

INVESTIGATION INTO THE EFFECT OF CYANIDE AND HEAVY METAL CONCENTRATIONS FROM CASSAVA PROCESSING EFFLUENT ON OKRA

Antia, Orua¹; Antia, Emem²; Olosunde, William³

Department of Agricultural and Food Engineering, University of Uyo, Nigeria¹;

Department of Chemical and Petroleum Engineering, University of Uyo, Nigeria²;

Department of Agricultural and Food Engineering, University of Uyo, Nigeria³

Corresponding author: Antia, Orua, Email: oruaantia@yahoo.com

ABSTRACT

Okra is a very essential crop as it could be used for various purposes of economic importance including being eaten to provide the human body with nutrients. It is therefore necessary to investigate into the effect of cyanide and heavy metal from cassava processing effluent on the okra grown on cassava effluent affected soil. In this study, okra seeds were purchased and planted in soil conditioned and kept in containers. Three out of six containers were taken as control while the others were for watering using cassava effluent as against effluent free water for the control. The okra on maturity were harvested and analyzed for cyanide and heavy metal contents. The data obtained were presented in a bar chart for comparison with WHO/FAO acceptable limit. The result showed that, apart from zinc, all other heavy metals and cyanide considered in the cassava effluent, affected the okra to a level that, if eaten, may pose serious health challenge based on acceptable standard by WHO/FAO.

Keywords: Cyanide, Heavy metal, Cassava, Okra, Soil.

1. INTRODUCTION

Cassava is in the family of *Euphorbiaceae*. Apart from rice and maize, it is the next largest source of food carbohydrate. It is believed to originate from

south-American forest; and it can reach a height of 2–4 m on maturity. It can thrive from sea level to elevation of about 3500 ft (1067 m); and may not flourish at height of 4000 ft (1219 m) [1]. They are used in processing different types of products, using different methods. Some of these products are garri, starch, tapioca, chips and fufu. The waste water generated from cassava processing contains a major toxic component called cyanide. The inhibitory action of cyanide in cassava food could cause health challenge. The peeled out cover of cassava is a problem to the environment when disposed to the land. It ferments or decays and gives polluted foul odour which is poisonous if inhaled by animals or man. Therefore they cause infection and land problem which could take a long time to notice, rendering the soil unproductive, as a result of biological and chemical reactions that takes place between the continuously fermenting peels, soil and the surrounding vegetation [2]. The effluent from cassava processing is mostly discharged freely on land especially when processed domestically. The land in most cases is used in planting crops for domestic use and commercial purposes. However, it should be noted that despite the presence of some harmful elements in the discharged waste water from cassava processing, the waste water could generally assist crops such as okra not to lack water for their growth. The okra (*Abelmoschus esculentus*) is a

very important economic crop and its seed contains oil and protein apart from other components. The okra can grow to be up to 20 cm long. Okra is rich in pectin. It also contains calcium and iron. The fresh fruit has vitamin A. Generally, harvesting of the fruit should be when it is young. This is because as the fruit becomes older, it would become more fibrous. The okra could be cooked or ground into meal. It may also be used in bread making [3, 4, 5]. The calyces, leaves, flower and flower buds could be cooked as greens and be eaten. Okra is of great importance as it can, in addition, be used in flavouring. It can help to control blood sugar because it contains special fibre. The leaves may be dried and then crushed into powder for use. The valuable nutrients in okra fiber could help to ensure that intestine functions properly; as the nutrient could assist the intestinal microorganisms to work well. The edible oil in the seeds of okra could be up to 22% [6, 7, 5]. The seed can be used in coffee as a non-caffeinated substitute, water purification as aluminum salts, substitute as antispasmodic and stimulant [8, 9, 10]. The root and stem could be used to clean cane juice of which haggard could be prepared. The matured fruits and stem contain crude fibre that could be used in paper industry, as rope, biogas and fuel. The mucilage in okra could help in washing off blood cholesterol and toxic substance present in the liver. The fruit mucilage could be also be used in the treatment of dysentery, diarrhea, stomach irritation, bowel and kidney infection, drysuria, gonorrhoea, etc. The roots of okra are also rich in mucilage [8, 11]. Since okra is of economic importance and has immense contribution to health of human, it is necessary for okra to be grown in condition(s) that would minimize contamination from waste water on its composition. Generally, the waste water from cassava processing has to be disposed and it contains some harmful elements. However, there is recommended threshold level of some trace elements for crop production. Therefore, this study investigates to know if cyanide discharge from cassava processing waste effluents is absorbed and retained by okra plant at a level that can affect human after consumption of the okra. The result obtained would enhance safety awareness to the environment and may also facilitate possibility of having method(s) of reducing the effects of the discharging of cyanide from cassava processing waste water into the soil.

2. MATERIALS AND METHODS

2.1 Materials and Equipment

Raw material used in this research is okra (*Abelmoschus esculentus*). The apparatus involved in the experimental were burettes, pipettes (1 ml, 10 ml, 25 ml), mercury-in-glass Celsius thermometer, pH-meter (HACH model), water-checker, conical flasks, beakers, white polyethylene bottles, steam bath, oven, desiccator, emission-photometer (FEP), Atomic absorption spectrophotometer (AAS) and Unicam 8625 uvvis spectrometer.

2.2 Methods

(i) Sourcing of Materials

The dried seeds of okra ladies finger (*Abelmoschus esculentus* (L). *moench*) planted was purchased in a market in Uyo, Akwa Ibom State, Nigeria for this study.

(ii) Effluent Sample

The untreated effluent from cassava processing plant in Uyo, Akwa Ibom State, Nigeria was collected in a two litre container and was taken to laboratory for analysis. The physicochemical properties of the sample were analyzed following the standards methods of APHA [12].

(iii) Conditioning of Soil

The soil was tested and ensured to have same profile and was transferred into six-containers meant for planting of okra seed samples.

(iv) Determination of Soil Profile

The pH was measured with standard portable pH meter.

(v) Determination of Cyanide

Total cyanide was determined according to Wang and Filled methods [13].

(vi) Determination Heavy Metal Concentrations in Cassava Effluent

Determination of heavy metals such as lead chromium, zinc, nickel, iron and copper were done using atomic absorption spectrophotometer (AAS) based on standard methods described by APHA [12] and [14].

(vii) Experimental Procedure

Okra seeds were planted in soil conditioned and put into six containers. Three containers were the control while the remaining three were for watering using cassava effluent water as against effluent free water for the control. At maturity, the cyanide and heavy metal concentrations in the okra were analyzed and data generated [13, 14, 12]. Bar chart based on the data obtained was developed and used in comparing the contents of cyanide and heavy

metals with respect to okra planted in effluent affected soil and effluent free soil. The values obtained were also compared with the recommended safe limit by WHO/FAO.

3. RESULTS AND DISCUSSION

The values of cyanide/ heavy metals concentrations present in the okra compared with the acceptable safe limit by [15, 16] are presented in Figures 1.

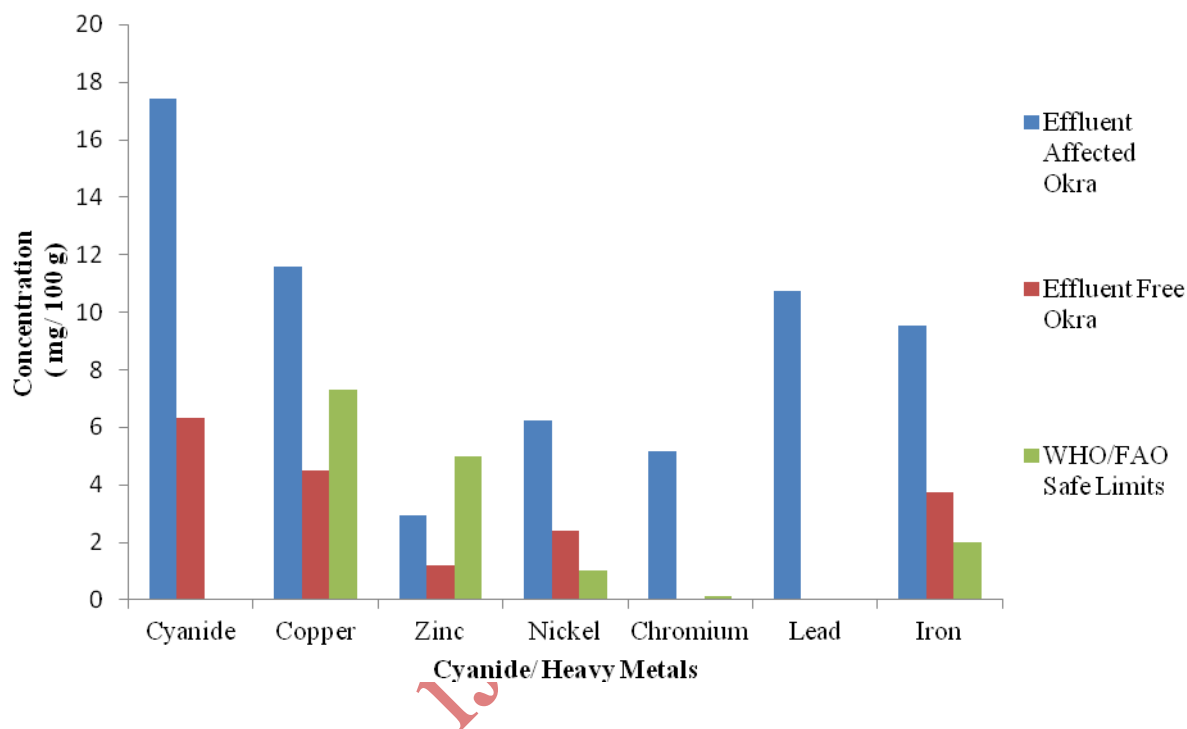


Fig 1: Bar showing cyanide/heavy metal concentrations in both effluent affected and effluent free okra (control)

From Figures 1, the concentrations of cyanide in effluent affected crops were higher than effluent free crops. Okra recorded had the highest value (17.41 mg/100g) of CN content while maize had the least content (17.41 mg/100g). Cyanide has the tendency to form complexes thereby inhibiting the activities of enzymes. The observed content of cyanide in effluent affected crops may be detrimental to human and livestock health.

Concentrations of copper in effluent affected crops (excluding maize) recorded the highest value when compared to that of the control and WHO/FAO safe limits (7.3 mg/100 g). Effluent affected okra 11.61 mg/100g while effluent free okra recorded 4.52 mg/100g. Cu as micronutrient can act as biocatalyst and may be required for pigmentation of the body. The Fe helps to prevent anaemia and

also maintain the central nervous system health [17]. The observed value in effluent affected okra may pose health challenge.

Concentrations of zinc in effluent affected okra were higher than that of the control but lesser than WHO/FAO safe limits (5.0 mg/100 g). Effluent affected okra had 2.93 mg/100g while effluent free okra recorded 1.18 mg/100g respectively. The least toxic element is therefore Zn. However, in diet, Zn is one of essential elements; and functions in maintaining the immune system. Zinc deficiency can be detrimental to the health of human; while excess of zinc may cause renal damage, vomiting, cramp, etc. Zinc could help to prevent growth retardation and sexual maturation delay. It is very useful in the protein synthesis and nucleic acid metabolism. In men and women, the dietary

recommended allowance for zinc is 15 and 12 mg /day, respectively [18, 19]. Concentrations of nickel in effluent affected okra recorded the highest values when compared to that of the control and WHO/FAO safe limits (1.0 mg/ 100 g). Effluent affected okra had 6.23 mg/100g while effluent free okra recorded 2.40 mg/100g. Nickel has a role to play in the health of human and animal. The observed values may therefore be detrimental. Concentrations of chromium in effluent affected crops recorded the highest values when compared to that of the control and WHO/FAO safe limits (0.13 mg/ 100 g). Effluent affected okra had 5.19 mg/100g while effluent free okra recorded 0.032 mg/100g. When excess chromium is taken through foodstuff, it may cause chronic accumulation of the heavy metal in the liver and kidney. This would result in having disruption of some biochemical processes. Hence, could lead to disease in nervous, bone, cardiovascular and kidney [20]. The observed concentration may pose health problem to human. Concentrations of lead in effluent affected okra recorded the highest values when compared to that of the control and WHO/FAO safe limits (0.03 mg/ 100 g). Effluent affected okra had 10.72 mg/100g while effluent free okra recorded 0.013 mg/100g. Plant lead concentrations tend to increase with increasing soil lead. It is necessary to note that when lead as soil contaminant could get accumulated with age in the aorta, liver, bone, spleen and kidney. In most cases, the source of lead into the body is from the uptake of 65%, 20% and 15% food, water and air, respectively. Lead can cause severe health challenge. Concentrations of iron in effluent affected okra recorded the highest values when compared to that of the control and WHO/FAO safe limits (2.0 mg/ 100 g). Effluent affected okra had 9.53 mg/100g while effluent free okra recorded 3.76 mg/100g. When iron is present in excess, it can help to cause pulse rate increase, coagulation of blood in the vessels, hypertension and drowsiness [21]. The observed value in effluent affected crops may cause health challenge.

4. CONCLUSION

Concentrations of cyanide and heavy metal with exception of zinc in effluent affected okra when compared with the control and WHO/ FAO safe limit. However, okra had the metal concentration in the order as follows: Cu > Pb > Fe > Ni > Cr > Zn.

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