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EFFECT OF ORGANIC FERTILIZER ON NUTRITIONAL STATUS OF *Hibiscus sabdariffa* AT A VEGETATIVE STAGE OF GROWTH

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ABSTRACT

Field experiment was conducted at Research Farm of Kano University of Science and Technology, Wudil, to determine the effects of organic fertilizer on the nutritional status of Hibiscus sabdariffa (Roselle). The results obtained indicated the manure fertilizer to be higher in protein (20.910%) and crude fiber contents (12.047%), Zn (30.689mg/kg) and Cu (18.571mg/kg) concentrations, no Pb was detected at all. However, the difference that exists amongst the fertilizers (T2 and T3) and poultry manure (T1) was found to be insignificant in so many parameters. Therefore, the study work with regard to the findings revealed that organic fertilizer (poultry manure) had the potential over the inorganic fertilizers for the dietary nutrients yielding in vegetables Hibiscus sabdariffa. However, the information will economically favor our local farmers and users to adapt the cheapest poultry manure for the optimum yield of qualitative produce vegetable as prospective against malnutrition in Nigeria especially North East where endemically affected by war.

Key words; Roselle leaves, vegetative stage, proximate analysis, elements, Kano

INTRODUCTION

Multitude factors can lead to malnutrition. These include poverty which prevents accessibility to nutritious food and basic farm inputs and also non reliable source in supplying food throughout the year. With an increase in the cost of mineral fertilizer and their future availability, there is renewed interest in organic recycling to improve soil fertility and productivity (Parr and Hornick, 1990). Evidence has shown that, indigenous vegetables offer a significant opportunity for the poorest people to earn a living as producers without requiring large capital investments (Schippers, 2000). Ali and Abdel-Mouty (2000) reported that, applying significant amount of organic matter becomes necessary in improving soil physical and chemical conditions. Vegetables are widely grown in the North- Eastern and middle belt regions of Nigeria (Akanya *et al*., 1997).Vegetables nutritive value depends in part on the soil and climate in which they are grown. Roselle has been found to thrive on a wide range of soil conditions. It can perform satisfactorily on relatively infertile soils but for economic purposes, a soil well supplied with organic materials and essential nutrients is essential (Tindal, 1986).

The World Health Organization had issued reports claiming that correct fresh vegetables produce intake alone could save 2.7 million lives a year and that 31% of heart disease cases are due to an insufficient intake of such foods (Johnston *et al*., 2006). Indigenous leafy vegetables such as *Hibiscus sabdariffa* (roselle), kenaf, spinach and amaranth, serve as indispensible constituents of the human diet (Ogunlesi *et al.,* 2010).

This work was carried out to exploit the feasibility of using organic fertilization as a substitute to mineral fertilizer for growing the dietary crops. There is an increasing demand for the organically produced vegetables, for their health and nutritional values. However, there is scanty information to encourage the usage of an environmentally friendly and economically cheap fertilizer against mineral fertilizers that are always on hike in the market. The plant *Hibiscus sabdariffa* studied for its proficiency to sustain organic farming diversification on our available indigenous plant was the objective of this work, to evaluate and give confidence to our farmers in organic fertilizer usage over the conventional inorganic and expensive types.

Aim of the Work

The aim of this work was to assess the nutritional status of *Hibiscus sabdariffa* at a vegetative stage.

Objectives

The aim of the research was achieved through the following set objectives;

i. To investigate the proximate constituents, essentials, and minerals concentrations of the *Hibiscus sabdariffa* at a dietary vegetative.
ii. To determine the level of anti-nutrient contents (oxalates and tannins) in the dietary leaves sample at this stage of growth.
iii. To compare the levels of the analytes in the samples between organic and mineral fertilizers using student's t-test for analysis of variance to test whether there is significance difference in the levels of the nutrients.

MATERIALS AND METHODS

Description of the study area

The study was conducted at Kano University of Science and Technology, Wudil Research Farm Kano State, in Northern-Western Nigeria. The geographical coordinates of this farm is; latitude $11^{o}51'28.05"$N, longitude 8^{0} 59'11.76"E, and on altitude of 430m above sea level.

The area has mean annual rain fall of about 800mm with relative humidity of 75% during the rainy season and the annual temperature (25^{o}C -26^{o}C).

Experimental design

The experimental design, consisted of a complete randomized block design with three replications, the distance between two consecutive blocks was 1m and 2m between replicates. The block was 3.6m long and 4.9m wide. All plots consisted of 6 rows of plants with 0.7m apart and 0.6m intra spacing within rows in the farm land. The work was carried out between July to November, 2014 during the rainy season.

Crop establishment and Treatments

The black variety of *Hibiscus sabdariffa* plant was used for this research and identified at Crop Science Department KUST, Wudil. The organic manure was also applied uniformly after land preparation before sowing at a rate of 10 ton/ ha (T1), and the other treatments were from mineral fertilizer NPK 15-15-15 at the rate of 75 kg N/ha (T2) and 100kg N/ha (T3) respectively. The seeds were directly sown by digging in furrows after rainfall. The thinning was done to an intra-row spacing three weeks after planting. Shallow cultivation was observed using hoe and hand pulling to keep the plants weed free, for about three times (Grubben, 2004).

Sample collection

Four central rows of *Hibiscus sabdariffa* L. (Roselle) were sampled at 25 days after sowing (vegetative stage) from the farmland plot. The collected samples were thoroughly separated into organs, rinsed with de-ionized water and the residue evaporated at room temperature on a clean background paper with constant turning over to prevent fungal growth. The dried sample was however, grounded into a fine powder using pestle and mortar, and packed in an air tight plastic container for the analyses.

Lists of apparatus/equipment used

i. Instruments; Atomic Absorption Spectrophotometer, Flame Emission Spectrophotometer, Centrifuge, Water bath, Hot air oven, Soxhlet extractor, Fiber cap, Heating mantle, Hot plates, Digestion block, Muffle furnace, Analytical balance, Refluxing component.

ii. Glass wares; Volumetric flasks, Conical flasks, Measuring cylinders, Filter papers (No.1 and No. 44), Crucibles, Petri dishes, Distillation flasks, Pipette, Burettes.

Chemical and reagents

All the chemicals and reagents used in this study were of analytical grade and are the products of Sigma - Aldrich.

List of reagents used

Perchloric acid (60%).
Conc. Nitric acid.
Conc. Sulphuric acid.
Catalyst; 500g Na_2SO_4, 50g anhydrous copper sulphate, 0.5g of selenium powder mixed and ground to powder.
Boric acid (2%).
NaOH (40 %).
0.01M HCl.
$NaCO_3$ (17%)
Petroleum ether (40 - 60^{o}C boiling point).
$KMnO_4$.
NH_4OH

i. Tannic acid standard; 0.05g tannic acid was dissolved in water and diluted to 500 cm^3 (1 cm^3=0.1mg tannic acid of the stock solution). This was prepared fresh.

ii. Folin-denis reagent; 50g of sodium tungstate was added to 375 cm^3 of water, followed by 10g phosphomolbdic acid and then 25 cm^3 orthophosphoric acid added and mixed together. This was also prepared a fresh.

iii. Mix indicator; 0.2g of methyl blue weighed into 100 cm^3 flask, also 0.4g methyl red added into another 100 cm^3 flask. Both were dissolved using ethanol and mixed in 200 cm^3 volumetric flask thoroughly.

iv. Calibration curve

The calibration curves prepared for each element were by serial dilution out of the stock solution. The standard and blank solutions were aspirated first in the instruments (Atomic Absorption and Flame Emission Spectrophotometers) for standardization, blanking and the establishment of calibration curves at a required wave length as; 283.3nm Pb, 279.5nm Mn, 3248nm Cu, 248.3nm Fe and 213.8nm for the Zn respectively (Allen *et al.*, 1974).

Proximate Analysis

The recommended methods of the Association of Official Analytical chemists (AOAC, 1995;2010) were used in the determination of moisture, ash, crude fat, fiber, and protein and carbohydrate contents.

(a) Determination of moisture content

Moisture content was determined according to the standard method described by AOAC (1995). About 5 g of fresh sample was weighed and placed in a clean dry moisture dish and the weight of the sample and dish taken. These were placed in a free heated hot air oven at the temperature of 105^{0}C. The samples were dried for 3 hours, cooled in desiccators and weighed. The method was repeated at I hour interval until a constant weight was obtained. The moisture content in the samples were calculated using the formula:

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

(b) Determination of ash content

5 g of a fresh sample was weighed into a cleaned weighed crucible, and charred by heating in a fumes hood till smoking ceased.

The charred samples were then transferred to a muffle furnace and the temperature was increased gradually to 550^{o}C. The samples were then turned completely ash. Temperature was reduced, samples were removed and cooled in a desiccators before weighing (AOAC, 1995). The amount of ash was therefore calculated using the formula:

$$\%\text{Ash} = \frac{\text{Weight of crucible+ash}-\text{weight of empty crucible}}{\text{Weight of sample}} \times 100$$

(c) Determination of protein content

One gramme (1g) of sample was weighed into a digestion flask together with a combined catalyst of 5 g potassium sulphate and 0.5 g of copper sulphate and 15 ml of sulphuric acid. The mixture was heated in a fume hood till the digest color turned blue. The digest was cooled, transferred to 100 ml volumetric flask and topped up to the mark with de-ionized water. A blank digestion with the catalyst was also made. Exactly 10 ml of the diluted digest was transferred into the distilling flask and washed with distilled water. 15 ml of 40% NaOH was added and this was also washed with distilled water. Distillation was done to a volume of about 60 ml distillate. The distillate was then titrated using 0.02 M HCl to an orange color of the mixed indicator, which signified the end point (AOAC, 1995). The nitrogen in the samples was calculated using the formular below;

$$\%\ \text{Nitrogen} = \frac{(V1-V2)x\ N\ x\ F}{(VXS)} \times 100$$

Where:

V_1 = the titre for sample in ml, V_2 = titre for blank in ml, N= normality of standard HCl (0.02), F= factor of std HCl solution, V= volume of diluted digest taken for distillation (10 ml),

S= weight of sample taken for distillation (1 g).

The protein content was then calculated as:

% protein = Nitrogen x protein factor (6.25).

(d) Determination of fat content

A 250ml boiling flask was washed, dried in an oven (at 105-110°C) and then cooled in a desiccator. About 2g of the sample (W_2) was weighed using an electronic balance and put in the extraction thimble and then plugged. It was then placed back in the soxhlet apparatus. The cleaned boiling flask was also filled to about 2/3(ml) with petroleum ether of 40-60^{0}C boiling point range. The Soxhlet apparatus was then assembled and allowed to flux for about 6 hours which then completed the extraction. The thimble was carefully removed and dried at 80°C for 30 minutes in the oven and cooled in a desiccator and then finally weighed (W_3) (AOAC,2010). The fat content was calculated as follows;

$$\%\ \text{fat content:} = \frac{W2-W3}{W1} \times 100$$

Where: W_1 = Weight of empty thimble, W_2 = Weight of empty thimble + sample, W_3= Weight of W_2 after extraction.

(e) Determination of crude fiber content

About 2g (W_1) of sample was weighed using analytical balance and put in a 250ml beaker, then boiled for 30 minutes with 100ml of 0.12M H_2SO_4 and filtered through a funnel. The filtrate was washed with boiling water until the washing was no longer acidic. The solution was then boiled for another 30 minutes with 100ml of 0.012M NaOH solution, filtered with hot water and methylated spirit three times. The residue was then transferred into a crucible and dried in the oven for 1 hour. The crucible with its content was then cooled in a desiccator and then weighed (W_2). The residue was then taken into a furnace for ash at 600°C for 1 hour. The ashes sample was then removed from the furnace and put into the desiccator for cooling and later weighed (W_3) using balance (AOAC, 2010).

The percentage crude fiber was calculated thus:

$$\%\text{Crude fiber content} = \frac{W2-W3}{W1} \times 100$$

(f) Determination of carbohydrate content

The carbohydrate content was determined by difference in proximate analysis as described by Oyenuga (1968) using the equation below;

%Carbohydrate = [100 – (%Moisture + %Ash + %Protein +%fat+%fiber)] (AOAC, 2010)

Estimation of energy value

The sample calorific value was therefore estimated (in Kcal), by multiplying the percentage crude protein, crude lipid and carbohydrate with the recommended factor (2.44, 8.37 and 3.57 respectively used) in proximate analysis (Asibey-Berko and Tayie, 1999).

Determination of Tannin contents

The sample of approximately 0.1gram was weighed into 100 cm^3 conical flask, 50ml of water then added, mixed and boiled for 1 hour using hot plate. The extract was then filtered whilst warm through No.44 filter paper into a 50 cm^3 volumetric flask. The filtered diluted to volume after cooling by running the water onto the extract residue on filter paper, blank also received the same treatment. The color was developed by pipetting a suitable aliquot (5 cm^3) of the sample, where then 0 to 3 cm^3 of tannic acid pipetted into 50cm^3 volumetric flask making range of (0 to 0.3mg) tannic acid standard, at this point, the samples and standard solutions were then treated equally by adding water to each flask up to two-third full. The folin-denis reagent solution 2.5 cm^3 was added followed by 10 cm^3 of Na_2CO_3 solution mixed and diluted to mark. The mixture finally kept in water bath at 25^{o}c temperature for 20 minutes, where the optical density of standard read and obtained calibration curve of mg tannic acid for the samples at 760nm. Blank reading was also measured for subtraction from the sample.

Calculation for tannin content;

$$\text{Soluble tannin (\%)} = \frac{\text{C (mg) x extract volume (cm3)}}{\text{10xaliquot (ml) x sample wt (g)}}$$

Determination of oxalate content

According to the AOAC (1999) method, oxalate was determined by weighing 0.1 g of sample and mixed with 30 cm^3 of 1M HCl. Each mixture was then shaken in a water bath at 100^{0}C for 30 minutes.

To each extract, 0.5ml of 5% calcium chloride was added and mixed thoroughly for the precipitation of calcium oxalate. The suspension was then centrifuged at 3000rpm for 15 minutes to separate the supernatant. The pallets were washed twice with 2 cm^3 of 0.35M NH_4OH and dissolved into a 0.5M H_2SO_4. The mixture was then titrated with 0.1M $KMnO_4$ solution while, temperature maintained at 60^oC. Where the end point was achieved as the faint violet color appeared and persisted for at least 15 seconds. The oxalate contented calculated as; 1 cm^3 titer value was equivalent to 2.2mg of oxalate.

Mineral Analysis

The minerals comprising the elements; Manganese, Iron, Zinc, Lead and Copper, which were determined according to the method of Allen *et al*., (1974), by Atomic absorption spectrometer, where their absorption compared with that of standards for the respective elements.

Digestion of plant sample for elemental analysis

0.20-0.50g of oven dried plant sample was weighed into a 100ml khjeldahl flask.1ml 60% $HClO_4$, 5ml HNO_3 and 0.5 ml H_2SO_4 was added, swirled gently and digested slowly at a moderate heat and increased later for 15 minutes after white fumes appeared and cooled. The digests were then diluted and filtered using No.44 paper, into 50ml volumetric flask and diluted to mark. Also, blank was treated the same way and then used for blanking before the elemental analysis by Atomic Absorption Spectrometry (Allen *et al*., 1974).

Data analysis

All determinations were carried out in triplicates. The data generated from the experiments were subjected to statistical analysis using the Statistical Package for Social Science (SPSS) Version 16. Descriptive statistics, ANOVA and post hoc (LSD) were used to interpret the results obtained.

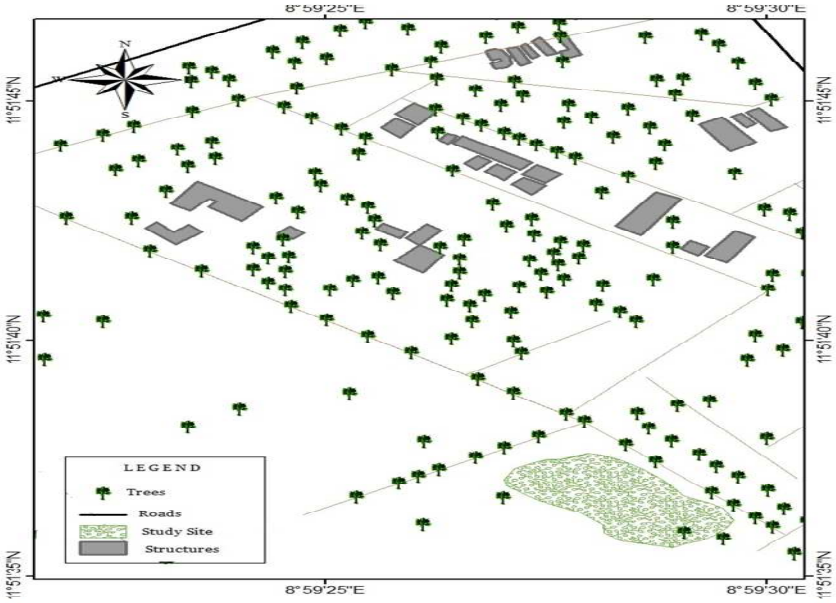

Figure 3.1: Map of KUST Research Farm, Gaya indicating the sampling site

SOURCE: GIS Unit, Dept. of Geography KUST, Wudil (2017)

RESULTS AND DISCUSSION

Analysis of proximate and mineral compositions has shown the ability of organic fertilizer in nutrients supplementation as presented in Tables 1 and 2, when compared to mineral fertilizers, where the anti-nutrients contents from Table 3, does not implicate any toxicity to the dietary vegetable produced(*Hibiscus sabdariffa*).

Proximate composition

The poultry manure (M) had the highest protein(20.910%) and crude fiber(12.047%) contents compared to mineral fertilizers studied, this was in line with the findings of Dania *et al*., (2014) who worked on moringa and compared the NPK fertilizer with organo-mineral fertilizer. However, the result was comparably similar to that of Ren *et al*., (2014) who demonstrated that soil organic carbon and total nitrogen pool concentrations in the 0-10cm soil layer decreased significantly without organic manure and mineral N applications, primarily because of the decomposition of stable carbon.

However, when observing at the mineral fertilizers' influence; the fertilizer concentration at a rate of 100 kg per hectare (F100) had shown predominantly higher contents in ash, crude fat and carbohydrate, but only found significant with crude fat content alone. In addition, the moisture content that recorded exceptionally higher was found with mineral fertilizer at 75 kg per hectare (F75) Table 1.

This is also analogous to the findings of (Akanbi *et al.,* 2010), who investigated that the application of 75 kg N/ ha, gave the highest okra fruit yield, and is a good determinant for the marketable produce vegetables like okra and *Hibiscus sabdariffa* for their demand is always coupled to their freshness, even though to our findings here the difference exist was found statistically insignificant in comparison to organic manure fertilizer.

The results of the statistical analysis from all the proximate compositions revealed that the difference that existed among the fertilizers studied was found insignificant, which means poultry manure fertilizer (M) has the equivalent power to other minerals fertilizers except, in the crude fat content where F100 fertilizer became significant at ($p>0.05$) compared to other fertilizers investigated. This clearly revealed that the concentration of mineral fertilizer F100 increased the dry matter content of *Hibiscus sabdariffa,* that proportionally enhanced the crude fat content remarkably by the higher fertilizer level used. This is in harmony to the findings of Akanbi *et al.*(2010), who reported that, the dry matter yield increases with an increased in compost rate peak at 6.0 mg/ha for most N levels in okra. The information will require future research for *Hibiscus sabdariffa* to be included in a campaign for the renewable energy sources from vegetable oils production that has increased rapidly in recent years (Onder Ustundag *et al.*, 2013).

Mineral composition

The highest concentrations of mineral Zn and Cu were recorded from M fertilizer (Table 3). However, the results were found similar to the work of Michael *et al*, (2010), who studied the effect of fertilizers on red lettuce as the chicken manure exhibited relatively higher values on number of leaves, plant height, marketable yield and mean leaf dry mass. Also Akanbi *et al*, (2010) reported the same influence on growth, dry matter and fruit yields components of okra. Moreover, the maximum Zn and Cu concentrations recorded in M fertilizer indicated that, manure is a good fertilizer for the supplementation of these elements better, which is found in harmony to the work of Kadiri *et al.*, (2015). The greater levels of zinc recorded from this study are adequate when compared to recommended dietary allowance (RDA) value of 15mg/day for men and 12mg/day, for women and, the consumption of this plant will correct zinc deficiency in developing countries. In addition, the copper concentration was found to be above the RDA value of 12mg/day (Dickson, *et al.*, 2012) except, for the F75 fertilizer, although the values recorded were still within the permissible limit of 20mg/kg (WHO/FAO, 2001).Vegetables are dependable for their minerals, vitamins, fibers and other nutrients which are essential for metabolism, tissue formation and reproduction. Henceforth, the poultry manure deserved to be a substituent fertilizer over the mineral fertilizers for its potential and economic advantage.

On the other hand the mineral fertilizers; F100 fertilizer reported with higher Mn and Fe concentrations, and yet the difference was statistically found insignificant among the fertilizers. Nonetheless, the element Fe concentrations obtained can be adequately considered when compared to RDA value of 8mg Fe/day for men (19 years and older) and for women over 50 years, 18mg/day for (girl and women) 11 to 56years (FNB, 2001). The Food and Nutrition Board (NRC, 1980) recommends 10mg of iron per day for children between 1 to 10years. Minerals components like, iron concentrations of foods is the most important constituent of forming hemoglobin, which is the bare root of anaemia, and this will validated the use of *Hibiscus sabdariffa* as a vegetable plant to be recommended as good and cheap source for dietary Fe. The difference that exist amidst the fertilizers (Table 3), was found to be insignificant at ($p>0.05$), which proven the fairness of fertilizers effect toward the growing and nutritional yield in *Hibiscus sabdariffa*.

Importantly, the Pb concentration recorded were at below detection level amidst the fertilizers used for this study, and its absence at the harvesting stage is exhibiting evidence that, *Hibiscus sabdariffa* vegetable is safe for patronage as dietary vegetable diet. Similarly, the harvesting time piloted for this study is the most frequent period for the plant usage in many traditional dishes like stew, soup, meal and tea. In this regard, our finding is in agreement to the statement of Mohammed and Sharif, (2011), who indicated that vegetables are valuable sources of nutrients most especially in local communities consisted of predominantly poor people. Besides, the research findings revealed that, green leafy vegetables are indispensible food crops that provide safe mineral nutrients, depending on the vegetable consumed (Fasuyi, 2006).This clearly revealed that poultry manure is capable of minerals nutrients supplementation.

Anti-nutrients composition

These are very important parameters in the dietary plant harvest and fertilization. Oxalate contents were observed to decreased with an increase of mineral fertilizer level in the soil and ranged from 8.190 - 9.978% (Table 2), in which M fertilizer had the highest content and F100 was the least, where the difference that existed among fertilizers was found to be insignificant at ($p>0.05$). On comparing the oxalate content obtained in this work to those of green and variegated cultivars of sorrel (14.7 and 24.4g/100g) as reported by Tuazon and Savage (2013), the content obtained from *Hibiscus sabdariffa* studied was recorded lower to those obtained in the later findings. The oxalate tolerable limit is 256mg/100g, from this investigation the values recorded were at high sight. Ruan *et al.,* (2013) demonstrated that, boiling reduces the level of the anti-nutrients contents in taros plant boiled in water for 40 min, which decreased oxalate contents by at least 47%. The raw sample of *H. sabdariffa* oxalate content can equally be removed in boiling process before been used as diet.

The tannin contents however, found increased with an increase in the fertilizer level, where M fertilizer had the least value, while mineral fertilizer F75 possessed the higher tannin content of 2.756%. Overall, the tannin content obtained was below permissible limit of 76-90g/kg (Alekor, 1995). This indicated that anti-nutrients obtained in this study have no health effect to the dietary value of *Hibiscus sabdariffa* as far as its vegetative stage is concerned. Though, *Hibiscus sabdariffa* vegetables will have passed through blanching and boiling process before used as a diet.

Ilelaboye *et al*. (2013), reported that, blanching caused a significant reduction of 31.26% to 49.24% in the oxalate and further reduction of 39.22%g to 54.42% was achieved when the blanched vegetables were processed to vegetables' soups. However, there was no significant difference existing among the fertilizers used on the tannin contents (p>0.05).

Table 1; Proximate compositions of *Hibiscus sabdariffa* (at a vegetative stage) grown under mineral and organic fertilizer levels

Sample /Parameters	(%) Moisture content	(%) Ash content	(%) Crude protein	(%) Crude fat	(%) Crude fiber	(%) Carbohydrate
M	6.812±0.253	12.411±0.600	20.910±2.132	15.455±2.428 **b**	12.047±0.684	32.366±5.555
F75	6.989±1.053	12.742±0.999	15.322±5.568	14.402±4.712 **b**	11.47±9.462	42.223±12.184
F100	6.504±0.354	13.130±2.564	18.426±0.704	30.710±0.054 **a**	11.173±0.054	41.960±7.657

All data were mean ± standard deviation of triplicate determinations, Mean within a column of parameters followed by unlike letter(s) amongst the treatments (a, b) are significantly different using LSD at 5% level of significance. M= manure, F75=75 Kg of fertilizer/ha and F100=100 Kg of fertilizer/ha.

Table 2; Anti-nutrients compositions of *Hibiscus sabdariffa* (at a vegetative stage) grown under mineral and organic fertilizer levels.

Sample /Parameters	(g/100g) Oxalate	(g/100g) Tannin
M	9.978±2.359	2.685±0.068
F75	8.455±3.364	2.756±0.114
F100	8.190±0.213	2.736±0.454
RDA	0.256g	7.6 – 9g

All data were mean ± standard deviation of triplicate determinations, Mean within a column of parameters among the treatments were found to be insignificantly different using LSD at 5% level of significance.
M= manure, F75=75 Kg of fertilizer/ha and F100=100 Kg of fertilizer/ha.

Table 3; Mineral compositions of *Hibiscus sabdariffa* (at a vegetative stage) grown under mineral and organic fertilizer levels.

Sample/ Elements	Mn	Fe	(Kg) Zn	Pb	Cu
M	714.810±0.104	750.311±2.300	30.689±0.018	BDL	18.571±0.038
F75	586.839±0.803	922.508±2.486	30.150±0.0426	BDL	10.428±0.0121
F100	781.717±1.225	1377.294±6.543	21.833±0.102	BDL	13.222±0.0387
WHO	600.00	17.00	20.00	0.03	10.00

All data were mean ± standard deviation of triplicate determinations, Mean within a column of parameters among the treatments were found to be insignificantly different using LSD at 5% level of significance.
M= manure, F75=75 Kg of fertilizer/ha, F100=100 Kg of fertilizer/ha

CONCLUSION

The findings of this study revealed that, poultry manure has potential over the conventional mineral fertilizers used as there were no significant different existed in nutrients yielding as, (Mn, Fe, Zn and Cu), and also, Ash content, crude protein, crude fiber and carbohydrate. The toxic lead content was therefore obscured, where the moisture level was at remote content which further prevailed the freshness of this vegetable if harness by this fertilizer.More so, the results entailed that, mineral fertilizer 100kg/ha have a good enhancing capacity for the vegetable oil exploitation.

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