WWJMRD 2023; 9(05): 31-34
www.wwjmrd.com
International Journal
Peer Reviewed Journal
Refereed Journal
Indexed Journal
Impact Factor SJIF 2017: 5.182 2018: 5.51, (ISI) 2020-2021: 1.361
E-ISSN: 2454-6615

Chidubem-Nwachinemere, Ncheta Obianuju
Department of Applied Microbiology and Brewery, NnamdiAzikiwe University, Awka, Nigeria.

Orji, M.U.
Department of Applied Microbiology and Brewery, NnamdiAzikiwe University, Awka, Nigeria.

Achugbu, Adaeze Nnedinma
Department of Botany, Nnamdi Azikiwe University, Awka, Nigeria.

Achugbu, Obioma Erochukwu
Department of Chemical Engineering, Nnamdi Azikiwe University, Awka, Nigeria.

Okoli, Uzoma O,
Osilo Chidimma,
Nwakuche Adaugo Ozioma
Department of Applied Microbiology and Brewery, NnamdiAzikiwe University, Awka, Nigeria.

Correspondence:
Chidubem-Nwachinemere, Ncheta Obianuju
Department of Applied Microbiology and Brewery, NnamdiAzikiwe University, Awka, Nigeria.

Physicochemical Composition of Cassava Mill Effluents in Five Processing Plants in Anambra State, Nigeria

Chidubem-Nwachinemere, Ncheta Obianuju, Orji, M.U., Achugbu, Adaeze Nnedinma, Achugbu, Obioma Erochukwu, Okoli, Uzoma O, Osilo Chidimma, Nwakuche Adaugo Ozioma

Abstract
Cassava processing releases abundant volumes of effluents that are indiscriminately discharged into the environment. This study examines the physicochemical components of cassava mill effluents (CME) from five cassava processing plants in Anambra State. Cassava mill effluents were collected from five processing plants in sterile bottles for analyses. The cassava mill effluents were subjected to physicochemical screening. The pH and TDS were measured using the pH and TDS meter. The BOD and COD content were determined by titration. The cyanide content, carbohydrate content, and heavy metal content were evaluated using the UV spectrophotometer. The results of the pH in all the samples were ranged from 4.95-5.19. CME 2 and 4 had highest pH values of 5.19 but CME 3 had the lowest pH value of 4.95. The value of total dissolved solids was lowest in CME 4 with the value of 28mg/l while CME 2 had the highest value of 30g/l. The BOD values of cassava effluents samples ranged from 29mg/l to 30.20mg/l and the corresponding COD values ranged 31.89mg/l to 33.9mg/l.The heavy metal evaluationindicated the presence of Pb, Cd, Zn, Cr and Fe.The CME in all the samples has very low protein content that ranged between 2.70 and 2.95% but has high carbohydrate content (77.89mg/l - 78.85mg/l).This study revealed that cassava mill effluents are composed of physical and chemical constituents that may pose hazard to the receiving environments especially water bodies and farmlands.

Keywords: Cassava mill effluents, physicochemical, heavy metals, environmental hazard.

Introduction
Cassava is a perennial plant that can be harvested within the range of 12-18 months and it is a major food in Nigeria and other African Continents of the world; that is composed of laticifers and produces latex (Onwueme, 1978). Daramola and Osanyinlusi, (2006) opined that Nigeria is the world's largest producer of cassava being the major economic supplier of starch. It normally grows in tropical lowland intemperate, damp climate within the temperature range of 25-30 °C and precipitation of 100-150cm annually (Agwaranze et al., 2018). The soil cassava is grown is sandy-loamy soil. Cassava is composed of two major categories which are linked to the features and components of cyanogenic glycosides that are contained in the cassava tubers and roots. These two categories are namely; bitter and sweet category. When the cyanogenic glycosides iscontained in the tuber in high concentrations, they are bitter but when cyanogenic glycosides is in the peels and in low concentration, then it is sweet (Agwaranze et al., 2018). These concentrations on the different cassava varieties are largely dependent on the environmental condition at the growth stage (Abiona*et al.*, 2005).
Countries like Tanzania, Angola and Malawi utilize leaves of the plant as vegetable for cooking for human consumption while in some countries like Nigeria, the leaves serve as domestic animal feed. The tubers are processed as food for human consumption, namely; meal, flour, chips and starch production.
Cassava serves as a source of income to farmers. Cassava leaves which are consumed by a

group of individuals are rich in vitamins AandB and even proteins. For Latin Americans and southeast Asia, cassava is an economic crop whereby it is utilized as binding agents due to its affordable source of starch (Okunade and Adekalu, 2013). The starch is used in making textiles, paper and monosodium glutamate (MSG) a very useful flavouring agent for cooking in Asian. In Nigeria, cassava is fermented to produce garri which is a major for both high- and low-income earners in the country. It is a fermented and drained cassava food product with high starch content and a major source of calories as well.

Both solid and liquid wastes are produced from cassava production and processing. These wastes demean the atmosphere with severe repercussion on the health of mankind. The height of pollution and dilapidation caused by the wastes generated depends on the nature of the wastes and their constituents (Bello et al., 2017). The wastes range from dusts from the tubers, peels from cutting of the tubers, by-products of fibrous materials from sieving and crushing the tubers, that is the pulp waste, starch residues after starch settling and waste water (effluent) which is the focus of the research. The quality of cassava mill effluent is basically determined by the physicochemical quality and the microbial quality examines the cassava mill effluent based on the population density of different microbial class that is, cellulolytic lipolytic, lactic acid bacteria count, total fungi, total heterotrophic bacteria count, coliforms, phosphate solubilizing and nitrifying bacteria (Ukaegbu-Obi *et al.*, 2018). Physicochemical screening evaluates both the physical and chemical parameters. Physicochemical parameters analyses the physical and chemical related parameters as well as the appearance (turbidity), total hardness, total suspended solids, turbidity, pH, odour, color, taste, electrical conductivity, carbonates, potassium, magnesium, sodium, calcium, sulphate, nitrite, nitrate, cyanide, salinity, total alkalinity, total alkalinity, salinity, cyanide, nitrate, nitrite, sulphate, dissolved oxygen chemical and biological oxygen and heavy metals (mercury, silver, lead, chromium, cadmium, copper, zinc, manganese, iron etc (Ukaegbu-Obi *et al.*, 2018). Cassava mill effluents contain organic matter, suspended solids, cyanides, heavy metals which makes it very acidic and hazardous (Sackey and Bani, 2007). The impact of the effluents in the air can be as a result of the foul odour stemming from the decay of the nutrients (Okunade and Adekalu, 2013). It equally affects the physicochemical and microbial diversities of the soil that play vital roles in plant growth and maximum yield.

The presence of microorganisms in cassava effluents makes it a channel through which pathogens are transmitted thereby increasing the rate of disease incidences (Ezeand Onyilide, 2015).

The processing of cassava involves the release of large volumes of effluents and waste water that are composed of hazardous substances. With the current discovery of more economic values of cassava as a crop, there is increasing need for processing of the tubers with increasing discharge of effluents.

This study was therefore aimed at analyzing the physicochemical components of cassava mill effluents so as to determine the extent to which it contributes to environmental hazard.

Materials and Methods

Sample collection

Cassava mill effluents was collected from five different cassava processing plants in Anambra State, namely; Awka, Okpuno, Amansea, Amanuke and Ofemili. On request, the effluents were passed through a clean, sterile pipe from the plant to the clean, sterile 5litre gallon from each cassava processing plants. The collected samples were transported to the Microbiology laboratory of NnamdiAzikiwe University, Awka, for screening. The samples were stored at 4^0C.

Physicochemical screening of cassava mill effluents

Different physicochemical parameters of the soil samples were analyzed, namely; pH,temperature, total dissolved solids (TDS), total suspended solids (TSS), biological oxygen demand (BOD), chemical oxygen demand (BOD), cyanide content, crude protein, carbohydrate content and heavy metal contents. The pH was determined using pH meter Jenway Hanna multipurpose meter which was standardized with appropriate buffer while the temperature was measured with a thermometer.The total dissolved solids and total suspended solids were determined using the TDS meter. The biochemical oxygen demand and chemical oxygen demand were determined by titrimetric method described by APHA, (2011). Kjedahl, (1883) method was used to determine the crude protein while Southgate (1976) method was used to determine the carbohydrate content. Edori and Edori, (2012) method was used to determine the cyanide and heave metal content.

Results and Discussion

Table 1: Physicochemical parameters for CME.

Parameters	CME 1	CME 2	CME 3	CME 4	CME 5
pH	5.18	5.19	4.95	5.19	5.18
Temperature	28^0C	29^0C	27^0C	28^0C	28^0C
TDS	28.5g/l	30g/l	29g/l	28g/l	28.8g/l
BOD	29.86mg/l	29.95mg/l	30mg/l	29mg/l	30.20mg/l
COD	33.9mg/l	33.50mg/l	31.89mg/l	32.90mg/l	33.50mg/l
Cyanide	70.57mg/l	70.55mg/l	70.85mg/l	70.55mg/l	70.58mg/l

Table 2: Heavy Metal content of Cassava Mill Effluents.

Parameter	CME 1	CME 2	CME 3	CME 4	CME 5
Lead	6.33ppm	6.42ppm	6.30ppm	6.40ppm	6.43ppm
Cadmium	5.19ppm	5.25ppm	5.20ppm	5.19ppm	5.26ppm
Chromium	3.04ppm	3.08ppm	3.07ppm	3.05ppm	3.09ppm
Iron	2.15ppm	2.16ppm	2.15ppm	2.14ppm	2.16ppm
Zinc	2.56ppm	2.58ppm	2.50ppm	2.55ppm	2.57ppm

Table 3: Nutritional Composition of CassavaMill Effluents.

Parameters	CME 1	CME 2	CME 3	CME 4	CME 5
Crude protein	2.80%	2.90%	2.80%	2.70%	2.95%
Carbohydrate	78.49mg/l	77.00mg/l	78.99mg/l	78.85mg/l	78.50mg/l

The results of this study showed the physical, chemical and nutritional composition of cassava mill effluents that makes it unfit for indiscriminate disposal into farmlands, water bodies and pits. Table I shows the results of the pH, TDS, BOD, COD and cyanide content of cassava mill effluents. CME 2 and 4 had highest pH values of 5.19 but CME 3 had the lowest pH value of 4.95implying that it was more acidic than the other samples. These pH values are not optimal for plant growth because the nutrients that are needed by plant for growth are available at pH 6-7 (Agwaranze et al., 2018). Olorunfemi and Lolodi, (2011) discovered a much lower pH of 4.11. The increase in the acidity of the CME 3 sample could be associated with the level of cyanide content in the cassava effluents. Ayansina et al., (2015) documented a pH range of 5.49 and 6.88 in their study of cassava waste water.

The value of total dissolved solids was lowest in CME 4 with the value of 28mg/l while CME 2 had the highest value of 30g/l and is still within the standard range <500mg/l. Cassava mill effluents have been observed by Orhueet al.(2014), to have high content of TDS while Agarry (2016) reported a TDS value of 3445mg/l which is much higher than the values obtained in this study. TDS is used for the measurement of inorganic salts, organic matter and other dissolved materials in water. Increased concentration of TDS triggers toxicity through changes in ionic composition of the water and individual ions (Reyes *et al*., 2020). In this study, the TDS level was normal and is below the hazardous level

The BOD values of cassava effluents samples ranged from 29mg/l to 30.20mg/l and the corresponding COD values ranged 31.89mg/l to 33.9mg/l. The BOD value of the cassava mill effluents in this study is in agreement with the study conducted by Peres *et al.,* (2019). Their study showed a BOD value of 29.20mg/l. Achi *et al.,* (2019) recorded a COD value of 33.4mg/l which is in agreement with this work. . The high concentrations of COD and BOD show high content of organic substance in the CME due to the fact that it is the energy that aids in the oxidation of organic materials. The indication of BOD and COD in effluents shows that they may pose health risk in the environment where they are littered or discharged. The presence of varying concentrations of cyanide was detected in all the cassava mill effluents samples. CME 3 was highest in cyanide content with the value of 70.85mg/l while CME 2 and 4 had the lowest content (70.55mg/l). Izah*et al.,* (2018), observed the presence of cyanide in cassava waste water with a much lower value of 6.3mg/l. Ariyomo, *et al.,* (2017), documented that cassava contains cyanogenic glucoside and linamarin and lotaustralin stored in the plant cell vacuole which are changed to hydrogen cyanide (HCN). The value of the cyanide in the cassava mill effluents will have adverse effect on the stream which if the effluent contaminated water is used as irrigation water has the capacity to limit plant growth and crop yield depending on the content of the cyanide.

The heavy metal content of cassava mill effluents in this study showed the presence of Pb, Cd, Zn, Cr and Fe as presented in Table 2. CME 5 recorded the highest level of Pb (6.57ppm) while CME 3 had the lowest level of 6.30ppm. Iron (Fe) had the lowest concentration in all the samples with a value of 2.14ppm A lower level of lead was reported by Olaoye and Adekunle*et al.,* (2020) which also reported the presence of manganese, zinc and iron in much lower values. Oboh and Akindahunsi (2003a), recorded that cassava mill effluents contains heavy metals such as zinc, and iron. Olorunfemi, and Lolodi, (2011), reported the presence of zinc within the range of 1.07 to 5.90ppm which is in agreement with the findings of this study. High concentration of heavy metals in the cassava effluent could also be attributed to the wearing off or abrasion of the cassava milling machine parts and emission of the metals through the exhaust of the machine. Heavy metals inhibit cell growth, morphology and metabolic activities going on in the soil-by-soil microorganisms. This is achieved via disruption of the functioning, denaturation of proteins and membrane degradation. The presence of some of the heavy metals found in water bodies and their accumulation in the environment will have adverse effect and have been observed to have the capacity of being cytotoxic and genotoxic.

The result for nutritional composition of cassava mill effluents is presented in table 3. The CME in all the samples has very low protein content that ranged between 2.70 and 2.95% but has high carbohydrate content (77.89mg/l - 78.85mg/l). This finding agreed with Agwaranze et al., (2018) that discovered low protein and high carbohydrate content. . This explains the nutritional value of cassava as food product.

Conclusion

The results of the physicochemical properties of the cassava mill effluents explained the alterations it causes on the receiving environments. The increased concentrations of cyanide and heavy metals of cassava mill effluentsmake it an environmental hazard to the health of humans and toxic to farmlands that they flow into by affecting the soil composition which supports crop yield. It is therefore necessary that cassava effluents be treated before it is released into the environment.

References

1. Abiona, O., Sanni, L. and Bamgbose, O. (2018). An Evaluation of Microbial Load, Heavy Metals and Cyanide Contents of Water Sources, Effluents and Peels from Three Cassava Processing Locations. Journal of Food, Agriculture and Environment; 3: 207-208.
2. Agwaranze, D.I., Nwugo, V.O., Ogodo, A.C., Onudibia, M.E., Nwaneri, C.B., Aliba, N.V. (2018). Effects of cassava mill effluent (CME) on bacteria diversity of soil and aquatic environments in South-South Nigeria. Journal of Science, 2(4): 238–242.
3. APHA, (2011). Standard Methods for the Examination of Water and Wastewater. Washington, D.C, pp1193.
4. Ayansina, A.D., Garaba, E.O. and Baba, J. (2015). Some Physico-chemical parameters and major

microorganisms isolated from cassava waste water and a receiving nearby stream. Internajournal Journal of Current Microbiology and Applied Sciences, 4(6): 211-217.
5. Bello, O.S., Owojuyigbe, E.S., Babatunde, M.A., Folaranmi, F.E. (2017). Sustainable conversion of agro-wastes into useful adsorbents. Applied Water Science, 7: 3561-3571.
6. Daramola, B. and Osanyinlusi, S.A. (2006). Investigation on Modification of Cassava Starch using active components of ginger roots zingiberofficinale roscoe. African Journal of Biotechnology, 4:1117-1123.
7. Edori, O.S. and Edori, E.S. (2012). Effects of automechanic works on lead and iron content in two mechanic villages in Port Harcourt, Rivers State, Nigerian Journal of Applied Sciences Environmental, Management, 16(4): 317-321
8. Eze, V.C and Onyilide, D.M. (2015). Microbiological and physicochemical characteristics of soil receiving cassava effluents in Elele, Rivers State, Nigeria. Journal of Applied and Environmental Microbiological 3(1): 20-24.
9. Kjeldahl, J. (1883). Nene method zurBestimmung des Sticktoffs in organischenKorpern. Fresennius Journal of Analytical Chemistry. 22: 366-382.
10. Oboh, G. and Akindahunsi, A.A. (2003a). nutrient and antinutrient content of Aspergillus niger fermented cassava products flour and garri. Journal of Food Components Analysis, 15: 617-622.
11. Okunade, D.A. and Adekalu, K.O. (2013). Physico-chemical analysis of contaminated water resources due to cassava wastewater effluent disposal. European Journal of Science and Technology,2: 75 – 84.
12. Olorunfemi, D.I. and Lolodi, O. (2011). Effects of cassava processing effluents on antioxidant enzyme activities in Allium cepa L. Biokemistri, 23(2): 49-61.
13. Onwueme, I.C. (1978). The tropical tuber crops-yam, cassava, sweet potato and cocoyam. John Willey and Sons, Chichester, pp3-97.
14. Sackey, I.S. and Bani, R.J. (2007). Survey of waste management practices in cassava processing to garri in selected districts of Ghana. Journal of Food, Agriculture and Environment, 5(2): 325-328.
15. Ukaegbu-Obi, K.M., Appah, O.G., Itaman, O.V., Nwosu, P.C. (2018). Microbial and physicochemical Analysis of Soil Receiving Mill Waste Water in Umudike. NigerianJournal of Biotechnology. 35 (2): 99-107.