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Agro Based and Alkaline Activated (NaOH) Nano-fertilizer using Ripe Plantain (Musa paradisiaca) Peels.

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Abstract:*Waste and ripe plantain peels preserve crucial Phyto-vitamins (selected phytochemicals, minerals, and proximate) that may be recycled into beneficial materials like manures and fertilizers. Extraction and isolation of Nano biofertilizer using the peels of ripe plantain was the major goal of this research. The aqueous extracted, alkaline (NaOH) activated (1 %, 2%,3%, 4% & 5%) and citric-urea changed(5 %) ripe plantain Nano-fertilizer were subjected to physicochemical characterizations(, moisture content material, ash content, electric conductivity, total nitrogen, general phosphorus, overall potassium, and overall natural carbon) at pH 6.8, 7.0, 7.6, 9.5 and 11.2.The common floor regions and diameters of synthesize Nano fertilizer underneath the mapped alkaline circumstance using photo J nanoparticles software are1%(nil),2%(64.16 ± 31.23nm2; 27.67 ± 7.03nm), 3%(262.05 ± 37.32nm2; 57.37 ± 4.18nm), 4% (353.71 ± 40.04nm2; 68.39 ± 3.90nm) and 5% (480.59 ± 67.90nm2; 77.51 ± 5.55nm). Ripe plantain peels have been modified and stabilized for use as a bio Nano-fertilizer with the capacity of managing the particle size bodily /chemically at Nano degree and salvaging the environmental pressure from agro wastes.*

Keywords: Ripe plantain peel, Nano fertilizer, alkaline activation, pH, and image J nanoparticle software.

1.0 INTRODUCTION

Matured plantain is nutritionally vital as it is a reasonably cheap supply of dietary energy but, it's far one of the fundamental problems experienced primarily with agro-based industries in the area of waste management [1]. Plant biomasses and wastes in Nigerians are subjected to open-air burning or allowed to undergo natural disintegration with its attendant environmental implications [2]. Inefficient and mistaken disposal of stable wastes creates severe dangers to public fitness, which includes pollutants of air and water resources, an increase in rodents, bug vectors of ailment, public nuisances as well as interference with lifestyles and improvement [3]. The failure or incapability to salvage and re-use such materials economically results in needless waste and depletion of Phyto-natural resources. To this point, the emphasis is on the natural transformation of organic wastes, particularly agricultural wastes, and byproducts into value-added products. Plantain is one of the fundamental vegetative fruit whose peel represents about 30 % of the fruit [4]. This waste constitutes an environmental hassle because it incorporates large quantities of nitrogen, phosphorus, and relatively high water content that makes it vulnerable to modification by microorganisms to the advantage of plants [4]. Potassium, because of its critical detail for the plant; the use as fertilizer is vital for promoting standard plant vitality, building up, resistance to pests and disorders, and vital in fruit development [5]. The signals of potassium scarcity in flora can be seen as the older leaves have brown veins. Potassium content in plantain peels is about 200 mg or 40 percent as they offer nutrients that flowers required to thrive, and additionally as a pest repellent [5].Phosphorus is critical to plant development as it is located in the cell of every living plant. It coordinates several key plant functions, such as strength transfer, photosynthesis, the transformation of sugars and starches, nutrient movement inside the plant, and transfer of genetic traits from one generation to the subsequent ones. [9]. Phosphorus is classed as a major nutrient, which is needed by crops in incredibly large amounts. The entire phosphorus concentration in agricultural crops commonly varies from 0.1 to 0.5 percent [6].Nitrogen is a crucial macronutrient for plant features and is a key precursor for amino acids, which shape formulates the plant proteins and enzymes. Proteins make up the structural materials of entire living organisms and enzymes facilitating the sizable array of biochemical reactions within a plant. Nitrogen is likewise an entity required for the molecule of chlorophyll, which enables the plant to seize daylight energy by way of photosynthesis, aiding plant general developments. Nitrogen plays a vital position to ensure energy is available when and wherein the plant needs it to optimize yield. This essential nutrient is even present within the roots as proteins and enzymes assist modify water and nutrient uptake [7]. Meanwhile, diverse parts of plantain had been studied for different applications: a remedy for gastric ulcer, alcohol production, and pseudo-stem as a source of fiber. There is a huge consumption level of this plant in Nigeria, as fried ripe fruit, plantain chips, plantain flour, and indigenous beer. In a lot of these stated uses, there is a very little account of reuse or recycling of the waste peels, except for some insignificant use as animal feed [8]. In a bid to inspire the bioconversion of this biomass into beneficial and value-added products, we investigated the phytochemical and physicochemical outcomes of the alkaline activated (NaOH) peels at different strengths with chemical modification into biofertilizer.

2.0 MATERIALS AND METHODS

Ripe and mature plantain peels, potassium hydroxide, citric acid, and commercial grade urea

2.1 Phytochemical evaluations of matured PP

Phytochemical tests were performed to determine the presence of secondary metabolites: alkaloids, amino acids, fat and oil, glycosides, tannins, flavonoids, phenolic, saponins, and phytosterols with the powdered samples of ripe plantain peels in aqueous solution. [9].

2.2 Mineral analysis of the plantain peels

The mineral analysis was according to the AOAC method [10].

2.3 Proximate evaluations of the plantain peels

Proximate evaluation (moisture, fat,crude fiber,ash and crude protein) of the ripe pulverized pattern turned into done the use of the usual technique of the affiliation of reputable Analytical Chemists [10].

2.4 Preparation of Nano fertilizer from ripe plantain peels

Considerable quantity (0.5kg) of ripe plantain peels were used. The extraction process was initiated by collection, washing, and air drying (5 days), shredding, and subsequently blended with deionized water by an industrial-grade mechanical blender. The acquired viscous slurry was activated by mixing with 1%, 2%, 3%, 4%, and 5% NaOH for a minute of stirring in each case to homogenize the slurry. Each was then subjected to heating at 60oC with steady for 3minutes. They were further concentrated by heating to acquire a semi-solid and darkish brown materials that were converted into Nano based products via the addition of a 5% mixture of urea and citric acid with uniform stirring [5]. They (Plantain Nano fertilizer) were then preserved in five labeled zip lock sachets.

2.4 Selected proximate parameters of the modified Plantain Peel Nano Fertilizer

PH [11], moisture content [12], ash content ([13]), electric conductivity [14]. [15], total nitrogen (Kjeldahl technique) [16], total soluble phosphorus (Quinoline method). [17], Total potassium [17] and organic carbon (Dichromate oxidation [18].

2.5 Scanning electron microscope test (SEM)

SEM analysis was carried out using a JSM-6400 scanning electron microscope (JEOL, Tokyo, Japan).

3.0RESULTS AND DISCUSSION

Table 1. Selected phytochemical screening of matured plantain peel

Phytochemical	Test	Remark
Alkaloids	Wagner	+
Tannins	Tannin	−
Saponins	Foam	+
Glycosides	Legal	+
Flavanoids	Shinod	+
Phenolic	Ferric chloride	+
Phytosteroids	Liberman Buchard	−
Reducing sugar	Fehling	+

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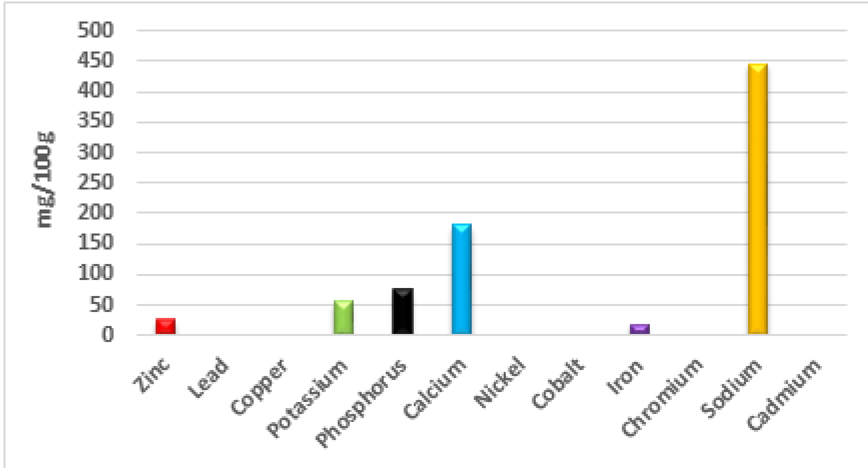

Figure 1.Metallic analysis of the matured plantain peels

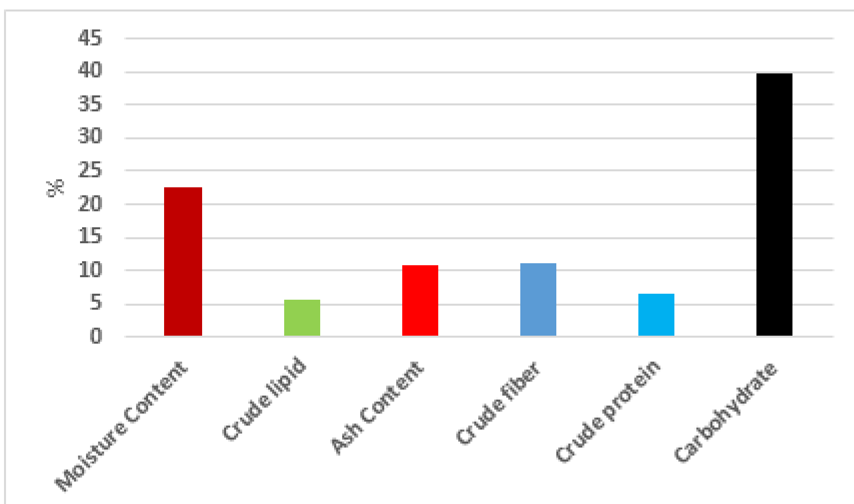

Figure 2.Selected proximate analysis of the matured plantain peels

Table 2. Selected proximate parameters of the modified Plantain Peels Nano Fertilizer.

NaOH (%)	pH	Moisture content (%)	Ash content (%)	Electrical Cond(uS/cm)	Total Nitrogen (mg/g)	Total phosphorus (mg/g)	Total potassium (mg/g)	Total organic carbon (mg/g)
1	6.8	24.32	57.02	32.00	18.13	25.15	29.57	800.28
2	7.0	19.40	58.71	32.94	18.69	25.88	30.34	623.27
3	7.6	14.60	63.28	35.75	20.35	28.20	32.95	498.61
4	9.5	13.45	78.56	45.09	25.45	35.09	41.20	459.24
5	11.2	12.60	92.31	57.42	32.52	45.10	52.92	446.22

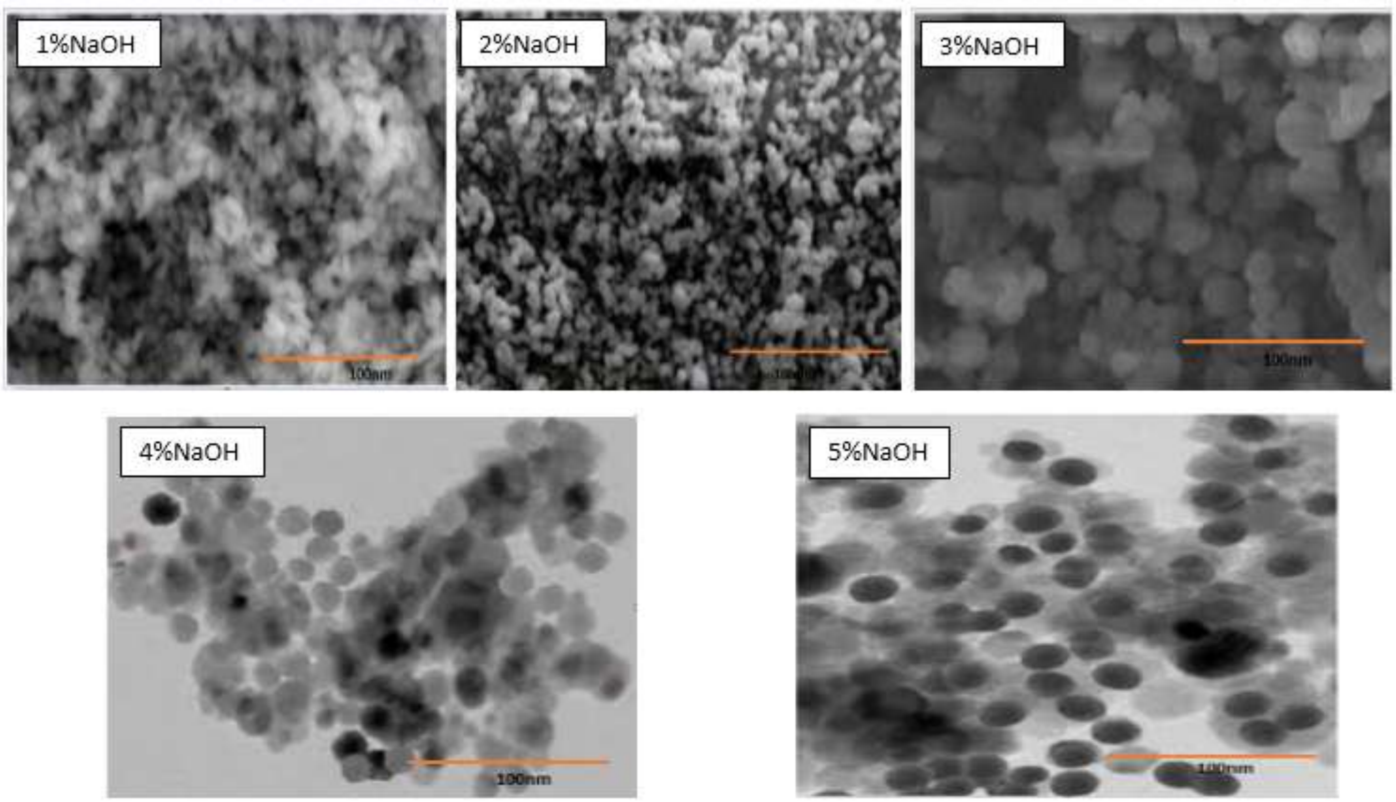

Figure 3. SEM pictures of the alkaline activated plantain (modified) peel Nano fertilizer

Table 3. Average dimensions of the alkaline activated plantain peel Nano fertilizers

% NaOH	pH	Average nanoparticle area(nm^2)	Average nanoparticle diameter(nm)
1	6.8	-	-
2	7.0	64.16 ± 31.23	27.67 ± 7.03
3	7.6	262.05 ± 37.32	57.37 ± 4.18
4	9.5	353.71 ± 40.04	68.39 ± 3.90
5	11.2	480.59 ± 67.90	77.51 ± 5.55

Results of the phytochemical screening showing the presence of different bioactive compounds in the aqueous extracts of the ripe plantain peels (Table 1). The outcomes revealed that only tannins and phytosterols were absent, while alkaloids, saponins, glycosides, flavonoids, phenolic, and reducing sugars were actively present. Metallic components of the peels were deduced as shown in figure 1. Sodium, calcium, phosphorus, potassium, zinc, and iron were registered while nickel, lead, cobalt, chromium, and cadmium were absent. Proximate parameters like carbohydrate which depicts the organic nature of the biomass; moisture, which justifies the capability of the biomass in stabilizing the homogeneity with other biomaterials that practically releases essential macro and micro molecules to the soil environment; ash and fiber are the level of insoluble organic matter; lipid, the level of oleophilic and crude protein as the index of free amino acid components. (Figure 2). Table 2. Is the selected proximate parameters of the alkaline modified plantain peels Nano biomass (fertilizer) relative to the strength of the alkaline conditions. pH values (which control the nature of isolation of functional groups with the biomass), ash content, electrical conductivities (the level and mobility of ions in solution), total nitrogen, total phosphorus, and total potassium progresses proportionally to the concentration of the alkaline conditions, while moisture and total organic carbon were inversely related to the concentrations. SEM snapshots of each condition were presented in figure 3. The defined scale of 100nm with image J nanoparticles size application was adopted. 1% NaOH sample portion was rough and difficult to resolute at this general magnification scale. However, 2, 3, 4, and 5% of the samples were estimated (Area and diameter). The average nanoparticle surface areas and diameters were presented according to table 3.

4.0 CONCLUSIONS

The potential and nature of ripe plantain peels as a natural agro-based resource for use as an organic Nano bio-fertilizer has been established. Technically, the alkaline activated Nano fertilizer has been prepared with validation of adopting scanning electron microscopy (SEM) and image J nanoparticles analyzer. Exploiting nanotechnology in the transformation of plantain peel extract to Nano form will add value as a plant growth agent, curbs the menace of environmental challenges of most agro wastes.

5.0 REFERENCES

1. Emenike, P. C., Omole, D. O., Ngene, B. U., & Tenebe, I. T. (2017). Assessment of KOH-activated unripe Musa paradisiaca peel for adsorption of copper from aqueous solution.
2. Mary B.Ogundiran et al (2011). Determination of Metal Content and an assessment of the potential use of waste cashew nut ash (CNSA) as a source for potash production. BioResources 6(1),529-536
3. Okorie DO et al (2015). Nutrient and Heavy Metal Composition of Plantain (Musa paradisiaca) and Banana (Musa paradisiaca) Peels. Journal of Nutrition & Food Sciences 5:3.
4. Anand and Maini, (1997). Musaceae - an overview. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/musaceae.
5. H S Hussein et al (2019). Preparation of nano-fertilizer blend from banana peels. Bulletin of the National Research Centre volume 43, Article number: 26
6. Functions of Phosphorus in Plants (1999). Better Crops/Vol. 83 No. 1
7. Nitrogen - Nutrient Management. Mosaic Crop Nutrition. (2020).https://www.cropnutrition.com/nutrient-management/nitrogen.
8. Joshua O. Babayemi et al (2010).Determination of potash Alkali and metal Contents of Ashes Obtained from peels of some varieties of Nigeria Grown Musa Species. Bioresources.cnr.ncsu.edu.https://bioresources.cnr.ncsu.edu
9. K.Sahira Banu and Dr. L.Cathrine (2015). General Techniques Involved in Phytochemical Analysis. International Journal of Advanced Research in Chemical Science (IJARCS) Volume 2, Issue 4, April 2015, PP 25-32 ISSN 2349-039X (Print) & ISSN 2349-0403 (Online) www.arcjournals.org
10. AOAC Official Methods of Analysis. 2010. Association of Official Analytical Chemists, 18th Ed. Washington DC
11. JIS Z 8002: Methods for determination of pH of aqueous solutions (2011).
12. Society for the Study of Feed Analysis Standards Methods of Analysis of Feeds and Feed Additives (2009) -I, p. 37 - 39, Incorporated Administrative Agency Food and Agricultural Materials Inspection Center, Saitama.
13. A5TM D 2974-87 Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
14. JIS K 0130: General rules for electrical conductivity measuring method.(2008)
15. JIS Z 8815: Test sieving - General requirements (1994).
16. Kimie KATO et al (2012).Verification of Performance Characteristics of Testing Method for Total Nitrogen Content in Fertilizer by Kjeldahl method, Research Report of Fertilizer, Vol. 5, p. 156 – 166
17. Masayoshi KOSHINO (1988): Second Revision of the Methods of Analysis of Fertilizers (Details), p. 98 - 106, Yokendo, Tokyo.

18. Yuji SHIRAI et al (2010).Validation of Determination Method for Organic Form Carbon in Sludge Fertilizer and Compost, Research Report of Fertilizer, Vol.3, p. 117 - 122