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# Comparative Study on Physicochemical Composition of *Eichhorina Crasipes* Compost and Bacterial Isolates from Forest Soils as Biofertilizing Potentials in the Niger Delta, Nigeria

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**ABSTRACT**

In this study the comparative composition of *Eichhorina crasipes* compost (WHC) and bacterial isolates from forest soil were screened for biofertilizing potential. Preparations comprising live or dormant cells of effective species of microbes that promote plant development and growth are known as biofertilizers soil sample was collected from forest in the Niger Delta of Nigeria.(WH) samples were collected and processed into compost from the wild in Rivers state. The microbial load and physicochemical parameters of Water hyacinth compost were determined using standard methods. Results show the total heterotrophic bacterial count for the soil was 69.33 ± 3.50x $10^8$ CFU/g while WHC was 2.67± 3.50x10 $^8$ CFU/g and the hydrocarbon utilizing bacterial count for soil was 32.33 ± 1.52x $10^8$ CFU/g while for WHC was as 1.62± 3.50x $10^8$CFU/g respectively. the Ash content was 20% for the soil and 35.2% for the WHC, the Moisture content was 12.5 for the soil and 40.5% for the WHC. The level of NPK in the soil was 3.13 ± 0.03, 1.84 ± 0.05 0.84 ± 0.05 respectively and WHC 8.38± 3.17, and 4.51 ± 0.05 respectively, from the result we discovered that WHC has a higher ability of Biofertilizing Potential and we concluded that the use of water hyacinth compost positively will improves the growth rate and is enriched with essential plant nutrient when compare to forest soil without compromising the health of consumers by heavy metal toxicity build up

Key words: biofertilizing, hydrocarbon, water hyacinth compost, Standard method

## 1.0 Introduction

The ideal definition of a forest is an area of the earth with a high percentage of trees or a large area of land with trees that provides home for wild animals. In contrast to natural forests, which are created and managed by humans, all forests are either man-made or indigenous. The most common microorganisms in forest soils, which are among the most varied microbial environments on the planet, are bacteria. Forest soils have a pronounced vertical stratification due to the weathering of the mineral matrix and the decomposition of organic matter derived from litter. As soil depth increases, so does the quantity and quality of organic matter, as well as microbial biomass, respiration, and extracellular enzyme activity. For example, the bacterial communities of organisms are found in horizons specifically, even though they exhibit a significant amount of taxonomic overlap. In temperate Quercus forest, for example, the organic and mineral strata are dominated by members of the Actinobacteria, Proteobacteria, and Bacteroidetes, as well as Acidobacteria, which comprise 40–50% of all sequences.

In soils from coniferous forests, bacterial populations also vary by horizon. In contrast to the known patterns of the plant and animal groups, the composition of the soil bacterial community has been demonstrated to exhibit predictable biogeographic patterns on a continent-scale. The first thorough investigation found that the primary determinant of the genetic makeup of the bacterial community is the pH of the soil. Bacterial taxa's ecological strategy is demonstrated by their preference for settings with particular nutrient and biological matter compositions. Current research indicates that members of the Acidobacteria can be found in soils with a wide variety of carbon levels and account for 20% of all bacteria on average. Their abundance can reach 60% in acidic forest soils that have significant quantities of organic matter and carbon allocated by tree roots. The fact that the overall number of Acidobacteria did not initially equal the amount of carbon in soils supports the theory that they are slowly developing oligotrophs that evolved in response to resource restrictions (Suleiman et al., 2022).

One invasive plant that thrives and multiplies in aquatic environments is the water hyacinth (Eichhornia crassipes). Usually found in lakes, reservoirs, rivers, and stagnant swamps, this freely floating aquatic plant (Jirawattanasomkul et al., 2021). At the individual, genetic, and environmental levels, it jeopardizes biological and socioeconomic diversity. Its explosive development raises concerns around the world because unchecked growth can damage power stations and choke waterways. Furthermore, by blocking sunlight from reaching water bodies and lowering oxygen concentrations, water hyacinth disrupts aquatic ecosystems by depriving the atmosphere of oxygen (Madikizela, 2021).

## 2.0 Materials and Methods

### *2.1 Sample Collection*

Water hyacinth compost (WHC) was produced using *Eichhornia crassipes* plants harvested from the wild, and following a documented procedure (Abu *et al*., 2024). The compost is stored inside polythene bags at ambient conditions for further use.

#### *2.1.1 Soil sample*

Soil samples was gotten from forests from the Niger Delta region of Nigeria Samples were collected and transfer to the laboratory for further analysis

### *2.2 Methods*

Calculation of total hydrocarbons using bacteria in WHC and forest soil By plating aliquots (0.1 ml) of samples from 10-2, 10-3, and 10-4 dilutions on mineral salts agar that contained (gl-1): NaCl,10.00; MgSO4.7H2O, 0.42; KCl,0.29; KH2PO4, 0.83; Na2HPO4.H2O, 1.25; NaNO3, 0.42; Agar,15.0 and deionized or distilled water to the 1000 ml mark (pH, 7.2), mean counts of total hydrocarbon utilizers were determined. The medium was autoclaved for 15 minutes at 1210C and 15 psi of pressure to sterilize it. Every plate was incubated for 24 to 48 hours at 37.0C.

### *2.3 Physicochemical analysis of forest soil and WHC*

he physicochemical characteristics that were investigated included pH, moisture content, organic matter content, nitrogen content, and potassium phosphate content. All analyses were triplicate, and the mean values were reported using the Margesin et al. (2003) approach. The pH of the samples was measured after two hours of mixing one part compost with 2.5 parts 10mM CaCl2. The pH of the experimental solution and the control (C) solution were measured using the Mettler Toledo MP220 pH meter. Loss on ignition, a measurement of the amount of organic matter, was calculated by weighing the oven-dried compost after six hours at 250°C (Margesin et al., 2003).To ascertain the moisture content, compost that had been oven-dried for three hours at 1050C was constantly weighed (Onifade, 2007)

## 3.0 Results

### *3.1 Microbiological Properties of the soil and WHC samples*

The Total Heterotrophic Bacterial Count (THBC) of the soil and water hyacinth compost samples is shown in Table 3.1. The count of forest soil was 69.33 ± 3.50x $10^8$ CFU/g and 2.67± 3.50x$10^8$ CFU/g for the water hyacinth compost. The hydrocarbon utilizing bacterial (HUB) for forest soil was 32.33 ± 1.52x $10^8$ CFU/g and 1.62± 3.50x $10^{8}$ for the water hyacinth compost

**Table 3.1: Bacterial population on the forest soil and WHC**

| Samples | THBC (CFU/g) | HUBC (CFU/g) |
|---|---|---|
| Forest soil | 69.33 ± 3.50x $10^8$ | 32.33 ± 1.52x $10^8$ |
| WHC | 2.67± 3.50x$10^{8}$ | 1.62± 3.50x $10^{8}$ |

Values are mean±S.D of triplicate determinations (n=3)

### *3.2 Proximate quality of forest soil and water hyacinth compost*

The results presented in Table 3.2 show the proximate composition of water hyacinth samples used in the study. The moisture content of forest was 12.5 %, others are: % crude protein 5± 0.30, % ash content 47± 0.40, % crude fat10.5± 0.50, % carbohydrate 20± 0.60 and % crude fibre5± 0.20. The moisture content of water hyacinth was 40.5 %, others are: % crude protein 3.5±0.40,% ash content 5.5±0.42,% crude fat 0.2± 0.02,% carbohydrate 35.2 ±1.03 and % crude fibre 15.1±0.1. This demonstrated that the soil was enriched with ash content and carbohydrate. Water hyacinth compost is almost hygroscopic and is rich in carbohydrates and crude fibre.

**Table3.2: Proximate composition of forest soil and Water hyacinth**

| Parameters | FOREST SOIL | (WHC) |
|---|---|---|
| Moisture Content (wt%) | 12.5± 0.20 | 40.5± 0.40 |
| Crude Protein (%) | 5± 0.30 | 3.5± 0.04 |
| Ash Content (wt %) | 47± 0.40 | 5.5± 0.42 |
| Crude Fat (wt%) | 10.5± 0.50 | 0.2± 0.02 |
| Carbohydrate (%) | 20± 0.60 | 35.2±1.03 |
| Crude Fibre (%) | 5± 0.20 | 15.1± 0.10 |

Values are mean±S.D of triplicate determinations (n=3)

***3.3 The physicochemical characteristics of forest soil and WHC.***

The values in Table 3.3 are mineral components of soil and WHC as used in the study the WHC have higher value for almost all the parameters except calcium, sodium, manganese, and trace element The compost is enriched with Nitrogen, Phosphorous and Potassium representing plant major nutrient parameter are find higher in WHC and this indicated it has nutrient replenished ability to Agriculture. .

**Table 3.3 shows the physicochemical characteristics of forest soils and water hyacinth compost**

| Parameter | Forest Soil | Water hycianth compost |
|---|---|---|
| Ph | 6.58 ± 0.07 | 7.23 ± 0.05 |
| E/C (µs/cm) | 108.38 ± 0.06 | 117.46 ± 0.05 |
| Nitrate (mg/kg) | 3.13 ± 0.03 | 8.38± 0.17 |
| Potassium (mg/kg) | 0.84 ± 0.05 | 4.51 ± 0.05 |
| Total organic carbon (%) | 2.63 ± 0.16 | 2.78 ± 0.11 |
| Phosphate $Po_4^{-3}$(mg/kg) | 1.84 ± 0.05 | 3.17± 0.05 |
| Magnesium (mg/kg) | 1.40 ± 0.50 | 3.48± 0.50 |
| Calcium (mg/kg) | 0.20 ± 0.00 | 0.60± 0.01 |
| Organic matter content | 12.70± 0.01 | 4.70± 0.01 |
| Moisture content | 15.70± 0.01 | 95.70± 0.01 |
| Sodium (mg/kg) | 0.10 ± 0.00 | 0.70± 0.01 |
| Zinc (mg/kg) | 1.48 ± 0.05 | 2.54 ± 0.31 |
| Manganese (mg/kg) | 0.50 ± 0.00 | 0.30± 0.01 |
| Iron (mg/kg) | 2.67 ±0.78 | 2.73 ± 0.12 |
| Mercury (mg/kg) | 0.01 ± 0.01 | 0.01 ± 0.00 |
| Lead (mg/g) | 0.45 ± 0.30 | 0.40 ± 0.21 |
| Copper (mg/kg) | 0.45 ± 0.50 | 0.10 ± 0.05 |

**Values are mean ± standard deviation (M±S.D) of triplicate determinations (n=3)**

## 4. Discussion

The water hyacinth compost is hygroscopic and nutrient-rich, as evidenced by its 42.5% moisture content, 35.2% carbohydrate content, 3.5% crude protein content, and 15.1% crude fiber content (Table 3.2). This finding is corroborated by the WHC samples' high microbial burden (Table 3.1). Water hyacinth may have a short shelf life due to its high moisture content. Dehydration would improve the water hyacinth meal's shelf life and preservation because of its high moisture content, which would also increase the relative concentrations of the other food ingredients (Suleiman et al., 2020).

The physicochemical parameters of soil samples and water hyacinth compost in table 3.3 showed that the pH of the samples was slightly acidic and neutral, However biofertilizers made the soils alkaline. The soil pH of 6.58 which is almost the same range as that of the hyacinth compost 7.23 Show that the soil is slightly acidic when compare to WHC.The electrical conductivity, organic matter, total organic carbon, moisture content, nitrogen, phosphorus, zinc and manganese concentrations were significantly. This result is consistent with the findings of Zhang et al. (2023), who applied WHC Amendments to soil used to grow spinach and reported significant levels of nutrients. Zhang et al. (2023) claim that acidic soil hinders crop growth and increases the generation of reactive oxygen species, which have a detrimental influence on plant metabolism. The findings of the physicochemical examination of soil samples concur with those of other research (Anli et al., 2020; Bertrand et al., 2024), which all found that the soil was acidic and deficient in mineral nutrients before biofertilization, which hindered plant development and performance.The prevalence of heavy metals (lead, mercury) in compost, water hyacinth, and soil can be explained by the metals' natural occurrence. The levels of heavy metals in the soil were within the WHO/FAO, 2003 norms of uncontaminated soil and WHC, notwithstanding their presence.

The capacity of the water hyacinth to absorb and hold onto nutrients and heavy metals from nutrients is responsible for the relatively higher concentration of heavy metals and plant nutrients in the soil and WHC hyacinth compost (Gunnarsson & Petersen 2023). Therefore, the utilization of water hyacinth and forest soil as biofertilizing potentials is justified due to their comparatively high nutritional content. As can be seen in table 3.3 above, the water hyacinth compost had higher potassium content than the soil, which resulted in a significant rise in nitrogen, phosphorus, and potassium—all of which are vital nutrients for plants demonstrated the competing ion effects and high soil K fixation potential. the availability of potassium and phosphorus while simultaneously increasing plant output (Mashavira et al., 2015) (Bharti et al., 2020).This raises the yield per water unit applied and the efficiency of water use. The findings showed that zinc concentrations in the hyacinth compost rates were greater than those of any other heavy metal. This pattern appears to be at odds with the findings of Mashavira et al. (2015), who discovered that, in comparison to other heavy metals, Cu and Ni were significantly concentrated. However, the results are consistent with regard to mercury concentrations, which were shown to be at their lowest levels in compost and soil. Because zinc has a very high mobility and is therefore available for plant absorption, there are considerable quantities of zinc in water at all hyacinth compost application rates. (D. Veenapani & Lata 2011)

## 5. Conclusion

When compared to forest soil, the use of water hyacinth compost increases development pace and enriches it with vital plant nutrients without endangering consumer health through the accumulation of heavy metal toxicity. However, an increase in the pace of composting can be suggested based on sustainable water hyacinth harvests from nearby water bodies, as this results in noticeably higher yields of water hyacinth compost with a higher nutrient content..

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