

DETERMINATION OF PHYSICOCHEMICAL CHARACTERIZATION OF INDIVIDUAL AND COMBINED SAMPLES OF *Dioscorea alata*, *Musa parasidiaca* AND *Xanthosoma sagittifolium* PEELS

¹ John, G.N. and ² Oriji, G.O

¹Department of Biochemistry/Chemistry Technology, School of Science Laboratory Technology, University of Port Harcourt.

²Department of Pure and Industrial Chemistry, Faculty of Science, University of Port Harcourt.

Received: 07-07-2025

Accepted: 13-08-2025

<https://dx.doi.org/10.4314/sa.v24i4.16>

This is an Open Access article distributed under the terms of the Creative Commons Licenses [CC BY-NC-ND 4.0]

<http://creativecommons.org/licenses/by-nc-nd/4.0>.

Journal Homepage: <http://www.scientia-african.uniportjournal.info>

Publisher: [Faculty of Science, University of Port Harcourt.](#)

ABSTRACT

This study investigates the physicochemical characterization of yam (*Dioscorea alata*), cocoyam (*Musa parasidiaca*) and plantain (*Xanthosoma sagittifolium*) plant wastes, with a focus on evaluating the impact of the individual and combined plant wastes. Tubers of yam (*Dioscorea alata*), cocoyam (*Musa parasidiaca*) and plantain (*Xanthosoma sagittifolium*) used in this study were obtained from Obibi in Etche Local Government Area of Rivers State, Nigeria. Yams are tubers, plantains are fruits, whereas cocoyam are derived from corms, underground stems, and swollen hypocotyls. All these crops can be propagated by vegetative parts and these include tubers (yams), sucker (Plantain) and side shoots, stolons, or corm heads (cocoyam). Peels from the yam tubers were obtained by using a kitchen knife to carefully remove the peels. The peels were then immediately oven dried at 45°C for 24 hours. The dried peels were then ground and filtered through a 40-mesh screen using a Wiley mill. Analyses conducted for physicochemical characterization used AOAC method. The results highlight the high ash content of Yam and Cocoyam Peel, which contributes to mineral enrichment; the enhanced moisture content of Plantain Peel, which has implications for water retention; and the low fat and oil content of Cocoyam Peel, which suggests that it is appropriate for use as a low-fat organic material. Yam Peel has a high crude fiber level, which indicates that it has the capacity to improve the structure of the soil. On the other hand, Yam and Cocoyam Peel stands out because it has the largest protein content, which is essential for the development of plants. Plantain and cocoyam peel has the largest carbohydrate content, making it an excellent source of energy for the bacteria and plants that live in the soil below it. These findings have practical implications for sustainable agriculture by optimizing crop yields in diverse agro ecosystems.

Keywords: *Dioscorea alata*, Physicochemical, *Musa parasidiaca* Characterization and *Xanthosoma sagittifolium*

INTRODUCTION

In recent years, the issue of environmental protection has become one of the most important priorities of international politics. The problem of progressive degradation of the

environment is primarily caused by large amounts of industrial waste. This particularly concerns waste products of the food industry, as they contain significant amounts of organic substances. About 0.16 tones of solid waste is obtained per ton of processed potato (Pathak et

al., 2018). Such waste includes potato wastewater, pulp and peel formed during the industrial processing of potatoes for food purposes. This waste, under conditions of improper management, may pose a threat to the environment, e.g. risk of microbial contamination or soil damage (Kozich *et al.*, 2013). The peels are mostly regarded as waste and often discarded indiscriminately in landfills, drainages and road sides; consequently posing a threat to the environment (Auta and Kumurya, 2015; Baiyeri *et al.*, 2011). Reports have shown the peels as being good potential substitute for corn starch in the diet of snails and also incorporated with other waste materials in the diet of pigs (Okareh *et al.*, 2015; Omale and Okafor, 2008). Meanwhile, in the chemical industry, peels have shown potential for the generation of important chemicals like ethanol and also alkali for the manufacturing of soap. As a way of ensuring a safer environment, attempts have been made to use polyphenolic resol resins from the ethanol extract of plantain peels for the adsorption of heavy metals since the peels show high retention affinity for lead, nickel and chromium (Andres *et al.*, 2015). In the food industry, flour made from the peels has been reportedly used to enrich wheat flour at various percentages in producing snacks like cookies and sausages; serving as a good source of fibre, antioxidants and potentially benefiting humans in the management and prevention of life style related diseases (Gilver and Liliana, 2017; Arun *et al.*, 2015). Several studies have reported the antifungal and antibacterial activities of different parts including the peel of plantain plant for the treatment of a large number of human ailments (Auta and Kumurya, 2015). The ethanol extracts of the peels were used against eight human pathogenic microbes; five bacteria and three fungi and they proved effective against these human pathogens which have been implicated in several human diseases (Ighodaro, 2012). Agricultural-based industries produced the vast amount of residues every year. If these residues are released to the environment without proper disposal procedure, this may cause

environmental pollution and harmful effect on human and animal health. Most of the agro-industrial wastes are untreated and underutilized. These untreated wastes create different problems with climate change by increasing the number of greenhouse gases. (GHG) (Bos and Hamelinck, 2014). So, now it is a worldwide concern to dictating the improvement of alternative cleaner and renewable bioenergy resources (Okonko *et al.*, 2009). These wastes cause a serious disposal problem (Rodríguez-Couto 2008). For examples, the juice industries produced a huge amount of waste as peels, the coffee industry produced coffee pulp as a waste, and cereal industries produced husks. All over the world approximately 147.2 million metric tons of fiber sources are found, whereas 709.2 and 673.3 million metric tons of wheat straw residues and rice straws were estimated, respectively, in the 1990s (Belewu and Babalola 2009). The composition of these agro-industrial residues are of great concern, they have high nutritional prospect, therefore they are getting more consideration for quality control and also categorized as agro-industrial by-products (Graminha *et al.* 2008). The aim of this study is to determine the physicochemical characterization of individual and combined samples of *dioscorea alata*, *musa parasidiaca* and *xanthosoma sagittifolium* peels. Thus, the peel extracts have been suggested for use in pharmaceutical and medical formulations. Some of the main pharmacological effects of the plantain plant including the peels are; antiulcer, analgesic, wound-healing, hair growth promoter, haemostatic activity among others (Alexandre *et al.*, 2019; Aruwa *et al.*, 2019; Barroso *et al.*, 2019; Mohamad Sukri *et al.*, 2019).

MATERIALS AND METHODS

Tubers of yam, plantain and cocoyam (*Dioscorea alata*, *Musa parasidiaca* and *Xanthosoma sagittifolium*) used in this study were obtained from Obibi in Etche Local Government Area of Rivers State, Nigeria. Peels from the yam tubers were obtained by using a kitchen knife to carefully remove them.

The peels were then immediately oven dried at 45°C for 24 hours. The dried peeled were then ground through a 40-mesh screen using a Wiley mill (MODEL) and stored in a desiccators until when they were analyzed.

Determination of Physico-chemical parameters of samples

pH and Temperature

Measurement of pH by Electrometric Method Using Electronic pH Meter (ASTM D1293-84) is done to determine the acidity or alkalinity of the sample.

Procedure:

The pH level of the samples was determined with the use of a portable pH meter (model DSPH-1BUS). The meter was calibrated prior to use with buffer solutions of pH 7.0, 4.0 and 10.0 of known calibration standard, after which the electrodes were thoroughly dipped in distilled water.

10g of each of the sample was weighed into a 250 ml beaker, 25 ml of distilled water was added and allowed to stand for 30 minutes and stirred occasionally with a glass rod. The instrument was powered on and the reading allowed stabilizing. Upon meter stabilization, the reading on the meter was read and recorded as the pH of the samples. The probe was rinsed in distilled water, and the display mode adjusted after each measurement.

The electronic meter is capable of reading temperature and it was immediately switched to the temperature mode after each pH

measurement. The stable reading on the screen was recorded as the temperature of the samples.

Electrical Conductivity

Measurement of EC by Electrometric Method Using Electronic EC Meter (APHA-2540-C, 1998)

Procedure:

10g of each of the sample was weighed into a 250 ml beaker, 25 ml of distilled water was measured with the use of a Conductivity meter (MODEL). The meter was calibrated prior to use with distilled water and a set of calibration standards according to manufacturer's specifications. The sample beaker was rinsed thoroughly with distilled water followed by small volume of the test sample. Some quantity of the sample was then poured into the beaker and the probe of the meter was dipped into the sample. EC reading on the screen of the meter was allowed to stabilize and values were recorded in micro Siemens per centimeters ($\mu\text{S}/\text{cm}$).

Determination of Sulphate

Reagent: KH_2PO_4 containing 500ppm P (extracting solution)

10g of each of the sample was weighed out after using a 2mm sieve and passed it through into a flask and 25ml of extracting solution was added. The mixture was agitated for 30 minutes on a mechanical shaker and centrifuged. The SO_4 content was determined by turbidity.

RESULTS AND DISCUSSION

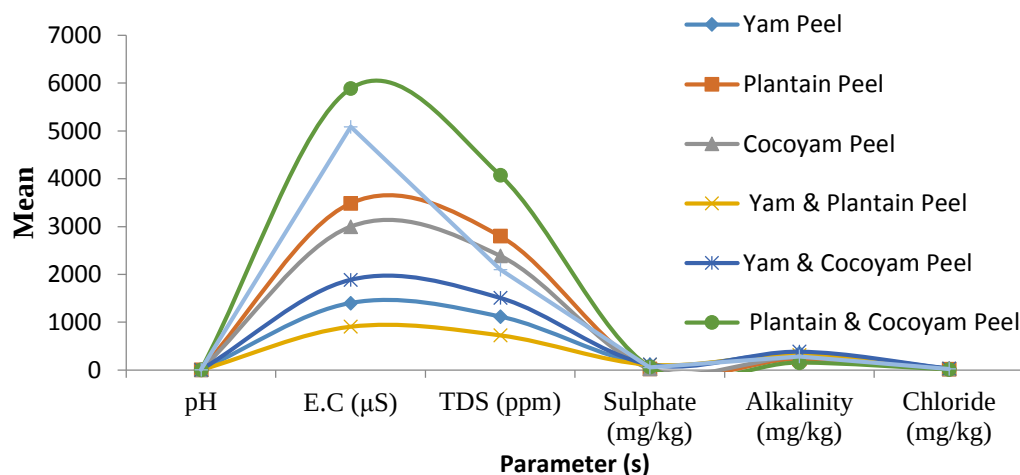


Figure 1: Scatter Plot for the Physicochemical Characterization of the Samples

DISCUSSION

The findings provide an in-depth physicochemical examination of a variety of parameters obtained from single and combined yam, cocoyam and plantain peels of plant waste samples. This research highlights the possible influence that these waste products might have on the characteristics of the soil. The pH readings indicate that the circumstances might be anything from slightly acidic to slightly alkaline. In particular, the values of Electrical Conductivity (EC) and Total Dissolved Solids (TDS) in Plantain Peel and Cocoyam Peel provide an indication of the concentration of dissolved salts, which in turn influences the salinity of the soil environment. The amounts of sulphate, alkalinity, and chloride vary from one sample to the next, which is a reflection of the variety of nutrients present. These results are also obvious as shown in figure 1, which demonstrates that the F-Statistics with p-values below 0.05 reveal substantial differences among the plant waste samples. This provides evidence for the viability of these materials as soil supplements for sustainable farming operations, and these findings are similar to those reported by Okunlola *et al.* (2023). When taken as a whole, the findings highlight the fact that various forms of plant waste have a wide variety of nutritional compositions. The results highlight the potential for these waste items to function as soil supplements, which may influence the

pH, salinity, and nutrient content of the soil on a variety of levels. This concept that certain plant waste products might be strategically exploited to improve soil qualities and contribute to sustainable farming practices is supported by the importance of the F-Statistics, which underlines the validity of these distinctions and provides support for the theory.

CONCLUSION

In conclusion, the findings show that various treatments significantly affect the yam, plantain, and cocoyam development factors. Highlighting the potential advantages of diversified and integrated agricultural approaches for maximizing crop yields, certain combinations of plant species have a favorable effect on plant development. On the other hand, Yam, Cocoyam and plantain Peel When taken as a whole, highlight the fact that various forms of plant waste have a wide variety of nutritional compositions with the potential for these waste items to function as soil supplements, which may influence the pH, salinity, and nutrient content of the soil on a variety of levels.

REFERENCES

- Alexandre, E.M.C., Silva, S., Santos, S.A.O., Silvestre, A.J.D., Duarte, M.F., Saraiva, J.A., Pintado, M., (2019). Antimicrobial Activity of Pomegranate P.Eel Extracts Performed by High Pressure And

- Enzymatic Assisted Extraction. *Food Research International* 115, 167-176.
- Andres, F.C., Milton, G., & Jose, H.C. (2015). Polyphenolic resin synthesis: optimizing plantain peel biomass as heavy metal adsorbent. *Polimeros* 25(4), 351-355.
- Arun, K. B., Persia, F., Aswathy, P. S., Chandran, J., Sajeev, M. S., Jayamurthy, P., & Nisha, P. (2015). Plantain peel-a potential source of antioxidant dietary fibre for developing functional cookies. *Journal of Food Science and Technology*, 52(10), 6355-6364.
- Aruwa, C. E., Amoo, S., & Kudanga, T. (2019). Phenolic compound profile and biological activities of Southern African *Opuntia ficus-indica* fruit pulp and peels. *Lwt*, 111, 337-344.
- Auta, S. A., & Kumurya, A. S. (2015). Comparative proximate, mineral elements and antinutrients composition between *Musa sapientum* (Banana) and *Musa paradisiaca* (Plantain) pulp flour. *Sky Journal of Biochemistry Research*, 4(4), 025-030.
- Baiyeri, K. P., Aba, S. C., Otitoju, G. T., & Mbah, O. B. (2011). The effects of ripening and cooking method on mineral and proximate composition of plantain (*Musa* sp. AAB cv. 'Agbagba') fruit pulp. *African Journal of Biotechnology*, 10(36), 6979-6984.
- Barroso, W. A., Abreu, I. C., Ribeiro, L. S., da Rocha, C. Q., de Souza, H. P., & de Lima, T. M. (2019). Chemical composition and cytotoxic screening of *Musa cavendish* green peels extract: Antiproliferative activity by activation of different cellular death types. *Toxicology in Vitro*, 59, 179-186.
- Belewu, M.A., & Babalola, F. (2009). Nutrient enrichment of some waste agricultural residues after solid state fermentation using *Rhizopus oligosporus*. *Journal of Applied Biosciences*, 13, 695-699.
- Bos, A., & Hamelinck, C. (2014). Greenhouse gas impact of marginal fossil fuel use. *Project number: BIENL14773*, 158.
- Gilver, R., & Liliana, S. (2017). Effect of plantain (*Musa paradisiaca* L. cv. Dominito Harton) peel flour as binder in frank further-type susage. *Acta Agronomy*, 66(3), 305-310.
- Graminha, É.B., Gonçalves, A.Z., Pirota, R.D., Balsalobre, M., Silva, R.J., & Gomes, E. (2008). Enzyme production by solid-state fermentation: Application to animal nutrition. *Animal Feed Science and Technology*, 144, 1-22.
- Ighodaro, O. M. (2012). Evaluation study on Nigerian species of *Musa paradisiaca* peels: Phytochemical screening, proximate analysis, mineral composition and antimicrobial activity. *Researcher*, 4(8), 17-20.
- Kozich, J. J., Westcott, S. L., Baxter, N. T., Highlander, S. K., & Schloss, P. D. (2013). Development of a dual-index sequencing strategy and curation pipeline for analyzing amplicon sequence data on the MiSeq Illumina sequencing platform. *Applied and environmental microbiology*, 79(17), 5112-5120.
- Mohamad Sukri, S.N.A., Shameli, K., Mei-Theng Wong, M., Teow, S.-Y., Chew, J., Ismail, N.A., (2019). Cytotoxicity and antibacterial activities of plant-mediated synthesized zinc oxide (ZnO) nanoparticles using *Punica granatum* (pomegranate) fruit peels extract. *Journal of Molecular Structure* 1189, 57-65.
- Okareh, O. T., Adeolu, A. T., & Adepoju, O. T. (2015). Proximate and mineral composition of plantain (*Musa Paradisiaca*) wastes flour; a potential nutrients source in the formulation of animal feeds. *African Journal of Food Science and Technology*, 6(2), 53-57.
- Okonko, I.O., Ogunnusi, T.A., Aloysius, F., Adejoye, O.D., & Adewale, O. (2009). Utilization of food wastes for sustainable development. *Electronic journal of environmental, agricultural and food chemistry*, 8(4), 263-286.
- Okunlola, F. O., Aboyeji, C. M., Adekiya, A. O., Ejue, W. S., Aremu, C., Erere, A., & Owojuona, O. M. (2023). Potentials of plantain peel and *Tithonia diversifolia* leaves as soil amendments in enhancing performance and nutritional contents of

- tomato (Solanum lycopersicum). *Heliyon*, 9(4).
- Omale, J., Okafor, P.N., (2008). Comparative antioxidant capacity, membrane stabilization, polyphenol composition and cryotoxicity of the leaf and stem of *Cissus multistriata*. *African Journal of Biotechnology* 7(17), 3129-3133.
- Pathak, P. D., Mandavgane, S. A., Puranik, N. M., Jambhulkar, S. J., & Kulkarni, B. D. (2018). Valorization of potato peel: a biorefinery approach. *Critical Reviews in Biotechnology*, 38(2), 218-230.
- Rodríguez-Couto, S. (2008). Exploitation of biological wastes for the production of value-added products under solid-state fermentation conditions. *Biotechnology Journal*, 3, 859–870.