IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)
e-ISSN: 2319-2402,p- ISSN: 2319-2399.Volume 15, Issue 7 Ser. I (July 2021), PP 01-06
www.iosrjournals.org

Improving Starch Content in Cassava (*Manihotesculenta*Crantz) Using Organic Chelates

*[1]Ikuli, J. M., [2]Akonye, L.A and [2]Eremrena, P. O

I Department of Crop and Soil Science, Niger Delta University, Wilberforce Island, PMB 071, Yenagoa, Bayelsa State, Nigeria.
2 Plant Science and Biotechnology Department, University of Port Harcourt, PMB 5323 Choba, Port Harcourt, Rivers State, Nigeria.

The study investigated the potentials of organic chelates used in enhancing micro nutrients in cassava to increase the starch content in cassava Root. The study used EDTA as standard chelate, Bontera as a commercial organic chelate and periwinkle effluents (PE) and Smoke Solution (SS) as local organic chelates. The cultivars used were TME419 and TMS3168/UMUCASS/36 also known as YELLOW ROOT (YR). One hundred (100ml) of 100µg of zinc obtained from zinc oxide and 100µg of iodine obtained from potassium iodide were added separately and combined to 5000ml each of deionized water, 1ml/L Bontera, 1ml/L EDTA, Periwinkle effluents and Smoke solution. The treatments were applied through foliar application at 3 months after planting, repeated 3 weeks later and 7 months after planting. The study showed that organic chelates enhanced starch production in cassava, especially in YELLOW ROOT.The study also revealed that YELLOW ROOT responded better than TME419 in the use of chelates with regard to starch production. One hundred (100%) percent of all the treatments increased starch content in YR, while only 45% of the treatments increased starch content in TME419.Among the organic chelates used, smoke solution distinguished its potential in promoting starch availability as the best. The study also revealed that iodine hinders starch production in TME419. And zinc promotes starch production. When only iodine or periwinkle effluents having high iodine contentwas used, starch content reduced, while only zinc or in combination with chelates increased starch contentin cassava.

Key words: *Starch content, Cassava, Chelates, Organic*

Date of Submission: 20-06-2021 Date of Acceptance: 05-07-2021

I. Introduction

Starch provides lasting energy for the human body. It is a major component in most staples that feed the world. Cassava contains resistant starch which plays crucial role in feeding probacteria in human gut and enhance reduction in inflammation and promote digestive system. Cassava starch also has the potential to improve metabolism and reduce type2 diabetes and obesity (Elliot, 2017). It is the main source of energy to the human brain and nervous system. Cassava is the highest agricultural food crop produced in Nigeria, because of its adaptive potentials in harsh environmental conditions. It is the number one choice crop for peasant farmers.Cassava is the number one staple food crop that feed Nigeria (Ikuli and Akonye, 2019) and fifth that feed the world (Redy, 2008). It is therefore necessary to improve the starch content in cassava when biofortifyingnutrients in cassava using natural (organic) resources to improve human health in different perspectivesin life and free the populace from the risk of chronic diseases.

The objective of the study is to determine the potentials of organic chelates to improve starch content in cassava Root.

II. Materials And Methods

Land Preparation and Plot Layout The research was conducted at University of Port Harcourt, University Park, Port Harcourt Latitude 4º 54' 33'' N, Long. 6º 54' 39'' E and Lat.4º 54' 30'' Long.6º 54' 32'' E from December, 2017 to December, 2018.

Land Preparation and Plot Layout

A total land area of 1062m^2 was cleared, ploughed and was partitioned into 60 plots. The plot size is 2m x 5m with twenty (20) treatments and three replicates. The distance in-between treatment is 1m and replicates 1.5m apart. Treatments were arranged in a Randomized Complete Block Design (RCBD).

Planting Material and Planting
Cassava (*Manihotesculenta*Crantz) stem cuttings TME 419 and TMS3168/UMUCAS/36 (Yellow root; PRO-vitamin A) were obtained from the University of Port Harcourt, Faculty of Agriculture Teaching and Research Farm.
Treatment Material
Ethylenediaminetetra-acetic acid (EDTA), Potassium iodide (KI), Zinc oxide (ZnO),Hydrochloric acid (HCl) and Nitric acid were obtained from BENERCO EnterpriseAlakahia, Port Harcourt, Rivers State.
Bontera; A microbial soil enhancer was obtained from Organico, A division of Amka Products in South Africa was used as a commercial organic chelate.
Smoke solution used as local organic chelate was locally prepared from dry wood particles
Periwinkle extract used as local organic chelate 2 obtained from OmuchioluAluu Local market

Treatment Preparation
1. First the glass wares were treated with HCl to remove all trace of iron and contaminants in it.
2. Zinc oxide and potassium iodide used as zinc and iodine fertilizers were diluted to 100µg of zinc and iodine concentration fortifying solutions were prepared in the following steps:

ZnO
1. Zinc oxide (ZnO) weighing 6.23 was dissolved in 20ml nitric acid, added deionized water to 1000ml level (solution A):
2. Five millilitres(5ml) of solution A was diluted in 1000ml of deionized water (solution B):
3. Ten millilitres (10ml) of solution B was further diluted in 100ml of deionized water to give 1ml = 100µg (solution C).
4. One hundred millilitres (100ml) of solution C was added to 5000ml each of deionized water, 1ml/L Bontera, 1ml/L EDTA, Periwinkle effluents and Smoke solution.

KI
1. Potassium iodide (KI) weighing 6.541g was dissolved in 500ml of redistilled water and diluted to 1ml = 10mg of iodine (solution A):
2. Ten millilitres (10ml) of solution A was diluted in 100ml of redistilled water to get 1ml = 1mg (solution B):
3. Ten millilitres (10ml) of solution B was diluted in 100ml of redistilled water to give 1ml = 100µg (solution C).

One hundred millilitres (100ml) of solution C was added to 5000ml each of deionized water, 1ml/L Bontera, 1m/L EDTA, Periwinkle effluents and Smoke solution.

Treatment Application
The prepared treatment solutions were applied through foliar application with the aid of a snack sprayer on the planted plants at early Tuberization and bulking stage of the plant development .i.e. the third month after planting and repeated application after three weeks.
Application was repeated on the 7th month (Late Tuberization and bulking stage of the plant).
After harvest, samples of the Cassava root (peel and flesh) were collected and analyzed to ascertain the amount of starch in the root.
The method of Gaithersburg (AOAC, 2006) was adopted to determine the Starch content.

SAS Software (2012); SPSS Version 21 was used for the statistical analysis.

III. Results And Discussion

Starch Distribution
When only iodine was used to treat the cultivars, the starch content in TME419 decreased 0.36% but increased by 37.27% in YELLOW ROOT. When only zinc was used to treat the cultivars, the starch content increased by 7.86% in TME419 and increased in YELLOW ROOT by 27.17%. And when iodine and zinc were combined to treat the cultivars, the starch content in TME419 decreased by 7.10% and increased by 20.74% in YELLOW ROOT as presented in Figure 1.

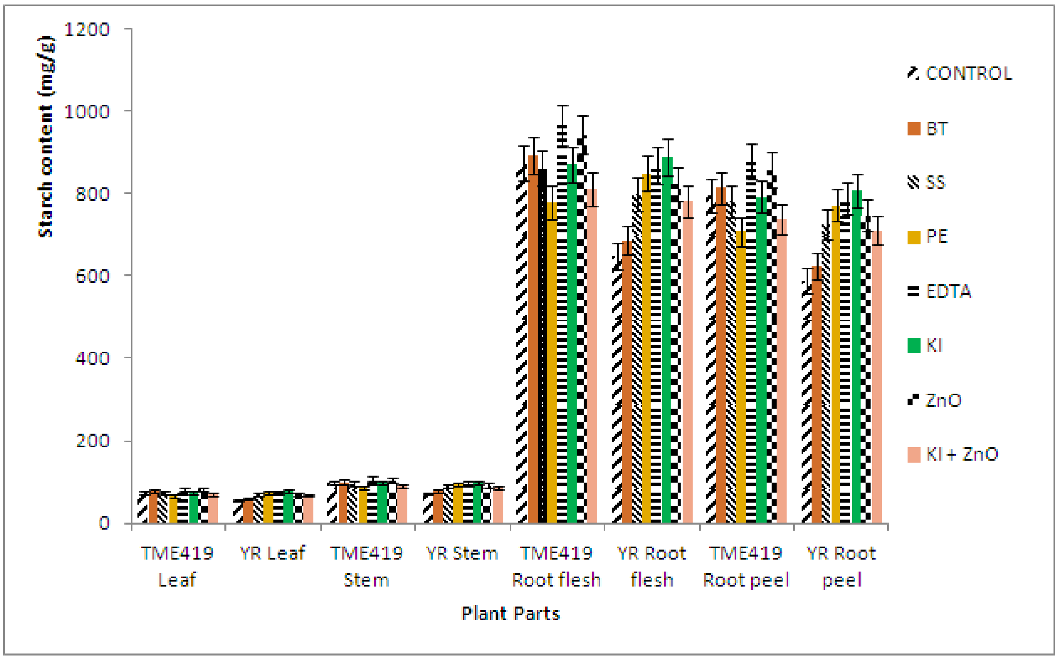

Figure 1: Starch Distribution in the Whole Cassava Plant when chelates and Nutrient sources were added separately

The starch content in the edible root in control was 87.493mg/g in TME419 and 64.799mg/g in YELLOW ROOT. When the cultivars were treated with Bontera, the starch content increased by 2.32% in TME419 and increased by 5.90% in YELLOW ROOT. When iodine was added to Bontera, the starch content decreased by 4.48% in TME419 and increased by 33.07% in YELLOW ROOT. When zinc was added to Bontera, the starch content in TME419 reduced by 7.16% and increased by 19.97% in YELLOW ROOT. When both iodine and zinc were added to Bontera, the starch content decreased by 9.47% in TME419 and increased by 33.84% in YELLOW ROOT as presented in Figure 2.

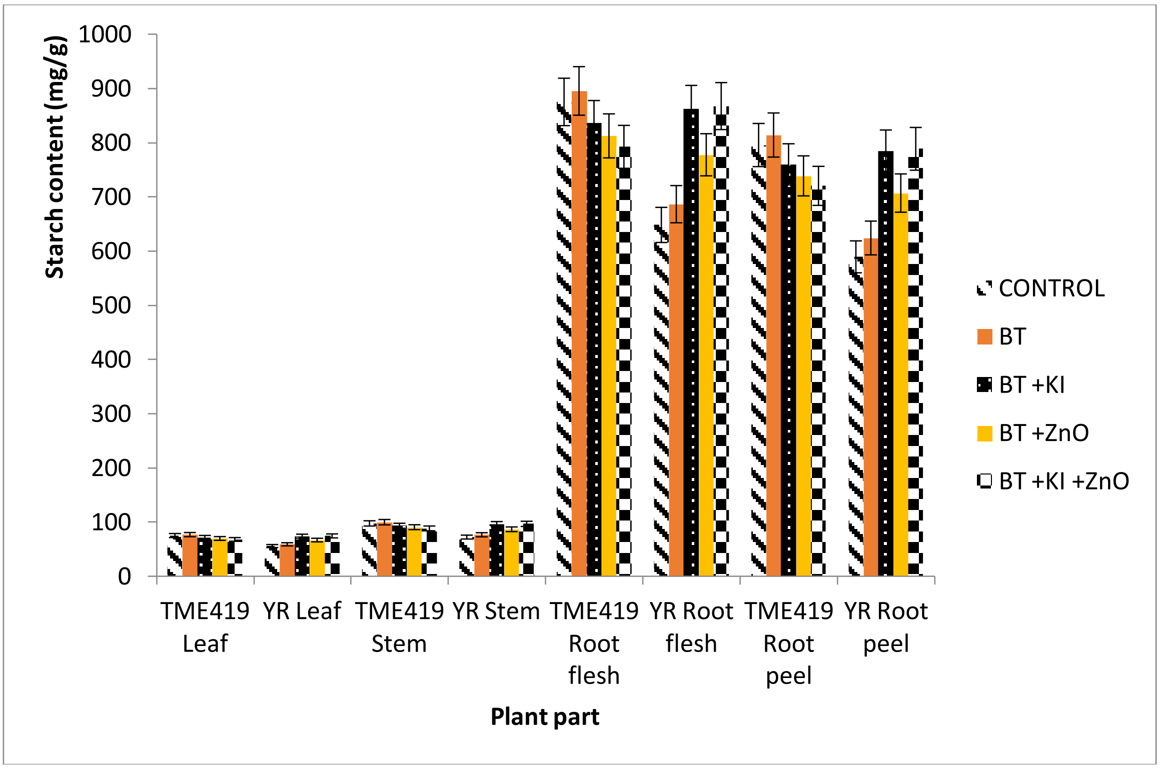

Figure 2: Starch Distribution in the Whole Cassava Plant Treated with Bontera (BT), BT + KI, BT +ZnO, BT +KI + ZnO

When only EDTA was used to treat the cultivars, the starch content in TME419 increased by 10.50% and by 34.13% in YELLOW ROOT. When iodine was added to EDTA, the starch content in TME419 increased by 2.54% and increased by 15.20% in YELLOW ROOT. When zinc was added to EDTA, the starch content in TME419 increased by 12.08% and increased by 21.55% in YELLOW ROOT. When both iodine and zinc were added to EDTA, the starch content in TME419 decreased by 13.91% but increased by 35.55% in YELLOW ROOT as presented in Figure 3.

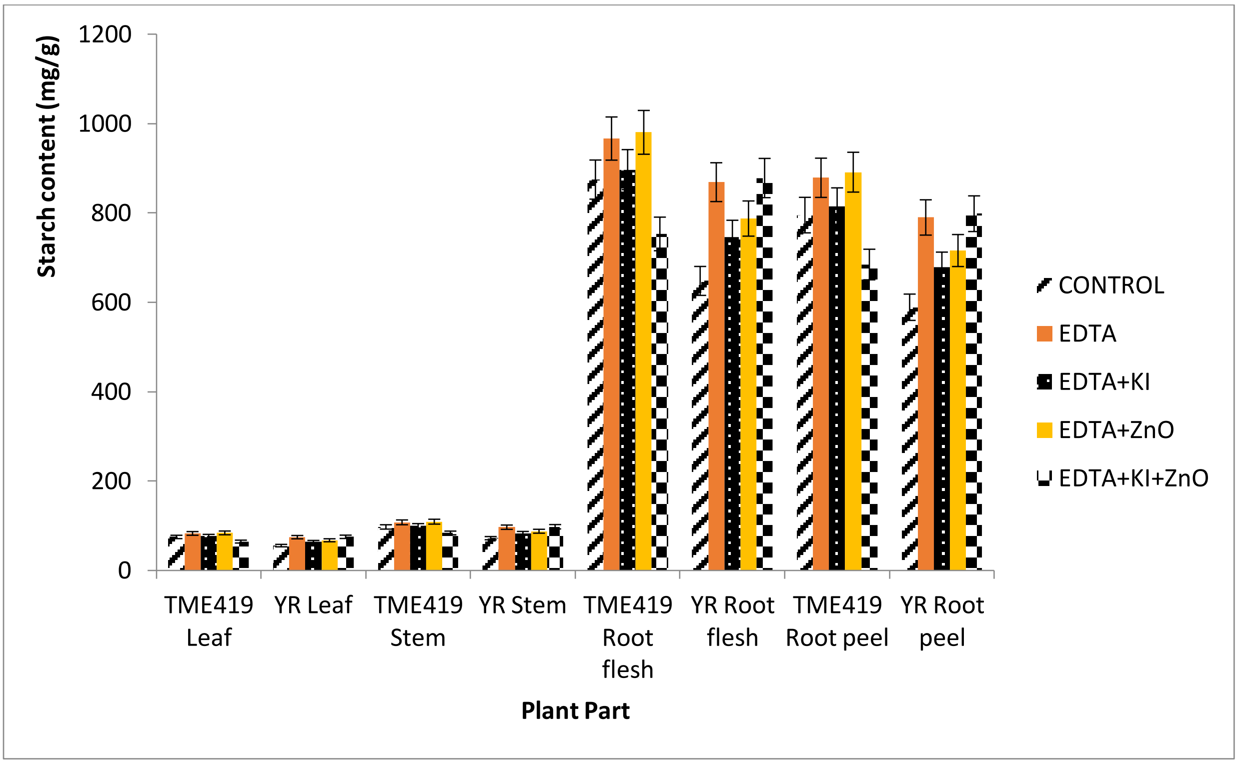

Figure 3: Starch Distribution in the Whole Cassava Plant when iodine and zinc were added to EDTA

When periwinkle effluents was used to treat the cultivars, the starch content in TME419 decreased by 10.95% but increased by 31.22% in YELLOW ROOT. When iodine was added to periwinkle effluents, the starch content in TME419 increased by 0.42% and increased by 16. 07%. When zinc was added to periwinkle effluents, the starch content in TME419 reduced by 9.55% but increased in YELLOW ROOT by 33.89%. When both iodine and zinc were added to periwinkle effluents, the starch content in TME419 decreased by 8.56% but increased by 20.09% in YELLOW ROOT as presented in Figure 4.

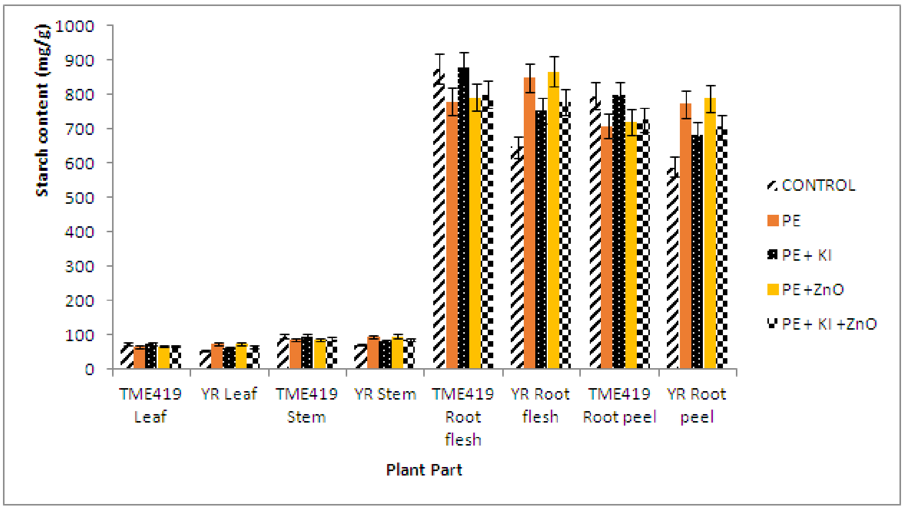

Figure 4: Starch Distribution in the Whole Cassava Plant when iodine and zinc were added to Periwinkle effluents

When only smoke solution was used to treat the cultivars, the starch content in TME419 decreased by 1.59% but increased by 23.35% in YELLOW ROOT. When iodine was added to smoke solution, the starch content increased by 4.16% in TME419 and increased by 23.90% in YELLOW ROOT. When zinc was added to smoke solution, the starch content in TME419 increased by 2.80% and increased by 41.69% in YELLOW ROOT. When iodine and zinc were added to smoke solution, the starch content in TME419 decreased by 11.27% and increased by 16.18% in YELLOW ROOT as presented in Figure 5.

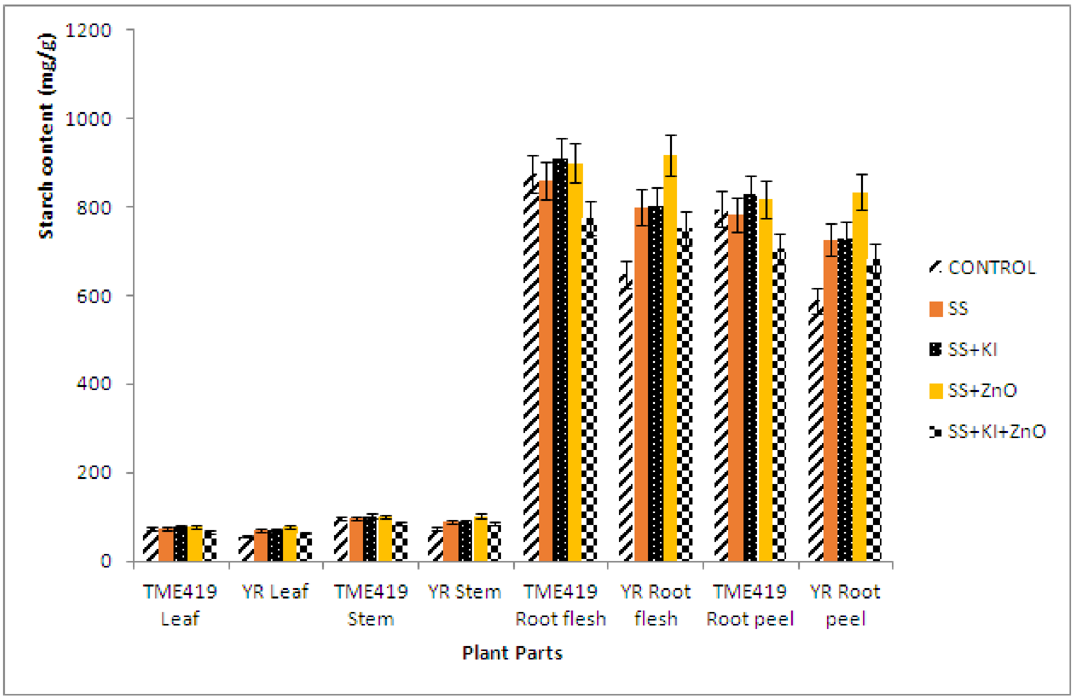

Figure 5: Starch Distribution in the Whole Cassava Plant when iodine and zinc were added to Smoke Solution

Starch Distribution

Starch is an important and major constituent in cassava, and is found in all parts of the cassava plant. The study also revealed that in every cassava plant among the cultivars used in this research; 4.06% of the total starch content is partitioned to the leaf, 5.28% is partitioned to the stem, 47. 49% is partitioned to the edible flesh and 43.17% to the root peel in every 1g regardless of the content. In other words, if one gram of leaf gives 4.06mg of starch, 1g of stem will produce 5.28mg, 1g of edible flesh will produce 47.49mg and 1g of root peel will produce 43.17mg of starch (4.06: 5.28: 47.49: 43.17). Among the chelates used smoke solution promoted increased starch increase more than other chelates. This may as a result of balanced K, Ca and Mg content without interference.

Starch and Human Health

Starch is a major source of energy in the human body. It provides a lasting energy for the body.

Starch increase in the Organic chelate biofortification in cassava promote healthy digestive system and promote human gut health. Cassava contains resistant starch which serves as prebiotic and symbiotic (Topping *et al*, 2003; Fuentes *et al*, 2011; Zaman and Sarbini, 2016) and plays crucial role in feeding probacteria in human gut and enhance reduction in inflammation and promote digestive system (Ogbo and Okafor,2015; Elliot, 2017). Cassava starch also has the potential to improve metabolism and reduce type 2 diabetes and obesity (Elliot, 2017). Consumption of cassava starch will also enhance recovery from infectious diarrhea in human (Topping *et al*, 2003).

Starch is used as food additives, for processing foods; it is used as thickeners and stabilizers in foods like pudding, sauces, gravies, pie filling, etc. It is also used as binder to food. It also reduce fermentation. The peels of these cassava roots will also provide energy rich supplements for farm animals.

IV. Conclusion

Organic chelates improved starch content in both cultivars. However, all the treatments did better in Yellow Root comparing to their control. The study also revealed that for better improvements, that organic chelates should not combined with KI and ZnO at the same time for application. The use of organic chelates in biofortification of micronutrients should be encouraged as it simultaneously provides important necessities needed other than the main purpose, like increasing starch content as well as improving other nutrients content in the cassava root.

References

[1]. Cardoso, P.A., Mirione, E., Ernesto, M., Massaza, F., Cliff, J., Haque, M.R and Bradbury, J.H (2005). Processing of Cassava roots to remove Cyanogens. *Journal of Food Composition and Analysis* 18, 451 – 460

[2]. Elliott, B (2017). Cassava: Benefits and Dangers. Healthline Media a Red ventures Company. Retrieved 20thOctober, 2019.

[3]. Fuentes-Zaragoza, E, Sanchez-Zapata, E, Sendra, E, Navarro, C, Fernandez-Loez,J, Pere-Alvarez, A (2011). Resistant starch as a prebiotic: A Review, *Starch – Starke*, 63 (7), 406 – 415.

[4]. Ikuli, J. M and Akonye, LA (2019). Microbial Soil Enhancer: The Panecea to Land as a limiting Resource in Agricultural Productivity. *Greener Journal of Agricultural Sciences* 9 (1), 65 – 75.

[5]. Ogbo, FC and Okafor,EN (2015).The Resistant Starch content of some cassava based Nigerian foods. *Nigeria Food Journal*. 33 (1), 29 – 34.

[6]. Reddy, G.R (2008). *Principles of Crop Production* 3rd edition, Kalyan Publishers, New Delhi – 110002

[7]. Statistical Analysis System (SAS, 2012), SPSS Version 21.

[8]. Topping, DL, Fukushima, M, Bird, AR (2003). Resistant Starch of the art. Proc. *Nutrition Society* 62 (1), 171 - 176

[9]. Zaman, SA and Sarbini, SR (2016). The Potential of Resistant Starch as a prebiotic. Crit. *Review Biotechnology*, 36 (3), 578 – 584.

Ikuli, J. M, et. al. "Improving Starch Content in Cassava (ManihotesculentaCrantz) Using Organic Chelates." *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*, 14(7), (2021): pp 01-06.