Assesment of Cassava effluent contaminated soil in Ohimini L.G.A, Benue State,Nigeria.

Onyeke Ochu[1*] and Amali Okwori [2]

[1]*Mathematics Programme (Applied), National Mathematical Centre, P.M.B 118, Abuja,Nigeria.*
[2]*Department of Biological Sciences, Federal University of Agriculture, Makurdi, Benue State, Nigeria*

ABSTRACT

OHIMINI LOCAL GOVERNMENT AREA IS FAMOUS FOR ITS CASSAVA PROCESSING COTTAGE INDUSTRIES IN BENUE STATE. THE PROCESSING OF CASSAVA TUBERS INTO GARRI INCURS LARGE VOLUMES OF WASTE FLUID (EFFLUENTS) THAT CONTAMINATES THE SOIL AROUND SUCH AREAS. THEREFORE THE STUDY IS AIMED AT ASSESSING THE IMPACT OF CASSAVA WASTEWATER ON SOIL QUALITY AT SELECTED GARRI PROCESSING AREAS OF BENUE STATE. THE STUDY WAS CARRIED OUT AT FIVE WARDS WITHIN OHMINI LOCAL GOVERNMENT AREA DURING THE DRY SEASON IN JUNE, 2017. EXCHANGEABLE BASES, PH, % ORGANIC CARBON, % ORGANIC MATTER AND CYANIDE LEVELS OF SOILS RECEIVING THE WASTEWATER (IMPACTED) AS WELL AS SOILS NOT RECEIVING WASTEWATER (CONTROL) WERE ANALYSED ACCORDING TO STANDARD METHODS AND VARIATIONS WERE OBSERVED. IMPACTED SOIL HAD A FOUL SMELL AND STRONGLY ALKALINE (8.59) WITH A PH VALUE RANGED AT (7.35-9.25), CYANIDE LEVELS RANGED AT (1.22-4.16), % ORGANIC CARBON AND %ORGANIC MATTER RANGED AT 0.60-2.07 AND 1.69-6.50 RESPECTIVELY. ALL PARAMETERS ANALYSED HAD HIGHER VALUES AT IMPACTED SOIL THAN THE CONTROL SAMPLES EXCEPT POTASSIUM(K). CASSAVA WASTEWATER ALTERS SOIL PROPERTIES, THEREFORE WITH THE LARGE NUMBER OF INDIVIDUALS CARRYING OUT THIS ACTIVITY THUS , IT IS NECESSARY TO ANALYSE SOIL PROPERTIES IN SUCH AREAS IN ORDER TO CURB OR HALT FURTHER ALTERATIONS OF THE SOIL IN THE AREA.

Keywords: [Cassava wastewater, soil quality, effluent}

*Corresponding Author
E-mail address:ochuonyeke@gmail.com

1. INTRODUCTION

The high starch content present in cassava roots makes it a rich source of dietary energy as well as the cheapest source of calories available in many sub-Saharan African countries [1]. [2] reports that cassava is the third major source of carbohydrate in the world having varieties of use based on different communities that consume it, serving as food security for millions of individuals in the developing world.

Nigeria is currently the world's largest producer of cassava (52,403 million tons) with Brazil (25,411 million tons) and Indonesia (24,010 million tons) in tow [3]. Consequently, amongst the thirty-six (36) states in Nigeria, Benue State which is acroymned the "food basket of the nation", is one of the Major cultivators of cassava. In developing countries such as Nigeria, about 70% of harvested cassava roots are processed into garri, a toasted granule. The production of garri is mostly done by small-scale processors that use simple implements for cassava processing. Cassava processing as an industry caters for 30% of nation's informal sector in terms of employment and revenue [4]. Most individuals in the rural areas use part of their residence or a designated area for the cassava processing and are most times self-employed .Therefore, they produce and move their produce to the available market for sale. Consequently, the traditional method of processing cassava into garri produces a lot of waste [5]. A lot of areas in Benue state still carry out the traditional method of processing garri which incurs a lot of waste. Also, the study by [6] concluded that cassava effluent alters the physicochemical characteristics of soils. Consequently, the current backing of the Nigerian government in the area of cultivation of cassava for industrial, export and domestic purposes has given rise to a complementary increase in production and processing that has also increased the amount of cassava effluent and its discharge to the environment [4]. Also, the establishment of cassava processing centres is an on-going process of the government in Nigeria [7].Such centres have been cited in Okpokwu local government area of Benue State. [8] state that currently, there is neither a specific method of disposal nor treatment of the cyanide-laden effluent emanating from cassava processing in Nigeria or any government policy guidelines. Consequently, there is a need to assess the impact the cassava wastewater on soil quality of soil receiving such wastewater. A report by [9] states that the cyanide contents of the cassava contaminates the soil mainly during processing Cassava processing effluent has a high polluting strength if allowed to move freely within the soil which tends to pollute the soil and subsequently, contaminate groundwater [4]. Investigations made by researchers on the effect of cassava effluent on the environment found out that the effluent had negative effects on plants, air, domestic animals, soil and

water. However, the treatment and disposal of cassava effluent from industrial or smallholder sources still continues[5].

In Benue state, a lot of communities are known for the production of high quality garri (a Cassava product). Waste incurred from the garri processing centres in the communities are discharged into the environment with little or no treatment and allowed to rot. Consequently, due to the large number of cassava processing activity in such an area, it becomes imperative to assess the environmental conditions of the soil receiving such waste in order to ascertain the level of contamination present in the soil. Therefore this study is aimed at assessing the levels contamination in soils imparted with cassava effluent at selected garri processing areas in Ohimini.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY.

2.1 Study area.

Ohimini local government area which is the study area, is located in Benue State, Nigeria. Benue State is located between latitude 7°43′50″N and longitude 8°32′10″E with temperature ranging between 21°C to 35°C. Its vegetation cover consists of the Southern guinea savannah, with rainfall averages of 1,200 - 1,500mm, high relative humidity and very fertile soil. These elements contribute immensely as to why the state is termed the Food Basket of the Nation. The common occupation of the people here is agriculture with major crops such as yam, Soy beans (accounts for 70% of the nation's soy bean production), sesame, cassava, oil palm, mangoes, oranges, plantain and sweet potatoes [10].

2.1.1 Sampling sites

Ten (10) sampling sites were chosen from the study area. The sites were randomly selected from the wards in each local government area. The selected wards are as follows; Oglewu, Ehatokpe, Onyangede-Ehaje, Onyangede-Icho and Awume in Ohimini.

Table 1: Global Positioning System (GPS) coordinates of all locations sampled

Study area	Locations		Latitude	Longitude	Altitude
Ohimini	Oglewu	A	N7°15′4.206″	E8°4′25.086″	194.5m
	Onyangede-Ehaje	B	N7°21′21.048″	E7°53′34.062″	229.2m
	Onyangede-Icho	C	N7°21′33.144″	E7°48′25.806″	244.5m
	Awume	D	N7°17′18.096″	E7°49′25.044″	183.7m
	Ehatokpe	E	N7°20′49.77″	E7°57′18.024″	226.9m

Source: Author using GPS coordinates version 1.0.1

2.1.1.1 Soil sampling

The soil around the cassava processing areas and non-processing areas (Control) was collected aseptically into black polythene bags. All soil samples will be kept in well-labelled sampling bags and transported to the laboratory for analysis. The method adopted for the sample collection was stratified random sampling technique with layers designated L_1 (0-15cm) and L_2 (15-30cm). A quadrant of 10m x 10m was measured around each location and 7-10 sub-samples were randomly collected using a sterilized soil auger and pooled to give a

composite sample. To avoid contamination, the soil auger was rinsed with distilled water after each sampling. The age of each location was not less than 5-10 years and carryout the hydraulic press/ Wood press of the cassava tubers every other day within the week.

3. RESULTS AND DISCUSSION

3.1 Physicochemical parameters and Exchangeable bases.

Table 2: Mean Concentrations of Physiochemical parameters and exchangeable bases at the different locations sampled

	Oglewu		Onyangede-Ehaje		Onyangede-Icho		Awume		Ehatokpe	
Parameters	**Control**	**Impacted**	**Control**	**Impacted**	**Control**	**Impacted**	**Control**	**Impacted**	**Control**	**Impacted**
Ph	**6.30**	**8.95**	**6.30**	**9.25**	**6.88**	**7.35**	**6.25**	**8.35**	**5.70**	**9.05**
Ca	**0.00**	**0**	**0.00**	**81.01**	**0.00**	**4.21**	**0.00**	**31.84**	**0.00**	**1.51**
Mg	**7.33**	**11.84**	**2.67**	**25.96**	**0.14**	**20.46**	**4.12**	**20.18**	**0.00**	**22.92**
K	**49.69**	**27.43**	**20.55**	**14.53**	**4.58**	**14.01**	**22.57**	**20.36**	**20.70**	**39.37**
Na	**17.38**	**9.86**	**34.35**	**51.62**	**2.96**	**49.53**	**23.11**	**25.07**	**31.22**	**25.85**
%OC	**1.57**	**2.07**	**0.87**	**1.84**	**0.60**	**0.97**	**1.15**	**1.32**	**0.74**	**1.36**
%OM	**3.69**	**6.50**	**3.67**	**3.12**	**2.11**	**2.78**	**2.05**	**4.44**	**1.69**	**3.90**
Cyanide	**0.43**	**1.22**	**0.96**	**1.70**	**0.54**	**4.16**	**0.28**	**1.31**	**0.23**	**2.00**

Figure 1 shows the mean concentration of pH values for the two depths (L_1 (0-15) cm and L_2 (15-30)) at the five locations in Ohimini. The control soil samples shows ph value range as 5.70 – 6.88 while imparted soil samples range was 7.35 – 9.25. According to The United States Department of Agriculture Natural Resources Conservation Services classification of soil pH , this indicated that Soils in Ohimini are moderately acidic to neutral while the imparted soils were neutral to very strong alkaline. Figure 1 also shows the overall mean of the ph value of Ohimini as slightly acidic (6.29) while the imparted soil as strongly alkaline (8.59). This shows that cassava wastewater alters the soil pH of the area. However, only soil samples from onyangede-Icho (C) and Awume (D) fell within permissible limits of pH of 7-8.5. Studies done by [8] also had one of its location as moderately alkaline(8.1) while the others were strongly acidic to slightly acidic(5.5-6.2) The cassava crops possess high tolerance to acidic soils [1]. This explains the reason crops grow well in the study areas however, the wastewater from conversion of these tubes into garri increases the soil pH of the soil where it freely flows.

Figure 2 shows the mean concentration of organic carbon and organic matter at sample location. Organic carbon and Organic matter were higher in impacted soil samples when compared with the control soil samples. However in location B (Onyangede-Ehaje) organic matter was higher in the control soil samples. %Organic carbon for imparted soils (0.97-2.07) as well as %Organic matter (2.78-6.50) exceeded standard values of parameters of soil (0.5-0.75 for % Organic carbon and 0.8-1.29 for %Organic matter) [12] . A better soil structure is shown by a high level of organic matter.

Figure 3 shows the mean concentration of all parameters at the five locations. The Impacted soils had higher values as compared with the control samples except in potassium.

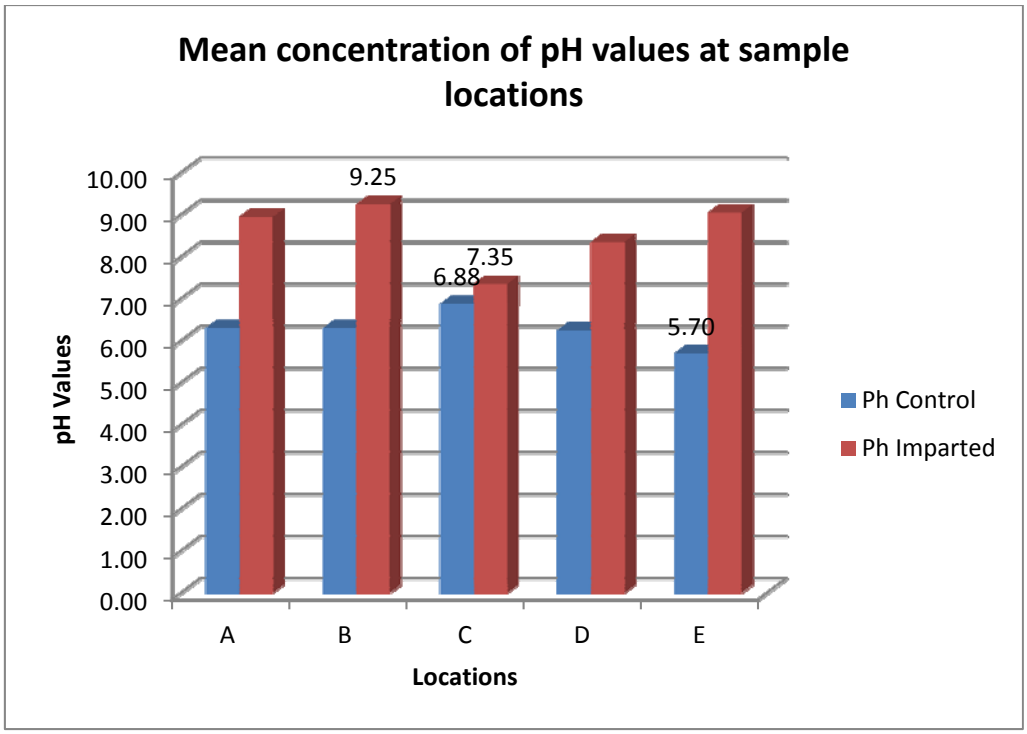

FIGURE 1: SHOWING THE MEAN CONCENTRATION OF PH VALUES AT SAMPLE LOCATIONS

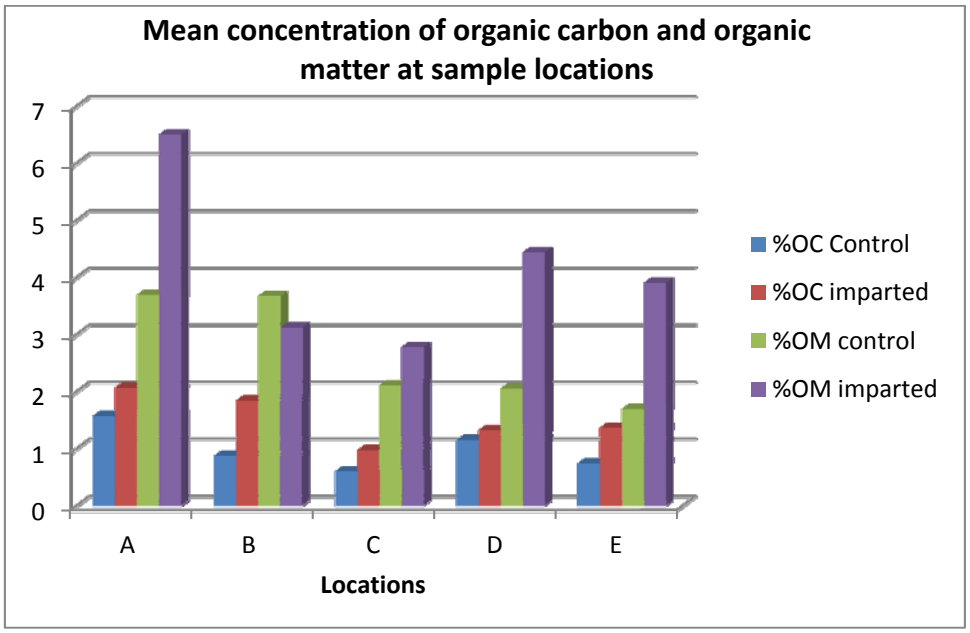

FIGURE 2: SHOWING THE MEAN CONCENTRATION OF %ORGANIC CARBON AND %ORGANIC MATTER AT SAMPLE LOCATIONS

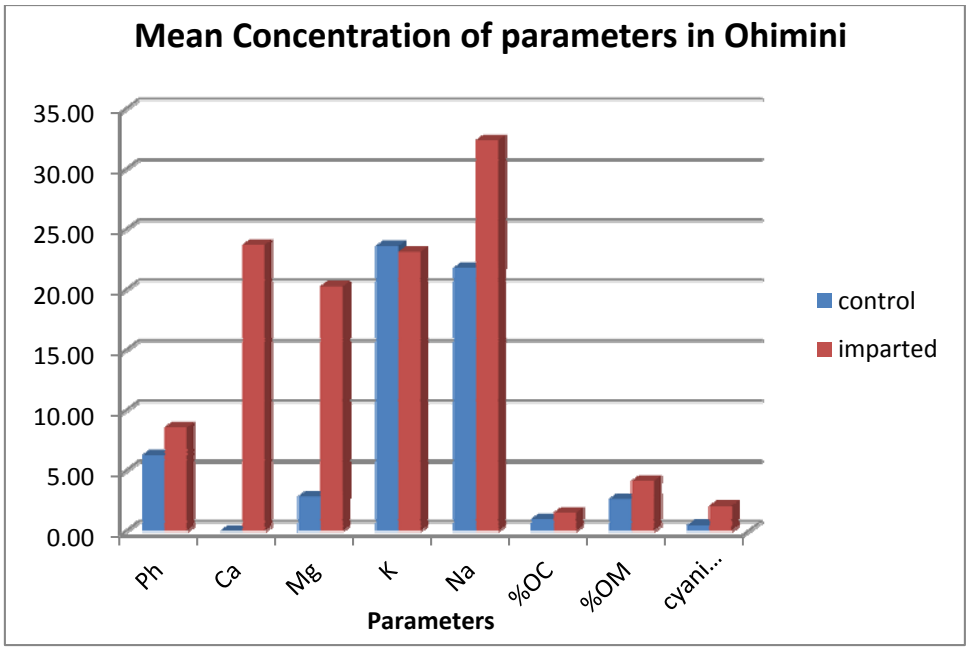

FIGURE 3: SHOWING THE MEAN CONCENTRATION OF ALL PARAMETERS IN OHIMINI.

4. CONCLUSION

Imparted soils contain elevated levels of all the physiochemical parameters as well as the exchangeable bases which indicate that cassava effluent alters receiving soils properties. Calcium is absent in all the control samples but is present in all the imparted soils except in Oglewu. There are considerable increases in the level of magnesium and cyanide in the imparted soil. Also there is a decrease in potassium level in all the imparted soils as compared with the control samples except in Onyangede-Icho and Ehatokpe. Calcium, Magnesium and Potassium are macro nutrients needed by plants to grow healthy. Thus, there is a need to educate as well as implement various wastewater treatment methods before their discharge into the environment to prevent soil and groundwater contamination as well as preservation of plant life.

COMPETING INTERESTS

Authors have declared that no competing interest exists

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration with the Authors. 'Author O.O and A.O designed the study, Author O.O carried out the field analysis and wrote the draft of the manuscript.

REFERENCES

1. Food and Agriculture Organisation of the United Nation (FAO), (2013) Save and Grow: Cassava, A guide to sustainable production intensification. Rome , 2013.

2. Obueh, H.O and Odesiri-Eruteyan, E. (2016). A Study on the Effects of Cassava Processing Wastes on the Soil Environment of a Local Cassava Mill. Journal of Pollution Effects and Control 4: 177. doi: 10.4176/2375-4397.1000177.
3. Mara Suyane Marques Dantas, Mário Monteiro Rolim, Anamaria de Sousa Duarte, Ênio Farias de França de Silva, Elvira Maria Regis Pedrosa, and Daniel da Costa Dantas (2014). "Chemical Attributes of Soil Fertilized with Cassava Mill Wastewater and Cultivated with Sunflower," The Scientific World Journal, vol. 2014, Article ID 279312, 10 pages. https://doi.org/10.1155/2014/279312.
4. Omotosho, Olayinka & Amori, Anthony. (2015). Caustic Hydrogen Peroxide Treatment of Effluent from Cassava Processing Industry: Prospects and Limitations. International Journal of Engineering and Technology Innovation. 5. 75-85.
5. Oladele, P.K. (2014). Cassava Processing and the Environmental Effect. The 4th World sustainability Forum 2014. Conference Proceedings Paper. http://www.sciforum.net/conference/wsf-4
6. Izonfuo,W-Al; Bariweni; Pa,George;DMC. (2013). Soil Contamination from Cassava Wastewater Discharges in a Rural Community in the Niger Delta, Nigeria. J. Appl. Sci. Environ. Manage. Vol. 17 (1) 105 - 110
7. Akpan, J.F.,Eyong,M.O and Isong, I.A. (2017) The Impact of Long-term Cassava Mill Effluent Discharge on Soil pH and Microbial Characteristics in Cross River State. Asian Journal of Soil Science and Plant Nutrition 2(1): 1-9, 2017; Article no. AJSSPN.36917.
8. Okunade,D.A. and Adekalu,K.O.(2013). Physico-Chemical Analysis of contaminated Water Resoures Due to Cassava Wastewater Effluent Disposal. European International Journal of Science and Technology. Volume 2,No.6.

9. Adewumi, J. R., Babatola, J. O and Olayanju, O. K. (2016). The Impact of Cassava Wastewater from Starch Processing Industry on Surrounding Soil: A Case Study of Matna Foods Industry, Ogbese. FUOYE Journal of Engineering and Technology, Volume 1, Issue 1, September 2016.
10. Nnamonu, L.A and Eli, A.E (2013). Perception of Agrochemical Use and Organic Farming in Makurdi, Benue State. International Journal of Environmental Protection. Vol 3, Issue 8, pp. 48-52

11. Harish, E.R. and David,M. (2015) Assessment of Potentially Toxic Cyanide from the Gold and Copper Mine Ore Tailings of Karnataka, India. The International Journal Of Science & Technoledge (ISSN 2321 –919X). retrieved from https://www.researchgate.net/publication/280919638_Assessment_of_Potentially_Toxic_Cyanide_from_the_Gold_and_Copper_Mine_Ore_Tailings_of_Karnataka_India 31/08/2018.

12. Neetika Mathur and Ashwani Kumar (2013). Physico-Chemical Characterization of Industrial Effluents Contaminated Soil of Sanganer. Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 4(2): 226-228