



A COMPARATIVE PROXIMATE ANALYSIS OF CASSAVA AND SWEET POTATO GARRI: A PUBLIC HEALTH DIAGNOSTIC FOR DIETARY DIVERSIFICATION IN NIGERIA

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Citation: Bello A. A, Sulaiman A. A, Asimiyu R. A, Abdulwasiu A. O (2026) Comparative Proximate Analysis of Cassava and Sweet Potato Garri: A Public Health Diagnostic for Dietary Diversification in Nigeria. Int J Ann Med Health Sci 4(1):1-6.

Received date: March 9, 2026; **Accepted date:** March 17, 2026; **Published date:** March 26, 2026

Abstract

Cassava Garri is a popular food in Nigerian households, regarded as a source of cheap dietary energy. The nutritional content is primarily carbohydrates, with low protein, fiber, and mineral content. This has generated health concerns about the overdependence on a single staple food source. Sweet potato, which nutritionally differs from cassava by containing appreciable amounts of fiber and provitamin A, offers a possible alternative in the production of Garry as part of efforts aimed at improving the quality of the Nigerian diet. The proximate composition of cassava Garri (GA) and sweet potato Garri (GB) was compared in this study to evaluate their basic nutritional differences. The proximate composition was evaluated in duplicate according to the AOAC guidelines (2019). The independent samples t-test was used to compare means, with a significance level of $p < 0.05$. Both samples were carbohydrate-rich ($>85\%$) with low protein ($\sim 1.8\%$) and lipids ($\sim 0.6\%$). GB exhibited significantly lower moisture ($6.24 \pm 0.08\%$ vs. $8.22 \pm 0.18\%$; $p < 0.05$), higher crude fiber ($3.03 \pm 0.02\%$ vs. $2.73 \pm 0.20\%$; $p < 0.05$), carbohydrates ($87.02 \pm 0.01\%$ vs. $85.31 \pm 0.02\%$; $p < 0.001$), and calorific value (1506.37 ± 2.65 kJ/100g vs. 1482.10 ± 6.46 kJ/100g; $p < 0.05$). Ash, protein, and lipid levels showed no significant differences ($p > 0.05$). Sweet potato Garri has nutritional benefits in fiber and energy content, complementing macronutrient composition and encouraging diversification of diet. Its promotion, together with cassava Garri, provides a relevant approach to improving nutrition in Nigeria. Future studies should focus on the measurement of provitamin A carotenoids and acceptability.

Keyword: Garri, Sweet potato, Proximate composition

Introduction

Cassava (*Manihot esculenta*) is one of the most important root crops cultivated in Nigeria, serving as a major source of dietary energy for a large proportion of the population. It is

commonly processed into Garri, a granular, fermented staple food widely consumed across Nigerian households in various forms (Borku et al., 2025; Akpogheli et al., 2025). However, the nutritional quality of this dominant staple is a

critical public health consideration.

While a major concern has been the potential cyanide toxicity from inadequate processing, proper fermentation, dewatering, and roasting effectively mitigate this risk, ensuring safety (Akpoghelie et al., 2025; Oladipo et al., 2025). A more pressing issue is the inherent nutritional profile of cassava-based Garri. Studies, such as that by Edet et al. (2023), report a proximate composition dominated by carbohydrates (70–85%), with consistently low levels of crude protein (0.3–5%), crude fiber (0.4–2%), and ash (1.3–1.6%). This indicates that while Garri is an excellent source of dietary energy, it is characteristically low in nutrients essential for combating micronutrient deficiencies, positioning it as a potentially imbalanced cornerstone of the diet.

In contrast, sweet potato (*Ipomoea batatas*) is a nutritionally distinct staple, reported to contain appreciable levels of protein, dietary fiber, and minerals alongside its carbohydrates, and it contains negligible cyanogenic compounds (Alam, 2021; Laveriano-Santos et al., 2022). Its use in producing Garri-like products presents a viable pathway for dietary diversification—a key strategy for improving population nutrition.

The reported variability in cassava gwarri's composition, influenced by factors like variety and processing method (Edet et al., 2023), underscores the need for standardized nutritional evaluation. Crucially, while the proximate composition of cassava Garris has been documented and the nutritional potential of sweet potato is established, there is a definitive lack of direct comparative analysis. This gap in evidence hinders objective evaluation and informed advocacy. In a bid to fill this crucial evidence gap and inform public health policy, this study will undertake a comparative proximate analysis of cassava and sweet potato Garri to evaluate the basic nutritional content of these foods and establish the potential of sweet potato Garri to enhance nutritional quality.

METHODOLOGY

Sample Preparation

Cassava Garri was bought from Oke-odo along University of Ilorin Road. Sweet potato Garri was prepared according to a modified traditional

method for cassava Garri. Fresh sweet potato tubers bought from Tanke were peeled, thoroughly washed, and grated into a fine mash using a mechanical grater. The mash was then placed in a porous sack and allowed to ferment at room temperature for 48 hours. After this, the mash was dewatered using a mechanical press to remove excess moisture, after which it was sieved to achieve a uniform granular texture. The granules were subsequently dry-roasted in a heated pan at approximately 120°C for 15–20 minutes with constant stirring until a crisp, light-brown product was obtained. The final Garri was cooled to room temperature and stored in airtight containers before analysis.

Proximate Composition Analysis

The proximate composition (moisture, ash, lipid, crude fiber, and crude protein) of the Garri samples was determined according to the standard methods of the Association of Official Analytical Chemists (AOAC, 2019). All analyses were performed in duplicate Moisture content and Dry matter.

Moisture content was determined gravimetrically in accordance with the standard methods of the Association of Official Analytical Chemists (2019) by the loss in weight that occurs when the sample is dried in an oven to a constant weight. About 5.0 g of ground samples each were weighed into a sterile pre-weighed aluminum dish, and the weight of the dish and the weight of un-dried sample (in duplicate) were taken. This was transferred into an oven set at 80°C for 2 h and at 100°C for 3 h respectively. This was removed and cooled in desiccators. Then the weight was measured using a measuring scale balance. It was transferred back into the oven for another hour and then reweighed. The process continued until a constant weight was obtained. The difference in weight between the initial weight and the constant weight gained represents the moisture content.

% Where is the initial weight of the sample before drying and is the weight after drying.

Dry matter) (%) = 100 - moisture (%)

Ash content

The ash represents the inorganic component (**minerals**) of the sample after all moisture has

been removed, as well as the organic material. The method is a destructive approach based on the decomposition of all organic matter, such that the mineral elements may be lost in the process. 20 g of each of the samples was weighed into a clean, dried, and cooled platinum crucible with a known weight. It was put into a furnace set at 550° C and allowed to blast for 3h. It was then brought out and allowed to cool in desiccators and weighed again.

where W_1 is the weight of the crucible plus ash after incineration, W_2 is the weight of the sample, and W_3 is the weight of the crucible Lipid (fat) content.

The method employed was the Soxhlet extraction technique. 15 g of the samples were weighed and carefully placed inside a fat-free thimble. This was covered with cotton wool to avoid the loss of the sample. The thimble was loaded and put in the Soxhlet extractor, about 200 ml of petroleum ether was poured into a weighed fat-free Soxhlet flask, and the flask was attached to the extractor. The flask was placed on a heating mantle so the petroleum ether in the flask refluxed. Cooling was achieved by running the tap connected to the extractor for at least 6hrs after which the solvent was completely siphoned into the flask. A rotary vacuum evaporator was used to evaporate the solvent, leaving behind the extracted lipids in the Soxhlet. The flask was removed from the evaporator and dried to a constant weight in the oven at 60 °C. The flask was then cooled in a desiccator and weighed. Each determination was done in triplicate. The amount of fat extracted was calculated by difference.

Ether extracts (100g) dry matter = (weight of extracted lipids/weight of dry sample) x 100.

Crude protein

Crude protein content was determined using the AOAC Official Method 981.10 (AOAC, 2012), based on the Kjeldahl nitrogen digestion procedure. Duplicate samples (1.0 g) were digested with concentrated sulfuric acid (H₂SO₄) in the presence of digestion catalyst (K₂SO₄: CuSO₄; 10:1) at 420°C until a clear green digest was obtained. The digest was distilled with 40% NaOH, and the liberated ammonia was collected in 4% boric acid containing Tashiro's indicator. The ammonia-borate complex was titrated against 0.01 N HCl to the pink endpoint. Nitrogen content was calculated as:

Crude protein was estimated by multiplying nitrogen content by 6.25. where W is the weight of the sample used

Crude fiber

The bulk of roughages in the sample is referred to as fiber and is estimated as crude fiber. Twenty grams (20 g) of the different samples were defatted with diethyl ether for 8 h and boiled under reflux for exactly 30 min with 200 mL of 1.25% H₂SO₄. It was then filtered through a cheesecloth on a funnel. This was later washed with boiling water to completely remove the acid. The residue was then boiled in a round bottomed flask with 200 mL of 1.25% sodium hydroxide (NaOH) for another 30 min and filtered through a previously weighed couch crucible. The crucible was then dried with samples in an oven at 100 °C, left to cool in a desiccator and later weighed. This was later incinerated in a muffle furnace at 600°C for 2 to 3 h and later allowed to cool in a desiccator and weighed where W_1 is the weight of the crucible plus sample before incineration, W_2 is the weight of the crucible plus ash after incineration and W_3 is the weight of the sample.

Total carbohydrates

% Carbohydrates = 100 - (% Moisture + % Ash + % Lipid + % Crude Fiber + % Crude Protein).

Calorific value

Caloric Value (KJ/100g) = (Protein * 16.7) + (Lipids * 37.7) + (Carbohydrate * 16.7)

Statistical Analysis

All experiments were carried out in duplicate. The data obtained were analyzed statistically and presented as mean ± standard deviation (SD). An independent samples t-test was employed using Microsoft Excel to compare the mean values of each proximate parameter between cassava Garri (GA) and sweet potato Garri (GB). Differences were considered statistically significant at $p < 0.05$.

RESULTS

The proximate composition of cassava Garri (GA) and sweet potato Garri (GB) is presented in Table

1. Both samples exhibited a high carbohydrate

content and low levels of protein and lipid, consistent with their classification as energy-dense staple foods. However, statistically significant differences were observed for several parameters.

Moisture content was significantly higher in cassava Garri (8.22%) compared to sweet potato Garri (6.24%) ($p < 0.05$). Conversely, sweet potato Garri showed a significantly higher crude fiber content (3.03% vs. 2.73%; $p < 0.05$) and total carbohydrate content (87.02% vs. 85.31%; $p < 0.001$). The calculated calorific value was also significantly greater for sweet potato Garri (1506.37 kJ/100g) than for cassava Garri (1482.10 kJ/100g) ($p < 0.05$).

No significant differences were detected between the two Garri types for ash, crude protein, or lipid content ($p > 0.05$), indicating comparable mineral residue, protein, and fat profiles.

Parameters	GA	GB
%Moisture	8.22 ± 0.18a	6.24 ± 0.08b
%Ash	1.19 ± 0.14a	1.28 ± 0.08a
%Crude Protein	1.86 ± 0.01a	1.83 ± 0.03a
%Lipid	0.70 ± 0.18a	0.60 ± 0.06a
%Crude Fiber	2.73 ± 0.2a	3.03 ± 0.02b
%CHO	85.31 ± 0.02a	87.02 ± 0.01b
Calorific value (kJ/100g)	1482.10 ± 6.46a	1506.37 ± 2.65b

Table 1. Proximate composition and calorific value of cassava Garri (GA) and sweet potato Garri (GB).

Results are expressed as mean ± standard deviation ($n = 2$). Means within the same row with different superscript letters are significantly different (independent samples t-test, $p < 0.05$).

GA: Cassava Garri **GB:** Sweet Potato Garri.

DISCUSSION

The proximate composition of Garri from cassava (GA) and sweet potato (GB) revealed that the raw materials used affected some quality attributes of the two products. The significantly lower moisture content in GB (6.24%) than in GA (8.22%) was established ($p < 0.05$). This suggests improved storage life because lower

moisture content inhibits microbial growth and spoilage of dried foods. This result is consistent with the moisture content reported by Edet et al. (2023) for cassava Garri and confirms that both products are sufficiently dried for storage. However, the moisture content in Garri is also influenced by processing factors such as pressing efficiency and roasting time, and hence, the difference may be due to a combination of the type of raw material and the loss of moisture during the processing of the Garri.

The crude fiber content was significantly higher in GB (3.03%) than in GA (2.73%) ($p < 0.05$), and this could be attributed to the naturally higher fiber content of sweet potato compared to cassava, as reported by Alam (2021) and Laveriano-Santos et al. (2022). Although the difference was small, it did indicate that sweet potato Garri could be a source of a significantly higher intake of dietary fiber, especially in communities where Garri is eaten daily as a staple food. A higher intake of fiber is generally associated with improved digestive function and improved blood glucose regulation, and hence could be beneficial in communities where Garri is eaten frequently and in large quantities.

Carbohydrate was the major constituent in both samples, thus reaffirming Garri as a high-energy food source obtained from starchy roots. The significantly higher carbohydrate concentration in GB (87.02%) than in GA (85.31%) ($p < 0.001$) and consequently, higher energy value (1506.37 kJ/100g vs. 1482.10 kJ/100g; $p < 0.05$) suggest that sweet potato Garri may offer slightly higher energy per unit weight. This is not surprising, given the high starch concentration associated with root and tuber crops and may be beneficial in a food-insecure setting where the daily energy requirement is a major concern.

Protein and lipid concentrations were low and comparable in both products, and no significant differences were observed ($p > 0.05$). The protein content (approximately 1.8%) is within the range (0.3-5%) reported by Edet et al. (2023) for cassava Garri, and this is expected due to the natural composition of cassava and sweet potato roots. This result further supports an important public health note stressed by Akpoghelie et al. (2025). Garri, irrespective of the root used, cannot supply proteins and therefore must be consumed with protein sources such as meat, fish, eggs, or

beans to make it a balanced diet. The similarity in ash content (approximately 1.2%), which is the mineral residue, further indicates that the overall mineral composition is similar for both products, although individual mineral analysis would be necessary to identify any differences in the levels of the various minerals.

Generally, both cassava and sweet potato Garri had a similar proximate composition characteristic of carbohydrate-based staple foods. The major differences noted were the lower moisture content and the substantially higher fiber and carbohydrate contents of sweet potato Garri, which could have some small advantages in terms of storage and nutritional value.

Within the framework of the food-based strategies proposed by the Frontiers in Public Health review (2016), diversification of the diet remains the most sustainable strategy for the control of micronutrient malnutrition. The addition of sweet potato Garri to the traditional cassava Garri would provide a feasible, acceptable strategy for the expansion of the list of locally available carbohydrate sources and the alleviation of pressure on a single crop.

Limitations of the study

Some limitations to this study should be noted. The sample size is relatively small ($n = 2$ per group), and future studies should consider analyzing samples from multiple batches and different sources. The proximate analysis is limited to a macronutrient analysis and does not include the measurement of micronutrients, phytochemicals, or antioxidant activity. Considering the known beta-carotene content of yellow-fleshed sweet potatoes (Laveriano-Santos et al., 2022), future studies should consider the provitamin A carotenoid content of sweet potato Garri, which may be a major public health benefit in regions with vitamin A deficiency. Finally, sensory analysis studies would be required to evaluate the feasibility of promoting sweet potato Garri as a mainstream food item.

CONCLUSION

This research work offers a comparative assessment of the proximate composition of Garri from cassava and sweet potato as a means of encouraging diversification of the diet in Nigeria. Both sources were discovered to be

mainly carbohydrate-based staple foods with low protein and fat contents, thereby emphasizing their major role as sources of energy in the Nigerian diet. Sweet potato Garri, however, had significantly lower moisture content and significantly higher fiber, carbohydrate, and energy values, suggesting possible advantages in terms of storage and nutritional value.

The results of this research work indicate that sweet potatoes can be used in the production of Garri without changing the basic nature of the food that consumers are accustomed to. With the over-reliance on cassava as a staple food source in Nigeria, the development of sweet potato Garri can help to diversify the sources of carbohydrates that are locally available. The increased use of sweet potatoes in foods that are commonly eaten can also help to improve the intake of dietary fibers.

In terms of public health, the promotion of the production and consumption of sweet potato Garri, in addition to cassava Garri, is a sensible and acceptable approach to improving diversification and food security. This is particularly relevant in addressing nutritional deficiencies that are associated with a monotonous diet based on a single staple food. Further studies on micronutrient content (specifically provitamin A carotenoids) and acceptability are recommended to confirm the role of sweet potato Garri in improving national nutrition.

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