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Characterisation of Cassava (*Manihots calentacrantz*) Waste-Water

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Abstract— *Wastewater is an inevitable substance released during cassava-foofoo processing. It is either a by-product of initial production process or they arise when the cassava tubers are indiscriminately discharged to a nearby water body. Since human life generally involves the activities that result in the production of cassava waste water, it is of importance in this research to know the importance of cassava waste water to humans and to characteristize it. Cassava waste water was produced and characterized for its rust-removing capabilities. Organic components were also separated by GC-MS. The results show that the waste water contains alcohols, acids and others (3-penten-2-ol, 1-butanol, 3-hexanol, octadecanoic acid, Oleic acid, n-hexadecanoic acid, acetoin, dibutyl phthalate, Squalene, and bis(2-ethylhexyl) phthalate). It can remove rust from metallic substances such as nails.*

Keywords— *Cassava, waste water, GC-MS, rust-removal.*

I. INTRODUCTION

Cassava is a staple food for at least 500 million people in the tropics [1] that provides carbohydrates, or energy. Apart from being the supplementary staple food of many Africans, it is also used as livestock feed particularly for monogastrics [2].

Traditional African food products such as garri and fufu are obtained from cassava by series of operations such as grating, dewatering, fermenting and roasting. In these processes, it generates waste which includes wastewater and solid waste.

The various fermentation processes have been broadly categorized into submerged fermentation process, which involves the soaking of the roots under water as in fufu production (rotting), and the solid fermentation process, which does not involve soaking as in the gari production [3, 4].

The peels are also problematic to the environment when disposed. They ferment or decay to give out foul odor, and are poisonous when inhaled by man or animals when dumped in a large amount near households.

The aim of this research was to characterize cassava waste water in order to assess its possible use. The waste water was characterized for its ability to remove rust from rusty nails, and the waste water was also analysed by GC-MS.

II. MATERIALS AND METHOD

Cassava (*Manihots calentacrantz*), dichloromethane, Gas chromatography quadrupole mass spectrometry (GC-Q/MS), GC-2010 Ultra (Shimadzu) and the mass spectrometer GCMS-QP2010 SE (shimadzu), equipped with a split/split less injector.

Sample Collection

Cassava used in this study was bought from Amassoma Community in Southern Ijaw Local Government Area of Bayelsa State, Nigeria The cassava was first peeled and then washed with ordinary water to remove foreign material present (dirt and sand). The washed cassava was soaked in two different buckets (plastic and stainless steel) of water and allowed to ferment for one week. The fresh foo-foo was removed and the organic compounds were extracted with dichloromethane by liquid-liquid extraction from the waste water.

Sample Preparation (Liquid-Liquid Extraction with Dichloromethane)

Liquid-liquid extraction of the aqueous solution of the cassava waste water (20 mL) was carried out using 20 mL of dichlorormethane. This was repeated and the organic phases collected. The total volume (40 mL) of the organic phase was pre-concentrated to 5 mL and this was analyzed using GC-MS.

GC-MS Analysis of Cassava Waste-Water

The waste water extracts were analysed by using a gas chromatography quadrupole mass spectrometry. A capillary column HP-FFAP (30 m × 0.25mm i.d, 0.25 mμ film thickness) was used with an injection volume of 1μL. The temperature was programmed as follows: temperature was held at 50°C for 5 min and then programmed to rise from 50°C to 200°C, at 3°C/min, held at 200°C for 10 min and then programmed to go from 200°C to 240°C, at 10°C/min and finally, it was held at 240^{o}C for 20 min. The carrier gas was helium at 49.5kpa, which corresponds to a linear speed of 15.5 cm/s.

Rust Removal with Cassava Waste Water

2 L of cassava waste water was added to some pieces of rusty nails in a pot and boiled for 20 min. The nails were brought out, cooled and a piece of metal was used to scrape the nail and the result was recorded. 2 L of water was added to some pieces of rusty nails in a pot and boiled for 20 min. The nails were brought out, cooled and a piece of metal was used to scrape the nail and the result was recorded.

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III. Results and Discussion

Figures 1, 2, 3 respectively shows the chromatogram of neat dichloromethane (blank), dichloromethane-extract of cassava waste-water from plastic bucket, dichloromethane-extract of cassava waste-water from stainless steel bucket. Table 1 shows the concentration of organic compounds found in the dichloromethane-extract of cassava waste water. Figure 1 does not show any peaks found in Figures 2 and 3 indicating that the organic compounds shown in Figures 2 and 3 were from the cassava waste-water, and not from the blank (dichloromethane). Figure 3 does not show peaks 8 and 10 corresponding respectively to dibutyl phthalate and bis (2-ethylhexyl) phthalate in observed in Figure 2 and this observation showed that these compounds (plasticizers) may have leached from the plastic container to the waste-water.

Teeguarden [5] studied and attributed some toxicity (via inhalation) to n-butyl acetate, n-butanol, and/or nbutyric acid in rats. Thijssen [6] studied the effect of stearic, oleic, and linoleic acids on serum lipoprotein profiles in rats. Gaba´s-Rivera [7] verified the influence of genetic background and long-term administration of squalene on mouse plasma parameters and lipoprotein distribution in different mouse models. Zeng [8], through their studies, showed that DBP accumulated in subcutaneous tissue (sweat gland, hair follicle) and viscera being rich in fat (liver kidney) and DBP could overcome several physiological barriers to penetrate testes.

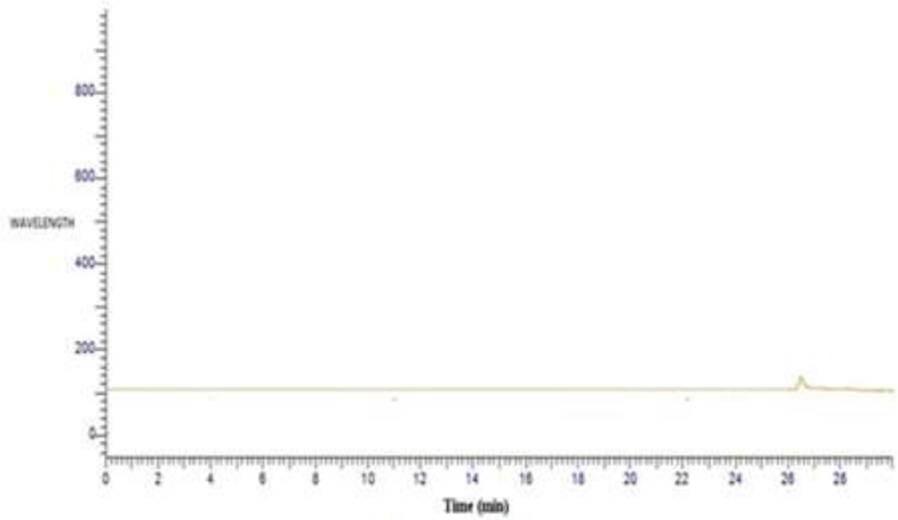

Figure 1. Chromatogram of neat dichloromethane

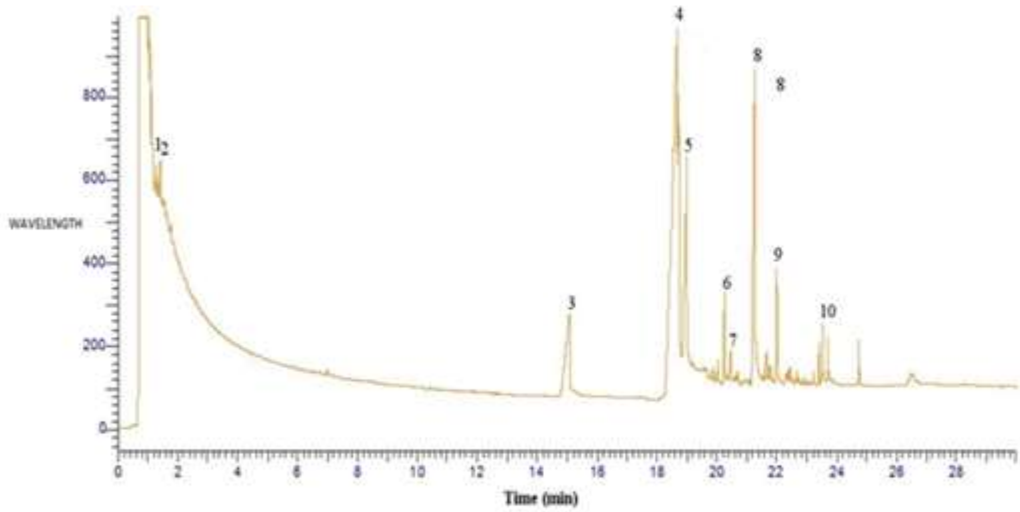

Figure 2. Chromatogram of dichoromethane extract of cassava waste water.
1 = 3-pentene-2-ol, 2 = 1-butanol, 3 = 3-hexanol, 4 = octadecanoic acid, 5 = oleic acid, 6 = n-hexadecanoic acid, 7 = acetoin, 8 = di-butyl phthalate, 9 = squalene, 10 = bis (2-ethylhexyl) phthalate . Fermentation container, plastic bucket

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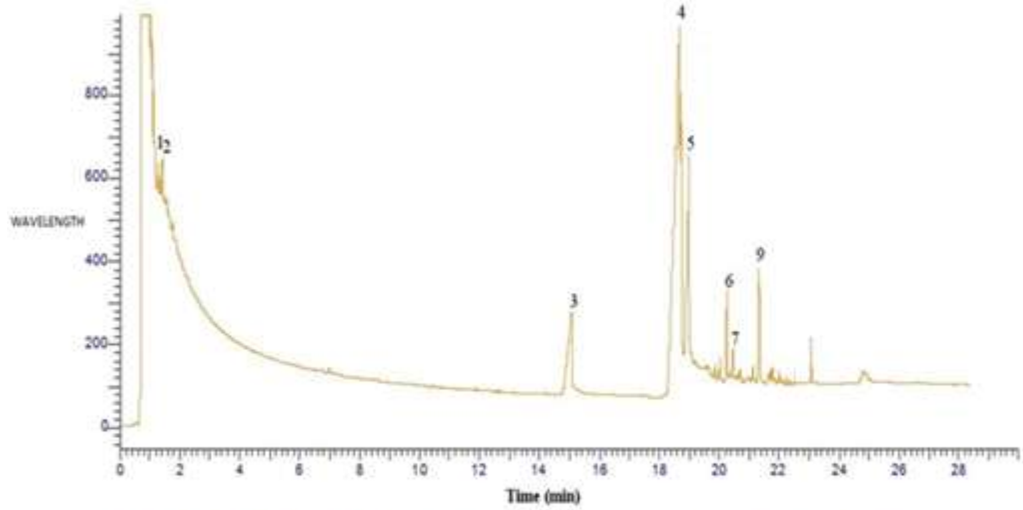

Figure3. Chromatogram of dichoromethane extract of cassava waste water.
1 = 3-pentene-2-ol, 2 = 1-butanol, 3 = 3-hexanol, 4 = octadecanoic acid, 5 = oleic acid, 6 = n-hexadecanoic acid, 7 = acetoin, 9 = squalene. Fermentation container, stainless steel bucket

TABLE 1. Concentration of organic compounds

Component	Concentration in ppb
3-penten-2-ol	276.007
1-butanol	259.561
3-hexanol	95.897
Octadecanoic acid	495.085
Oleic acid	135.546
n-hexadecanoic acid	71.417
Acetoin	362.956
Dibutyl phthalate	140.801
Squalene	76.9188
Bis(2-ethylhexyl) phthalate	73.686

Figures 4, 5, and 6 show the results of the rust-removing tests; Figure 4 shows the rusty nails, Figure 5 shows the results of the rusty nails boiled with water; Figure 6 shows the results of the rusty nails boiled with cassava waste water. The rusty nails boiled with water remained rusty while the one boiled with cassava waste-water became cleaner.

Figure 4. Rusty nails

Figure 5. Rusty nails boiled with water

Figure 6. Rusty nails boiled with cassava wastewater

IV. Conclusion

It is shown, by this research work, that cassava waste water contains n-butyl acetate, n-butanol, n-butyric acid, stearic, oleic, linoleic acids, squalene and these have been known to affect the health of mouse and rats adversely. Cassava waste water has also been shown to display rust-removing capabilities. Although, phthalates were detected in the waste water, they may have leached from the plastic

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container used in fermenting the cassava; and not from the cassava waste water.

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