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Effects of Cassava Processing Mill Effluents on the Surrounding Soil Using Heavy Metals, Conductivity and Ph

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ABSTRACT

Ten soil samples were collected at cassava processing sites at Erho – Abraka in Ethiope East Local Government Area of Delta State, Nigeria (three samples were from three locations and one from a farm land that served as a control) and were analysed for the presence of heavy metals, conductivity and pH. Results of analyses showed the presence of heavy metals to range as follows: Fe (72.21 – 133.01mg/kg), Cu (0.479 – 0.24mg/kg), Mn (2.06 – 3.11mg/kg), Cr (0.001 – 0.003mg/kg), Zn (1.071 – 1.730mg/kg) and Cd recorded 0.001mg/kg for all locations. The pH was found in the range of 4.00 – 4.84 while the conductivity range from 198.4 – 260.7**μS/cm.** The results were found to be higher than the control samples which suggested pollution which was attributed to the nature of activities in the study sites. The cassava mill effluents decrease soil pH while it led to higher level of electrical conductivity. The result of heavy metals analysis showed elevated level of heavy metals in the soils. The pH and EC of the soil revealed that cassava mill effluent had detectable changes on the availability of the metals tested for.The millings stage is a major stage in processing cassava tuber ready for consumption. As a result, use of cassava millings machine cannot be avoided

KEY WORDS: Cassava, heavy metals, pollution, contamination and control

INTRODUCTION

Increasing damages to natural soil has been found to have resulted from various anthropogenic activities and this has heightened great concern for environmentalists. The risks caused to human lives and aquatic organisms constituted by agriculture and wastes discharge cannot be overemphasized (Etinosa and Ozede, 2015). Farming activities are most times responsible for the release of contaminants into the soil. The earth had therefore become loaded with diverse pollutants that are released as agricultural by-products. The world environment is changing drastically as a result of unfavourable alteration of nature due to human activities which affect the ecosystem directly or indirectly (Abegunde*et al.*, 2017). Agricultural pollution has become a major environmental problem in Africa and it must be halted without delay before leading to disastrous irreversible environmental health problem. The waste generated cannot be put away totally but an improved processing method, the reuse of the by-product and improved waste disposal system will be of great economy value and as well as creating a safe environment

Cassava, a tuberous, woody perennial plants of spongy family has become a staple food in most developing countries of the sub Saharan Africa as well as most Asia countries (Ezeand Azubuike, 2010)

Cassava is the third major source of carbohydrate in the wood with diverse uses depending on the community serving as food security for the many millions of people in developing world (Akorado, 1995)

Cassava processing in Nigeria's Niger Delta is done majorly by local farmers who do not have the technology to adequately manage the cassava effluents wastewater as a result the waste water generated is discharged freely into open channels, gutters, streams, pond and waterways. This indiscriminate discharge of cassava wastewater impacts negatively on the environment as its organic content may contaminate groundwater supply and cause eutrophication of surface water (Omotioma*et. al.*, 2013)

Many if not all the weal cassava processing outlets in villages of the Niger Delta Area do not consider cassava effluent disposal a problem, since the impact of such waste on the environment is not immediately discoverable. This gap in knowledge according to FAO (2000) is as a result of lack of proper understanding of the relationship between cost effective ways of treating cassava waste water as well as value added advantage of treating cassava waste products.

Despite the ignorance about cassava wastewater treatment by local farmers various research works have been directed towards cassava effluent treatment systems capable of treating waste and converting some of the waste products to useful products (Omotioma*et. al*, 2012).

METHOD

Sample collection and preparation

Soil samples were collected at cassava processing sites at Erho – Abraka in Ethiope East Local Government Area of Delta State, Nigeria. The soil samples were air driedfor a period of one week in a clean well ventilated laboratory, homogenized by grinding, passed through 2mm (10 mesh) stainless sieve and were stored in a labeled plastic can until chemical analysis.

Sample digestion

1.0$\pm$0.05g dried and ground soil samples were placed inside a crucible and ignited in a muffle furnace at 500^0C for three hour. The ignited mass was cooled inside desiccators and transferred into a 100ml borosil beaker and 10ml concentrated HCl was added and the suspension was kept inside a thermostatic controlled water bath and the supernatant was decanted and kept inside a 100ml volumetric flask. These contain mostly alkaline earth metals. To the residue in the beaker, 10ml each of HCl (concentrated) and $HClO_4$ (concentrated), 70% pure and few porous bead were added, and was evaporated to dryness over a hot plate. The process was repeated where necessary. The dried residue was dissolved completely, by using minimum amount of concentrate HCl. This solution was then transferred to the same volumetric flask where precious extract containing alkaline earth metal extract was stored. The flasks were then made to the mark by using distilled water and stored inside a refrigerator. These extract were then kept for trace metals analysis

Heavy metals analysis

Atomic absorption spectrophotometer (Buck scientific model-210) using element specific hollow cathode lamps in default condition by flame absorption mode was used to approximate the metal concentration within the sample.

Determination of pH and conductivity

The soils pH was measured in a soil water ratio of 1:2 (that is, 10g of soil in 20ml distilled water). The mixture was stirred by using magnetic stirrer for a period of 30 minute. The mixture was then tested for pH by using pH meter (Model- PHS-25)
The electrical conductivity (EC) was determined by using conductivity meter according to Chopra and Kanzar (1988)

RESULTS

TABLE 1: pH and conductivity of soil from cassava processing mills

SAMPLE	pH	CONDUCTIVITY (µS/cm)
ERHO A1	4.00	198.4
ERHO A2	4.07	240.6
ERHO A3	4.66	241.1
ERHO B1	4.17	200.4
ERHO B2	4.32	227.3
ERHO B3	4.78	246.6
ERHO C1	4.61	201.7
ERHO C2	4.63	241.3
ERHO C3	4.84	260.7
CONTROL	6.88	76.6

Table 2: Distribution of heavy metals (mg/kg) in soil around cassava processing sites

LOCATIONS	Fe	Cd	Cu	Mn	Cr	Zn
ERHO A1	127.11	0.001	0.611	2.70	0.002	1.730
ERHO A2	110.07	0.001	0.604	2.07	0.001	1.642
ERHO A3	101.16	0.001	0.591	2.06	0.001	1.611
ERHO B1	133.01	0.001	0.717	2.51	0.003	1.698
ERHO B2	116.16	0.001	0.624	2.27	0.003	1.560
ERHO B3	98.61	0.001	0.521	2.18	0.003	1.540
ERHO C1	87.11	0.001	0.521	3.10	0.001	1.155
ERHO C2	80.17	0.001	0.520	2.71	0.001	1.113
ERHO C3	72.21	0.001	0.479	2.66	0.001	1.071
CONTROL	61.10	0.001	0.211	0.72	<0.001	0.112

Table 3: Mean heavy metals (mg/kg) in soil around cassava processing sites

SAMPLE	Fe	Cd	Cu	Mn	Cr	Zn
A	112.78	0.001	0.62	2.28	0.001	1.661
B	115.93	0.001	0.652	2.32	0.003	1.600
C	79.83	0.001	0.507	2.82	0.001	1.113
CONTROL	61.10	0.001	0.211	0.72	<0.001	0.112

DISCUSSION

Table 1 above shared the results of the pH and electrical conducting (EC) of soils from the various study locations. The pH of the soils range from 4.00 - 4.84 indicating that the soils are acidic which suggest that the effluent from the cassava in the various mills imparted acid properties to the soil. This could be attributed to the presence of hydrogen cyanide in the cassava mill effluents. The acidity was found to decrease farther from the point source that is, 20m and 40m away. It should be noted that soil pH determines the availability of nutrients and the potency of toxic substance as well as the physical properties of soil. In this study, the pH value showed high tendency for high availability of metal which could increase the risk of heavy metals uptake in plants grown on the soil. The increase in acidic value of the soil suggested pollution by the effluents at the various mills as there was significant difference between the means and the control which showed that the discharged of the effluent on the soil would have many negative effects on plants grown on it

The electrical conductivity (EC) of the soil range from 198.4 - 260.7µS/cm as shown in table 2. The values obtained in this experiment shows that there is an increase in the concentration of soluble salt as EC is used as a means of appraising soil salinity and this implied that there are reasonable or significant presence of anions in the soil which could also be due to the presence of discharge or leakage of effluents from the cassava mills on the soils as there was a difference between the study site and the control.

The distribution of heavy metals in the soils from the study sites are shown in table 2 with corresponding means in table 3. The concentration of the metals such as Fe, Cu, Mn, Cr and Zn were generally higher at the point source than at 20m and 40m away. For all the metals analyzed, this higher level of metals at the point source on the soil was expected since that is the point of contact. The heavy metals level at all the sites were found to be significantly higher than the levels observed in the control sites which implies that the soils receiving the cassava mill effluents have some levels of heavy metals enrichments. Fe recorded the highest concentration at all the sites though it has been confirmed that natural soils contain significant concentration of iron. Eddy *et. al.*,(2004) suggested that the pollution of the environment by iron cannot be conclusively linked to waste effluents alone but to other natural sources as the case could be. However, since the levels of iron at the source point is higher than the control, it showed that the cassava mill effluent also contributed to the increase.

The general elevated levels of heavy metals at the point source decreased gradually away from the impact point suggested that the cassava mill effluent is a source of some of the metals detected in the soil. The abundance of the metals in the sites followed the order Fe>Mn>Zn>Cu>Cr>Cd. Fe was the most occurring while Cd was the least

The chart below showed the comparison of the various metals in the study site and that of the control

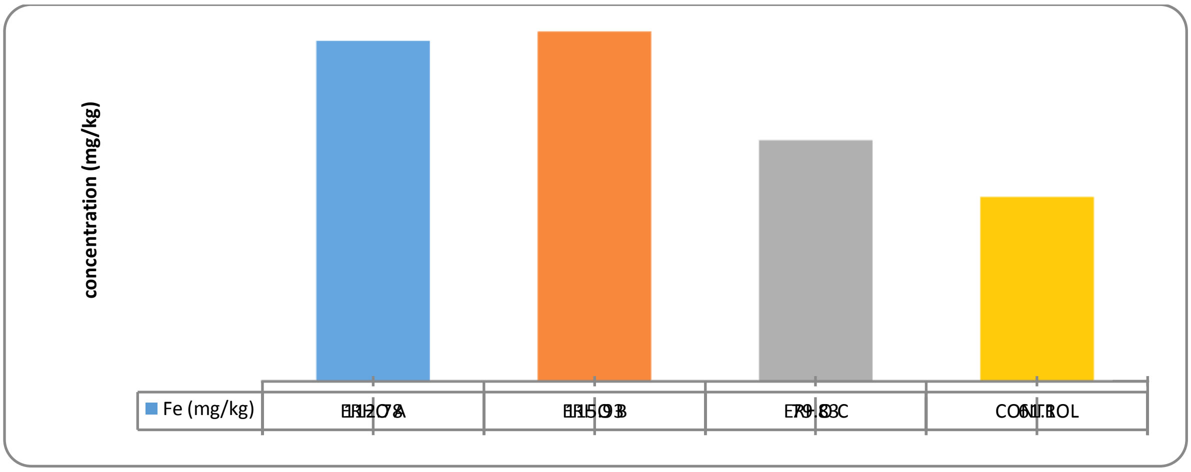

Fig 1: Fe concentration in soil alt cassava mills composed with control.

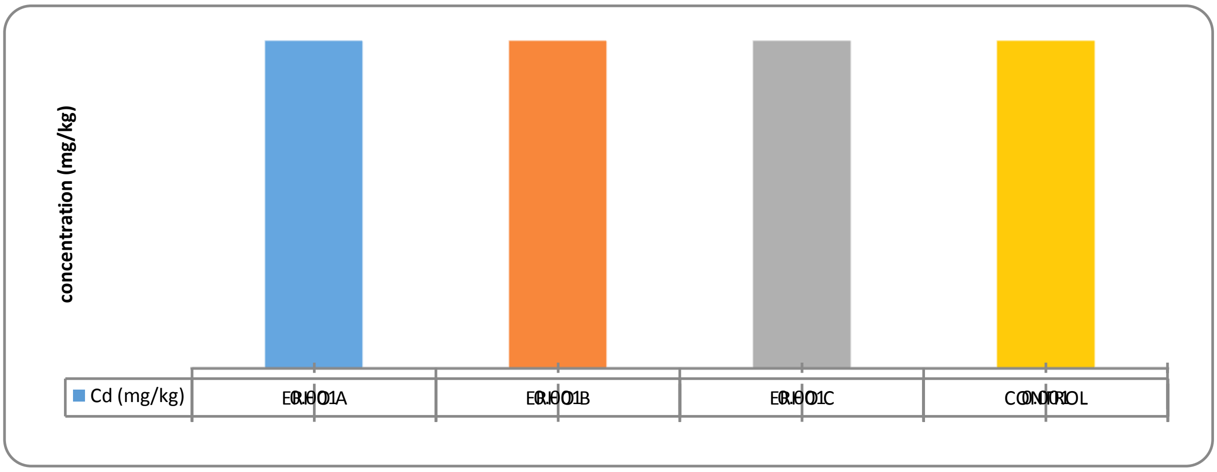

Fig 4.2 Cd concentration in soil at cassava mills compared with control.

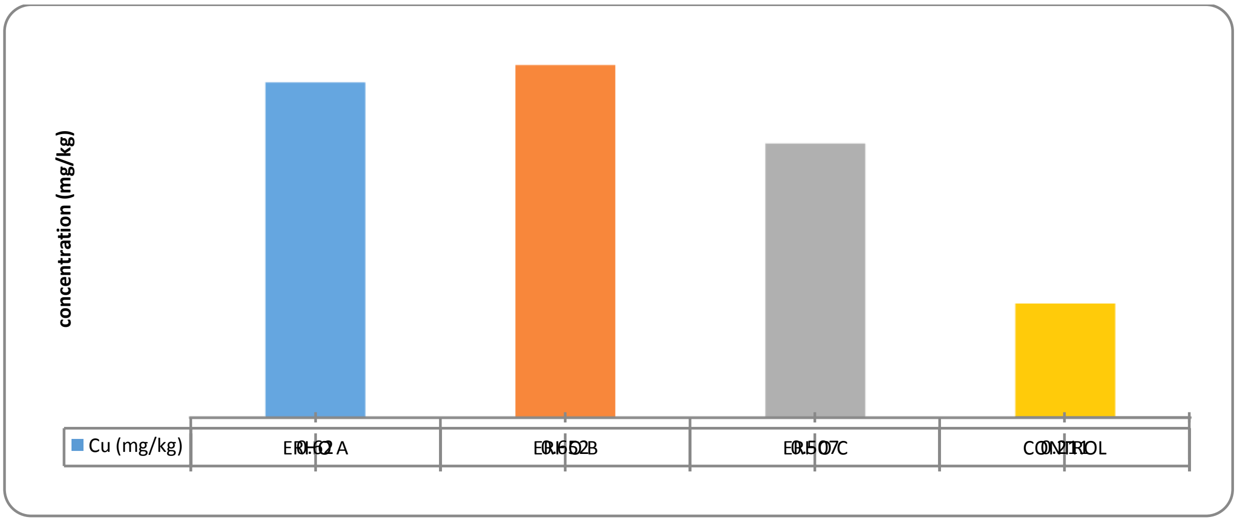

Fig 3: Cu concentration in soil at cassava mill compared with control.

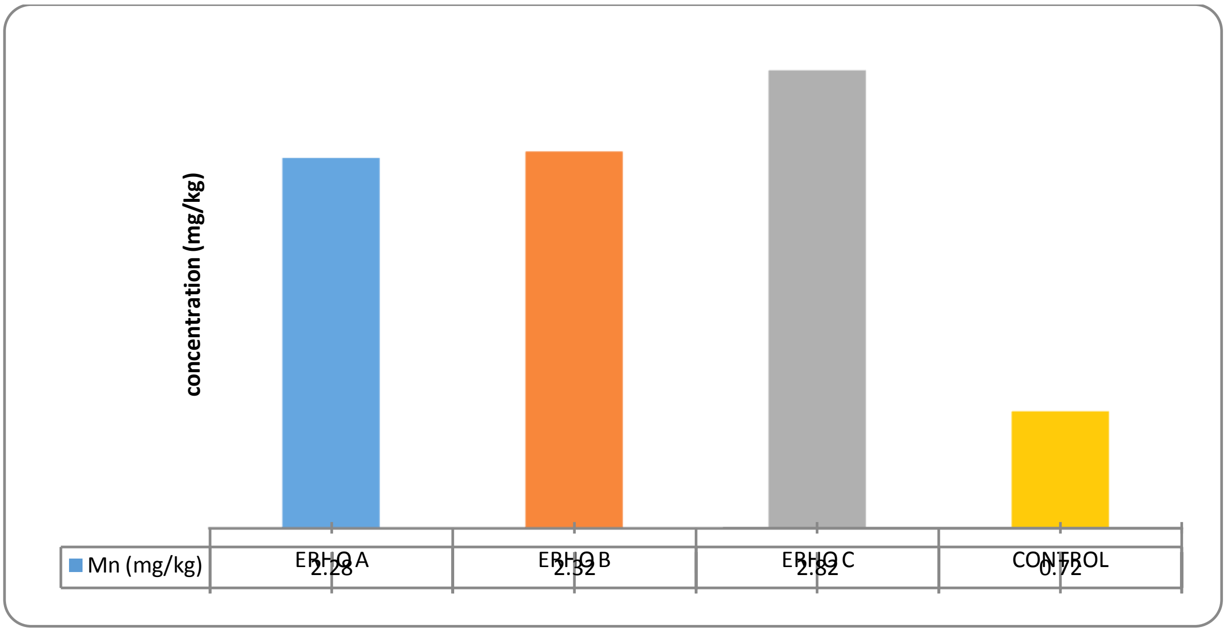

Fig 4.4 Mn concentration in soil compared mill soil at cassava mill and control

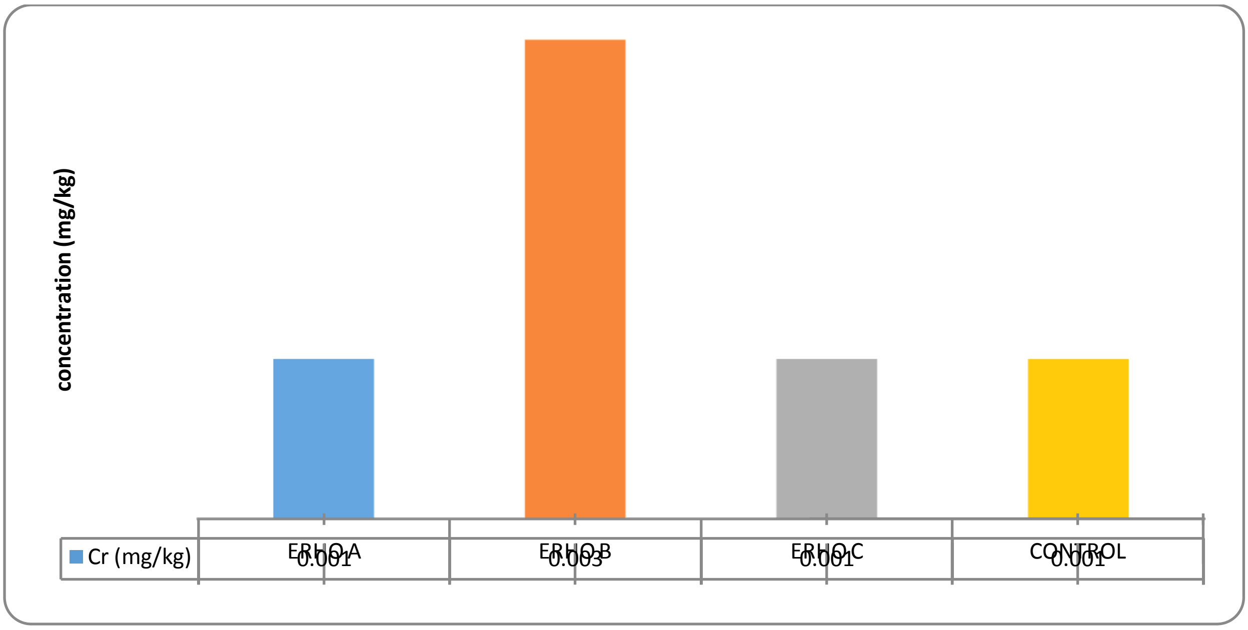

Fig 4.5 Cr concentration in soil at cassava mill compared with a control

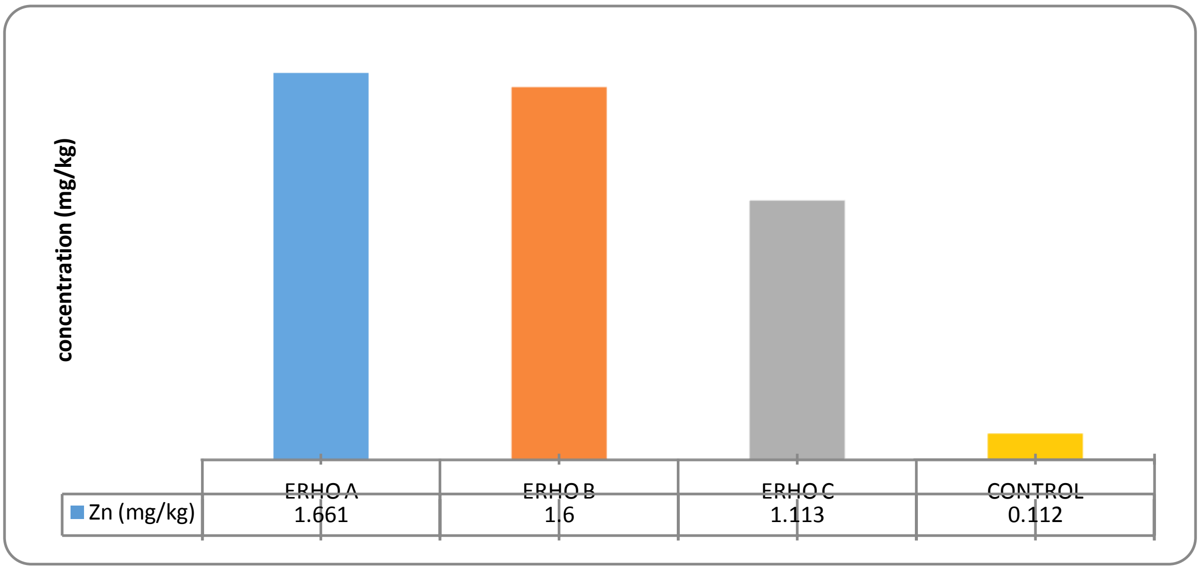

Fig 4.6 Zn concentration in soil at cassava mill compared with a control

CONCLUSION AND RECOMMENDATION

The cassava mill effluents decrease soil pH while it led to higher level of electrical conductivity. The result of heavy metals analysis showed elevated level of heavy metals in the soils. The pH and EC of the soil revealed that cassava mill effluent had detectable changes on the availability of the metals tested for.The millings stage is a major stage in processing cassava tuber ready for consumption. As a result, use of cassava millings machine cannot be avoided. It is therefore recommended that processing milling machines should be located away from residential area and from where farming activities is being carried out

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