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Nutritional Composition and Sensory Evaluation of Tapioca Fortified With a Blend of Groundnut (*Arachis hypogaea*) and Tigernut (*Cyperus esculentus*) Flour

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ABSTRACT

Tapioca, a cassava derivative, is a light, carbohydrate-rich snack or full meal. It lacks essential nutrients like protein, fiber, and healthy fats, potentially leading to malnutrition and health issues. This study investigated the nutritional composition and characteristics of tapioca enhanced with tigernut and groundnut flour. The tapioca was blended with groundnut and tigernut flour in varying proportions (100, 80-10-10, 70-15-15, 60-20-20, and 50-25-25) and evaluated for proximate composition, mineral content, and sensory attributes. The results showed significant improvements in protein (0.84-0.69%), fibre (0.98-1.04%), and mineral content (calcium, iron, and sodium) with increasing levels of fortification. Sensory evaluation revealed that the fortified tapioca had enhanced acceptability, taste, and texture in comparison to the control sample. The 70-15-15% fortification level was deemed optimal, offering a balance between nutritional enhancement and sensory appeal. This study demonstrates the potential of groundnut and tigernut flour as nutritious enhancer for tapioca, contributing to the development of value-added, nutrient-dense food products.

Keywords: Tapioca, Mineral composition, Proximate properties, Sensory evaluation, Groundnut flour, Tigernut flour.

INTRODUCTION

In Nigeria, especially in the Niger-Delta Region, tapioca—lightly cooked cassava starch grits—is primarily consumed and produced as a convenient dish that is often served with milk or sugar. It is made by modifying the garri production procedure. This traditional treat can be consumed dry with edible worms, groundnuts, or dried fish, or it can be soaked in water and flavoured with milk, honey, or salt (Nwafor *et al.,* 2015). According to nutritional data, tapioca has a significantly high starch content (78–96%) (Samuel *et al.,* 2012). After rice, sugar, and maize, it is the fourth most significant energy source in human diets globally and the sixth most important overall. Depending on the cassava species, tapioca's protein level can range from 0.31 to 1.20 percent (Adeboye *et al*., 2019).

Although tapioca is widely consumed, especially in tropical and subtropical climates, it is frequently criticized for lacking important elements such protein, vitamins, and minerals. This nutritional deficiency can lead to various health issues, particularly in populations that rely heavily on tapioca as a primary food source (Noah and Abiaziem, 2019). To combat these deficiencies, food fortification has emerged as a crucial strategy aimed at enhancing the level of nutrients in dietary items (Olson *et al*., 2021). The nutritional enhancement of tapioca can be achieved through the incorporation of various nutrient-dense ingredients. Fortification involves the deliberate addition of micronutrients, such as vitamins and minerals to food items to address specific dietary gaps and improve overall health outcomes. By fortifying staple foods like tapioca with nutrient-dense ingredients, it is possible to significantly improve their

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nutritional profiles, thereby addressing prevalent deficiencies in populations worldwide (Das *et al*., 2019). Groundnut (*Arachis hypogaea*) and tigernut (*Cyperus esculentus*) flour are two promising candidates for this purpose.

Groundnut, or peanut, is a nutrient-dense legume that is particularly rich in protein, making it an excellent source of this essential macronutrient, which is vital for growth, tissue repair, and overall bodily function (Pardeshi, 2019). Tigernut, often considered a tuber rather than a nut, is renowned for its high fibre content, which aids in digestion and promotes gut health by maintaining a healthy microbiota and avoiding constipation (Yu *et al*., 2022). The latter is rich in vitamins E and C, as well as minerals like iron and calcium, which contribute to antioxidant protection, improved iron status, and enhanced bone health (Gadanya *et al.,* 2021; Nwosu *et al.,* 2022).

Malnutrition remains a critical challenge in developing countries, particularly in Nigeria, where a significant portion of the population relies heavily on cassava-based meals, consuming them several times daily (Otegbayo *et al*., 2013; Nwafor *et al.,* 2015; Olanrewaju *et al*., 2023). This dietary pattern often leads to micronutrient deficiencies, exacerbating health issues and hindering overall development. Given the low nutritional profile of tapioca, which primarily consists of carbohydrates and lacks essential proteins and micronutrients, there is an urgent need to explore effective fortification strategies. The incorporation of nutrient-dense ingredients, such as groundnut and tigernut flour, into tapioca presents a promising solution to enhance its nutritional composition. However, there is limited research on the optimal formulations for enhancing the nutritional composition of tapioca while maintaining desirable sensory attributes. Therefore, this study seeks to fill this gap and to evaluate the nutritional composition and sensory characteristics of tapioca fortified with varying blends of groundnut and tigernut flour, aiming to provide insights that could inform food fortification strategies and contribute to better health in vulnerable populations.

MATERIALS AND METHODS

Sample Collection and Preparation

The tapioca, groundnut and tigernut samples were purchased from local markets in Delta State. The samples were cleaned to remove any foreign matter, washed, and dried at 60 °C in a hot air oven. until constant weight was obtained. A laboratory mill was utilised to grind the dehydrated samples into flour and stored in airtight containers at 4 °C.

Preparing fortified tapioca samples involved a systematic approach to blend tapioca with groundnut and tigernut flour in specific ratios. Five groups were established, with Group 1(A) consisting solely of 100% tapioca. Group 2(B) had 80% tapioca, 10% groundnut, and 10% tigernut; Group 3(C) contained 70% tapioca, 15% groundnut, and 15% tigernut; Group 4(D) comprised 60% tapioca, 20% groundnut, and 20% tigernut; and Group 5(E) contained 50% tapioca, 25% groundnut, and 25% tigernut. Each blend was meticulously weighed and mixed in a clean container to ensure a uniform distribution of ingredients. Following the blending process, the fortified samples were stored in airtight containers at room temperature to preserve their quality until further analysis.

Determination of pH

Ten gramme of the sample were weighed and dissolved in distilled water. The latter had been previously neutralized to a pH of 7.0. The resulting solution was made up to the mark in a 100 mL volumetric flask. The pH meter was standardized according to the manufacturer's instructions, with a buffer

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solution of pH 7.0. The sample solution was then transferred into a 100 mL beaker, and the pH was measured by immersing the pH meter electrode into the sample solution.

Moisture Content

This was established in accordance with the Association of Official Analytical Chemists' official methods of analysis (AOAC, 2019). Petri dishes were carefully cleansed and oven dried. They were placed inside a desiccator to cool and the weight of the empty cooled dishes were recorded and noted as (W_1). 5 g of the powdered sample were transferred into the previously weighed dishes and the dish and sample weights were noted as (W_2). This process was done in duplicate. The dishes containing the samples were transferred into an oven to dry for 3 hours at 105 ^{0}C. Tongs were used to take the dried samples from the oven and placed in a desiccator to cool. The dish's dried weight plus the dried sample was then noted as (W_3). Utilising the following formula, the moisture content was determined:

$$\%\, moisture = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

Where: W_1 = initial weight of empty petri dish; W_2 = weight of petri dish + food before drying and W_3= initial weight of petri dish + food after drying.

Crude Protein

Kjeldahl method was used to analyse this (AOAC, 2019). With the aid of selenium powder as a catalyst, 0.5 g of the sample was weighed into a 100 mL conical flask and digested for approximately two hours with 10 mL of concentrated sulphuric acid. After cooling, the digested solution was topped off with distilled water to reach 100 mL in a volumetric flask. The distillation apparatus was filled with 10 mL of the digested solution and an equal volume of 40% NaOH solution. The mixture was distilled into 10 mL Boric acid (containing 3 drops of mixed indicator) until the solution turned green. The latter was titrated with 0.1 N HCl to a yellow-red end point. Crude protein was obtained by the correlation:

$$\%\, N = \frac{100}{W} \times \frac{N \times 14}{W_2 - W_1} \times \frac{Vt}{Va} \times (T - B)$$

Crude Protein = % N x factor (6.25)

Where; W = weight of sample; N = normality of HCl; Vt = total volume of digest (100 mL);

Va = Volume of digest titrated (10 mL), T = sample titre value; B = blank titre value.

Crude Fat or Lipid

Crude fat content was measured by Soxhlet extraction with petroleum ether (AOAC, 2019). Gravimetric techniques are used to determine the fat content of a dry powdery material by continually using a light organic solvent, such as petroleum ether, for a minimum of one hour. Crude fat is obtained by the equation:

$$\%\ \text{Fat} = \frac{\text{Final weight of flask after drying of extract (g)} - \text{Weight of empty flask (g)}}{\text{Weight of sample taken (g)}} \text{ x } 100$$

Carbohydrate

This was obtained by the Anthrone technique. The sample was weighed, heated in a water bath, and then mixed with distilled water and Anthrone solution. The absorbance was measured in a UV-VIS spectrometer at 630 nm. A standard was prepared, and a calibration equation graph was plotted. The carbohydrate content was calculated with formula:

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$$\text{Carbohydrate} = \frac{\text{calibration reading x D. F}}{\text{Weight of sample taken (g)}} \text{ x } 100$$

Where D.F = Dilution Factor (This is the factor by which the sample was diluted before analysis; 1 mL of sample diluted to 10 mL, gives a dilution factor of 10)

Crude Fibre

The sample was extracted using light petroleum, air-dried, and added to a conical flask with sulfuric acid. The mixture was boiled for 30 minutes, filtered, and washed. The insoluble matter was then treated with sodium hydroxide and filtered. The insoluble matter was washed with alcohol and ether, and then transferred to a weighed ashless filter paper. The filter paper was incinerated, and the crude fibre content was calculated by subtracting the ash weight from the insoluble material.

$$\text{Crude Fibre} = \frac{\text{(Weight of dried residue)} - \text{(Weight of ash)}}{\text{Weight of sample (g)}} \text{ x } 100$$

Ash Content

Ash content was determined using AOAC's (2019) method, which involved incineration at 550 °C, cooling, and reweighing of the samples, and then calculated as a percentage of the original weight.

$$\text{Ash content (\%)} = \frac{\text{Weight of ash}}{\text{Weight of sample (g)}} \text{ x } 100$$

Essential Minerals

Perchloric and nitric acids were used to digest the samples' ash, and the Jenway digital flame photometer/spectronic 20 was used to measure the samples' potassium and sodium content (Bonire *et al.,* 1990). Vanado-molybdate colorimetric analysis was used to determine phosphorus (Ologhobo and Fetuga, 1983). Using a Buck 200 atomic absorption spectrophotometer (Buck Scientific, Norwalk, United Kingdom (UK)), calcium, magnesium, and iron were measured spectrophotometrically. (Essien *et al.,* 1992). All the analysis was done in duplicates (Okareh *et al.,* 2015).

Sensory Evaluation

A sensory evaluation of tapioca fortified with groundnut and tigernut flour was conducted using standard methods (Davies *et al*., 2012; Ijioma *et al*., 2016). Ten semi-trained panelists from Delta State University, Abraka, evaluated the taste, texture, color, aroma, acceptability and appearance of the samples. A nine-point hedonic scale as shown in Table 1, was used to measure preferences, with panelists rinsing their mouths after each stage to prevent carryover flavors.

Table 1: Nine-point Hedonic scale.

Grade	Score
Extremely dislike	1
Very much dislike	2
Moderately dislike	3
Slightly dislike	4
Neither like nor dislike	5
Slightly like	6
Moderately like	7
Very much like	8
Extremely like	9

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Source: (Davies *et al*., 2012).

Statistical Analysis

SPSS statistical software, version 20.0, was used to analyze the data. At 95% confidence level ($p<0.05$), the Duncan multiple range test was used to determine the significance of the sample mean differences.

RESULTS AND DISCUSSION

The results of the proximate analysis, sensory evaluation and essential minerals are shown in Table 2. Means that do not share same superscript in the same row are significantly different ($p>0.05$).

Table 2: Physicochemical Properties of the Samples.

Properties	1(A)	2(B)	3(C)	4(D)	5(E)
pH	5.70±0.14	6.25±0.07	6.00±0.14	6.05±0.07	5.40±0.14
Moisture Content %	4.07±0.18	1.88±0.08[a]	5.13±0.21	6.32±0.13 [a]	6.98±0.15 [a]
Crude Protein g/100g	0.77±0.11 [a]	1.56±0.10 [a]	6.74±0.49	13.32±0.41 [a]	9.37±0.22 [a]
Lipid g/100 g	0.18±0.01 [a]	2.21±0.05	6.01±0.10 [a]	7.30±0.65	9.51±0.14
Carbohydrate g/100L	91.52±2.96 [a]	85.51±3.44 [a]	73.47±5.13 [a]	67.85±5.59 [a]	45.66±3.92 [a]
Crude Fibre g/100g	1.01±0.04 [a]	2.82±0.04	3.84±0.13	5.50±0.25 [a]	5.58±0.25 [a]
Ash Content g/100g	0.89±0.06	1.51±0.05	1.78±0.09	2.23±0.18	2.29±0.16
Sodium mg/100g	1.12±0.13 [a]	23.69±1.57[a]	32.40±0.87[a]	41.24±0.52 [a]	52.55±1.20 [a]
Potassium mg/100g	15.13±3.10 [a]	34.65±1.68 [a]	66.63±2.40 [a]	83.70±0.85 [a]	100.91±0.13 [a]
Magnesium mg/100g	29.92±1.53 [a]	41.60±1.13	45.54±2.35	52.50±0.71	57.15±0.64
Calcium mg/100g	10.92±0.59*	49.91±1.41 [a]	69.77±2.58 [a]	90.92±0.64 [a]	112.23±0.60 [a]
Iron mg/100g	0.64±0.61 [a]	6.48±0.23	36.72±0.45 [a]	11.96±0.09	34.80±2.84
Phosphorus mg/100g	5.90±0.18 [a]	20.16±0.98	27.92±0.73	35.25±0.49	42.08±1.55

The pH values of the samples ranged from 5.40 to 6.25, with the highest pH observed in Sample 2(B) and the lowest in Sample 5(E) as shown in Figure 1.

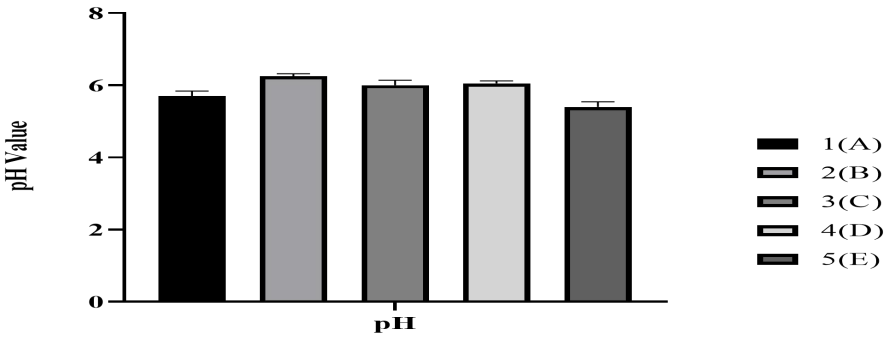

Figure 1: pH of samples.

These pH values indicate a slightly acidic to neutral environment, which supports microbial stability, shelf life and consumer acceptability the product (Awulachew, 2021). Otegbayo *et al.,* (2013) obtained a pH range of 8.97 to 9.26 for tapioca fortified with soy and coconut flour, indicating an alkaline nature. This variation is likely due to the influence of soy protein, which can raise the pH during fortification.

Moisture content varied significantly among the samples, ranging from 1.88% to 6.98%. The control sample 1(A) had a moisture content of 4.07%, while the highest moisture content was found in Sample 5(E) as shown in Figure 2.

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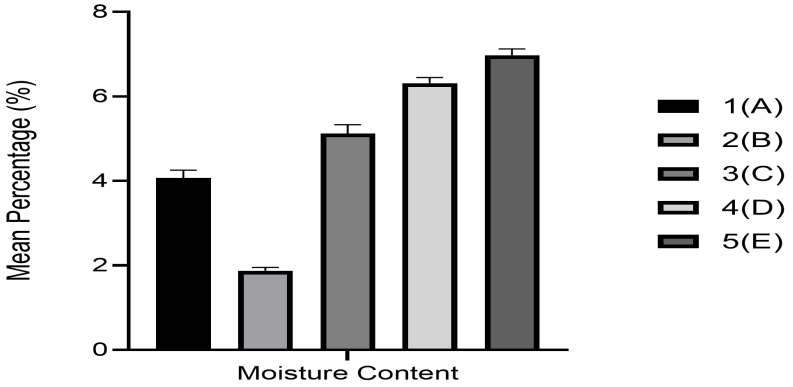

Figure 2: Moisture content of samples.

In contrast to the moisture values published by Balogun *et al.*, (2012) for qualitative attributes of meal fortified with defatted soy flour, which ranged from 15.08 to 15.20%, the moisture values obtained in this paper were lower. Products with higher moisture content (>12/100 g) typically have shorter shelf lives than those with lower moisture content (<12/100 g), due to a higher risk of microbial growth (Adegunwa *et al.*, 2017; Ohizua *et al.,* 2017)

The crude protein content showed a substantial increase in the fortified samples, especially in Sample 4(D) with 13.32 g/100 g, compared to the control sample 1(A) with only 0.77 g/100 g. The results of this work compare closely with the findings of Imoisi *et al.,* (2024) with crude protein content of 1.10 % to 20.49 % for tapioca fortified with dates, soybean and coconut. This enhancement in protein content can be attributed to the protein-rich nature of groundnut flour. Lipid content followed a similar trend, with a significant increase in fortified samples, particularly in Sample 5(E) with 9.51 g/100 g, compared to the control sample with only 0.18 g/100 g. The incorporation of tigernut flour, known for its high lipid content, likely contributed to this increase, enhancing the energy density of the fortified tapioca.

Carbohydrate content decreased as the level of fortification increased, with the control sample having the highest carbohydrate content at 91.52 g/100 g and the lowest in Sample 5(E) at 45.66 g/100 g. A similar result was obtained by Imoisi *et al.,* (2024). This reduction in carbohydrate content is consistent with the substitution of tapioca, primarily composed of carbohydrates, with protein and lipid-rich groundnut and tigernut flours. Conversely, crude fibre content increased in the fortified samples, with Sample 5(E) showing the highest crude fibre content at 5.58 g/100 g. The latter was slightly higher than the maximum of 5.5 % obtained by Imoisi *et al.,* (2024). This increase is beneficial for enhancing the dietary fibre intake, which is important for digestive health. Figure 3 gives the proximate properties of the samples at a glance.

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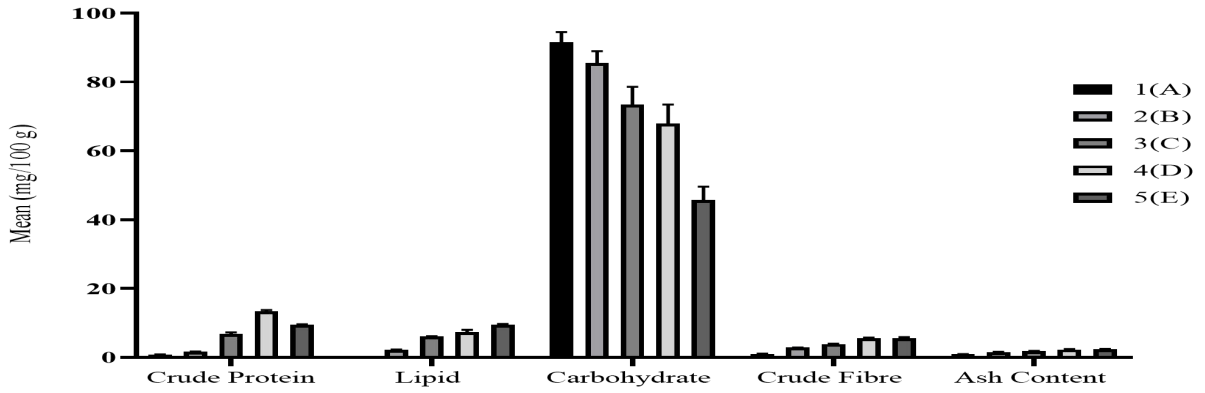

Figure 3: Proximate composition of the samples

There is a marked increase in crude protein and lipid content as fortification levels rise. This is particularly evident in Sample 4(D) and Sample 5(E), where the protein and lipid contents are highest. Meanwhile, carbohydrate content decreases as fortification increases, reflecting the substitution of tapioca starch with protein and fat-rich flours. The increase in crude fiber and ash content across samples also indicates enhanced nutritional value, contributing to better digestive health and increased mineral content.

The mineral content, especially sodium, potassium, magnesium, calcium, and iron, showed a marked increase in the fortified samples. Calcium levels, for example, increased from 10.92 mg/100g in the control to 112.23 mg/100g in Sample 5(E) as can be seen in Figure 4.

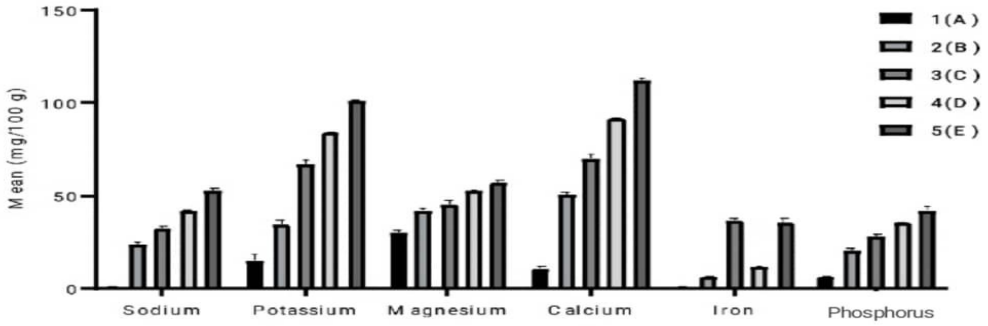

Figure 4: Mineral composition of the samples

This significant enhancement can be attributed to the mineral-rich nature of both groundnut and tigernut flours. The high levels of potassium and magnesium in the fortified samples are particularly noteworthy, as these minerals play crucial roles in maintaining cardiovascular health and bone strength (DiNicolantonio *et al.,* 2018).

CONCLUSION

Incorporation of tigernut and groundnut flour into tapioca in varying ratios has effects on the nutritional property of the product. Tigernut and groundnut fortification resulted in improvement of calcium, iron, sodium, potassium, magnesium and phosphorous. However, the low shelf life of tigernut, was

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one challenge to contend with in this work. The study revealed that groundnut and tigernut flour are nutritious enhancers for tapioca, offering a promising strategy for developing value-added, nutrient-dense food products. The significant enhancements in protein, fiber, and mineral content, combined with improved sensory properties, make these flours an excellent addition to tapioca.

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REFERENCES

Adeboye, A. S., Bamgbose, A., Adebo, O. A., Okafor, D. C., & Azeez, T. B. (2019). Physicochemical, functional and sensory properties of tapioca with almond seed (*Terminalia catappa*). *African Journal of Food Science*, 13(8): 182 – 190.

Adegunwa, M.O., Adelekan, E.O., Adebowale, A.A., Bakare, H.A., Alamu, E.O (2017). Evaluation of Nutrtional and Functional Properties of Plantain (*Musa paradisiacal* L.) and Tigernut (*Cyperus esculentus* L.) Flour Blends for Food Formulations. *Analytical Chemistry*, 3: 1383707.

Association of Official Analytical Chemists (AOAC) (2019). Official Methods of Analysis, 21st Edition.

Awulachew, M. T. (2021). Understanding to the Shelf-life and Product Stability of Foods. *Journal of Food Technology and Preservation* 5(8): 1-5.

Balogun M.A., Karim O.R., Kolawole F.L. and Solarin A.O (2012). Quality Attributes of Tapioca Meal Fortified With Defatted Soy Flour. *Agrosearch* 12(1): 61 – 6.

Bonire, J. J., Jalil, N. S. N. & Lori, J. A. (1990). Sodium and Potassium Content of Two Cultivars of White Yam (*Dioscorea rotundata*) and their source soils. *Journal of the Science of Food and Agriculture*, 53(3): 271-274.

Das, J. K., Salam, R. A., Mahmood, S. B., Moin, A., Kumar, R., Mukhtar, K., Lassi, Z. S. & Bhutta, Z. A. (2019). Food Fortification with Multiple Micronutrients: Impact on Health Outcomes in the General Population. *Cochrane Database of Systematic Reviews*, 12(8): 1-18.

Davies, O. A., Davies, R. M. & Abolude, D. S. (2012). Organoleptic and Economic Appraisal of Fish Smoked with Water Hyacinth Briquettes and Traditional Energy Sources. *FS Journal of Research in Basic and Applied Sciences*, 1(2): 4-7.

DiNicolantonio, J. J., Liu, J., & O'Keefe, J. H. (2018). Magnesium for the Prevention and Treatment of Cardiovascular Disease. *Open Heart,* 5(2), e000775. https://doi.org/10.1136/openhrt-2018-000775

Essien, A. I., Ebana, R. U. B. & Udo, H. B. (1992). Chemical Evaluation of Pod and Pulp of the Fluted Pumpkin (*Telfairia occidentalis*) Fruit. *Food Chemistry*, 45(3): 175-178.

Gadanya, A. M., Abubakar, M. Y., Maigari, F. U., Mudassir, L. & Abubakar, S. M. (2021). Comparative Analysis of Nutrients Content and Characterization of Oil from Two Varieties of Tiger nut (*Cyperus esculentus*). *Asian Journal of Research in Biochemistry*. 8(1): 11-21.

Imoisi, C., Iyasele, J.U., Igbenosa, E.N., Efemena, A.N., Okwoma, O. & Sa'ad, M. (2024). Proximate Analysis and Nutritional Fortification of Tapioca with *Phoenix dactylifera*, *Cocos nucifera* and *Glycine max* Flour.

DOI: 10.56892/bima.v8i4.1144

Research Journal of Medicinal Plants, 18(1), 55-65.

Noah, A.A. & Abiaziem, C.V. (2019). Nutritional Composition and Sensory Evaluation of Tapioca Fortified with Soy-Coconut Flour. *Food Science and Quality Management*. 92: 36- 41.

Nwafor, O.E., Akpomie, O.O. & Ejiro, P.E. (2015). Effect of Fermentation Time on the Physico –Chemical, Nutritional and Sensory Quality of Cassava Chips (Kpo-Kpo Garri) a Traditional Nigerian Food. *American Journal of BioScience.* 3(2): 59-63.

Nwosu, L.C., Edo, G. I. & Ozgor, E. (2022). The Phytochemical, Proximate, Pharmacological, GC-MS Analysis of *Cyperus esculentus* (Tiger nut): A fully validated approach in health, food and nutrition. *Food Bioscience.* 46(1):-101551.

Ohizua, E. R., Adeola, A. A., Idowu, M. A., Sobukola, O. P., Afolabi, T. A., Ishola, R. O., Ayansina, S. O., Oyekale, T. O., & Falomo, A. (2017). Nutrient Composition, Functional, and Pasting Properties of Unripe Cooking Banana, Pigeon Pea, and Sweet Potato Flour Blends. *Food Science & Nutrition,* 5(3), 750–762.

Okareh, O.T., Adeolu, A.T. & Adepoju, O.T. (2015). Proximate and Mineral Composition of Plantain (*Musa Paradisiaca*) Wastes Flour; a Potential Nutrients Source in the Formulation of Animal Feeds. *African Journal of Food Science and Technology.* 6(2): 53-57.

Olanrewaju, O. R., Ifesan, B. T. & Ifesan, B. O. T. (2023). Nutritional Characteristics and Sensory Evaluation of Tapioca Supplemented with Fermented and Germinated Moringa (*Moringa oleifera*) Seed Flour. *GSC Biological and Pharmaceutical Sciences*, 24(3): 177–186.

Ologhobo, A. D. & Fetuga, B. L. (1983). Investigation on the Trypsin Inhibitor, Hemagglutinin, Phytic and Tannic Acid Contents of Cowpea (*Vigna unguiculata*). *Food Chemistry,* 12(4): 249-254.

Olson, R., Gavin-Smith, B., Ferraboschi, C. & Kraemer, K. (2021). Food Fortification: The Advantages, Disadvantages and Lessons from Sight and Life Programs. *Nutrients*. 13(4): 1118.

Otegbayo, B. O., Samuel, F. O., & Alalade, T. (2013). Functional Properties of Soy-enriched Tapioca. *African Journal of Biotechnology.* 12 (22): 3583-3589.

Pardeshi, S. (2019). Assessment of Physico-chemical Characteristics of Extracted oil of Different Groundnut Varieties Grown in India. *International Journal of Innovative Science, Engineering and Technology.* 6(8): 39-46.

Samuel, F. O., Otegbayo, B. O. & Alalade, T. (2012). Nutrient and Anti-nutrient Content of Soy-enriched Tapioca. *Food and Nutrition Sciences.* 3(6): 784-789.

Yu, Y., Lu, X., Zhang, T., Zhao, C., Guan, S., Pu, Y. & Gao, F. (2022). Tiger Nut (*Cyperus esculentus* L.): Nutrition, Processing, Function and Applications. *Foods*, 11(4): 601.