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An evaluation of microbial load, heavy metals and cyanide contents of water sources, effluents and peels from three cassava processing locations

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Abstract

Microbial load, heavy metals and cyanide contents of water sources and effluents from three processing locations (Ibadan, Abeokuta and Ilaro) were evaluated. Water samples and effluents were aseptically collected using sterile containers and analysed for microbial load, heavy metals and cyanide contents. The peels were also analysed for cyanide content. Water samples from cassava processing location at Ilaro had the highest microbial load with a value of $1.8x10^6$ cfu/ml. The values of fungi ($1.1x10^2$-$2.0x10^2$ cfu/ml) in water samples from Abeokuta were highest. In terms of coliform counts (0.9 $x10^2$-$1.0x10^2$ cfu/ml), water samples from Ibadan and Ilaro were most contaminated. There were significant differences ($P< 0.05$) in cyanide contents of peels and in Mn and Fe contents of effluent and water samples. Peels, effluents and water samples from cassava processing location at Ilaro recorded the highest values for cyanide, Mn and Fe respectively. There was no detectable level of Pb in effluents and water samples from Abeokuta and Ilaro.

Key words: Microbial load, cyanide, heavy metals, effluents, Cu, Mn, Fe, Pb, water source.

Introduction

Water is undoubtedly the most precious natural resource that exists on our planet. Without the seemingly invaluable compound comprised of hydrogen and oxygen, life on earth would be non-existent, and it is essential for everything on our planet to grow and prosper. Although we recognize this fact, we disregard it by polluting our various water sources. Subsequently, we are slowly but surely having our planet to the point where our source of potable water has become greatly affected [3]. When water is unfit for its intended use, it is considered polluted. Two types of water pollution exist, point source and non-point source. The former occurs when harmful substances are emitted directly into a body of waterhole, the latter delivers pollutants indirectly to the water source.

Because cyanogenic glycosides, linamarin and latanstalin are synthesized in tissues of cassava plant, cyanide is introduced to the environment in the form of hydrocyanic acid during processing of cassava by the pressing and washing effluents. If these products are not properly treated and managed, they constitute a great danger to the environment, especially to the water sources that are used for cassava processing [6]. Unfortunately, most processors and Nigerians in general do not know the deleterious effects these have on their health and safety [7]. The threat to high quality standard of water sources increases also due to human traffic and activities in cassava processing environments. This study evaluates the microbial load of water sources in selected areas and cyanide and heavy metal contents of water and effluents from cassava processing.

Materials and Methods

Study areas were Ibadan, Abeokuta and Ilaro. The selection was based on the extent of human traffic and activities around the sites and sites nearness to streams. Water samples were aseptically collected using sterile containers. Effluent samples were immediately chilled (0-4°C) and later kept frozen until required for analysis. The heavy metals (Fe, Cu, Mn and Pb) were investigated using standard methods [1]. Determination of cyanide was as described by Cooke [4]. The cyanide extracted from effluents and peels was analysed by quantitative CN^- screening using aqueous 0.1 M phosphoric acid. Total bacterial, coliform and fungi counts were determined according to Oyewole and Odunfa [5]. The statistical analyses were performed with Hewlett Pack 41 CV equipped with SPSS software package. Data were subjected to two-way analysis of variance and means were separated using Duncan's multiple range test.

Results and Discussion

Microbial load: Microbial loads of water samples from the study locations are presented in Table 1. Water samples collected at Ilaro had the highest bacterial load with a value of $1.8x10^6$ cfu/ml followed by those from Abeokuta and Ibadan respectively. The

Table 1. Microbial load of water sources.

S/No	Parameter	Ibadan	Abeokuta	Ilaro
1	Total bacteria (cfu/ml)	$1.0x10^5$	$1.2x10^5$	$1.8x10^6$
2	Total fungi (cfu/ml)	$1.1x10^2$	$2.0x10^2$	$1.0x10^2$
3	Coliforms (cfu/ml)	$1.0x10^2$	0.0	$1.9x10^2$

values of fungi $1.0x10^2$-$2.0x10^2$ cfu/ml were highest in water samples from Abeokuta. In terms of coliform counts ($0.9x10^2$-$1.0x10^2$ cfu/ml), the results showed that water samples from Ibadan and Ilaro were most contaminated. High bacterial counts suggested faecal contamination of the water sources and this is corroborated by the presence of high levels of coliform bacteria which are normally used as indicators of faecal contamination. The water source at Ibadan plant site seemed to be more faecally polluted than those from other processing sites. This is probably due the higher population density, human traffic and activities. The plant at Ibadan is very close to a mechanic workshop, hence the high human traffic and activities explain the relatively high density of coliforms. Lower values recorded for water samples from processing locations confirmed that fungi are normally more resident and abundant in terrestrial than in aquatic ecosystems.

Cyanide content of effluents and peels: Table 2 presents the cyanide content of cassava effluents and peels from the three processing sites. The cyanide contents of effluents from cassava processing locations were not significantly different ($P<0.05$) (0.2-0.4 µg/100 g net wt.) while there were significant differences ($P<0.05$) in cyanide contents of peels (56.9 -63.7 µg/100 g net wt.). The cassava processing centre in Ilaro recorded the highest value. Higher values for peels are expected because Bediako et al.[2] found that linamarin is virtually synthesized in all tissues of cassava plant. Even though the cyanide content of the effluent is lower than that of the peel, it constitutes a great danger by being a point source contaminant to water sources which are used for cassava processing. If this happens it portends a serious danger to the safety of the products.

Table 2. Total cyanide in the effluents and peels (wastes) from the three processing sites.

S/No.	Processing site	Effluents (µg/100 g net wt.)	Peels (µg/100 g net wt.)
1	Ibadan	0.2 ± 0.1^a	59.9 ± 0.4^{ab}
2	Abeokuta	0.4 ± 0.0^a	56.9 ± 0.2^b
3	Ilaro	0.3 ± 0.0^a	63.7 ± 0.3^a

Values are means ± standard deviation. Each value represents mean of three replicates. Mean values having the same superscript within columns are not significantly different at 5% confidence level.

Heavy metal contents of effluents and water: Heavy metal contents of effluents from various cassava processing locations are presented in Table 3. There were significant differences in manganese and iron of effluent samples. Effluents from Ilaro plant recorded the highest while Ibadan plant recorded the lowest values of heavy metals. There were no detectable levels of lead in effluents from Abeokuta and Ilaro processing locations. The levels of heavy metals were within the maximum allowable limits recommended by WHO for portable waters. There were significant differences in heavy metal contents of the three processing locations. The observed lead values for effluents from Ibadan location may be as a result of the presence of mechanic workshop in the village around the processing site where petroleum products are used and released into the drainage path within the environment.

Table 3. Heavy metal concentrations (µg/L) of effluents.

Heavy metal	Ibadan	Abeokuta	Ilaro
Mn	34.9 ± 7.8^a	36.2 ± 6.2^b	43.2 ± 5.5^b
Fe	37.2 ± 2.8^b	40.5 ± 2.9^b	45.4 ± 1.7^a
Cu	1.0 ± 0.2^a	1.2 ± 0.2^a	1.3 ± 0.1^a
Pb	1.0 ± 0.0	N.d.	N.d.

Values are means ± standard deviation. Each value represents mean of three replicates. Mean values having the same superscript within columns are not significantly different at 5% confidence level. N.d. = Not detected.

Table 4 presents the results of heavy metal analysis for water sources in the three processing locations. There were significant differences ($P < 0.05$) in manganese and iron of water samples. Values of water sources were highest for manganese in Ilaro, for iron and copper in Abeokuta. The lowest values were recorded for manganese in Abeokuta and for iron and copper in Ibadan. Detectable levels of lead (2.1±0.6 µg/l) were found in water samples from cassava processing locations in Ibadan. All the detectable concentrations of heavy metals were within the maximum allowable levels recommended by WHO for potable water. However, the continuous usage of lead polluted water could cause accumulation in the human body system which might be injurious to the health of processing workers and resultant consumers of cassava products.

Table 4. Heavy metal concentrations (µg/L) of water sources.

Heavy metal	Ibadan	Abeokuta	Ilaro
Mn	1.9 ± 1.0^b	1.7 ± 0.2^b	2.3 ± 0.9^a
Fe	22.6 ± 1.5^b	24.9 ± 2.6^a	24.5 ± 1.3^b
Cu	0.9 ± 0.2^a	1.3 ± 0.1^a	1.1 ± 0.3^a
Pb	2.1 ± 0.6	N.d.	N.d.

Values are means ± standard deviation. Each value represents mean of three replicates. Mean values having the same superscript within columns are not significantly different at 5% confidence level. N.d. = Not detected.

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