites, soil*

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## I. INTRODUCTION

Environmental contamination by medical waste has been a major issue in most countries of the world owing to the poor waste disposal methods. Medical wastes are generated on a daily basis due to continuous increase in healthcare activities for the increasing population. (Essien Ubong et al., 2019; Mouhoun-Chouaki et al., 2019). A Healthcare Facility (HCF) is a place with trained staff that provides high quality medical services to citizens with health problems as reported by Fatima et al (2018). It is a paradox that health-care activities for the preservation of life are also a major source of waste generation posing a health hazard. Solid and liquid wastes generated within the HCFs are commonly referred to as medical waste or hospital wastes, there are several nomenclatures describing same category of waste such as clinical waste, biomedical waste, healthcare waste to list a few. There are several categories of medical waste which include: (1) Pathological wastes (2) Infectious wastes composed of pathogens which can cause disease e.g culture and stock from infectious patients, laboratories and surgical waste. (3) Pharmaceutical wastes (4) Cytotoxic wastes composed of expired drugs, remnants of cytotoxic drugs, (5) Chemical waste comprising discarded solutions, solid and gaseous chemical materials etc. (6) Radioactive waste from radioactive materials. (7) Other waste containing heavy metals from batteries and mercury from broken thermometers. ( Lekwot (2012)

Toxic substances are released from the decomposition of the dumped medical waste and this may adversely impact the environment (Kebede et al., 2016). The negative influences of improper disposal of medical waste on the ecosystem have been on the increase in developing countries such as Nigeria. Few studies have been conducted on the influence of medical waste dumpsite on the physicochemical properties of soil.

Medical waste is noted by studies to be loaded with micro-organisms (ICRC, 2011). Studies show that medical wastes generated from healthcare facilities in LMICs are disposed in inappropriate dumpsites, trashed

into drainages, or flushed down sewage tanks within the HCFs (Inyang et al., 2012). Medical waste is hazardous due to its high content of pathogenic bacteria and may pose a great danger for disease transmission in the overall environment (Veda et al., 2007; Babanyara et al. 2012). Inappropriate disposal of medical waste could be detrimental to the wellbeing of healthcare workers and patients (Oguzie 2023, Aljabre, 2002). The indiscriminate dumping and burning of MW may result in the accumulation of toxin in soil with far reaching negative impact on the environment (Kawu and Shaibu, 2007).

Recent studies identified poor practice of medical waste disposal in Healthcare facilities, despite the attendant risk associated with them (Ngwuluka et al., 2009). Nigeria has relevant laws (UNDP, 2020), for proper medical waste disposal. However, it is a common practice that medical waste is dumped in the municipal waste dumpsite or burnt in open dumps within the HCF premises leading to negative impact on the soil. MW could pose a great threat to both humans and the natural environment as pathogenic substances may become accessible to plants, farmers, scavenger and animals with resultant complications (Lekwot et al., 2012).

The increase in farming activities around HCF waste dump sites calls for concern as this could lead to outbreak of ailments due to the accumulation of toxins in the soil and may negatively impact deep feeding plants (Anikwe and Nwobodo, 2001). There has been a dearth of knowledge on the impact of medical waste disposal on soil and environs; this research seeks to assess the effect of MW dumpsite on the soil physicochemical properties in selected public and private HCF in Owerri municipal in comparison to a neutral. Findings from this study will help enlighten the general public on the impact of MW on the soil around dumpsites especially for agricultural activities around or within HCFs which many studies are yet to explore.

## II. MATERIALS AND METHOD

**Study Area**

Owerri Municipal is a Local Government Area in Imo State, Nigeria. Its headquarters is in the city of Owerri. It has an area of 58 km² and a population of 127,213 according to the 2006 census. Owerri city sits at the intersection of roads from Port Harcourt, Onitsha, Aba, Orlu, Okigwe and Umuahia.

**Sample Collection**

Soil samples were collected with the aid of a soil auger at a depth of 0-15cm (top soil) and 15-30cm (subsoil). Samples were collected from these depths because these are the zones of active changes in soil in close proximity to the MW dump site, as well, these form the major concentration of cropping and root plants (Ogidiolu, 1998). A total of 7 samples were collected for the study. The collected soil samples were carefully transferred into black high density polyethylene bags, properly labeled and transported to the laboratory.

**Quality Assurance**: All plastic containers, crucibles, mortar and refuse were washed. Glasses were washed with liquid soap, rinsed with distilled water and then soaked in 10% $HNO_3$ solution for 24hours (Todoroui et al., 2001). They were dried in Mammary drying oven at 80$^oC$ for 5 hours.

The following physico-chemical parameters were assessed for soil analysis**:** $_PH$, Color, Electrical Conductivity, Cation Exchange Capacity (CEC), Total Organic Carbon, available Nitrogen (N), Phosphorus (P), Potassium (K), Bacteria, Fungi, Nematode and Earthworm.

**pH**: 20g of each air-dried soil was weighed into 50 ml beaker and 20 ml of distilled water was added. It was stirred with a glass rod and allowed to stand for 30 minutes and the pH was recorded. It was calibrated with HANNA PH meter (Model H 1991000). (Black, 1965)

**Colour:** Soil samples were compared to colour standards and graded.

**Electrical conductivity:** 25 g of air dried soil sample was placed into a 250 ml beaker. Distilled water was added slowly drop by drop uniformly over the entire soil surface until the soil appears to have been wetted. A stainless steel spatula was used to form a homogeneous soil saturated paste. The beaker was covered, 50ml distilled water was added and shaken for 1hour. 40ml of the diluted extract was placed into 100ml beaker and the conductivity meter was inserted and the electrical conductivity of the soil recorded in uScm.

**Cation exchange capacity (CEC):** 10 g of soil sample was weighed into 100 ml plastic beaker. 40 ml of 1.0 $moldm^{-3}$ ammonium acetate solution (pH 7) was added and stirred then left overnight. It was then suction-filtered with 55 mm Buchner funnel. The residue from filtration was leached with four 25ml portions of 1 moldm3 $NH_4Cl$ solution (pH 7). The solution was discarded and the electrolyte washed out of the sample with ethanol. The sample was allowed to drain completely and leached gradually with acidified NaCl to 250 ml. 50 ml of 2% boric acid was measured into 250 ml comical flash and 3 drops of mixed indicator were added. The acidified NaCl leachate was poured into 500 ml flask and 10 ml of NaOH and anti-bumping granules were added. The leachate was distillated over the boric. 1.5 ml of ammonium borate was titrated with standard 0.1 moldm3 HCl and the CEC determined as follows (Todoroui *et al*., 2001):

$$\text{CEC (C mol kg}^{-1}) = \frac{(\text{Titre} - \text{Blank}) \times M \times 100}{\text{Weight of sample}}$$

**Determination of Organic Matter Content:** Two crucibles were dried in an oven at 105$^{o}$C for 24 hours. They were allowed to cool and their weights were taken separately. 1 gram of oven dried soil sample was weighed within each of the two crucibles. Each sample was heated on a Bunsen burner for 30 minutes, with occasional stirring using a mounted needle. The crucibles were transferred into desiccators and the sample in it was cooled down. Each crucible with the sample in it was weighted. The weights of the heated soil samples were determined using the formula below: Loss in Weight of Sample X 100%

Initial Weight of Sample

**Nitrate:** It was extracted using Ammonium chloride ($NH_4Cl$) solution by adding 250ml of Ammonium chloride; this was then added to ten (10) grams of the sample. It was shaken for one about hour and filtered, and then it was recorded using the cadmium reduction method**:** This was determined by adding 30ml of calcium sulphate extracting solution to a 2 gram scoop of soil and shaken for 15 minutes. The nitrate level in the filtered extract was then measured on the analyser by the cadmium reduction method

**Phosphate:** Phosphate was extracted using sodium bicarbonate in soil water. The extracted phosphate was added to Ammonium molybdate under reducing condition in acidic solution to form a blue cultured complex. The intensity of the blue coloration is proportional to the phosphate level in the soil which is determined by Amino acid method. The phosphate is then determined in the sample by using multi- parameter photometer. (Absorbance 882nm in spectrophotometer)

**Potassium:** This was extracted from the soil by mixing 10ml of ammonium acetate, pH7 with 1g scoop of air dried soil and shaken for 5 minute. The available potassium was then measured by analyzing the filtered extract on absorption spectrometer 776nm.

**Determination of Bacteria and fungi in soil samples using the spread plate method (APHA 9215B/9610C):** Materials: Petri dishes, Nutrient agar, Sabouraud dextrose agar, Conical flask, Glass rod, 10ml Pipette.

The soil sample was mixed, and a suspension of 1 g (dry weight equivalent) in 10 ml of sterile water was prepared. 1ml of the soil suspension was then diluted serially (ten-fold) and used in the estimation of aerobic heterotrophic bacterial and fungal populations by the standard spread-plate dilution method, in triplicate. Nutrient agar containing 0.015% (w/v) nystatin (to inhibit fungi growth) was used for bacteria isolation and incubation were at 35$^{o}$ for 24hours. Sabouraud dextrose agar to which 0.05% (w/v) chloramphenicol was added (to inhibit bacteria growth) was used for fungal isolation, and incubation was at ambient temperature for seven days.

**Determination of nematodes in soil samples (APHA 10750):** This technique is for the extraction of nematodes from soil. The soil was washed in water, decanted and nematodes were collected on sieves of different aperture followed by cleaning the suspension with a Baermann funnel dish. The method makes use of differences in size, shape, and sedimentation rate between nematodes and soil particles, and of nematode motility.

Material: A 10L container, Stirring rod, Aperture sieve, Watch glass, Baermann funnel, Glass beakers, Compound microscope, Counting slide, Microscope slide, Procedure

200 mg of soil was added to a 10L container and 5L of water was added, Soil suspension was Stirred vigorously for 10s and allowed to settle for 45s, The supernatant was poured through a bank of 3 sieves of different aperture sizes, Debris was washed and collected into a clean glass beaker, The suspension was carefully poured from the beaker with the help of a watch glass onto the cotton-wool milk filter supported by a plastic sieve in the Baermann funnel, After 24 hrs, the nematodes were collected from the Baermann funnel in a glass beaker, Nematodes were examined at higher magnification using a compound microscope.

**Determination of Earthworm from soil**

The soil was removed and searched for earthworms before being discarded. Earthworms were carefully hand-sorted from the soil.

## III. RESULT

Table 1: Showing the result of the Physicochemical analysis

| S/N | Parameters | SAMPLE A | SAMPLE B | SAMPLE C | SAMPLE D | SAMPLE G | SAMPLE K | SAMPLE L |
|---|---|---|---|---|---|---|---|---|
| 1 | pH | 6.80 | 6.97 | 5.47 | 4.95 | 6.86 | 7.94 | 7.40 |
| 2 | Color | 7.5YR 2.5/3 Very Dark Brown | 7.5YR 3/4 Dark Brown | 7.5YR 4/6 Strong Brown | 5yr 4/4 Reddish Brown | 7.5YR 2.5/2 Very Dark Brown | 7.5yr 2.5/2 Very Dark Brown | 5yr 4/6 Yellow Red |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | **Electrical Conductivity, µS/cm** | 48 | 51 | 76 | 103 | 282 | 149 | 40 |
| 4 | **Cation Exchange Capacity, meq/100g** | 5.57 | 2.98 | 0.87 | 0.89 | 6.28 | 5.72 | 1.63 |
| 5 | **Total Organic Carbon, %** | 2.048 | 2.067 | 0.722 | 0.644 | 2.165 | 3.335 | 2.067 |
| 6 | **Available Nitrogen, mg/kg** | 0.088 | 0.028 | 0.112 | 0.103 | 0.024 | 0.057 | 0.039 |
| 7 | **Phosphorus, mg/kg** | 4.532 | 4.502 | 2.510 | 2.217 | 2.403 | 8.837 | 6.685 |
| 8 | **Potassium, mg/kg** | 0.899 | 0.899 | 0.553 | 0.470 | 1.004 | 5.003 | 1.761 |
| 9 | **Bacteria, cfu/g** | $1.70 \times 10^6$ | $1.48 \times 10^7$ | $1.22 \times 10^7$ | $1.05 \times 10^6$ | $2.56 \times 10^6$ | $1.30 \times 10^6$ | $1.75 \times 10^6$ |
| 10 | **Fungi, cfu/g** | $4.50 \times 10^3$ | $3.90 \times 10^4$ | $2.20 \times 10^3$ | $2.70 \times 10^3$ | $2.30 \times 10^4$ | $3.80 \times 10^4$ | $2.70 \times 10^3$ |
| 11 | **Nematode** | ++++++ | ++++++ | ++++++ | +++++ | + | + | ++ |
| 12 | **Earthworm** | ++++++ | ++++++ | ++++++ | +++++ | + | + | ++ |

The soil mapping unit was classified as well drained, friable to firm consistence with sub-angular blocky structure at sub soil. They are very dark brown (7.5YR 2.5/3, Moist) at the top and dark red (2.5YR 4/6 moist) at the subsoil (Table 1). A higher clay content at the sub-soil than the top soil was observed. This is due to the variation in the MW sediments in the area and the natural soil colour in Owerri municipal.

Table 2: Comparison of physico-chemical properties of the top soil quality between MWD sites and control

| | MWD<br>Mean ± SD | Control<br>Mean ± SD | t | P value |
|---|---|---|---|---|
| PH | 7.20 ± 0.64 | 5.48 ± 0.01 | 3.596 | 0.037 |
| Electrical conductivity | 159.67 ± 117.36 | 76.02± 0.02 | 0.956 | 0.409 |
| Calcium exchange capacity | 5.86± 0.37 | 0.93± 0.08 | 17.493 | < 0.001 |
| Total organic carbon | 2.52± 0.71 | 0.73± 0.01 | 3.365 | 0.044 |
| Available Nitrogen | 0.05 ± 0.03 | 0.11 ± 0.01 | 2.482 | 0.089 |
| Phosphorous | 5.26± 3.28 | 2.52± 0.01 | 1.120 | 0.344 |
| Potassium | 2.30± 0.33 | 0.54± 0.01 | 1.006 | 0.388 |
| Bacteria | 185333333± 64384263 | 1215000000±7071067 | 21.392 | < 0.001 |
| Fungi | 2183333± 1678044 | 215000± 7071 | 1.574 | 0.214 |

Table 2 shows that PH was significantly higher in surface soil with MWD (7.20 ± 0.64) than the controls (5.48 ± 0.01), (t = 3.596, p = 0.037).Calcium exchange capacitywas significantly higher in surface soil with MWD (5.86 ± 0.37) than the controls (0.93 ± 0.08), (t = 17.493, p < 0.001).Total organic carbon was significantly higher in surface soil with MWD (2.52 ± 0.71) than the controls (0.73 ± 0.01), (t = 3.365, p = 0.044). Conversely, bacteria was significantly lower in surface water with MWD than the controls (t = 21.392, p < 0.001). The null hypothesis is hereby rejected and the alternative accepted. Therefore, there is a significant effect of MWD practices on the physico-chemical properties of the surface soil quality in selected hospitals in Owerri.

Table 3: Comparison of physico-chemical properties of the sub surface soil quality between MWD sites and control

| | MWD<br>Mean ± SD | Control<br>Mean ± SD | t | P value |
|---|---|---|---|---|
| PH | 7.19 ± 0.30 | 4.97 ± 0.02 | 10.301 | |
| Electrical conductivity | 45.50± 7.78 | 102.95± 0.07 | 10.445 | 0.009 |
| Calcium exchange capacity | 2.31± 0.95 | 0.89± 0.01 | 2.098 | 0.171 |
| Total organic carbon | 2.07± 0.01 | 0.64± 0.01 | 285.600 | < 0.001 |
| Available Nitrogen | 0.03± 0.01 | 0.11± 0.01 | 11.198 | 0.008 |
| Phosphorous | 5.59± 1.54 | 2.21± 0.01 | 3.097 | 0.090 |
| Potassium | 1.33± 0.61 | 0.48± 0.01 | 1.984 | 0.186 |
| Bacteria | 827500000± 92277434 | 104500000±707106 | 1.108 | 0.383 |
| Fungi | 2085000± 256679 | 275000± 7071 | 0.997 | 0.424 |

Table 3 shows that $_{P}$H was significantly higher in surface soil with MWD (7.19 ± 0.30) than the controls (4.97 ± 0.02), (t = 10.301, p = 0.009).Electrical conductivity was significantly lower in sub surface soil with MWD (45.50 ± 7.78) than the controls (102.95 ± 0.07), (t = 10.445, p = 0.009).Total organic carbon was significantly higher in sub surface soil with MWD (2.07 ± 0.01) than the controls (0.64 ± 0.01), (t = 285.600, p < 0.001). Available Nitrogen was significantly lower in sub surface water with MWD (0.03 ± 0.01) than the controls (0.11 ± 0.01), (t = 11.198, p = 0.008). The null hypothesis is hereby rejected and the alternative

accepted. Therefore, there is a significant effect of MWD practices on the physico-chemical properties of the surface soil quality in selected hospitals in Owerri.

## IV. DISCUSSION

The samples in this series were generally slightly acidic to neutral in reaction with the lowest acidity at the surface. The $_{P}H$ was significantly higher in surface soil with MW (7.20 ± 0.64) than the controls (5.48 ± 0.01), (t = 3.596, p = 0.037) as well, it was significantly higher in sub soil with MW (7.19 ± 0.30) than the controls (4.97 ± 0.02), (t = 10.301, p = 0.009). This demonstrates the acidity of the normal soil in Owerri compared to the medical waste dumpsite containing more alkaline deposits. The pH around MW dumpsite varied between slightly acidic to alkaline as against the pH value of the control site (Table 2) which was strongly acidic. This may be attributed to the sediments of medical waste at the dumpsite. The alkalinity of soil around the dumpsite has a great impact on concentration of element and soil infiltration. This is higher than the values (4.8- 7.66) obtained by Obianefo et al., (2017) but within the earlier findings on dumpsites by Obasi et al., (2012); Osunwoke and Kurofiji (2012); Mouhoun-Chouaki et al., (2019) and Enerijiofi and Ekhaise, 2019 and Agbeshie et al., (2020). The significant higher pH values recorded in the dumpsite soils could be ascribed to the presence of elevated amount of lime material, and biological activities of soil microorganism on the medical wastes (Ideriah et al., 2006; Osei et al., 2011; Kebede et al., 2016; Agbeshie et al., 2020). It has been reported that pH has constant relationship with soil chemical properties and nutrients is made available to plants in higher concentration at pH value of 6.5-7.5 (Whalen, 2000; Praveena and Rao, 2016). Thus, it is a major property that determines numerous chemical processes that occurs in soil (Chang et al., 2014).. A favourable pH and availability of substrate are key to microbial survival, activities, growth, and proliferation.

The available phosphorus of the sample soil at the dumpsites were 4.5 mg $kg^{-1}$ and 8.8 $mgkg^{-1}$ at the top soil and 4.5 $mgkg^{-1}$ and 6.7 $mgkg^{-1}$on the sub soil of both public and private HCF respectively in comparison to the control 2.5 $mgkg^{-1}$. When compared to other values of different locations, it is confirmed that the dump site has a higher content of available phosphorus than control. This indicates that sample soils are suitable for plant growth as phosphorus is an essential element for plants to thrive. There is no statistical significant difference in the available phosphorus of both control and sample (P value 0.160).

The overall Nitrogen content (N) of subsoil around the studied dumpsite varied between 0.03 ± 0.01 on the MWD site to 0.11 ± 0.01% in the control. There is a significantly lower available Nitrogen in the MWD subsoil site than the control (t = 11.198, p = 0.008).

Thus, the N for studied dumpsite is less than that of the control site in both HCFs, therefore medical waste is a major contributor to the low levels of these soil properties. This less Nitrogen concentration of these locations may have contributed to the poor growth of plants observed around the sites. As well the total organic carbon (%) in soil influences the chemical and physical processes. It is an important indicator of the soil quality as a rooting environment. However, organic carbon of the sub-soil organic carbon was significantly higher in MWD (2.07 ± 0.01) than the controls (0.64 ± 0.01), (t = 285.600, p < 0.001) and top soil with MWD (2.52 ± 0.71) than the controls (0.73 ± 0.01), (t = 3.365, p = 0.044). Organic carbon is not a necessity for plant growth, the high concentration may be due to the degradable MW in the dumpsite furthermore the availability of organic carbon in soil result increases the cation exchange capacity (CEC) which helps in the accumulation of nutrients taken in by plants. Significant higher mean values of organic carbon (OC), total nitrogen (N) and phosphorus (AP) observed from dumpsite soils when compared to control is attributed to the decomposition of organic waste by microbial activities that has led to increase in the soil organic matter contents which serve as major source of nitrogen and phosphorus, which are essential for plant growth (Obute et al., 2010, Amos-Tautua et al., 2014). The variations in OC, TN and P when compared with the other two location sites were similar to the results of other studies (Obianefo et al., 2017; Agbeshie et al., 2020).

**Exchange capacity** is the number of exchangeable cations per unit mass of dry soil which is a major index for soil fertility. It is defined as the total number of exchangeable basic cations: Calcium (Ca), Sodium (Na), Magnesium (Mg) and Potassium (K) ions in a soil sample. It depends on the properties of soil and soil elements like pH, clay and organic matter contents. (Agbeshie et al., 2020) The study findings show that Cation exchange capacity was significantly higher in top soil with MWD (5.86 ± 0.37) than the controls (0.93 ± 0.08), (t = 17.493, p < 0.001). This is at variance with the findings in a similar study.

The Electrical conductivity was significantly lower in sub surface soil with MWD (45.50 ± 7.78) than the controls (102.95 ± 0.07), (t = 10.445, p = 0.009). The significantly low mean EC values in subsoil when compared to the control is an indication of the presence of less cations and anions in the the dumpsite as a result of lower ionizable materials (Ahmed et al., 2014; Akintola, 2014; Mekonnen et al., 2020). The values of EC is lower compared to (389.22 - 1543.56 µS/cm) as in the similar studies conducted on dumpsites (Ahmed et al., 2014; Agbeshie, 2020, Mekonnem et al., 2020) and similar to those reported by Osazee et al., (2013) and Enerijiofi and Ekhaise (2019). The reason for this could be due to the age of the dumpsites, waste types, and study locations.

Although MW contain significant concentrations of microorganisms, they should not be seen as harmless indicators of contaminations but rather as pathogens that cause disease and propagate antibiotic resistance due to their exposure to diverse amounts of antibiotics (Carraro et al., 2016; Hocquet et al., 2016). Medical waste has high attendant risk associated with them due to the high pathogenic microbial load (Babanyara et al., 2012).
Many studies have reported about the presence of bacteria, in our study, the bacteria was significantly higher in top soil with MWD than the controls ($t = 21.392$, $p < 0.001$). This indicates that MW is one of the primary sources for the release of high concentrations of pathogens in various environmental matrices. A similar finding of elevated microbial communities has been documented from medical waste sites by Babanyara et al. 2012, As well Abah and Ohimain, 2011 and Ngwuluka et al., 2009. The occurrence of non-soil living organisms in a large population could be attributed to invading organism responding to substrate available in the medical waste, or from laboratory cultures and specimens containing these organisms. Although non-soil microbes are expected to have a short survival duration in the soil (ICRC, 2011), the constant healthcare activities and indiscriminate dumping of MW may account for their continuous existence in the soil.

## V. CONCLUSION

In conclusion there is a significant effect of MWD practices on the physico-chemical properties of the soil in selected hospitals in Owerri. It is evident that soils at MW dumpsites are heavily loaded with pathogenic micro-organism, which could pose a direct danger to the health of people, animal and plants. It is important HCFs to adhere to appropriate medical waste disposal practices.

Conflict of Interest: The authors have declared no conflict of interest

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