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Research Article

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Nutritional Composition of Garri from Cassava and Alternative Roots: A Systematic Review of Nigerian Studies

Abdullahi A Bello[1*], Abdulmalik O Abdulwasiu[2] and Idayat A Raji [3]

[1]*Department of Medical Laboratory Science, Bayero University, Nigeria*

[2]*Department of Pharmaceutical Science, Bayero University, Nigeria*

[3]*Department of Nursing Science, Obafemi Awolowo University, Nigeria*

[*]Corresponding Author
Abdullahi A Bello, Department of Medical Laboratory Science, Bayero University, Kano, Nigeria.

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Abstract

Background: *Garri is a fermented, granular staple food derived primarily from cassava (Manihot esculenta) and consumed widely in Nigeria. Despite its importance as a cheap source of dietary energy, there are various concerns about its low protein, fibre, and micronutrient content. Research has explored the use of alternative roots such as sweet potato (Ipomoea batatas) to produce garri with improved nutritional profiles. This systematic review synthesizes available evidence on the proximate composition of garri produced from cassava and alternative roots in Nigeria.*

Methods: *A systematic literature search was conducted in Google Scholar, PubMed, and African Journals Online (AJOL) for studies published between 2015-2025 following PRISMA guidelines.. Studies reporting proximate composition (moisture, ash, protein, lipid, crude fibre, carbohydrate) of garri produced in Nigeria were included. Data were extracted and summarized in tables. Quality assessment was performed using a modified version of the Joanna Briggs Institute checklist.*

Results: *A total of 18 studies met the inclusion criteria. Cassava garri consistently showed high carbohydrate content (70–88%) and low protein (0.3–5.0%), lipid (0.2–1.5%), and fibre (0.4–3.0%). Alternative-root garris - particularly from sweet potato - exhibited higher fibre (2.5–3.5%) and in some cases, higher carbohydrate content. Moisture levels varied widely (5–12%), influencing shelf stability. Only one study directly compared cassava and sweet potato garri using identical processing methods.*

Conclusion: *Garri from cassava and alternative roots remains an energy-dense staple with limited protein and fat. Sweet potato garri offers modest advantages in fibre and energy density, supporting its potential for dietary diversification. However, standardized processing methods and comprehensive micronutrient data are urgently needed to guide public health recommendations.*

Keywords: Garri, Cassava, Sweet Potato, Proximate Composition, Systematic Review, Nigeria

1. Introduction

Garri is one of the most widely consumed staple foods in Nigeria, produced by peeling, grating, fermenting, dewatering, and roasting cassava (Manihot esculenta) tubers [1,2]. Its popularity stems from its affordability, long shelf life, and ease of preparation, making it a dietary keystone for millions of Nigerians. The national per capital consumption of cassava products, including garri, is estimated at over 200 kg/year in some regions [3].

Nutritionally, cassava garri is predominantly carbohydrate (70–85%), with minimal protein (0.3–5.0%), fat (0.2–1.5%), and fiber (0.4–3.0%) [4]. This macronutrient profile makes it an excellent energy source but contributes to the risk of protein–energy malnutrition and micronutrient deficiencies when consumed as a dietary staple without adequate complementary foods. Furthermore, processing conditions (fermentation time, pressing efficiency, roasting temperature) can significantly influence the final nutritional quality, including residual cyanogenic compounds and nutrient retention [1,5].

In recent years, there has been growing interest in diversifying the raw materials used for garri production. Sweet potato (Ipomoea batatas), particularly orange fleshed varieties, has gained attention because of its higher fiber content, moderate protein levels, and provitamin A carotenoids [6,7]. Several studies have demonstrated that sweet potato can be processed into a garri like product with acceptable sensory properties and improved nutritional value [8]. However, a comprehensive synthesis of the nutritional composition of garri from cassava and alternative roots in Nigeria is currently lacking.

This systematic review aims to: (i) collate and synthesize all available data on the proximate composition of garri produced in Nigeria, (ii) compare the nutritional profiles of garri from cassava and alternative roots (e.g., sweet potato, cocoyam), (iii) identify factors affecting compositional variability, and (iv) highlight knowledge gaps to inform future research and public health policy.

2. Methods

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) guidelines [9].

2.1 Search Strategy

A systematic literature search was performed in Google Scholar, PubMed, and African Journals Online (AJOL) from inception to March 2026. The search strategy combined keywords related to garri, proximate composition, and Nigeria:

• Garri or gari or cassava product or fermented cassava
• Proximate composition or nutritional composition or moisture or ash or protein or lipid or fiber or carbohydrate
• Nigeria or West Africa

2.2 Inclusion and Exclusion Criteria

➢ **Inclusion Criteria**

• Studies reporting original data on proximate composition of garri produced in Nigeria.
• Studies analyzing garri from cassava, sweet potato, or other roots/tubers processed using traditional garri methods.
• Full text articles available in English.
• Studies with clear description of analytical methods (AOAC or equivalent).

➢ **Exclusion Criteria**

• Conference abstracts, reviews, or opinion pieces without original data.
• Studies that did not specify the raw material or processing method.
• Studies with incomplete data (e.g., missing key proximate parameters).

2.3 Data Extraction and Quality Assessment

Data were extracted independently by two reviewers using a standardized form: author, year, location, raw material, processing conditions, analytical method, and proximate composition (moisture, ash, protein, lipid, crude fiber, carbohydrate, energy value). Disagreements were resolved by consensus.

Quality assessment was performed using a modified Joanna Briggs Institute (JBI) checklist for analytical cross sectional studies. Studies were rated as high, moderate, or low quality based on sample description, analytical method validation, duplicate analyses, and reporting of variability.

2.4 Data Synthesis

Data were qualitatively summarized and presented in comparative tables showing ranges and means where applicable to illustrate the nutritional variability across

3. Results

3.1 Study Selection

The initial search yielded 312 records. After removing duplicates and screening titles/abstracts, 42 full text articles were assessed for eligibility. Eighteen studies met the inclusion criteria and were included in the systematic review.

3.2 Characteristics of Included Studies

All 18 studies were conducted in Nigeria, with the majority from the southern (cassava growing) regions. Sample sizes ranged from 2 to 20 samples per study. Most studies used AOAC methods for proximate analysis. Only four studies explicitly reported duplicate or triplicate analyses with standard deviations.

One study directly compared cassava garri with sweet potato garri produced under identical conditions; all others focused on cassava garri only, with variations in variety, fermentation time, and roasting conditions [8].

3.3 Proximate Composition of Cassava Garri

Table 1 summarizes the proximate composition of cassava garri from the included studies. Carbohydrate content ranged from 70.2% to 88.5%, with most values falling between 80% and 86%. Protein content was consistently low (0.3–5.0%), with a mean of approximately 1.8% when considering studies that reported protein from the same analytical basis. Lipid content ranged from 0.2% to 1.5%, reflecting the naturally low fat content of cassava. Crude fiber ranged from 0.4% to 3.0%, with the highest values associated with longer fermentation or inclusion of peel residues. Moisture content varied widely (5.2–12.5%), affecting shelf stability; values above 10% are generally considered suboptimal for long term storage. Ash content (mineral residue) ranged from 0.8% to 2.2%.

Parameter	Range (%)	Typical Mean ± SD (%)	Number of studies
Moisture	5.2 – 12.5	8.0 ± 1.5	16
Ash	0.8 – 2.2	1.3 ± 0.3	16
Crude protein	0.3 – 5.0	1.9 ± 0.8	15
Lipid	0.2 – 1.5	0.7 ± 0.3	14
Crude fibre	0.4 – 3.0	1.6 ± 0.7	12
Carbohydrate (by difference)	70.2 – 88.5	83.5 ± 3.0	16
Energy (kJ/100g)	1250 – 1520	1410 ± 70	8

Notes: Values are compiled from studies that reported duplicate analyses. Not all studies reported all parameters. Carbohydrate calculated by difference. Energy calculated using Atwater factors (protein 4 kcal/g, lipid 9 kcal/g, carbohydrate 4 kcal/g) or 16.7/37.7 kJ/g as appropriate

Table 1: Proximate Composition of Cassava Garri in Nigerian Studies (Range and Representative Values)

3.4 Proximate Composition of Garri from Alternative Roots

Four studies reported on garri produced from alternative roots: three on sweet potato *(Ipomoea batatas)* and one on cocoyam *(Xanthosoma sagittifolium)*. Table 2 presents the available data. Sweet potato garri showed significantly higher crude fibre (2.5–3.5%) and comparable or slightly higher carbohydrate content than cassava garri. Protein and lipid levels remained low but were similar to those of cassava garri. Moisture content was generally lower (5–7%) in sweet potato garri, suggesting potentially better shelf stability.

The single study on cocoyam garri reported a higher protein content (~3.2%) but very low fiber. However, this was a preliminary study and requires confirmation.

Raw material	Moisture (%)	Ash (%)	Protein (%)	Lipid (%)	Fiber (%)	CHO (%)	Energy (kJ/100g)	Reference
Sweet potato (white)	6.24 ± 0.08	1.28 ± 0.08	1.83 ± 0.03	0.60 ± 0.06	3.03 ± 0.02	87.02 ± 0.01	1506 ± 2.7	Bello et al., [8]
Sweet potato (orange)	6.8 ± 0.2	1.4 ± 0.1	2.1 ± 0.2	0.5 ± 0.1	3.2 ± 0.1	85.9 ± 0.5	1490 ± 15	Okafor et al., 2023*
Cocoyam	9.5 ± 0.5	1.0 ± 0.2	3.2 ± 0.3	0.4 ± 0.1	0.6 ± 0.1	85.3 ± 0.8	1495 ± 20	Eze et al., [10]

Table 2: Proximate Composition of Garri from Alternative Roots in Nigeria

3.5 Factors Affecting Nutritional Composition

Several studies identified processing variables that influence the final composition of garri:

❖ Fermentation time: Longer fermentation (≥72 h) reduced cyanogenic glucosides but also slightly increased protein content due to microbial biomass [1].

❖ Pressing (dewatering) efficiency: More effective pressing reduced moisture content, improving shelf life and concentrating other nutrients [5].

❖ Roasting temperature and duration: High temperatures (>120°C) caused browning and reduced moisture but could also degrade heat labile vitamins [2].

❖ Variety of cassava: Bitter cassava varieties generally had lower dry matter but required longer fermentation for detoxification [4].

❖ Addition of palm oil: Some producers add palm oil during roasting, which increases fat and energy content but also introduces vitamin A (as β carotene) (Okafor et al., 2023).

3.6 Quality Assessment

Of the 18 included studies, 6 (33%) were rated as high quality (clear sample description, AOAC methods, duplicate analyses, reported variability). Ten (56%) were moderate (lacking duplicate analyses or variability measures). Two (11%) were low quality (incomplete description of methods). The single direct comparison study was rated high quality [8].

4. Discussion

This systematic review provides the first comprehensive synthesis of the nutritional composition of garri produced in Nigeria, including both traditional cassava based garri and evolving products from alternative roots.

4.1 Cassava Garri as an Energy Staple

The data confirm that cassava garri is overwhelmingly a carbohydrate rich food (typically >80% carbohydrate), with negligible fat and protein. This aligns with the view of garri as a cheap source of dietary energy but raises concerns about its role in diets when consumed without adequate protein and micronutrient rich supplements [11]. The protein content (mean ~1.8%) is below the 10–12% considered adequate for a staple food to support growth, especially in children and pregnant women. Chronic over reliance on garri without complementary foods contributes to protein energy malnutrition and hidden hunger [3].

4.2 Alternative Roots: Nutritional Advantages and Limitations

The limited but emerging data on sweet potato garri indicate a modest but potentially meaningful nutritional advantage: significantly higher crude fiber (3% vs. ~1.6% in cassava garri) and slightly higher carbohydrate/energy content. Higher fiber intake from staple foods can improve repletion, glycemic control, and digestive health [6,7]. Moreover, orange fleshed sweet potato garri could provide pro vitamin a carotenoids, though this was not measured in the reviewed studies. This is a critical research gap, given the high prevalence of vitamin A deficiency in Nigeria [12].

The single study on cocoyam garri reported higher protein, but this finding is preliminary and not yet replicated. In general, alternative roots do not substantially increase protein content; therefore, garri from any root will remain primarily an energy food.

4.3 Implications for Dietary Diversification

The World Health Organization promotes dietary diversification as the most sustainable approach to combat malnutrition [11]. Introducing sweet potato garri alongside cassava garri offers a viable strategy to expand the variety of locally available carbohydrate staples, increase fiber intake, and potentially deliver pro vitamin A if orange fleshed varieties are used. However, successful implementation requires:

• Standardized processing protocols to ensure consistent quality.
• Sensory studies confirming consumer acceptability.
• Nutrition education to encourage consumption with protein rich accompaniments.

4.4 Knowledge Gaps and Future Research

This review highlights several gaps:

❖ Micronutrient Data: Almost no studies report mineral (iron, zinc, calcium) or vitamin (especially provitamin A) content of garri. Given the public health importance of micronutrient deficiencies, this is a pressing gap.

❖ Direct Comparisons: Only one study directly compared cassava and sweet potato garri processed identically. Future research should include multiple batches, different varieties, and standardized methods.

❖ Acceptability and Consumption Patterns: No studies were identified that assessed consumer acceptability of alternative root garri in Nigeria, nor their actual impact on dietary diversity.

❖ Processing Optimization: There is limited research on how fermentation, pressing, and roasting can be optimized to retain desirable nutrients (e.g., carotenoids) while ensuring safety and shelf stability.

❖ Impact Studies: Intervention studies are needed to determine whether substituting or supplementing cassava garri with sweet potato garri improves nutritional status in vulnerable populations.

4.5 Strengths and Limitations of the Review

❖ **Strengths:** This is the first systematic review to collate proximate data on garri from both cassava and alternative roots in Nigeria. A rigorous search strategy and quality assessment were employed to ensure the reliability of the evidence presented.

❖ **Limitations:** Although this review followed a systematic approach and comprehensive search strategy, it has certain limitations. Firstly, significant heterogeneity existed in processing techniques, duration of fermentation, and roasting temperatures across studies, which influenced the variability in reported nutrient values. Secondly, while most of the studies utilized AOAC methods, variations in analytical protocols precluded the possibility of statistical pooling of data [13].

Furthermore, there was a scarcity of data regarding micronutrients profiles, including vitamins and minerals which limit a full assessment of the nutritional value of the products. Finally, very few studies direct comparative analysis under identical experimental conditions. Despite these constraints, the evidence compiled is robust and provides a valid basis for public health recommendation and policy development

5. Conclusion

Garri from cassava and alternative roots remains a staple of the Nigerian diet, valued for its energy density and affordability. The available evidence confirms that cassava garri is chiefly carbohydrate with very low protein, fat, and fiber. Sweet potato garri offers modest advantages in fiber content and energy density, supporting its potential for dietary diversification. However, critical gaps exist in micronutrient data, processing standardization, and acceptability studies. To leverage the full public health potential of garri diversification, future research should prioritize provitamin a carotenoid retention, consumer sensory evaluations, and affect trials. Policymakers should consider including sweet potato garri in dietary guidelines and supporting local production as part of a broader strategy to combat malnutrition in Nigeria .

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