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Evaluation of Physicochemical Characteristics of Water and Soil Samples from Cassava Processing Mill in Parts of Edo North, Edo State, Nigeria

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ABSTRACT: The problem of contaminated water sources and soil pollution has persisted in the study area emanating from cassava effluents from the processing of cassava in the study area. Physicochemical analysis was carried out in water and soil samples obtained in and around cassava processing mill in the Environment where cassava is been process to determine areas prone to contamination by taking soil and water samples in the various study location at a depth of 1.2 m for soil samples and 10 m for water samples in a hand dug well. The result from the physicochemical analysis of the Soil and water samples shows traces of heavy metals when compared with the standard set by World Health Organization (WHO). It is evident that in some sites investigated, the water and soil has been polluted by the discharge from the cassava effluent. The research thus point out the need for environmental Education and proper management/location of cassava processing sites in the study area by relevant Agencies.

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The shallow subsurface of the earth is an extremely important zone that supports our industrial, agriculture and infrastructure. Soil is one of the important resources in achieving food security through direct association with agricultural production. A safe and effective use of the near-surface environment is a major challenge facing our society, there is a great need to improve our understanding of the shallow subsurface. Cassava is extensively cultivated in the tropical and subtropical regions of the world and it grows to edible starch, tuberous roots with more than 200 calories/day of food value (FAO, 2004).

In processing of cassava, the outer covering of the cassava root is peeled off. The peel which contains the outer thin brown and a thick leathering parachymatons inner covering are discarded as waste and allowed to rot, also discarded are the fiber, cassava juice and the residues water produced after separating starch and fiber during the periods of fermentation and drying, respectively (Oboh and Akindahuasi, 2003). These wastes contain varying concentration of heavy metals either as simple metals or complexes (Igbozuruike et al, 2009). Oti (2002), revealed that cyanide forms an acidic complex called hydrogen cyanides acid. Continuous discharge of these wastes has accentuated the adverse effect of cassava waste to the environment and biodiversity (Goodley, 2004). For instance, the garri processing waste discharged to the environment causes foul smell and produces unattractive sights (FAO and IFAD, 2001). Like every other waste, cassava mill effluence upsets the marine ecological equilibrium. (Arimoro et al, 2007) showed a depletion of dissolved oxygen, depression in pH values, elevation nitrate values in the tropical stream of southern Nigeria. pH is known to effect a number of edaphic factors including clay, organic matter cation exchange capacity and some other soil physicochemical properties such as heavy metals (Nabulo et al, 2006).

A number of edaphic factors, including pH, organic matter, effective cation exchange capacity and clay have been indicated to affect cyanide availability in soils. (Uzoije *et al*, 2011). However, groundwater is not as pure as traditional assumed. This is because water is an excellent solvent and contains lots of dissolved chemicals. The impact of leachate on groundwater and other sources has attracted a lot of attention worldwide because of its overwhelming environmental significance (Jegede, 2009). This work is aimed to evaluate the environmental impact of waste emanating from cassava processing in the various investigated communities in the study area and assess its harmful nature to the ground water supply and soil properties for agricultural purpose. The aim of this research is to evaluate the physicochemical properties and some metal ions of concern Water and Soil Samples from Cassava Processing Mill in Parts of Edo North, Edo State, Nigeria.

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MATERIALS AND METHODS

Location of the study area: Edo State is an inland State in central southern Nigeria. Its capital is Benin City. It was created from the defunct Bendel State on the 27th of August 1991 and is located in the rain forest belt of Nigeria between Longitude 5" 42' and 6o 45'E and Latitude 5" 45'N and 7" 35'N. It is bounded by Kogi State to north; to the east by both Kogi and Anambra States; to the South by Delta State and by Ondo State to the west. It has a total land mass/area of 19,281.93 square kilometers ad eighteen (18) Local Government Areas that make up the three (3) Senatorial Districts, namely Edo South, Edo Central and Edo North. Natural resources abound in the state and these include: hardwood and timber, limestone, marbles lignite crude oil, gold, clay, Kaolin, granite, amongst others.

EXPERIMENTAL

Physicochemical analysis was carried out on the Environment where cassava is been process to determine areas prone to contamination by taking soil and water samples in the various study location close to the cassava processing mill in the study area. Soil samples were collected from three different towns in Edo north at cassava processing sites. They are Ozalla sites SO1 and SO2; Uzebba sites SU1 and SU2; Sabogida-ora sites SS1 and SS2. In each of the sampling site, soil samples were taken using soil Augar. The depth of soil samples collected in each site ranges from 0.6 m to 1.2 m.

Water samples were also collected from three different towns in Edo north at cassava processing mill in a close vessel in nearby borehole and hand dug wells producing water. They are Ozalla sites WO1, WO2, WO3 and WO4; Uzebba sites WU1, WU2, WU3 and WU4; Sabogida-ora sites WS1 and WS2. The depth of water samples collected at each site ranges from 10 m. The pH and EC were obtained using pH and EC meters respectively. Calcium, magnesium, chloride and alkalinity were analyzed using the titration method.

RESULTH AND DISCUSSION

The water and soil analysis was done at Quality Analytical Laboratory Services Ltd., located in Benin City, with the results presented in Tables 1 and 2.

The pH analysis of the soil samples: The pH of the study area ranges from 5.1 - 6.8. This suggests that the effluent imparted acidic properties to the soil. The acidity could be attributed to the presence of hydrogen cyanide in the cassava mill effluent. Banjoko and Sobulo (1994) reported that some Nigeria soils especially in the forest and savannah regions are within a pH range of 5.70 - 6.50. This was taken as the normal pH range of ordinary soils that favors plant and microorganisms.

The pH analysis of the water samples: pH of water is the measure of acidity and alkalinity of water. Results of pH showed in table 2 ranges from 5.8 – 6.8. Sample WU2, WO3 and WU4 falls within the standard for drinking water as stipulated by WHO except for Sample WS1, WS2, WU1, WO1, WO2 and WO4.

Electrical Conductivity (EC) analysis of the soil samples. The electrical conductivity in this study falls between 127.3 µS – 3900 µS. In sample WU1, WU2, WU4 the EC falls above the WHO standard for portable water, this is as a result of amount of dissolve substance present in the water of this location. Since the increase in the total dissolve substance lead to increase in the electrical conductivity.

Total Dissolved Solid (TDS) of the soil samples: Total dissolved solid (TDS) is that amount of dissolve substance present in water. TDS in the study areas value range from 94 – 1902 mg/L. The TDS in some of the sites is within the range recommended by WHO for drinking water, except sample WU1, WU2, WU3 and WU4. Some Heavy Metals: Zinc (Zn), Copper (Cu), Manganese (Mn), Iron (Fe) Cadmium (Cd), Nitrogen (Ni) found in the soil.

These heavy metals are also known as micro-nutrients. They form part of food nutrition and they are present in cassava tuber, yam tuber etc. They enter into the environment (water and soil) during food processing. Higher concentration of these heavy metals can cause toxicity. The levels of heavy metals investigated in this study indicate that Zn, Cu, Fe, Mn, Cd, Ni range from 0.2 – 0.5 mg/L, 0.2 – 1.00 mg/L, 0.5 – 1.0 mg/L, 0.2 – 0.8 mg/L, 0.01 – 0.02 mg/L and 0.05 – 0.07 mg/L respectively. The metals investigated in the study area falls below WHO recommended standard except iron. The presence of heavy metals in the ground water may be due to leaching from the cassava effluents from the top soil. This has been reported by Oviasogie and Ofomaja, (2007).

Cyanide: Cyanide is a carbon-nitrogen compound unit which can combine with organic and inorganic materials when released to the ecosystem. In the present study the levels of CN ranges from 0.00- 0.03 mg/L. In some of the sites, the levels of CN are above the permissible limit of drinking water as stipulated by WHO. The presence of CN may be due to leaching from the top soil as cassava effluents are concentrated.

Table 1: Results of the physicochemical analysis of soil samples from the various sites investigated

	SO1	SO2	SU1	SU2	SS1	SS2
GPS reading	N06° 51.567' E006°15.883'	N06° 51.385' E006°15.911'	N07° 26.067' E006°04.659'	N07° 26.027' E006°04.606'	N06° 48.164' E006°01.143'	N06° 47.990' E006°01.250'
Ph	5.6	6.6	6.8	5.9	6.2	5.1
EC (mS)	4.83	8.81	6.06	4.64	3.94	2.31
Ca (mol/kg)	11.66	1.76	2.80	25.60	1.60	2.00
Na (mol/kg)	0.28	0.14	0.38	0.18	0.23	0.42
Sand (%)	83.47	74.47	73.47	90.47	89.47	85.97
Clay (%)	11.81	19.81	21.81	3.81	7.81	10.81
Silt (%)	4.72	5.72	4.72	5.72	2.72	3.22
Mn (mg/kg)	1.30	1.00	1.00	1.00	1.70	1.10
Zn (mg/kg)	5.40	4.30	4.40	4.90	5.10	3.80
Fe (mg/kg)	8.00	8.60	9.80	11.00	6.80	7.70
Cd (mg/kg)	1.20	1.00	1.00	0.60	1.30	1.10
CN (mg/kg)	24.64	22.89	23.13	21.14	20.99	23.34

Table 2: Physicochemical analysis of the water samples from the various sites investigated

	WS1	**WS2**	**WU1**	**WU2**	**WU3**	**WU4**	**WO1**	**WO2**	**WO3**	**W04**	**WHO**
pH	6.4	6.3	6.4	6.8	6.7	7.1	5.6	5.8	6.7	5.8	6.50-9.50
EC µS	1515	810	2280	3940	2250	3900	471	508	127.3	437	1000
TDS (mg/l)	895	423	1825	1652	1902	1627	263	311	94	302	1000
BOD (mg/l)	3.95	3.23	2.77	2.24	2.98	1.86	2.53	3.11	4.54	3.12	10
COD(mg/l)	6.14	5.93	4.84	4.42	4.09	3.45	4.69	5.73	8.01	6.54	7.5
Zn (mg/l)	0.20	0.50	0.20	0.20	0.30	0.40	0.50	0.20	0.40	0.30	5.00
Pb (mg/l)	< 0.08	< 0.08	< 0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	0.05
Cu (mg/l)	0.60	0.20	0.30	0.60	0.40	0.40	0.80	0.50	1.00	0.40	1.00
Fe (mg/l)	1.00	0.60	0.70	1.00	0.90	1.10	1.00	0.90	0.50	0.80	0.30
Mn (mg/l)	0.70	0.30	0.30	0.10	0.40	0.20	0.80	0.50	0.40	0.20	0.05
Cd(mg/l)	< 0.01	0.02	< 0.01	< 0.01	0.02	0.01	<0.01	0.01	<0.01	< 0.01	3.00
Ni (mg/l)	0.05	< 0.05	< 0.05	0.05	< 0.05	0.06	0.05	0.05	0.07	0.05	
CN (mg/l)	0.01	0.02	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.02	0.01

*Conclusion***:** It is evident that in some sites investigated, the water and soil has been polluted by the discharge from the cassava effluent**.** It is therefore concluded from this research work that the reason for the high values of the various parameters recorded from the analysis of the water and soil samples is possibly as a result of migration of leachate from cassava effluents within the vicinity of the investigated area emanating from the processing of cassava in the study area.

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