NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 54 Number 2, December 2023 Pg. 155-161
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org.ng

Fermented Cassava Processing Effluents as Soil Conditioners Modulate the Growth and Biochemical Compositions of Black Nightshade

***[1]Ojewumi, A.W., [2]Sanusi, J. F.O., [1]Olawale, T. H., [1]Tope-Akinyetu, R. O. and [1]Omolokun, K.T.**

[1]Department of Botany, Lagos State University, Badagry Express Way, Ojo Lagos
[2]Department of Biological Sciences, Crescent University, Abeokuta, Ogun State, Nigeria
Corresponding author's mail: anthony.ojewumi@lasu.edu.ng; ojewumianthony@yahoo.com

Abstract
This experiment investigated the effects of varying levels of cassava processing effluents (25, 50, 75, and 100%) of Lafun effluent (LE), Gari effluent (GE) and Akpu effluent (AE) and distilled water (control) on growth and nutritional compositions of black nightshade. Sodium (128.75mg/100g), calcium (68.15mg/100g), potassium (56.50mg/100g) and magnesium (29.70mg/ 00g) were significantly higher ($p<0.05$) in GE compared with other levels of effluents. Plant height (48.17cm) was higher ($p<0.05$) in the black nightshade applied with 25% GE as well as the number of leaves (89.67) in control. Leaf area (228.05cm^2), specific leaf area (116.25m^{2}kg^{-1}), leaf area index (16.90m^{2}m^{-2}), relative growth rate (0.214 mg-1day-1), net assimilation rate (0.009 gm^{-2}day^{-1}) and leaf area ratio (0.83 m^{2}kg^{-1}) showed significant increase in the vegetable applied with 100% GE. Also, 75% of AE produced higher fat (0.22%) ash (0.93%), crude fibre (1.83%), crude protein (2.21%) and carbohydrate (1.78%). Niacin (0.99 mg/100g), ascorbic acid(12.81mg/100g) and tocopherol (0.91 mg/100g), as well as sodium (11.89mg/100g), potassium (439.10mg/100g), calcium (45.07 mg/100g), magnesium (41.28 mg/100g) and phosphorus (106.91mg/100g), showed significant increase in the vegetable applied with 75% LE. In conclusion, 25 % GE and control improved morphological parameters while 75 % AE and LE enhanced the physiological and nutritional attributes of the vegetables.
Keywords: Cassava wastes, soil amendments, cassava effluents, soil nutritional profile, soil properties, and growth components

Introduction

Nightshade *(Solanum nigrum L)* is a dicot. vegetable belonging to the Solanaceae family. It is one of the underutilized vegetables (Jain *et al*., 2011). The vegetable is a source of several metabolites, making it a suitable food source, pharmacological reservoir as well as fodder for domestic herbivores (Akubugwo *et al*., 2007). Despite the huge economic importance of neglected vegetables, many of them including black nightshade are going on extinction due to poor cultivation, the influence of unevenly distributed organic soil contents, unhealthy soil health status and the presence of effluents of agricultural products such as cassava. In most cases, the effluents are poured indiscriminately on the farmlands during the processing of farm products such as cassava (Gari, Lafun, Fufu and Akpu) (Oti. 2002). The effluents and other products such as peels are major waste products generated during the processing of cassava tubers. Other products such as latex, wash water, and milky colloids extracted from cassava tubers are released into the environment indiscriminately and act as pollutants on herbaceous plants (Olorunfemi *et al*., 2008; Agwaranze *et al*., 2018). The aforementioned cassava-generated pollutants have become more pronounced due to the increase in population and high demand for cassava products (Agwaranze *et al*., 2018).

Based on technological advancement, specific mills such as cassava mills are now being developed to process cassava tuber into various products such as Gari and Fufu, but the technology has not taken care of sustainable management of wastes generated through the process. The cassava mill wastes are discharged into farmlands and emit a foul smell to the environment without a proactive approach towards curbing or sustainably managing the menace (Olorunfemi *et al*., 2008). In addition, the increasing cassava cultivation with a harvest target of 150 million tons annually and the establishment of hundreds of cassava processing centres in Nigeria (International Institute of Tropical Agriculture, International institute of tropical agriculture (2011) has resulted in the generation of various cassava effluents without proper waste management culture. Also, indiscriminate disposal of the effluents has been reported to have nutrient-

depleting effects on land and physiological processes such as dormancy and retardation of morphological characters on plants (Olorunfemi *et al*., 2008). On the other hand, effluents from cassava processing firms are regarded as harmless waste water which is allowed to spread over farmlands to improve soil contents, enhance the eco-friendly environment and boost soil nutritional contents (Olorunfemi *et al.* 2008; Nwakaudu *et al*., 2012).

Nevertheless, continuous discharge of the effluents into the farmland for a long period may have devastating effects not only on the floral parts but also on the physiological process as well as nutritional compositions of vegetables *(*Oboh*et al*., 2002). Therefore, there is a need to harness the sustainable use of these effluents towards the production and nutritional quality of black nightshade. The present study therefore investigated the effects of cassava processing effluents as soil conditioners on the growth and biochemical compositions of black nightshade

Materials and methods

Study Area

The study was conducted in the greenhouse of the botanical garden, Department of Botany, Lagos State University, Ojo campus. The garden lies on latitude 06.4667°N and longitude 003.1994°E.

Sources of Seeds and effluents

Matured seeds of black nightshade were collected from local farmers in Okeho, Oyo State, Nigeria. The seeds were identified at the Forestry Research Institute of Nigeria, Ibadan. Cassava (TME 419) effluents were collected from a local cassava processing factory located at Ipari Oda, Okeela Street Ilaro, Abeokuta expressway, Ogun State. The coordinates of the factory are latitude (6.8882°N) and longitude (3.0345°E). The TME 419 effluents were selected because it is the most cultivated cassava variety in the area.

Determination of nutritional contents of cassava effluents

Minerals elements (Ca, Mg, Fe, Cu and cyanide) in the effluents were determined using an Atomic absorption spectrometer) (AOAC 1995) while Na and K were determined using a flame photometer (AOAC 1995).

Soil Collection and preparation for planting

The method described by the National Soil Characterization Database of the United States Department of Agriculture, modified by (Vijay*et al*., 2019) was used to collect the soil used.

Nursery preparation

Seedlings of black nightshade were raised in the greenhouse for 21 days. The seedlings were randomly transplanted into the planting buckets (one seedling per bucket) when they were 17 cm high. The seedlings were thereafter watered for another week to ensure their acclimatization to the planting buckets as described by (Ojewumi *et al,* 2022).

Determination of different levels of cassava effluents

Cassava effluents were prepared by modifying the method of Olorunfemi *et al*. (2008). Lafun, Gari and Akpu effluents obtained were sieved to remove dirt. In each case, 1000 mL effluent of each product was measured using a measuring cylinder and used to constitute different levels of effluent of cassava products. 250, 500, 750 and 1000 mL Lafun effluent (LE) were diluted in 750, 500- and 250-mL distilled water to constitute 25, 50 and 75% effluent. 100 mL of 1L of each effluent was regarded as 100 %. The same procedure was repeated for Gari (GE) and Akpu effluents (AE). Distilled water served as control.

Experimental design

The experiment was 3 x 4 factorial combinations of three types of effluents and four levels of each. The buckets were arranged in a Randomized Completely Block Design with five replications. One hundred ml (100 mL) of each treatment prepared was exogenously applied daily on the seedlings for eight weeks.

Data collection

Morphological characters

Plant height was determined using a meter rule calibrated in centimetres (cm). The number of leaves was determined using physical count at two-week intervals (Ojewumi *et al*., 2022). Fresh leaf weight was determined using a digital Mini scale (Model- MT 1000, TN series).

Physiological parameters

The total leaf area was determined using LI-3000 C Portable Leaf Area Meter by DMP Ltd. Using the leaf area and weight of leaves, specific leaf area (SLA) and leaf area index (LAI), relative growth way (RGR), Net Assimilation Rate (NAR)and Leaf Area Ratio (LAR)were computed as described by (Alireza *et al*., 2012).

$$\text{Specific leaf area} = \frac{\text{Leaf Area (LA)}}{\text{Corresponding Weight Of Leaf (WL)}}$$

$$\text{Leaf Area Index} = \frac{\text{Leaf Area (LA)}}{\text{Area Of Litter} - \text{Fall}}$$

$$\text{RGR} = \frac{\text{LogeW 2} - \text{LogeW 1}}{t2 - t1}$$

W_1= first measured weight (g) W_2= second measured weight (g) T_1= initial time (weeks),
T_2= final or second time (weeks)

$$\text{NAR} = \frac{W2 - W1}{A2 - A1} \cdot \frac{\text{Loge A2} - \text{Loge A1}}{t2 - t1}$$

$$\text{LAR} = \frac{W2 - W1}{t - t1} \cdot \frac{\text{Loge A2} - \text{Loge A1}}{W2 - W1}$$

A_2= Area of leaf at t_2, W_1= first measured weight (g), W_2= second measured weight (g)
T_1= initial time (weeks), T_2= final or second time (weeks)

Determination of chlorophyll contents in black nightshade eaves

Chlorophyll a and chlorophyll b were determined using spectrophotometry (Metzner *et al* 1965) cited (Dawood *et al*., 2014).

Determination of nutritional contents in black nightshade leaves

Crude fat: Two grams of a crushed sample of nightshade leaves were kept using a paper thimble in a known weight fat extractor. Approximately, 80 ML of $C_6H_{14}$was further added, refluxed, allowed to cool and weighed.

The crude fat was determined by the formula shown below.

$$\text{Crude fat (\%)} = \text{Flask weight} \times 100$$

Moisture: moisture was calculated using the formula below;

$$\text{Moisture} = \frac{\text{weight of the sample before drying} - \text{weight of the sample after drying}}{\text{Weight of the sample before drying}} \times 100$$

Crude fibre: Two grams (2g) each of the defatted samples of the black nightshade leaves were boiled in 20 ML of 1.25 % H_2SO_4 for 30 minutes. Thereafter, the contents were filtered, washed thoroughly in hot water and boiled using 200 ML of 1.25 % NaOH for 30 min. The spotless beaker was dried (100±5°C), and the weights of the contents were determined. Both the spotless beakers with their content were dried using a muffle furnace (9320F-11120F) for 2-4 hours, cooled and weighed. The crude fibre was determined using the formula shown below;

$$\text{Crude fiber} = \text{Sample } 100$$

Total carbohydrate =100 – (%moisture + % fat + %protein + %fiber) (A.O.A.C 2000).

Total nitrogen (N) content was determined using Micro-Kjeldahl (Adarsh *et al*., 2013)

Crude protein: The total nitrogen was determined using Micro-Kjeldahl (Ojewumi *et al*., 2020). Protein content (%) was determined using the formula below

$$\text{Protein (\%)} = \frac{\text{Titter value} \times 1.4 \times 6.25 \times 0.1\text{N HCL} \times \text{Vol (used)}}{\text{Weight of sample} \times \text{Aliquot digested sample} \times 1000} \times 100$$

Determination of mineral elements in *black nightshade* ***leaves***

Two gram (2g) powdered samples of the vegetables were assayed for calcium, potassium, magnesium, zinc, iron, phosphorus and sodium using an Atomic Absorption Spectrophotometer (Perkin-Elmer Model 2280). The phosphorus content of the digest, total phosphorus and iron were determined by calorimetric methods (Mohammed *et al*., 2011).

Determination of Vitamins in *black nightshade* ***leaves***

β-carotene was determined following the procedure of A.O.A.C (2000) cited (Ojewumi *et al*., 2020). Two (2 g) powder samples were weighed, and 10 ml of distilled water was added and shaken thoroughly after which 25 ml of alcoholic KOH solution was added. The mixture was heated gently in the bath for one hour, shaken, and allowed to cool and 30 ml of water was added and the hydrolysate obtained was transferred into a separator funnel. The solution was extracted with 250 ml chloroform. Also, 2 g anhydrous Sodium sulphate was added to the extract to remove traces of water and filtered into a 100 ml volumetric flask and made up to mark with chloroform. Standard solution of B-carotene Vitamin A ranged from 0- 50 µg/ml with chloroform by dissolving 0.003 g of standard L-carotene in 100ml of chloroform. The above gradients of the standard solutions were determined and an average gradient was used to calculate **β** carotene in µg/100 g) using a Spectrophotometer at 328 nm.

Niacin: Five (5 g) of the sample was applied with 50 ml of 1 N 11 SO, and shaken for 30 minutes. 3 drops of the ammonia solution were added and filtered. Afterwards, 10 ml of the filtrate was added into a 50 ml volumetric flask followed by 5 ml of 0.02 N H_2S04, 470 nm.

Ascorbic acid: One gram (1g) of the samples was weighed and 10ml of oxalic acid (0.05 M)-EDTA (0.02 M) solution was added and placed in the sample for 24 hours to provide the required reaction time. After 24 hours, the samples were filtered through using 0.45 pm filter paper. Then 2.5 ml of each sample was transferred to a separate 25 ml volumetric brown flask, after which 2.5 ml of the oxalic acid (0.05M)-EDTA (0.02 M) solution was added. Also, metal phosphoric acid was added separately with acetic acid (0.5 ml), 1,50, (5% v/v) solution (1 ml) and ammonium molybdate solution (2ml) in each volumetric brown flask and the volume made up to 25 ml with distilled water. The absorbance was taken at 760 nm.

Tocopherol: One (1 g) of powder was weighed into a 250 ml conical flask, filtered after which 10 ml of absolute alcohol and 20 ml of IM alcoholic H SO_4 were added. The condenser and flask were wrapped in aluminium foil refluxed for 1 hour and cooled for another 15 minutes. Fifty (50 ml) of distilled water was added to the mixture and transferred to a 250 ml separating funnel covered with aluminium foil. The unsaponifiable matters in the mixture were extracted with 5 x 30ml dimethyl ether. The combined extracts were washed free of acid and dry evaporated at a low temperature and the residues obtained were dissolved in 10ml absolute alcohol. Aliquots of solutions of the samples and standards (0.3-3.0 mg vitamin E) were transferred to a 20 ml volumetric flask after which 5 absolute alcohol was added, followed by 1 ml conc. Nitric acid. The flasks were placed in a water bath at 90 °C for exactly 3 minutes from the time the alcohol began to boil, volume with absolute alcohol and absorbance was taken at 470 nm against a blank containing absolute alcohol and 1 ml conc. Nitric acid was treated in a similar manner A.O.A.C(2000).

$$\text{Tocopherol: (µg/100g)} = \text{Sample weight}$$

Determination of pantothenic acid in *black nightshade* ***leaves***

Three (3 g) of the sample were weighed into a 250 ml volumetric flask, shaken thoroughly with 200 m1 distilled water, diluted to mark to distilled water and filtered through. Whatman filter paper into a 100 ml volumetric flask. 5 ml of an aliquot of the filtrate was pipetted into a 2 ml beaker, 5 ml of 12 % potassium bromide (KBr), and 10 ml of KMNO4 were added and mixed thoroughly. The mixture was transferred to a stopper flask and put in a boiling water bath for 10 minutes. The hot solution was cooled in ice for 10 min and 20% freshly prepared H SO_4, was added dropwise to decolonize the excess $KMNO_4$ solution, 10 ml of 2,4 dimitrophenylmrazine (5 g/l) was also added and mixed thoroughly. The mixture was heated for 15 minutes in a steam bath and allowed to cool. The yellow precipitate obtained was dried for 30 minutes in an oven at 100 °C

and later dissolved in a hot pyridine solution and mixed thoroughly to form in homogenous suspension. The suspension was filtered through a Whatman filter paper into a 50 ml volumetric flask and made up to mark with pyridine solution. All aliquot of the solution above was pipetted into 200 ml of flask 50ml and distilled water was added, followed by 5 ml of 5M NaOH solution to develop the blue colour. The absorbance of the sample and standard pantothenic and solution were read at 570 nm.

Pantothenic acid (μgk) = Factor weight x 100

Determination of pyridoxine in black nightshade leaves

The pyridoxine content of the sample was determined by extracting 1 g of the sample with 0.5 g of ammonium chloride, 45 ml of chloroform and 5 ml of absolute ethanol. The mixture was thoroughly mixed in a separating funnel by shaking for 30 minutes, and 5 ml of distilled water was added. The chloroform layer containing the pyridoxine was filtered into a 100 ml volumetric flask and made up to mark with chloroform. 0-10 ppm of pyridoxine standard solutions were prepared and treated following the same procedure and absorbance was measured using a spectrophotometer at 415 nm. Pyridoxine was determined using the formula.

Pyridoxine (μg) = Factor weight x 100

Determination of Phylloquinone in black nightshade leaves

Five (5 g) of the sample was weighed into a 250 ml beaker and 30 ml of Butyl alcohol was added. The mixture was thoroughly shaken to obtain a homogenous solution. The resulting mixture was filtered through a filter paper into a 100ml volumetric flask and made up to mark with butyl alcohol. 10 ml aliquot of the filtrate was pipetted into a 30 ml centrifuge tube and 3 drops of 2, 4-dinitrophenyl hydrazine was added to develop the blue colour which will subsequently change to bluish green upon addition of 3ml of alcoholic ammonia. Standard solutions of Phylloquinone from 0-20 μg/ml were prepared and treated as samples to obtain a gradient factor. The Absorbances of standards and sample were read at 480mm

Phylloquinone(μg) = Factor weight

Statistical analysis

Statistical analysis Data were subjected to two-way analysis of variance using Statistical Analysis Software version 9.3 (SAS Institute Inc., Cary, NC., USA). Means were calculated using a one-way analysis of variance and separated using Duncan's Multiple Range Test(DMRT) at $P<0.05$.

Results and discussion

Results

Nutritional assessment of varying cassava processing effluents investigated showed significant increase ($p<0.05$) in sodium (128.75 mg/100g), calcium (68.15 mg/100g), potassium (56.50 mg/100g), magnesium (29.70 mg/100g), Iron (9.18 mg/100g) and cyanide (0.70 mg/100g) in Gari effluent compared with Lafun and Akpu effluents (Figure 1). Lafun, Gari and Akpu effluents at various levels produced significant effects on agronomic parameters of the black nightshade. Plant height (48.17 cm) was significantly increased ($p<0.05$) in black nightshade applied with 25 % GE (Table 1) as well as the number of leaves (89.67) in control at 8WAT (Table 2). Physiological parameters investigated in black nightshade were also significantly influenced by varying levels of Lafun, Gari and Akpu effluents. Leaf Area (163.15 cm^2), specific leaf area (56.72m^2kg^{-1}) and Leaf Area Index (12.08 m^2m^{-2}) were higher ($p<0.05$) in the vegetable applied with 100 % GE at 4WAT compared with other treatments. A similar significant increase was observed in the LA (228.05 cm^2), SLA (116.25 m^2kg^{-1}), LAI (16.90 m^2m^{-2}), RGR (0.214 mg-1day-1), NAR (0.009 $gm^{-2}day^{-1}$) and LAR (0.83 m^2kg^{-1}) (Table 3). Chlorophyll A (1.51 mg/g), Chlorophyll B (1.17 mg/g) and total Chlorophyll (2.68) revealed a significant increase in the leaves of the vegetable applied with 75 % LE compared with other levels of the treatments (Table 4). In the same trend, various levels of inclusion of cassava effluents inclusion produced significant effects on the proximate contents of the vegetable. Dry matter (6.17 %), fat (0.22%), ash (0.93%) crudefibre (1.83%), crude protein (2.21%) and carbohydrate (1.78%) were significantly higher ($p<0.05$) in the leaves of the vegetable grown under 75 % AE compared with other levels of the effluents (Table 5). Effluents of the cassava products produced significant variations in quantities of vitamins obtained in the leaves of the vegetable. Across the treatments, 75 % LE produced higher retinol (998.08 mg/100g), niacin (0.99 mg/100g), pantothenic acid (0.07 mg/100g), pyridoxine (0.28 mg/100g), ascorbic acid (12.81mg/100g), tocopherol (0.91 mg/100g) and phylloquinone (79.67 mg/100g) compared with other levels of the treatments (Table 6). Similar observations were noticed in the amount of mineral elements determined in the vegetable. Sodium (11.89 mg/100g), Potassium (439.10 mg/100g), calcium (45.07 mg/100g), magnesium (41.28 mg/100g), phosphorus (106.89 mg/100g) and zinc (1.23 mg/100g) were higher in the leaves of black nightshade applied with 75 % LE (Table 7).

Discussion

Exposure of plants to industrial effluents can accelerate or inhibit growth and other developmental processes of plants based on their nutritional contents. Nutritional assessment of different cassava processing effluents investigated in this study showed a significant increase in mineral elemental compositions of the effluents. These results indicated that cassava effluents contain appreciable nutrients that can enhance the growth and development of the vegetable or as a source of water for the vegetable most especially during drought by improving its water use efficiency (Olorunfemi *et al*., 2008). However, exposure of the effluents to the plants could be deleterious on the growth and biochemical compositions of plants including black nightshade, depending on their concentrations and duration of exposure. Lafun, Gari and Akpu effluents at various

levels of inclusions produced significant effects on the agronomic parameters of black nightshade. Higher height observed in the vegetable applied with 25 % GE may indicate the presence of an appreciable quantity of growth substances in the effluents, needed for the improvement of the agronomic character of the vegetable (Olorunfemi *et al*.,2011). The observation could also be attributed to the persistent effects of cassava effluent on plants including black nightshade growth. This is in agreement with the submission of Orhue *et.al*, (2014) who reported that the application of cassava effluent to soil improved the growth and yield of fluted pumpkin.

Physiological parameters investigated in black nightshade were significantly influenced by different levels of Lafun, Gari and Akpu effluents. Higher leaf area observed in the vegetable grown under 100 % GE implies that the treatments enhanced formation, development of leaves and induced nutrient assimilation as well as accumulation of pigments for photosynthates partitioning in the vegetable (Fanuel *et al*., 2012). Furthermore, higher RGR, NAR and LAR recorded in the vegetable applied with 100% GE could indicate that nutrients recorded in the effluents and their uptake enhanced the growth of the vegetable. This is in agreement with the submissions of Meshram *et al*., (2020) who opined that nutrient uptake enhanced stimulation of soil structure and seedling establishment. However, low morphological and physiological attributes observed in black nightshade grown under 100% AE could indicate toxicity of the effluent. This is in line with the findings of Olorunfemi *et al*. (2008) who reported that a high level of cassava effluent could be detrimental to the ecosystem. In addition, Olorunfemi *et al.* (2008) reported that indiscriminate pouring of cassava effluent at high concentrations on vegetables could affect their physiological processes such as dormancy, seed germination, photosynthesis, gaseous exchange and respiratory potential of the vegetable.

Higher chlorophyll types recorded in the leaves of black nightshade applied with 75 % LE could suggest the presence of adequate nutritional contents in the effluents suitable for pigments and other biochemical molecule formation. This is in line with the assertion of Mohamed *et al*., 2008) who claimed that chlorophyll content and photosynthates were biochemical molecules formed as a result of the influence of soil conditioners on pigments accumulation and assimilatory potential of leaves. Various levels of cassava effluent inclusion produced significant effects on the proximate and vitamin contents of the vegetable. Variations observed in the nutritional composition of the vegetable as affected by varying levels of inclusion of cassava effluents may indicate that proximate contents of the vegetable showed a certain level of disparity based on the level of inclusion of cassava effluents. Furthermore, higher levels of vitamins and minerals observed in black nightshade applied with 75 % LE indicate the treatment is the appropriate dosage which can release the maximum amount of mineral elements needed by plants to ensure proper growth and development of their metabolites required by consumers of the vegetable. Higher mineral elements observed in black nightshade leaves as affected by 75% of the effluents implies that the treatment can enhance the vegetable to maintain the recommended dietary allowance RDA (in terms of mineral elements (Acipa, *et al*., 2013) needed to maintain intracellular and extracellular cations used in the regulation of plasma volume, acid-base balance, nerve and muscle contraction (Akpanyung *et al*., 2005).

Conclusion

In conclusion, 25 % GE and control improved morphological parameters while 75 % LE and AE enhanced the physiological and nutritional attributes of the vegetables therefore the use of the effluents of the products in a sustainable manner is encouraged.

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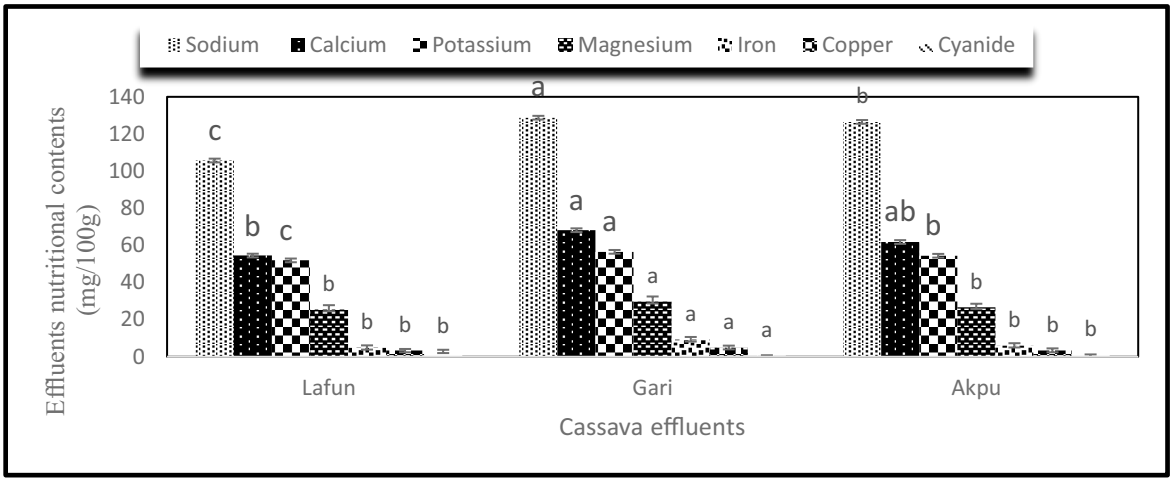

Figure 1: Mineral compositions of cassava effluents
Differences in lowercase letters on bars each week indicate significant differences among treatments at p<0.05

Table 1: Effects of different levels of cassava effluents on the height of black nightshade at various weeks

Cassava products	Effluent levels (%)	Weeks after treatments			
		2	4	6	8
LE	25	23.26±1.68^{bc}	30.10±1.90^{bc}	31.30±.94^{bc}	33.63±2.72^{cd}
	50	18.58±2.32^{c}	26.50±1.32^{cd}	28.70±1.39^{c}	34.74±4.02^{c}
	75	21.20±1.11^{bc}	31.80±2.58^{bc}	30.30±3.26^{bc}	35.60±2.24^{c}
	100	21.40±1.55^{bc}	37.64±1.634^{ab}	31.30±3.15^{bc}	33.90±2.90^{cd}
GE	25	30.33±1.45^{a}	41.00±3.46^{a}	44.67±2.85^{a}	48.17±4.11^{a}
	50	28.93±3.61^{ab}	37.33±0.33^{ab}	34.13±0.13^{bc}	35.33±7.06^{c}
	75	19.00±3.79^{c}	30.83±2.35^{bc}	33.67±6.67^{bc}	36.67±5.77^{c}
	100	26.50±1.33^{abc}	37.83±1.48^{ab}	38.00±2.00 ^{b}	40.33±0.88^{bc}
AE	25	26.14±1.18^{abc}	21.80±2.96^{d}	27.60±1.16 ^{c}	35.90±4.18^{c}
	50	27.70±1.45^{ab}	28.30±2.19^{c}	29.20±1.50^{c}	43.10±4.97 ^{b}
	75	32.00±3.85^{a}	27.12±0.97^{c}	28.80±1.66^{c}	35.50±5.89^{c}
	100	29.40±4.13^{ab}	29.00±2.80^{bc}	30.30±3.36$^{b\ c}$	39.40±1.91$^{b\ c}$
Control (Water)	Control (Water)	21.00±0.58^{bc}	28.17±3.47^{cd}	32.83±1.74$^{b\ c}$	33.00±6.08^{cd}

Means ± standard errors followed by different superscripts in the same column are significantly different at p < 0.05. LE= Lafun effluent, W= Water, GE= Gari effluent, AE= Akpu effluent.

Table 2: Effects of different levels of cassava effluents on the number of leaves of black nightshade at various weeks

Cassava products	Effluent levels (%)	Weeks after treatments			
		2	4	6	8
LE	25	22.00±3.50^{d}	37.00±4.03^{d}	40.60±4.06^{d}	49.50±3.86^{e}
	50	17.20±2.87^{de}	45.60±3.80^{c}	48.60±4.73^{c}	56.60±5.52^{d}
	75	14.60±0.93^{e}	38.00±3.49^{d}	42.00±7.71^{d}	54.80±4.19^{d}
	100	17.60±3.41^{de}	61.40±7.67^{ab}	71.00±10.96^{ab}	80.40±5.05^{b}
GE	25	31.67±3.84^{b}	65.67±6.69^{a}	76.67±6.69^{a}	82.33±5.93^{b}
	50	22.00±4.36^{d}	63.33±8.09^{ab}	60.67±2.91^{b}	74.67±4.37^{bc}
	75	17.33±2.40^{de}	61.67±9.94^{ab}	71.33±18.84^{ab}	83.67±4.70^{b}
	100	18.67±0.88^{bcd}	33.00±7.94^{e}	41.33±1.67^{d}	51.00±.58^{e}
AE	25	21.80±2.25^{d}	21.40±6.17^{f}	42.60±1.66^{d}	61.20±3.81^{c}
	50	30.00±4.91^{b}	35.40±3.88^{de}	40.20±1.11^{d}	65.20±8.59^{c}
	75	32.25±7.10^{b}	35.80±1.46^{de}	39.60±1.75^{e}	49.40±11.00^{abc}
	100	43.20±6.31^{a}	51.60±3.31^{bc}	58.60±4.71^{bc}	61.60±4.40^{c}
Control (Water)		28.67±2.96^{c}	56.00±9.07^{b}	77.00±5.03^{a}	89.67±12.11^{a}

Means ± standard errors followed by different superscripts in the same column are significantly different at p < 0.05. LE= Lafun effluent, W= Water, GE= Gari effluent, AE= Akpu effluent.