



## Comparative Studies on the Proximate Composition of Three Tubers of *Dioscorea* Species in Anyigba, Kogi State



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### ABSTRACT

The third world countries are not just suffering from food shortage, they are also plagued by malnutrition which stems from poverty coupled with inadequate informations about the nutritional contents of foods consume by most of her populace. Yam is a stable food consume by millions of Nigerians and the decision of which species to consume is often based on palatability and availability. Proximate analysis was carried out on *D. rotundata*., *D. cayenensis* and *D. alata* to compare their protein, carbohydrate, moisture, crude fibre, fat and ash content. The result reveals that Carbohydrate content of *D. cayenensis* (50.60%) was higher when compared to *D. rotundata* (48.8%) and *D. alata* (36.02%). Also, the crude fibre of *D. alata* (5.26%) was significantly higher compared to *D. cayenensis* (4.86%) and *D. rotundata* (4.75%), similar result was obtained for the protein content of *D. alata*; which was 3.46% compared to *D. cayenensis* (2.13%) and *D. rotundata* (1.61%) respectively. This research concludes that the proximate composition of the *Dioscorea* species studied varied significantly. Yam consumers and nutritionist are advised to select their yam species in view of the various proximate constituents to achieve a well balance diet in terms of food and composite flour. The cultivation of the *D. alata* species should be encouraged because of its low Carbohydrate and high protein contents, thus making it suitable for diabetic patients or people suffering from related illnesses.

**Keywords:** composition, *Dioscorea*, Diet, consumers, nutritionist, and Proximate.

### 1 Introduction

Yams belong to the family of *Dioscoreaceae* and it is regarded as third most important crop next to sweet potato, and Cassava [1, 2]. Different cultivars and forms of edible yam species are grown in different regions and they possibly differ in nutrient values and composition. Yam is an excellent source of starch and they possessed high moisture content, proteins, lipids, dry matter, and minerals. The nutrient content varies with varieties and species [2]. *Dioscorea rotundata*, *Dioscorea alata* and *Dioscorea dumetorum*; possessed distinctive flavor and nutritional content which are helpful to nutritionist, pharmaceutical and yam-based products [1]. In developing countries, Yam is the cheapest source of energy in form of carbohydrates and it is cultivated majorly because of its tuber which can be processed into various edible forms such as Yam flour which is used in

different culinary preparations and it is now also been used in bakery, although the nutritional quality of a particular yam species is a major criteria in selecting the yam for the production of yam based products by processors, stakeholders, and cultivation by farmers [2]. It can also be eaten as boiled, fried, roasted or mashed to meet the dietary requirement of different regions and customs [3].

Food and nutrition are critical to disease initiation and development because most chronic degenerative diseases that lead to death can be prevented with diet and proper nutrition [4]. Apart from water quality, balanced diet with necessary micronutrients and macronutrients is needed to achieve optimal health condition [2]. Recently, there has been tremendous interest in the area of nutrition; especially on the assessment of nutrients, mineral composition and vitamins of staple foods which are considered to be



socially, economically and culturally important in many tropic and subtropics regions of the world. In these regions, yam is being investigated for its nutritional quality [4]. Yam which is a major component of a Nigerian diet is a rich source of vitamins, proteins, fat and oil and carbohydrates; it is estimated to provide about 285 dietary calories per person daily for 300 million people in sub Saharan Africa [5]. [6] reported that *D. rotundata* and *D. alata* are excellent sources of starch, which provides calories and protein three times better than the one of cassava and sweet potato. Most people depend on these edible plants for their nutritional needs [7]. In the advent of composite flours (i.e mixtures of varied proportions of plant sources) to serve as local alternatives to wheat flours, cassava flour, banana and others, it has become necessary to understand the functional properties of various yam tubers in order to promote their beneficial usage [1].

*Dioscorea spp* also has comparative advantage for sustainable production due to its better agronomic characteristics such as ease of propagation and high yield, high nutritive value and longer storage of the fresh tubers which can help meet the demand of food security and income generation [6]. According to Jido et al., [8] proximate composition are used in the term of food and feed production to mean; the examination of the six basic components (crude protein, moisture, crude fibre, crude ash, Carbohydrates and Fats) that are important in understanding the nature and properties of the food or feed. The knowledge obtain from this study will provide information for genetic enhancement and sustainable use of yam in composite flour and other products [5]. The aim of this research is to compare the proximate composition of three tubers of *Dioscorea* species namely *D. rotundata* and *D. alata* and *D. cayenensis* in Anyigba in order to provide a healthy guide for consumers.

## 2 Materials and Methods

Healthy yam tubers of *Dioscorea rotundata*, *Dioscorea cayenensis* and *Dioscorea alata* were bought from Anyigba market and taken to the laboratory in a polythene bag. Tubers from each

sample weighing 100g were peeled, cut into small pieces. As described by [3] these samples were dried in an air convection oven at 60°C for 72 hours and kept at -20°C refrigerator. After drying, the samples were ground to powder and stored in airtight containers and kept at room temperature before analysis. Proximate composition of the ash, crude fat, crude protein, carbohydrates, moisture content and crude fibre was determined using the methods used by [3, 8]. Completely Randomized Design was used and the analysis of variance (One Way Anova) to separate the means using least significance difference (LSD) to determine levels of significance.

### 2.1 Determination of Moisture Content (Using Oven Methods)

About 5g of sample was rapidly transferred into pre-weighed drying dish. The dish and contents were weighed. It was dried to constant weight at 95-105°C under pressure not exceeding 100mmHg (about 6 hours) When drying has been completed, the dish was placed in a desiccator to cool. The sample was reweighed and the loss in weight was recorded as moisture. The percentage of moisture was calculated as follows-

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

where

$W_1$  = initial weight of empty crucible

$W_2$  = weight of crucible + food before drying

$W_3$  = Final weight of crucible + food after drying.

$\% \text{ total solid (dry matter)} = 100 - \% \text{ moisture.}$

### 2.2 Determination of Ash Content

2g of each sample was accurately weighed into a tarred silica or porcelain crucible. The sample was transferred into a pre-heated muffle furnace at 550°C. It was kept at this temperature for 2 hours and it was then dried in an oven. The sample was cooled in a desiccator and reweigh for following calculation-

$\% \text{ Ash (dry basis)}$

$$= \frac{\text{Weight of Ash}}{\text{Weight of Original Food}} \times 100$$

$$\% \text{ Ash (dry basis)} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

### 2.3 Determination of Crude Fibre

Five (5g) of material was defatted with petroleum ether. It was boiled under reflux for 30 minutes with 200ml of a solution containing 1.25g of H<sub>2</sub>SO<sub>4</sub> per 100ml of solution. The solution was filtered through linen or several layers of cheese cloth on a fluted funnel. The residue was transferred to a beaker and boil for 30 minutes with 200ml per 100ml. The final residue was filtered through a thin but close pad of washed and Ignited asbestos in a grouch crucible. It was dried in an electric oven and weighed. The loss in weight after incineration x 100 is the percentage crude fibre.

### 2.4 Determination of Carbohydrate

The carbohydrate content was estimated as the remainder after accounting for all moisture, Ash, fibre, fat and protein as-

$$100 - [\text{Moisture} + \text{Ash} + \text{Fibre} + \text{Fat} + \text{Protein}]$$

### 2.5 Determination of Fat

Soxhlet extraction method is commonly used. This method is carried out by continuously extracting each species of yam with a non-polar organic solvent such as Petroleum ether for about 1 hour or more. 250ml clean boiling flasks was dried in oven at 105-110°C for about 30minutes. It was then transferred into a desiccator and allowed to cool. 5g of samples was weighed accurately into labeled thimbles, Correspond labeled weighed, cooled boiling flasks, Boiling flasks was fill with about 300ml of petroleum ether (boiling point 40-60°C), The extraction thimble was plugged lightly with cotton wool, The soxhlet apparatus was assembled and allowed to reflux for about 6 hours, The thimble was removed with care and petroleum ether was collected in the top container of the set up and drained into a flash for re-use, When flask was almost free of petroleum ether, it was removed and dried at 105-110°C for 1 hour, It was transferred from the oven into desiccators, allowed to cool and then weighed for following calculation-

$$\% \text{ Fat} = \frac{\text{Weight of Fat}}{\text{Weight of Sample}} \times 100$$

### 2.6 Determination of Protein

5g of sample was weighed into kjeldahl flask, 5g of four tablets of kjeldhal catalyst was added, This was followed up by adding 1g of copper sulphate and a speck of selenium of 1 tablet of kjeldhal catalyst (each tablet contains 1g Na<sub>2</sub>SO<sub>4</sub> + 0.05g celenium) Into the mixture, 25ml concentration of sulphuric acid and glass beads was introduced (glass beads prevent bumping during heating) In the fume cupboard, it was heated gently at first and then the heat was increased with occasional shaking till solution assumes a green colour (temperature of digester is above 420°C for about 30min). Black particles showing at the mouth and neck of the flask were cooled and washed down with distilled water. Gently reheated at first until the green colour disappears then it was allowed to cool. After cooling, digest was transferred with several washing into a 250ml volumetric flask and make up to mark with distilled water. Distillation was done by using Markham distillation apparatus. Before use, it was steamed through the Markham distillation apparatus for about 15minutes Under the condenser, 100ml conical flask containing 5ml of boric indicator was placed such that the condenser tip is under the liquid, 5ml of the digest was pipette into the body of the apparatus via the small funnel aperture, it was washed down with distilled water followed by 5ml of 60% NaOH solution, Steaming was done for about 5-7 minutes to collect enough ammonium sulphate. The receiving flask was removed. Then the condensed water was removed; solution in the receiving flask was titrated using N/100 (0.01N) hydrochloric or sulphuric acid and the nitrogen content was calculated and hence the protein content of the food as follows-

$$\% \text{ Nitrogen} = \frac{(V_S - V_B) \times N_{\text{Acid}} \times 0.01401}{W} \times 100$$

where

V<sub>S</sub> = vol (ml) of acid required to titrate sample

V<sub>B</sub> = vol (ml) of acid required to titrate the blank

N<sub>Acid</sub> = normality of acid (0.01N)

W = Weight of sample in grams

$$\% \text{ Crude protein} = \% \text{ N} \times (\text{conversions factor})$$

$$(100\% \text{ Nitrogen in protein}) = \text{conversion factor}$$

**Table 1:** Proximate Composition of the Three Yam Tubers Studied

| Yam Species          | Moisture (%)            | Ash (%)                | Crude fibre (%)        | Fat (%)                | Protein (%)            | Carbohydrate (%)        |
|----------------------|-------------------------|------------------------|------------------------|------------------------|------------------------|-------------------------|
| <i>D. rotundata</i>  | 42.67±0.13 <sup>b</sup> | 1.60±0.00 <sup>b</sup> | 4.75±0.05 <sup>b</sup> | 0.54±0.02 <sup>c</sup> | 1.61±0.05 <sup>c</sup> | 48.83±0.25 <sup>b</sup> |
| <i>D. alata</i>      | 52.20±0.01 <sup>a</sup> | 2.18±0.03 <sup>a</sup> | 5.26±0.04 <sup>a</sup> | 0.89±0.01 <sup>a</sup> | 3.46±0.04 <sup>a</sup> | 36.02±0.22 <sup>c</sup> |
| <i>D. cayenensis</i> | 40.22±0.08 <sup>c</sup> | 1.53±0.03 <sup>b</sup> | 4.86±0.02 <sup>b</sup> | 0.67±0.03 <sup>b</sup> | 2.13±0.06 <sup>b</sup> | 50.60±0.01 <sup>a</sup> |
| <b>Total</b>         | <b>45.03±2.31</b>       | <b>1.77±0.13</b>       | <b>4.96±0.10</b>       | <b>0.70±0.07</b>       | <b>2.40±0.35</b>       | <b>45.15±2.91</b>       |
| P value              | 0.000*                  | 0.000*                 | 0.005*                 | 0.003*                 | 0.000*                 | 0.000*                  |

Mean in column bearing the same super script(s), do not differ significantly. (P ≤ 0.05)

### 3 Results

The result of the proximate analysis of the different yam tuber studied is presented in table 1 above, the result showed varied composition of Moisture, Carbohydrate, Ash content, crude fibre, Protein and Fat contents. The moisture contents of *Dioscorea alata* (52.20%), was higher when compared to *D. rotundata* (42.67%) and *D. cayenensis* (40.22%) respectively. The Ash content of *D. alata* (2.18%) was higher compared to *D. rotundata* (1.6%) and *D. cayenensis* (1.53%). Carbohydrate value was 50.60% in *D. cayenensis* compared to *D. rotundata* (48.8%) and *D. alata* (36.02%). The crude fibre was higher in *D. alata* (5.26%) compared to *D. cayenensis* (4.86%) and *D. rotundata* (4.75%), the fat content of *D. alata* was (0.89%) higher than *D. rotundata* (0.54%). Also, the protein content of *D. alata* (3.46%) was higher compared to *D. cayenensis* (2.13%) and *D. rotundata* (1.61%).

### 4 Discussion

The Proximate analysis of all the tubers of *Dioscorea* species studied showed positive for all the proximate composition tested (Moisture content, ash content, crude fibre, Protein, Carbohydrate and Fat) at varied composition. There was significance difference in the proximate composition of the three tubers of *Dioscorea* species studied. *Dioscorea alata* (52.20%), shows high moisture content followed by *D. rotundata* (42.67%) and *D. cayenensis* (40.22%). The Ash content of *D. alata* (2.18%) was higher compared to *D. rotundata* (1.6%) and *D. cayenensis* (1.53%) respectively. Also, the Carbohydrate value was 50.60% in *D. cayenensis* compare to *D. rotundata* (48.8%) and *D. alata* (36.02%). These results are in agreement with the report of [9]

who reported that there was significance difference in the proximate composition of *Dioscorea alata* and *Dioscorea rotundata*, although the proximate composition values gotten from this research differ from those reported by [9] above. This might be as a result of the age of plant, time of harvest, season of growth, research methodology and soil nutrient composition [10]. However, the result is valid and useful as a guide in the study area. *D. alata* has the highest crude fibre (5.26%) content compared to *D. rotundata* (4.75%) and *D. cayenensis* (4.86%) respectively. Studies by [10] have shown that increase in fiber consumption in foods reduces the incidence of obesity, type 2 diabetics, cardiovascular disease, digestive disorders and some cancers. Fiber consumption is also believed to increase stool bulk and moves waste faster in the gastrointestinal tract which helps to prevent digestive tract problems such as constipation and diverticulosis. The *D. alata* species also has high protein content (3.46%) compared to *D. rotundata* (1.61%) and *D. cayenensis* (2.13%) respectively, [4] reported that the intake of stable foods with low protein content may result to several impaired biological processes in the body. With the high protein content recorded from *D. alata* in Anyigba, it is a good source of protein to consumers. The low carbohydrate (suger) content of *D. alata* (36.02%) when compared to the high carbohydrate content of *D. rotundata* (48.83%) and *D. cayenensis* (50.60%) species respectively, also makes it a tolerable source of energy and this might relate to its recommendation for diabetic patients [11] who require low level of sugar in their body. This reveals the health benefit of *D. alata* in the prevention of chorionic disease; such as type 2 diabetes mellitus. Out of the three yam tuber



species studied; *D. cayanensis* (40.22%) has the lowest moisture content which suggests that it might store better compared to the two other species. According to [4] Moisture content is very important in food quality, preservation, and resistant to fungi attack. It has also been linked to many properties that affect the quality and shelf life of food and other products, including bacterial growth and texture [12].

## 5 Conclusion

This research concludes that the proximate composition of the tubers of *Dioscorea* species studied (i.e *Dioscorea rotundata*, *Dioscorea cayenensis* and *Dioscorea alata*) varied significantly. Yam consumers, processors and nutritionist are advised to choose their yam species in view of the nutritional contents highlights above for optimal utilization and healthy consumption, especially in the case of sufferers of diet related diseases. The cultivation of the *D. alata* species should also be encouraged due to its low Carbohydrate and high protein contents. More awareness should be done to enlighten various yam stakeholders about the variation in the nutrition values of yam species available at various localities. Researchers should look into genetically enhancing the *D. rotundata* species so as to increase its protein value in order to maximize its immense benefits.

## 6 Competing Interests

The authors declared that they do not have any conflicts of interest. The authors are responsible for the content and writing of this article.

## How to Cite this Article

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## References

- [1] Aathira, M., and P. Siddhuraju. "Evaluation on suitability of differentially processed *D. bulbifera* tubers (Aerial and Underground) as alternative in composite flours for future food innovations" *Evaluation* 2.6 (2017).
- [2] K. C. J. Nina, D. C. Ghislaine, K. K. Hubert, A. Y. D. Patrice, K. L. Patrice and K. Alphonse "Biochemical and Functional Properties of Yam Flour during the Post-harvest Conservation of *Dioscorea alata* Cultivar «

Azaguié »", *Current Journal of Applied Science and Technology* 21(6): 1-10, 2017.

- [3] Bekele, Atnafua, and Endashaw Bekele. "Proximate and Mineral Composition Variability in Ethiopian Yam (*Dioscorea* spp)" *Journal of Food and Nutrition Sciences* 6.1 (2017): 12.
- [4] Oko, A. O., and A. C. Famurewa. "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 (2015): 145.
- [5] T. Mulualem, F. Mekbib, S. Hussein and E. Gebre "Analysis of Biochemical Composition of Yams (*Dioscorea* spp.) Landraces from Southwest Ethiopia" *Agrotechnology* 7 (2018): 177.
- [6] Coursey, David G. "Cassava as food: toxicity and technology." *Chronic cassava toxicity*. IDRC, Ottawa, ON, CA, 1973.
- [7] M. Mulugeta, and T. Tebekab "Proximate and Some Minerals Analysis of *Colocasia esculenta* (Taro) Tuber in Southern Ethiopia" *international Journal of pharmacy and pharmaceutical Research*, September 2017 Vol.:10, Issue:2.
- [8] B.A. Jido, M. Haruna, M. A. Abdullah, A. A. Shehu, F. U. Sadiu, A. Yahaya, and M. Ali, "Determination of Proximate Composition of Selected Street Vended Fried Foods Sold in Wudil Town Kano State, Nigeria". *Chemistry Research Journal*, 2019, 4(1):33-39.
- [9] Nweke, F. U. "Some fungal pathogens of yam (*Dioscorea* Spp.) in storage and the effects of their infection on the nutrient composition." *Journal of Biology, Agriculture and Healthcare* (5) (2015): 153-157.
- [10] Nimenibo-Uadia, R. I., and A. V. Oriakhi "Proximate, Mineral and Phytochemical Composition of *Dioscorea dumetorum* Pax." *Journal of Applied Sciences and Environmental Management* 21.4 (2017): 771-774.
- [11] Udensi, E. A., H. O. Oselebe, and A. U. Onuoha. "Antinutritional assessment of *D. alata* varieties" *Pakistan Journal of Nutrition* 9.2 (2010): 179-181.
- [12] P. Parasoglou, E. P. J. Parrott, J. A. Zeitler, J. Rasburn, H. Powell, L. F. Gladden, and M. L. Johns. "Quantitative water content measurements in food wafers using terahertz radiation." *Terahertz Sci Technol* 3, no. 4 (2010): 176-82.

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