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Physicochemical Characteristics of Cassava Tuber and Cassava Meals from Eleme Local Government Area of Rivers State, Nigeria

Oluremilekun Opeyemi Moremi*, Michael Horsfall Jnr and Kaine Okorosaye-Orubite
Department of Pure and Industrial Chemistry, University of Port Harcourt, PMB 5323, Port Harcourt, Rivers State, Nigeria
moluremilekun@yahoo.com

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Abstract

Cassava tuber was obtained from four towns in Eleme Local Government Area and processed into four different meals that is: cassava flour, cassava fufu, cassava garri and cassava tapioca. The least value of pH (4.8) occurred in garri samples from Ebubu town while the highest value of pH (7.9) occurred in cassava tuber sample from Onne town. The least value obtained for conductivity (254 µs/cm), occurred in cassava tuber from Onne while the highest value of conductivity (475 µs/cm) was obtained in cassava tapioca from Ebubu. The result obtained for total organic carbon was lowest (52.80 %) in cassava tapioca from Ebubu while the highest value (66.66 %) occurred in cassava tapioca from Eteo. The least value obtained for total nitrogen content (0.07 %) occurred in cassava fufu from Eteo while the highest value for total nitrogen content (3.64 %) occurred in cassava tuber from Ebubu. The results obtained from this work showed that the pH of cassava flour from various sampling locations were the closest to neutral with a mean value of 7, while the pH of garri from various sampling locations were the most acidic with a mean value of 5.5.

Keywords: Physicochemical Characteristics, Cassava Tuber, Cassava Meals.

Introduction

Some physicochemical parameters used in the assessment of an environment or matrix are: pH, total organic carbon, total nitrogen content, total dissolved solids, total suspended solids, conductivity, moisture content, nitrite, nitrate, phosphate, temperature etc. These parameters give a proper indication of the status of the environment or matrix. The aim of this work is to examine some parameters i.e. pH, total organic carbon, total nitrogen content and conductivity of cassava tuber and cassava meals obtained from Eleme Local Government Area of Rivers State Nigeria.

Cassava is extensively cultivated in the tropical and sub-tropical regions of the world and it grows into edible starchy tuberous roots, with more than 200 calories/day of food value[1]. Cassava is a major source of carbohydrate and precisely, the third largest crop in the world, after rice and maize. Cassava is a major staple food in the developing world, providing a basic diet for over half a billion people. It is one of the most draught tolerant crops, capable of growing on marginal soil.

Nigeria is the world's largest producer of cassava. It is produced predominantly (99 %) by small farmers with 1-5 ha of land, intercropped with yams, maize, or legumes in the rainforest and savannah agro-ecologies of Southern, Central, and lately Northern Nigeria. About one-third of the total national output comes from the Niger-Delta region. Cassava, in its processed form, is a reliable and convenient source of food for tens of millions of rural and urban dwellers in Nigeria. It is estimated that more than 90 % of cassava production is processed into food[2,3]. But a significant industrial demand exists for cassava, primarily as substitution for imported raw materials and semi-finished products. Cassava is grown in Africa mostly for use as food. The roots of cassava are processed into garri, *fufu,* tapioca, chips and cassava flour for human consumption as well as paper, pellets, adhesive, and a carrier for pharmaceuticals etc.[4]. The main industrial use of cassava is for the manufacture of starch, presently cassava is produced for production of ethanol. Other uses include animal feed formulation[5] and agro-industrial uses (e.g. starch, ethanol, adhesive, fructose/glucose syrup). Also the peels are used in organo-mineral fertilizers formulation[6,7].

A survey conducted by the Federal Ministry of Health the results of which are shown in the table below indicates that the frequency of consumption of cassava products (weekly) is high in some states of the country.

Materials and Methods

Description of Study Area: Eleme Local Government of Rivers State Nigeria is located on Latitude 5.08333 and Longitude 6.65 with an altitude of 224. This is part of the Niger Delta in the South-South Zone of Nigeria. The total territory occupied by the Eleme people expands across approximately 140 square kilometres. Eleme is bounded in the north by Obio-Akpor and Oyigbo, in the South by Okrika and Ogubolo, in the East by Tai and the West by Okrika and Port Harcourt. Crops cultivated by Eleme people include yam, cassava, oil palm fruit,

fluted pumpkin and bitter leaf. Eleme is heavily concentrated with industries. Two major refineries, a foremost fertilizer plant in West Africa a sea port, with so many other companies in Onne like, Panapina, Intels, Dangote cement, P and O, Federal Lighter Terminal, Federal Ocean Terminal, WACT, etc. Most of these companies have exploited the land, roads and resources. With the discovery of oil in the Niger Delta in 1958, the Eleme territory has become home to both oil refineries and fertilizer industries. The nearest oil refinery is within a mile of an Eleme village, and around 100 wells are thought to be in use throughout the territory. The mining of oil has had a notable environmental effect on the status of the Niger Delta, with pollution from national industries in the area increasing acid rain and reducing soil, water and air quanlities.

Table-1
Frequency of Cassava Consumption in Nigeria[8]

State	1-2 times (%)	3-4 times (%)	More than 4times (%)
Osun	29	36	33
Akwa Ibom	29	39	33
Bayelsa	21	15	51
Edo	21	25	53
Imo	24	21	43
Kaduna	74	18	4
Kano	57	37	4
Kebbi	84	15	0
Kwara	24	38	35
Borno	65	28	4
Taraba	37	25	33
Zamfara	43	27	30

Sample Collection: Sampling was carried out between October and December, 2014.

Cassava tubers from Ebubu, Eteo, Eleme and Onne towns in Eleme Local Government Area of Rivers State, were peeled and washed thoroughly with water. The tubers from the different towns were shared into five parts i.e. for garri, fufu, flour, tapioca and the raw cassava tuber samples.

Preparation of Cassava Tuber and Cassava Meal Samples: Cassava tuber was obtained from four different towns in the Local Government namely Ebubu, Eleme, Eteo and Onne. The processing of the cassava tuber into cassava meals (cassava flour, cassava fufu, cassava garri and cassava tapioca) involved peeling of the cassava tuber, washing off dirt with water, rinsing with de-ionised water to remove impurities, slicing, fermentation, frying (in the case of garri), drying and sieving.

Determination of Some Physicochemical Characteristics of Cassava Tuber and Cassava Meal Samples from Eleme Local Government

Determination of pH: 20 g of dried cassava sample was weighed into a 250 ml conical flask. 100ml of distilled water was added and the mixture was agitated at intervals for 4 hours. The sample was filtered at the end of the four hours. The pH meter was put on to stabilize for 15 minutes and set to the effluent temperature. The electrodes were rinsed with a set of distilled water and the meter was calibrated with buffer 4 and 7. The electrode was rinsed again with a jet of distilled water and dipped into the sample filtrate. The figure displayed on the screen is allowed to stabilize and then recorded.

Determination of Conductivity: The sample was treated as in the pH measurement stated earlier. The meter was allowed to stabilize for 15 minutes. The meter was calibrated with KCl solution provided by the manufacturer and rinsed with jet distilled water. The electrode was dipped into the sample filtrate and allowed to stabilize. The figure displayed was recorded in µs/cm.

Determination of Total Organic Carbon (TOC): The total organic carbon was determined by Kermel Method as described below: 0.1 g of the dried sample was weighed into clean conical flask of 250 ml capacities, 5 ml of potassium (49.024 g/L $k_2Cr_2O_7$) and 7.5 ml concentrated sulphuric acid was added to the mixture and a separate 250 ml conical flask containing no sample which serves as blank was also added (i.e. 5 ml of potassium dichromate, ($K_2Cr_2O_2$), and 7.5 ml concentrated sulphuric acid). The samples were heated on electro-thermal heater for 15 minutes after which they were allowed to cool to room temperature before diluting to 100 ml with distilled water. 10 ml diluted digest was measured into a separate 250 ml conical flask and 2 drops of ferone was added as indicator, the sample were titrated with ferrous ammonium sulphate until colour changes to leafy green and the titre value was recorded.

Calculation

$$\% \text{ organic carbon} = \frac{\text{blank.filtrate.sample x 0.2 x 0.3}}{\text{weight of sample used}}$$

Determination of Total Nitrogen Content (TNC), the total nitrogen content was determined by KJeldahl Method as explained below.

Digestion: 1 g of sample was weighed into a clean conical flask 250 ml capacity, 3 g of digestion catalyst (anhydrous Na_2SO_4 and hydrated $CuSO_4$ in ratio 10:1) was added and the sample

was heated to digest the content from black to sky-blue colouration. The digest was cooled to room temperature and was diluted to 100 ml with distilled water.

Distillation: 20 ml diluted digest was measured into a distillation flask and the flask was held in place on the electro thermal heater or hot plate. The distillation flask was attached to a Liebig condenser connected to a receiver containing 10 ml of 2 % boric acid indicator 40 ml of 46 % sodium hydroxide injected into the digest via a syringe attached to the mono-arm steel head until the digest become strongly alkaline. The mixture was heated to boiling and the distilled ammonia gas through the condenser attached to the receiver beaker. The colour of the boric acid changed from purple to greenish as ammonia distillate was introduced into the boric acid.

Titration: The distillation was titrated with standard 0.1 N hydrochloric acid solutions back to purple from greenish. The volume of hydrochloric acid added to effect this change was recorded as titre value.

Calculation

$$\% \text{ Organic Nitrogen} = \frac{\text{Titre value x 1.4 x 100}}{\text{1000 x 20 x1}}$$

Weight; titre value = the volume of HCl in titrating the ammonium distillate. 1.4 = nitrogen equivalent to the normality of HCl use in the titration i.e. 0.1 N, 100 = the total volume of digest dilution, 100 = percentage factor. 1000 = conversion factor from gram to milligram. 20 = integral volume of digits analysed or distilled. 1 = the weight of sample in gram digested.

Results and Discussion

pH of Cassava Tuber and Cassava Meals from Eleme Local Government: The pH value obtained from the cassava tuber and cassava meals from various sampling locations in Eleme Local Government Area (Figure-1) is as follows. In cassava tuber the pH ranged from 5.7 in Ebubu to 6.2 in Eteo to 6.5 in Eleme to 7.9 in Onne. The pH of the cassava flour samples ranged from 6.1 in Eleme to 6.2 in Eteo to 7.8 in Ebubu to 7.9 in Onne. The pH of cassava fufu samples ranged from 6.0 in Ebubu to 6.1 in Eleme to 6.4 in Eteo to 6.5 in Onne. The pH of cassava garri ranged from 4.2 in Eteo to 4.8 in Ebubu to 5.2 in Eleme to 6.1 in Onne. The pH of the cassava tapioca samples ranged from 5.1 in Ebubu to 5.2 in Onne to 5.7 in Eteo to 6.1 in Eleme. Soil acidity or alkalinity (pH) is very essential as it affects the availability of all plant nutrients. Most plant nutrients are in their most available state between pH 6.0 to 6.5. A nutrient must be soluble and remain soluble long enough to successfully travel through the solution into the roots of plants. pH has an effect on the decomposition of mineral rock into essential elements that can be utilized by plants. Soil microorganisms that breaks down organic matter to the soluble form also depends on soil pH. The pH value is related to the availability of nutrients and toxic substances to crops. The pH values obtained in this work compares favourably with that reported in a similar study[9].

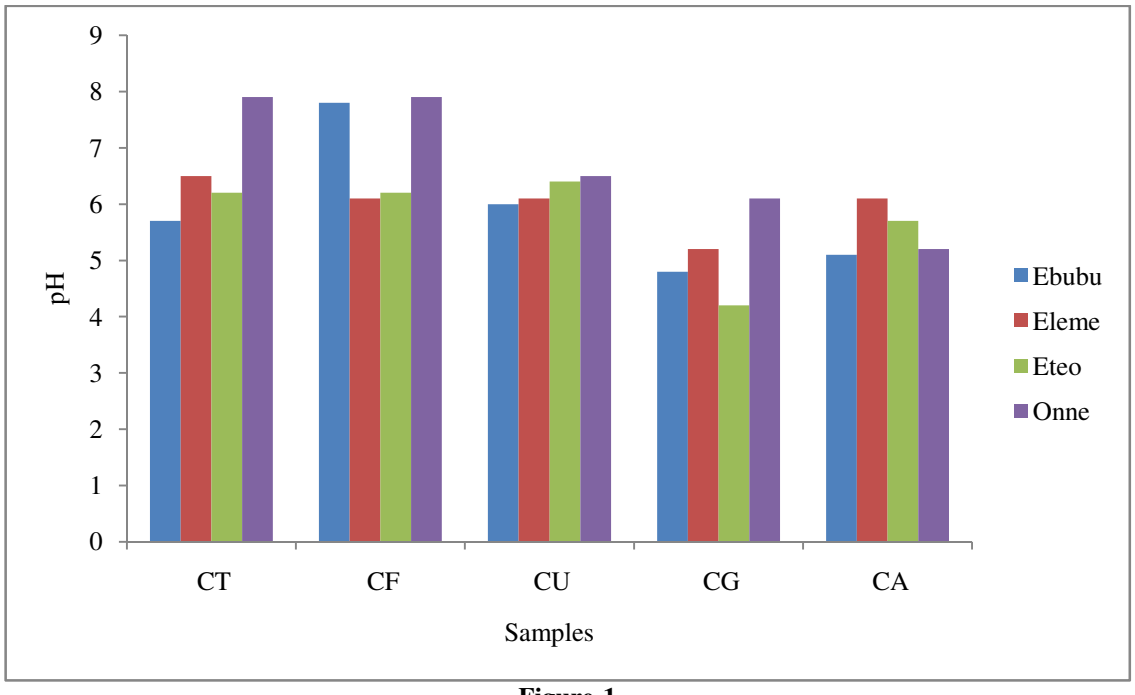

Figure-1
pH of Cassava Tuber and Cassava Meals
CT- Cassava Tuber; CF- Cassava Flour; CU- Cassava Fufu CG- Cassava Garri; CA- Cassava Tapioca

Conductivity of Cassava Tuber and Cassava Meal Samples: The conductivity values obtained in this work (as presented in Figure-2) ranged from 254 µs/cm in Onne to 362 µs/cm in Eteo to 395 µs/cm in Eleme to 426 µs/cm in Ebubu for cassava tuber samples. The conductivity of cassava flour from various sampling locations ranged from 259 µs/cm in Ebubu to 295 µs/cm in Onne to 385 µs/cm in Eleme to 415 µs/cm in Eteo. The conductivity of cassava fufu from various sampling locations ranged from 315 µs/cm in Eleme to 328 µs/cm in Onne to 335 µs/cm in Ebubu to 375 µs/cm in Eteo. The conductivity of cassava garri from various sampling locations ranged from 306 µs/cm in Onne to 401 µs/cm in Eleme to 412 µs/cm in Eteo to 420 µs/cm in Ebubu. The conductivity of cassava tapioca from various sampling locations ranged from 345 µs/cm in Eleme to 402 µs/cm in Eteo to 425 µs/cm in Onne to 475 µs/cm in Ebubu. Conductivity is used as a means of appraising salinity. The implication of high conductivity is that there is reasonable or significant presence of soluble salts.

Total Organic Carbon of cassava Tuber and Cassava Meals obtained from different sampling locations: Figure-3 reveals the total organic carbon (TOC) values recorded in this study. For cassava tuber from various sampling locations, the TOC values ranged from 57.60 % in Onne to 59.70 % in Eleme to 61.20 % in Eteo to 66.66 % in Ebubu. The TOC values for cassava flour ranged from 58.50 % in Eleme to 60.60 % in Ebubu to 62.80 % in Eteo to 66.6 % in Onne. The TOC values for cassava fufu ranged from 57.00 % in Eleme to 57.30 % in Ebubu to 58.50 % in Eteo to 60.60 % in Ebubu. The TOC values for cassava garri ranged from 53.70 % in Eteo to 57.00 % in Onne to 60.60 % in Ebubu to 66.00 % in Eleme. The TOC values for cassava tapioca ranged from 52.80 % in Eteo to 60.00 % in Onne and Ebubu to 61.80 % in Eleme. TOC is a measure of the organic content in a sample. It contributes significantly to acidity. The high values obtained for total organic carbon depicts the fact that cassava tuber and cassava meals are basically carbohydrate.

Total Nitrogen Content (%) of Cassava Tuber and Cassava Meals obtained from different sampling locations: The total nitrogen content (TNC) values are revealed Figure-4. For cassava tuber, the TNC ranged from 0.35 % in Eteo to 0.70 % in Eleme to 1.96 % in Onne to 3.64 % in Ebubu. For cassava flour, the TNC ranged from 0.28 % in Eleme to 0.98 % in Onne to 1.05 % in Ebubu to 1.26 % in Eteo. For cassava fufu samples, the TNC ranged from 0.07 % in Eteo to 0.49 % in Eleme to 0.56 % in Ebubu to 0.84 % in Onne. For cassava garri, the TNC ranged from 0.42 % in Onne to 0.56 % in Eteo to 0.70 % in Ebubu to 1.26 % in Eleme. For cassava tapioca, the TNC ranged from 0.70 % in Eteo to 1.68 % in Ebubu to 1.75 % in Eleme to 1.75 % in Onne. Nitrogen mineralisation determines the value of the total nitrogen recorded. Nitrogen is needed by plants for healthy growth.

Conclusion

The results obtained from this study shows that there were no significant differences between the pH of the cassava tuber and the cassava meals from a particular sampling location. The result also shows that cassava tuber and cassava meals are basically carbohydrate with little protein value. Therefore cassava meals should be highly subsidized with meals rich in protein.

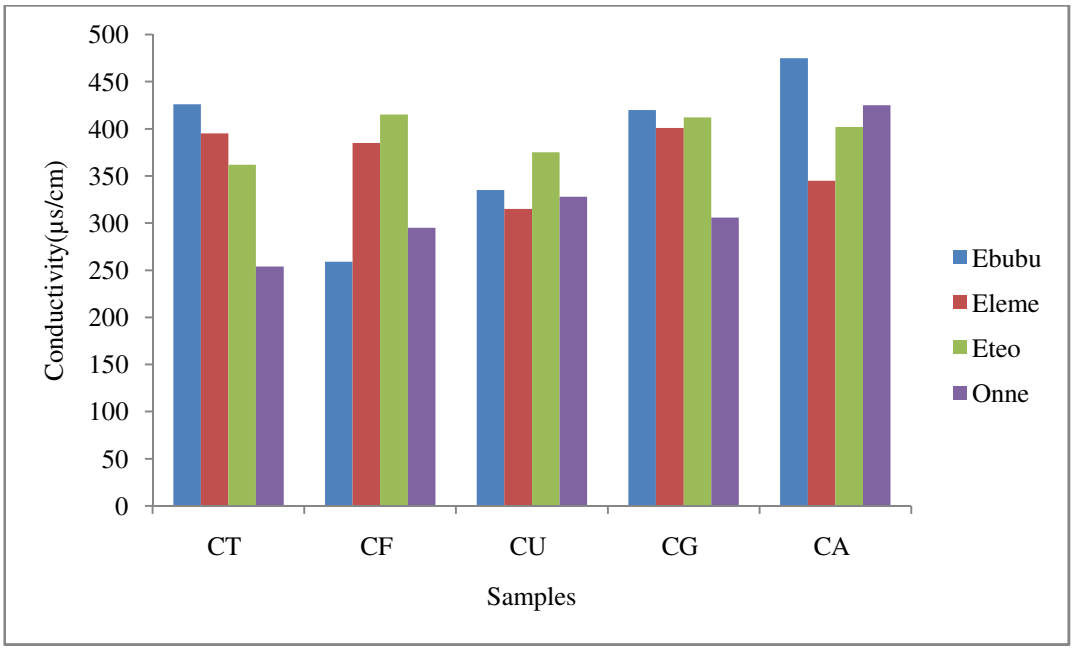

Figure-2
Conductivity of Cassava Tuber and Cassava Meals

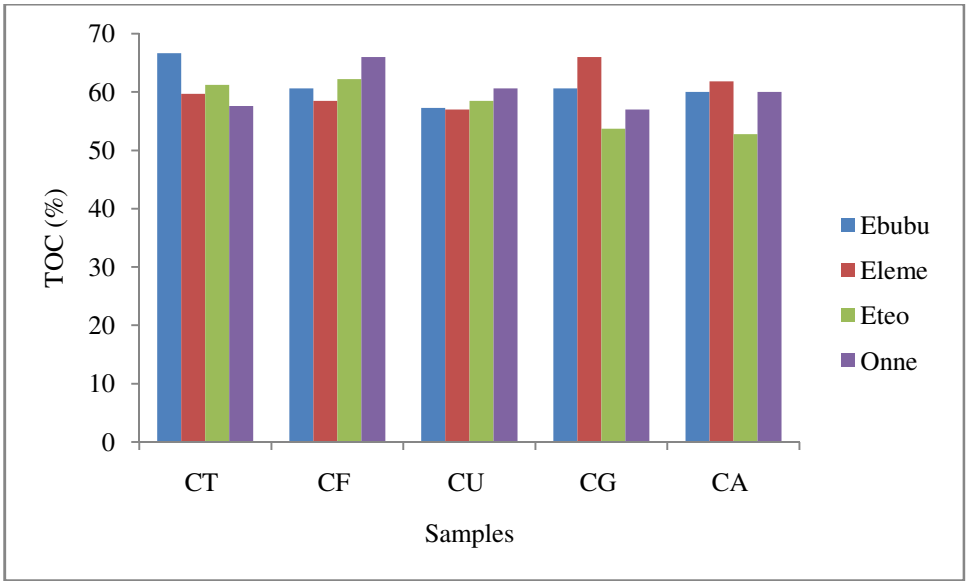

Figure-3
Total Organic Carbon (%) of Cassava Tuber and Cassava Meals

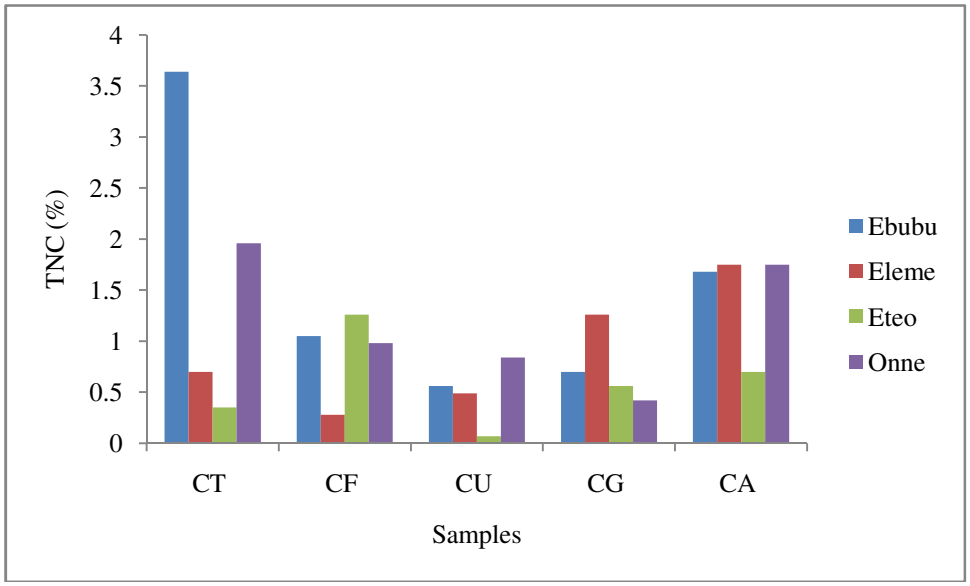

Figure-4
Total Nitrogen Content of Cassava Tuber and Cassava Meals

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