COMPARATIVE NUTRITIONAL COMPOSITION OF WATER YAM (*Dioscorea rotundata*), WHITE YAM (*Dioscorea alata*) AND COCOYAM (*Xanthosoma*)

Ejimofor Chiamaka Frances[1], Nwakuche Adaugo Ozioma[2]

[1] Department of Biological Sciences, Chukwuemeka Odumegwu Ojukwu University Uli, Anambra State
[2] Department of Botany, Nnamdi Azikiwe University Awka, Anambra State

ABSTRACT

The use of native foods is being promoted all across the world as a way to help people satisfy their nutritional needs. For many Nigerians, yam and cocoyam products are a staple source of energy. The purpose of this study was to compare the nutritional makeup of cocoyam (Xanthosoma), white yam (Dioscorea alata), and water yam (Dioscorea rotundata). After buying fresh yam and cocoyam tubers from Onitsha's Ose market, they were peeled, chopped into small pieces, and then divided into eight halves. Standard AOAC procedures were used to examine the proximate, vitamin, and mineral makeup of all samples. The white yam has very low levels of fat (1.40c+ 0.60), ash (2.66b+ 0.00) and crude moisture (51.00a+ 0.05) and carbohydrates (35.93a+ 0.10), although moderate levels of protein and fiber were also present. The highest levels of calcium (33.20a+ 0.20) and phosphorus (185.00a+ 0.00) were identified in cocoyam, while potassium and sodium levels were moderate and magnesium and iron levels were very low (10.77c+ 0.27). Vitamin B2 and C concentration was increased with water yam (p<0.05). Water yam was found to have moderate levels of vitamins A, B1, and D, whereas vitamin E had the lowest levels. In conclusion, in addition to determining the nutritional value of these popular, semi-perishable yams and cocoyams, it is advised to eat whatever type of yam you choose, whether it be water, white, or cocoyam.

KEYWORDS

WATER YAM, Dioscorea rotundata, WHITE YAM, Dioscorea alata, COCOYAM, Xanthosoma

I. INTRODUCTION

Members of the Dioscorea are referred to by the appellation "yam." In addition to being used as food, yams' roots, tubers, and rhizomes have also been utilized in traditional medicine (Singh, 2010). Different kinds of yams have been adapted as food sources in various habitations due to its high nutritional content and medicinal qualities for the treatment and cure of specific health issues. Yams have a special place in the hearts of ethnic communities and geographical locations. The class of crops that give humans energy in the form of carbohydrates includes roots and tubers. In Nigeria and other tropical

African nations, yam is a staple food with significant cultural, economic, and nutritional value (Ejimofor and Okigbo, 2023). They belong to the genus Dioscorea, which produces the starchy storage tubers that are eaten. Yam is cultivated for its tuber, which is high in energy. Nigeria is the world's largest producer of yams, which rank third among tropical root crops in Africa behind sweet potatoes and cassava (Lewu et al., 2010). There are very few yam species that are grown for food, Dioscorea rotundata, D. alata, D. cayenensis, D. dumetorum, D. esculenta, and D. bulbifera are the most significant species. The most extensively distributed species in the world, Dioscorea alata—also known as the "water yam," "winged yam," and "purple yam"—is second only to the white yam in popularity in Africa (Mwenye et al., 2011). In addition to food, it is a good source of pharmaceutical substances such as saponins and sapogenins, which are precursors of cortisone, an adrenal gland hormone used in medicine to treat certain allergies and arthritis (Mwenye et al., 2011).

The most economically significant yam species is the water yam (Dioscorea alata), which is a staple food for millions of people in tropical and sub-tropical countries and provides more than 150 million people in West Africa with more than 200 daily dietary calories per capita. Because D. alata has a low sugar content, it may also increase consumer demand for diabetic patients. The dry matter of water yams is primarily composed of sugar, minerals, vitamins, and starch, and its nutrient content varies depending on the species and cooking methods. Root crops are difficult to digest in their natural state and should be cooked before consumption. When cooked, its improved flavor, palatability, and digestibility are highly valued. However, cooking may alter the yam's phytoconstituent and nutritional makeup. Millions of people rely on white yams for nourishment in addition to basic food security and income. When ingested in high numbers, it contributes to vitamins and minerals and is a rich source of carbohydrates (Usman et al., 2015). Essential nutrition sources like carbs, protein, fat, vitamins, and other nutrients are found in water yam tubers. Its flesh often has a softer texture than white yam. In terms of production and use, it comes in second only to white yam. Furthermore, there are numerous other applications for water yam that might be developed in the industrial sectors, including cosmetics and medicine (Bradbury & Holloway, 2018).

Water yam was seen as a crop of little economic significance and unpopularity for consumption, despite its many nutritional benefits. Water yam is frequently eaten as (i) plain boiled, steamed, or fried tubers; (ii) cooked in a variety of culinary preparations, including gumpal (a rounded sweet fried dish made from grated water yam combined with grated coconut and palm sugar), kolak (slices of uwi mixed into boiled mung beans, coconut milk, palm sugar, and salt), and others; (iii) food processing goods like chips and flour used to produce breads, noodles, and other delicacies (Cornell, 2016). The biochemical properties of the native water yam are not well understood, and its consumption has lagged behind those of sweet potatoes and cassava. Agronomic traits including high yields, drought tolerance, and ease of propagation provide the water yam a comparative edge for sustainable production in addition to its high nutritional content. As a food-based strategy to satisfy dietary needs for nutrition, minerals, and micronutrients, water yam is also anticipated to support the food diversity and diet diversity that have been acknowledged and advised globally as essential elements of good diets (Ferraro et al., 2016). Additionally, diet and food diversification are thought to be beneficial. Additionally, compared to food fortification and supplementation, food diversification and diet diversity are seen to be more sustainable and effective ways to reduce micronutrient deficiency (Mignouna et al., 2014). Cocoyams, also known as "Ede bu Ji" in Igbo culture, are tubers that are grown extensively in tropical and subtropical climates worldwide. It is a perennial herbaceous wetland plant that can reach a height of one to two meters. The two primary categories of cocoyam are the "eddoes" and the "dasheen" varieties (Coursey, 2011). The tubers contain carbohydrates that humans can eat and are edible. According to Sarki and Agar (2010), cocoyam is a staple crop that is mostly farmed by women in Nigeria, the country that produces the most of it, and other West African nations. Since eating is one of everyone's basic needs, cocoyam is a valuable and economically significant food item in the majority of rural families where farmers grow their crop. Food is one of the people’s basic necessities of life, therefore cocoyam represents important vital economic food value in most rural households, farmers produce their crop mainly for consumption and family upkeep, and they also sell and preserve for replanting in the subsequent cropping season. The mature corms are mostly boiled, roasted, baked or fried. They can be eaten alone or with stew and they are served in some five-star hotels. Young cocoyam leaves are mixed with coconut cream to prepare a dish, which is then eaten with the boiled or roasted cocoyam, breadfruit or plantain (Ejimofor and Okigbo, 2023).

II. MATERIALS AND METHODS

A. Materials

Weighing crucible, Soxhlet extractor, Beaker, Filter paper, Bucker funnel, Muffle furnace, Kjeldahlflusk, Muslin cloth, Reagent, Distilled water, N-hexane, Sulpuric acid, Sodium hydroxide, Hydrochloric acid, Sodium hydroxide, H2SO4cristal

B. Method of collection of sample

White yam, water yam and Cocoyam were bought at Eke Awka market in Anambra State Nigeria. They were taken to the laboratory. The identification was carried out by my supervisor

C. Proximate Analysis

The determination of the crude protein, moisture, ash and fat contents of the samples were carried out in triplicates in accordance with Association of Analytical Chemist AOAC (2015).

Determination of moisture content

The gravimetric approach outlined by the AOAC (2015) was used to accomplish this. The sample's measured weight (5.0 g) was placed into a moisture dish that had already been weighed. After three hours of oven drying at 105°C, the sample in the dish was chilled in a desiccator and weighed. It was put back in the oven to continue drying, cooling, and weighing at hourly intervals until the weight stopped decreasing (a constant weight was achieved). A percentage of the weight of the sample under analysis was used to represent the weight of moisture lost. It was provided by the following expression:

$$\text{Moisture content (\%)} = \frac{M2 - M3}{M2 - M1} \times 100$$

Where:

M1 = Mass of empty moisture dish
M2 = Mass of empty dish + Sample before drying
M3 = Mass of dish + Sample dried to constant weight

Determination of crude protein

According to AOAC (2015), the Kjeldahl method was used for this. A micro Kjeldahl flask was made with one gramme of the material. The micro Kjeldahl flask containing the sample was filled with 25 mililiters of sulfuric acid (H_2SO_4), one gram of cupric acid ($CuSO_4$), and ten grams of sodium sulphate (Na_2SO_4). An inclination angle of 60 degrees was used to heat the flask. To prevent foaming, an anti-bumping agent was used. It was heated gradually at 70 degrees Celsius at first, then steadily until the liquid turned bluish green and no longer had any brown or black tint. After letting the flask cool, 200 milliliters of distilled water and 60 milliliters of 40/50% NaOH were added to dilute the contents. The flask was attached to a distillation equipment that included a condenser and head fitting. Two drops of screened methyl red indicator were introduced to a 250 mL conical flask containing 4% boric acid. In order to allow the distillate (ammonia gas) to become trapped in the boric acid, the mixture was heated at 80–90 degrees Celsius until the conical flask's contents reached 200 milliliters. Prepared 0.1N H_2SO_4 was added to a burette and titrated against the conical flask's contents until a pale pink hue was achieved.

Calculation:
Final reading (cm3/ml) , Initial reading (cm3/ml), Volume of titrant (Tv)

$$\text{\% Nitrogen} = \frac{(Tv \times 0.0014\ g \times 100)}{\text{Weight of the sample}}$$

% Protein = % Nitrogen × protein factor

Determination of total ash content

According to AOAC (2015), this was accomplished using the furnaces' incineration gravimetric method. A ceramic crucible that had been previously weighed was filled with precisely 10 g of the sample. For three hours, the sample was burned to ashes at 550°C in a muffle furnace. It was chilled in a desiccator and weighed once it was entirely ashed or gone grey. By calculating the difference, the weight of ash that was acquired was expressed as a percentage of the weight of the sample under analysis.

$$\text{Ash (\%)} = \frac{M2 - M1}{\text{Mass of sample}} \times 100$$

Where:
M1 = Mass (g) of empty crucible
M2 = Mass of crucible + Ash

Determination of crude fibre content

This was accomplished using the approach outlined by the AOAC (2015). A conical flask was filled with two grams of the defatted material. 200 mL of 1.25% or 0.127N H_2SO_4 was added to the conical flask, and it was boiled for 30 minutes at 80°C on a heating mantle. Using a muslin cloth, the solution was filtered while still hot, and the residue was then cleaned with boiling water. The residue was put into the conical flask and cooked for 30 minutes at 80 degrees Celsius using 200 milliliters of 1.25% OR 0.313M NaOH. Weighing and recording a filter paper (M1). After the mixture was filtered through the previously weighed filter paper, the paper and its residue were put in a petri dish and dried in an oven set to 80 degrees Celsius. It was weighed, documented, and allowed to cool in a desiccator after drying (M2). The paper with the residue was placed in a crucible (M4) that had already been cleaned, dried, cooled, and weighed. After being put in a muffle furnace, the crucible was left to burn at 600 degrees Celsius for five hours. It was then allowed to cool before being weighed as M5.

Calculation:

$$\% \text{ Fibre} = \frac{M7 \times 100}{M}$$

M3 = M2 – M1
M6 = M5 – M4
M7 = M3 – M6
M = mass of sample

Determination of crude fat content

The Soxhlet extraction method, as outlined by AOAC (2015), was used to determine this. Five grams of the material were placed in a thimble after being wrapped in Whatman filter paper, a porous paper. The thimble was installed inside a weighted extraction flask that held 250 milliliters of petroleum ether after being placed in a Soxhlet reflux flask. A water condenser was attached to the reflux flask's top. In the reflux flask, the solvent (petroleum ether) was heated, boiled, evaporated, and condensed. Soon after, the solvent was poured over the sample in the thimble until the reflux flask was full and the oil extract was siphoned over to the boiling flask. Four hours were spent repeating this procedure before the defatted sample was taken out. The oil extract remained in the flask while the solvent recovered. To get rid of any remaining solvent, the flask containing the oil extract was dried in an oven set to 60°C for 30 minutes. After cooling in a desiccator, it was weighed. The difference was used to calculate the weight of the oil (fat) extract, which was then expressed as a percentage of the sample weight under analysis.

$$\text{Fat } (\%) = \frac{M2 - M1}{\text{Mass of sample}} \times 100$$

Where
M1 = Mass (g) of empty extraction flask
M2= Mass of flask + oil (fat) extract

Determination of carbohydrate content

The carbohydrate content was determined by difference. That was by deducting the mean values of other parameters that were determined from 100.

Calculation:
% Carbohydrate =100 - (% Mc + %Cp + % Fat + %Crude fibre + % Ash)
Mc =moisture content
Cp = crude protein
%fat= fat

D. Mineral Analysis

The mineral content of the crackers samples was determined using the standard methods described by the AOAC (2010).

Digestion of sample

For six hours, twenty (20) grams of the material will be heated to 550 °C in a porcelain crucible and ash. After dissolving the ash in two milliliters of pure HNO3, it will be allowed to boil for one minute. After cooling, the liquid will be filtered through Whatman No. 42 filter paper into a 100 mL volumetric flask and heated with distilled water to the proper temperature. The minerals will be identified from the resultant (ash) solution after the solution has been thoroughly mixed.

Determination of calcium

The EDTA complex isometric titration was used to measure the test samples' calcium concentration. Panels of the masking agents, hydroxytannin, hydrochlorate, and potassium cyanide were placed to a conical flask containing twenty (20) milliliters of each extract. Twenty milliliters of ammonia buffer (pH 10.0) was then added. After adding a pinch of the indicator, ferrochrome black, the liquid was thoroughly agitated. Before taking a reading, it was titrated against a 0.02 N EDTA solution until a persistent blue color was seen. The following formula was used to determine the calcium contents.

$$\text{Calcium (mg/100 g)} = \frac{(Tv \times 0.4008 \times 1000)}{Vol. of\ sample\ used}$$

Determination of Magnesium

Exactly 10ml of the sample filtrate will be pipetted into 250ml conical flask after which 25ml of ammonia buffer solution will be added into the conical flask and will be properly mixed. Then a pinch of Erichrome black T indicator will be added and titrated with 0.02N of EDTA until the colour of the solution changed from wine-red to blue colour.

$$\text{Magnessium(mg/100g)} = \frac{(Tv \times 0.2432 \times 1000)}{\text{Vol of sample used}}$$

Determination of Iron

Five milliliters of the sample will be pipetted into a test tube, and then 1.5 milliliters of acetate buffer and 1 milliliter of 2.5% hydroquinol will be added. One milliliter of 0.1% pyridine will then be added, and everything will be thoroughly shaken to combine. Diluted water will be used to make up the volume of solution, and it will be well mixed. A spectrophotometer will be used to measure the absorbance at 530 nm after the color has had a maximum of 24 hours to develop.

Concentration of sample **=** (Absorbance of sample / Absorbance of standard) × Concentration of standard

$$\text{Iron(mg/100g)} = \frac{\text{Concentration (ppm) x Dilution factor x volume of extract used}}{\text{Wt.of Samplex100}}$$

Determination of potassium

20 ml sample solution was put in a 100 ml volumetric flask. The solution was neutralized with ammonia and nitric acid solution (1:2). Twenty (20) ml of vanadate molybdate reagent was added and diluted to the mark and then allowed to stand for 10 min and absorbance was read at 470 nm n the ultra violet region and the mineral concentration in mg/100 g was calculated using the following equation:

$$\text{Potassium (mg/100g)} = \frac{Concentration\ (ppm) \times Dilution\ factor}{Wt.of\ sample} \times 100$$

E. Vitamin analysis

Determination of Vitamin A

The method outlined by the AOAC in 2015 was used to determine vitamin A. After mixing one gram of the sample with thirty milliliters of 100% ethanol and adding three milliliters of a 5% alcoholic KOH solution, the mixture was heated for thirty minutes at 70°C under reflux. 150 ml of diethyl ether was added to the mixture after it had been cleaned with 50 ml of water in a separating funnel. The extract was dissolved with 10 milliliters of isopropyl alcohol and dried in a water bath at a low temperature of 50 degrees Celsius. The absorbance was then measured. After dissolving precisely 1 milliliter of the standard vitamin A solution in 5–10 milliliters of diethyl ether and transferring it to a cuvette, the absorbance of the standard was measured. The wavelength used to take the readings was 460 nm.

Calculation**:**

$$\text{Vit. A (mg/100g)} = \frac{\text{Absorbance of sample (x)} \times \text{Concentration of sample (y)}}{\text{Absorbance of standard} \times \text{mass of test portion}}$$

Determination of Vitamin B_1

In a 250 ml flask, one gram of the sample was dissolved in 65 ml of 0.1N HCl. It was cooked to the 100 ml mark on a boiling water bath for 45–60 minutes while being shaken often to maintain a pH of roughly 4.5. After pipetting 10 milliliters of the extract into the flask, 5 milliliters of a 10% potassium ferricyanide solution were added, and the mixture was gently stirred for two to three minutes. After adding around 2 milliliters of concentrated H2SO4 to acidify the liquid, it was cooled under running water. A small amount of zinc sulphate crystals and five milliliters of a 10% potassium iodide solution were added. One percent starch was employed as an indicator. It was titrated until a bluish-green color was achieved against 0.5N sodium thiosulphate.

Calculation:

$$\text{Vit. } B_1 \text{ (mg/100g)} = \frac{\text{Titre value} \times \text{molarity of titrant} \times \text{volume made up} \times 100}{\text{Aliquot estimated} \times \text{mass of sample in milligram}}$$

Determination of Vitamin D

Vitamin D was determined by the method stated in AOAC (2015). Five grammes of the sample was mixed with 50ml of distilled water and allowed to shake in a rotary shaker for 3 hours. The whole solution was filtered and 2ml of the filtrate was collected into a test tube. 6.5ml of distilled water was added and 2ml of deniges reagent was added. Deniges reagent was prepared by mixing 1g of mercury II oxide and 10ml of sulphuric acid and made to the mark in 100ml volumetric flask using distilled water. The sample was read against the blank at 525nm.

Calculation:

$$\text{Vit. D (mg/100g)} = \frac{\text{Absorbance} \times \text{volume of extract} \times \text{dilution factor}}{1000 \times \text{mass of sample}}$$

Determination of Vitamin C (Ascorbic Acid)

AOAC 2015 provided a description of the procedure. After 10g of the sample was extracted for one hour using 50 mL of EDTA/TCA extracting solution, it was filtered through Whatman filter paper into a 50 mL volumetric flask and the extracting solution was added to make up the difference. A 250 mL conical flask was pipetted with 20 mL of the extract, followed by the addition of 50 mL of water and 10 mL of 10% KI. This was titrated to a dark end point using a 0.01 N CuSO4 solution, and the ascorbic acid content was computed as follows:

$$\text{Vitamin C mg/100} = \frac{20 \times (V1-V2) \times C}{\text{Weight of sample}}$$

Determination of vitamin E

Ten grams of the sample and ten milliliters of ethanoic sulfuric acid will be combined, and the mixture will be gently heated for five minutes. The ether extract will be moved to a desiccator, dried for half an hour, and then evaporated to dryness at room temperature after being placed in a separating funnel and treated with three 30 ml doses of diethyl ether and recovering ether layer each time. Ten milliliters of pure ethanol will be used to dissolve the dry extract. Separate tubes will be used to hold 1 milliliter of the dissolved extract and an equivalent volume of regular vitamin E. Five milliliters of absolute alcohol and one milliliter of strong nitric acid solution will be added continuously. The combination will then be let to stand for five minutes, and the absorbance will be measured in a spectrophotometer at 410 nm using a blank reagent at zero.

$$\text{Amount of Vitamin E (mg/100g)} = \frac{\text{Absorbance of sample x Concentration of standard}}{\text{Absorbance of standard}}$$

Determination of Vitamin B_2

Vitamin B_2 was determined by the method stated in AOAC (2015). Five grammes of the sample was mixed with 50ml of distilled water and allowed to shake in a rotary shaker for 3 hours. The whole solution was filtered and 2ml of the filtrate was collected into a test tube. 6.5ml of distilled water was added and 2ml of deniges reagent was added. Deniges reagent was prepared by mixing 1g of mercury II oxide and 10ml of sulphuric acid and made to the mark in 100ml volumetric flask using distilled water. The sample was read against the blank at 525nm.

Calculation:

$$\text{Vit. } B_2 \text{ (mg/100g)} = \frac{\text{Absorbance} \times \text{volume of extract} \times \text{dilution factor}}{1000 \times \text{mass of sample}}$$

E. Statistical Analysis

Fungal colony means and percentages were computed. When significant at the 5% level of probability, the data were subjected to Analysis of Variance (ANOVA), and the Duncan Multiple Range Test (DMRT) was employed to differentiate the treatment means.

III. RESULTS

Table 1: Proximate composition of different Yam species

Proximate composition(%)	**White yam**	**Water yam**	**Coco yam**
Moisture	51.00^{a}+ 0.05	49.00^{a}+ 0.10	50.75^{a}+ 0.15
Protein	3.01^{c}+ 0.20	11.10^{a}+ 0.40	3.71^{b}+ 0.20
Lipid	1.40^{c}+ 0.60	8.60^{a}+ 0.00	6.60^{b}+ 0.00
Fiber	6.00^{b}+ 0.11	12.25^{a}+ 0.26	6.25^{b}+ 0.15

Ash	2.66^{b}+ 0.00	7.50^{a}+ 0.50	7.00^{a}+ 0.25
Carbohydrate	35.93^{a}+ 0.10	11.56^{c}+ 0.00	25.69^{b}+ 0.10

*Values are mean scores± Standard deviation of triplicate

*Data in the same column bearing different superscript differ significantly ($p < 0.05$)

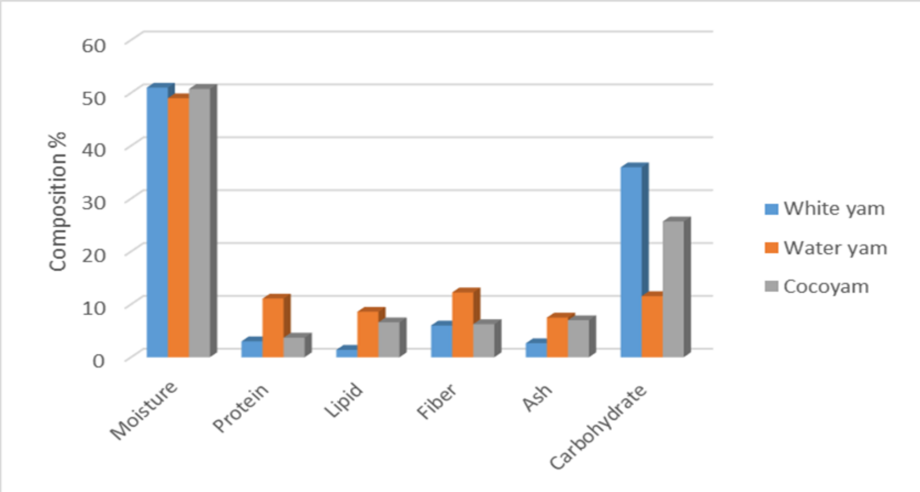

Fig 1: Proximate composition of different Yam species

Table 2: Mineral composition of different Yam species

Mineral composition (Mg/100g)	**White yam**	**Water yam**	**Cocoyam**
Calcium	$22.78^{c}\pm$ 0.36	$28.10^{b}\pm$ 0.16	$33.20^{a}\pm$ 0.20
Magnessium	$45.62^{b}\pm$ 0.55	$56.10^{a}\pm$ 0.00	$37.44^{c}\pm$ 0.40
Potassium	$264.60^{b}\pm$ 0.10	$306.10^{a}\pm$ 0.20	$305.10^{a}\pm$ 0.10
Iron	$11.40^{b}\pm$ 0.25	$12.40^{a}\pm$ 0.03	$10.77^{c}\pm$ 0.27
Phosphorus	$183.20^{a}\pm$ 0.20	$165.80^{b}\pm$ 0.21	$185.00^{a}\pm$ 0.00
Sodium	$2.38^{c}\pm$ 0.11	$31.99^{a}\pm$ 0.14	$27.85^{b}\pm$ 0.19

*Values are mean scores± Standard deviation of triplicate

*Data in the same column bearing different superscript differ significantly ($p < 0.05$)

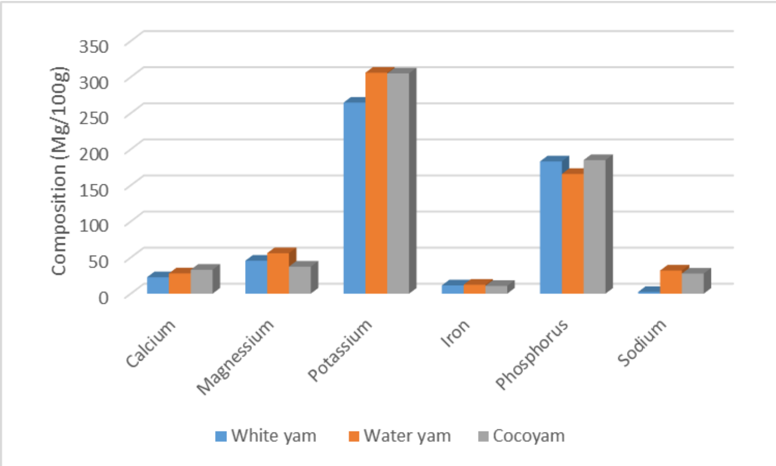

Fig 2: Mineral composition of different Yam species

Table 3: Vitamin composition of different Yam species

	White yam	**Water yam**	**Cocoyam**
Vitamin A	$0.07^{c} \pm 0.20$	$0.85^{a} \pm 0.20$	$0.09^{c} \pm 0.20$
Vitamin B1	$1.26^{a} \pm 0.20$	$0.74^{c} \pm 0.20$	$0.93^{b} \pm 0.20$
Vitamin B2	$0.67^{c} \pm 0.20$	$0.76^{b} \pm 0.20$	$1.08^{a} \pm 0.20$
Vitamin C	$12.25^{b} \pm 0.20$	$23.30^{a} \pm 0.20$	$13.00^{b} \pm 0.20$
Vitamin D	$1.94^{c} \pm 0.20$	$2.40^{a} \pm 0.20$	$2.07^{b} \pm 0.20$
Vitamin E	$3.12^{a} \pm 0.20$	$2.31^{b} \pm 0.20$	$2.76^{c} \pm 0.20$

*Values are mean scores± Standard deviation of triplicate

*Data in the same column bearing different superscript differ significantly ($p < 0.05$)

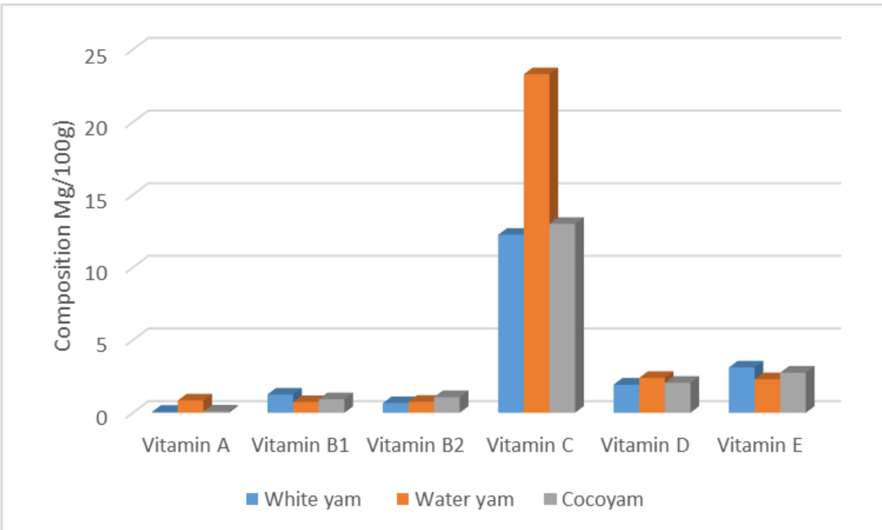

Fig 3: Vitamin composition of different Yam species

IV. DISCUSSION

These tuber crops' nutritional composition is a very difficult characteristic to assess because of their diverse features and the numerous elements that influence them (Anyaegbu and Okigbo, 2023). In order to provide useful dietary guidance, it will be very beneficial to determine the proximate vitamin and mineral contents of white yam, water yam, and cocoyam. Table 1 displays the findings of the three tuber crops' proximate composition. The findings of this investigation showed that the three tubers' varying mineral compositions may be caused by variations in each variety's capacity to absorb nutrients from the soil. Cocoyam has the highest moisture content, followed by water yam, and white yam has the lowest, which is in line with previous studies by Eleazu et al. (2013). The yam or cocoyam variety employed, weather conditions, and agronomic techniques may have contributed to the difference in moisture contents between 50% and 80% that both authors obtained. The percentage ash content is different from the range of 1 to 5% that has been described in the literature (Abebe et al., 2018). White yams have the lowest ash content (2.66b+0.00), whereas cocoyams have the highest (7.00a+0.25). The amount and kind of minerals in yam and cocoyam are determined by their ash content. Minerals are necessary for human growth and metabolism, and they also help prevent diseases caused by mineral deficiencies, such as anemia, goiter, cretinism, and myocardiopathy, as well as lower the risk of developing other chronic illnesses like cancer and cardiovascular disease (Agoreyo et al., 2018). Fiber content is highest in water yams, followed by cocoyams and white yams. Low fiber is bad because it can lead to constipation, which can lead to colon problems like cancer, appendices, and piles (Buttris, 2013).

The cocoyam's high carbohydrate content indicates that it is a superior crop when compared to other low-carbohydrate tubers. According to Butt et al. (2010), cocoyam is often a low-protein, high-carbohydrate energy source. This is consistent with the idea that tubers and other root crops are high in carbs, which accounts for their high calorie content.

The wateryam's mineral composition was high in potassium, magnesium, iron, and sodium, whereas the other kinds' rates were nearly identical. The findings showed that, in terms of calcium and phosphorus content, cocoyam has the greatest levels, followed by water yam and white yam.

According to the vitamin concentrations in this study, which are shown in table 3, cocoyam has higher qualitative values of vitamins A, B1, and B2 than water and white yams. All yam species had calcium, magnesium, potassium, sodium, and phosphorus concentrations between 21.4-64.9, 23.4-71.57, 46.76-59.07, 13.4-32.33, and 10.04-91. 8 mg/kg, respectively. With the exception of phosphorus, which was somewhat elevated but still within acceptable bounds, these concentration ranges are within allowable limits.

As a result, these yam species are safe to eat. In comparison to cocoyam (13.00b+0.20) and white yam (12.25b+0.20), water yam has the highest vitamin C content (23.30a+0.20). White yam had the lowest vitamin D concentration (1.94c+ 0.20) while cocoyam had the highest (2.07b+ 0.20). The analysis's findings showed that white yams had the highest vitamin E content (3.12a+0.20), while water yams had the lowest (2.31b+0.20) in comparison to cocoyams (2.76c+0.20). The outcome is consistent with Eshun's (2012) research.

V. CONCLUSION

Yam symbolizes wealth and prosperity. Many problems beset yam and cocoyam production in Nigeria, ranging from weed pressure, decline in soil fertility, soil borne pests and diseases, leaf and shoot diseases, storage pests, high labour, cost for land preparation and maintenance, staking, harvesting, barn construction and tuber quality deterioration. White yam, water yam and cocoyam have dense nutritional benefits. Raw cocoyam is very toxic due to the presence of calcium oxalate and the needle – shaped raphides Those toxins cause irritation of the throat and mouth if not thoroughly removed. One of the major uses of cocoyam is for food, the corm is boiled, fried, baked, roasted and the leave is not left out. The leaves are cooked as vegetables. They are also used to wrap other foods.

RECOMMENDATION

It is impossible to overstate the necessity of using molecular techniques in addition to traditional breeding methods for these tuber crops. By giving farmers heavily subsidized seeds, the federal and state governments ought to take yam and cocoyam into account under the growth enhancement assistance program. For the National Root Crops Research Institutes to fulfill their mission, adequate financing is desperately needed.

REFERENCES

[1] Abebe H, Tesema B and Tilku D (2018). Proximate composition, anti-nutritional factors and minerals content of composite flours and Bread from blends of wheat-Anchote-Soybean flour. Journal of advances in Nutrition and Food Science, ISSN: 2572-5971

[2] Abiodun OA and Akinoso, R. (2014). Textural and sensory properties of trifoliate yam flour and stiff dough ‘amala’. J Food Sci Technol. 14:13-17.

[3] Agoreyo, B.O., Akpiroro, H.O., Orukpe, O.A., Osaweren, O.R., and Owabor, C.N. (2011). The effects of various drying methods on the nutritional composition of Musa paradisiaca, Dioscorea rotundata and colocasia esculenta. Asian J Biochem 6: 458-464

[4] Alexander J, Coursey, DG. (2015). The Origins of yam cultivation; Ucko P.J, Dimbleby, G.H., Eds, Gerald Duckworth and co; London, UK.

[5] Anyaegbu, C.F and Okigbo, R.N. (2023). GC-MS of Allium sativum (Garlic) and Gongronema latifolium (Utazi) plant extracts and inhibition of post-harvest fungi in cocoyam. International Journal of Agricultural Technology. 19(6): 2367-2384

[6] AOAC (2010). Official Methods of Analysis, 15th edn. Association of Official Analytical Chemists,278 -28

[7] AOAC (2010). Official Methods of Analysis, 15th edn. Association of Official Analytical Chemists,24 -27

[8] Bradbury, DH, and Holloway, WD. (2018). Chemistry of tropical root crops. Significance of nutrition and agriculture in the pacific. J. Sci. Food. Agric. 62, 219-224

[9] Butt, M. S., & Batool, R. (2010). Nutritional and functional properties of some promising legumes protein isolates. Pakistan Journal of Nutrition: PJN, 9(4), 373–379.

[10] Buttriss, J. L. (2013). Food reformulation: the challenges to the food industry. Proceedings of the Nutrition Society, 72(1), 61-69.

[11] Cornell, J.A. (2016). A comparison between two ten-point designs for studying three component mixture systems. Journal of Quality Technology, 18,1.

[12] Coursey DG (2011). Yams: Tropical Agriculture series, Pp.25-28. Longmans London. Muzuc – Tucker I, Asemota HN, Ahmad 19H (2013). Biochemical composition and storage of Jamaica yams (Dioscorea spp.). Journal of the Science of Food and Agriculture.62: 219 – 224

[13] Ejimofor, C.F and Okigbo, R.N. (2023). Antifungal effects of some plant extracts on fungi isolated from post-harvest cocoyam. Newport International Journal of Scientific and Experimental Sciences. 3(1):23-49

[14] Ejimofor, C.F and Okigbo, R.N. (2023). DNA Extraction, purification and sequencing of some spoilage fungi of cocoyam. Newport International Journal of Scientific and Experimental Sciences. 3(1):57-70

[15] Eka, OU (2015). Roots and tuber crops in Osagie A and Eka OA Nutritional quality of plant foods. Post-harvest research unit, university of Benin: Benin City, Nigeria. (pp. 1-31).

[16] Eleazu CO, Kolawole S And Awa E (2013). Phytochemical composition and Anti-fungal actions of aqueous and ethanolic extracts of the peels of two yams varieties". Med aromat plants 2, 128.

[17] Eshun, G., (2012). Nutrient composition and functional properties of bean flours of three soya bean varieties from Ghana. African Journal of Food Science and Technology.3(8), 176-181.

[18] Ferraro V, Piccirillo C, Tomlins K, Pintado ME. (2016). Cassava (Manihot esculenta Crantz) and Yam (Dioscorea spp.) Crops and Their Derived Foodstuffs: Safety, Security and Nutritional Value. Food Sci Nutr. 56(16), 2714-27.

[19] Ghavidel, R.A. & Davoodi, M.G. (2014). Processing and assessment of quality characteristics of composite baby foods. World Academic Science Engineering Technology, 59, 20-43.

[20] Hallström, E., Sestili, F., and Lafiandra, D., (2011) A novel wheat variety with elevated content of amylose increases resistant starch formation and may beneficially influence glycaemia in healthy subjects. Food and Nutri Res 55: 1–8.

[21] Hoover, R., Hughes, T., Chung, H., and Liu, Q. (2010). Composition, molecular structure, properties, and modification of pulse starches: A review. Food Research International, 43(2), 399- 413.

[22] Hota, R., Jena, A. K., & Naranyana, K. L. (2016). Effects of inorganic and organic amendments on yield of cocoyam (Colocasia Esculenta), and on soil properties. World Journal of Agricultural Research, 2(2), 70 – 81.

[23] Irondi, A.E., Awoyale, W., Oboh, G., & Boligon, A.A. (2017). Effect of mango kernel flour addition on the phenolics profile, antioxidant activity and pasting properties of wheat flour. Journal of Food Measurement and Characterization, 11(4), 2202–2210.

[24] Kaczmarczyk MM, Miller MJ, Freund GG. (2012). The health benefits of dietary fiber: beyond the usual suspects of type 2 diabetes mellitus, cardiovascular disease and colon cancer. Metabolism. 61(8), 1058-1066.

[25] Lewu, M. N, Adebola, P. O., & Afolayan. (2010). Comparative assessment of the nutritional value of commericially available cocoyam and potato tubers in South Africa. Journal of Food Quality, 33(4), 461 – 476.

[26] Mbaeyi-Nwaoha, I. E., & Uchendu, N. O. (2016). Production and evaluation of breakfast cereals from blends of acha and fermented soybean paste (okara). Journal of Food Science and Technology, 53(1), 50–70.

[27] Mignouna DB, Akinola AA, Suleman I, Nweke F, and Abdoulaye T. (2014). Yam: A Cash Crop in West Africa. YIIFSWA Working Paper Series No. 3, Yam Improvement for Income and Food Security in West Africa International Institute of Tropical Agriculture. ISBN 978-978-8444. 38-1.

[28] Mwenye, O. J., Labuschagne, M. T., Herselman, L., & Benesi, I. R. M. (2011). Mineral composition of Malawian cocoyam (Colocasia esculenta and Xanthosoma sagittifolium) genotypes. Journal of Biological Sciences, 11, 331–335.

[29] Oko, AO and Famurewa, AC (2015) Estimation of Nutritional and Starch Characteristics of Dioscorea alata (Water Yam) Varieties Commonly Cultivated in the South-Eastern Nigeria. British Journal of Applied Science & Technology 6(2): 145-152.

[30] Olaleye, L. D., Owolabi, B. J., Adesina, A. O., & Isiaka, A. A. (2013). Chemical composition of red and white cocoyam (Colocosia esculenta) Leaves. International Journal of Science and Research, 2(11), 121 – 126.

[31] Sarki Yari, S and Agar, TM (2010). Comparative analysis on the nutritional and anti-nutritional contents of the sweet and bitter cassava varieties". Advance journal of food science and technology, volume 2(6), 328 – 334.

[32] Singh, SC. (2010) Some wide plants of food value in Nepal J. Plant Food Hum. Nutr. 4, 50-56.

[33] Udensi EA, Osabele HO, Onuoha AU (2010). Antinutritunal assessment of D.alata varieties. Pakistan Journal of Nutrition 9(2), 179-181.

[34] Usman, M., Madu, V. U., & Alkali, G. (2015). The combined use of organic and inorganic fertilizers for improving maize crop productivity in Nigeria. International Journal of Scienctific and Research Publications, 5(10), 1 - 7.