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Production, Proximate Composition, and Sensory Evaluation of Gurasa from Locally Grown Wheat Varieties in Northern Nigeria

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ABSTRACT: The increasing demand for wheat-based foods in Nigeria has led to heavy reliance on imported wheat, despite the availability of locally grown wheat. This research investigates the production of flour from locally grown wheat varieties, the processing of gurasa (a traditional Northern Nigerian flatbread), and the evaluation of its proximate and sensory qualities compared to imported wheat flour. Two varieties of wheat were conditioned, milled, enriched, and subjected to proximate composition analyses (moisture, ash, fat, fiber, protein, and carbohydrate content) following AOAC standard methods. Sensory evaluation was conducted to assess taste, texture, color, and overall acceptability. Results indicate that locally grown wheat can produce flour suitable for gurasa processing with proximate values comparable to imported wheat. Sensory evaluation revealed consumer acceptability of the locally grown wheat-based gurasa, though with variations in texture and color. This study underscores the potential of local wheat in reducing import dependence and promoting food security in Nigeria.

KEYWORDS: Wheat flour, Gurasa, Proximate composition, Sensory evaluation, Food security

I. INTRODUCTION

Wheat (Triticum aestivum) is among the most widely cultivated cereal grains globally and represents a cornerstone of human nutrition, providing approximately 20% of the calories and proteins consumed worldwide (Shiferaw et al., 2013). Its versatility and adaptability to diverse agro-ecological zones have made it an essential crop in both developed and developing countries. In Nigeria, the consumption of wheat-based products such as bread, noodles, pasta, and indigenous foods like gurasa has grown substantially, driven by urbanization, changing dietary habits, and population growth (Olabanji et al., 2021). Despite this increasing demand, the nation remains heavily reliant on wheat imports, spending billions of dollars annually on foreign exchange to meet domestic needs (FAO, 2020). This heavy dependence on imports raises concerns about food security, economic sustainability, and vulnerability to global price shocks.

Gurasa, a traditional flatbread widely consumed in Northern Nigeria, holds deep cultural, nutritional, and socio-economic significance. It is typically leavened and baked in clay ovens (tanderu), consumed as a daily staple across various socio-economic classes, and valued for its soft texture and distinct taste (Mohammed et al., 2019). As a culturally embedded food product, gurasa represents an important platform for the utilization of local agricultural resources. However, despite the cultivation of wheat in Northern Nigeria, imported wheat flour is still predominantly used in the production of gurasa due to perceptions of superior milling, baking quality, and sensory attributes (Oyetunde et al., 2020). This paradox underscores a critical research gap: while local wheat production exists, its underutilization in staple food processing perpetuates dependence on imports.

The proximate composition of wheat flour—covering moisture, ash, crude protein, fat, fiber, and carbohydrate content—plays a decisive role in determining the baking properties and overall quality of wheat-based products (AOAC, 2019). Variations in the chemical composition of flour directly influence dough rheology, texture, taste, and shelf-life of baked goods (Hoseney, 2010). Equally important is sensory evaluation, which assesses consumer perception of food attributes such as taste, texture, aroma, color, and overall acceptability. Sensory acceptance often dictates market potential, especially for culturally significant foods like gurasa. Previous studies have demonstrated that consumers may be willing to adopt locally grown cereals provided the sensory qualities of the end-products meet or approach those of imported varieties (Olapade & Ogunade, 2014).

In this context, the investigation of locally grown wheat varieties for gurasa production is of dual importance: first, to establish whether their proximate composition meets functional requirements for flatbread processing; and second, to assess consumer acceptance of products derived from local wheat flour. Success in both dimensions could significantly reduce Nigeria's reliance on imported wheat, enhance local agricultural value chains, and contribute to national food security. Furthermore, utilizing locally grown wheat supports rural economies, promotes sustainable agriculture, and aligns with the government's drive towards agricultural self-sufficiency and diversification away from oil dependency (Federal Ministry of Agriculture and Rural Development [FMARD], 2021).

Therefore, this study investigates the production, proximate composition, and sensory evaluation of gurasa made from flour processed from locally grown wheat varieties in Northern Nigeria, comparing them with those made from imported wheat flour. By providing scientific evidence on both nutritional and sensory qualities, this research aims to bridge the gap between local production and consumer preferences, ultimately underscoring the potential of Nigerian wheat in promoting food security, economic resilience, and cultural continuity.

II. BACKGROUND OF GURASA PRODUCTION

Wheat (Triticum aestivum) is a critical staple crop worldwide and ranks among the most cultivated cereals, alongside maize and rice. Globally, wheat contributes approximately 20% of the total dietary calories and protein consumed by humans, thereby making it indispensable in food security strategies (FAO, 2021). Its adaptability to different climates and its versatile use in the production of bread, pasta, noodles, and flatbreads has consolidated its global importance. In Nigeria, wheat consumption has significantly increased over the past three decades due to urbanization, population growth, and the widespread preference for wheat-based foods, including bread, pasta, and indigenous foods such as gurasa (Oni, 2020). Despite this increasing demand, domestic wheat production remains insufficient, compelling the country to rely on large-scale imports. Nigeria is currently one of Africa's largest importers of wheat, spending billions of dollars annually, which poses substantial challenges to the national economy and food sovereignty (USDA, 2022).

The production of gurasa, a traditional leavened flatbread predominantly consumed in Northern Nigeria, highlights the cultural and nutritional significance of wheat in the region. Gurasa is typically prepared from wheat flour dough and baked in a traditional clay oven known as tanderu. Its role in everyday diets, particularly in Kano and surrounding states, underscores its importance as both a staple food and a cultural heritage symbol (Abdulrahman & Garba, 2019). However, the reliance on imported wheat for gurasa production raises concerns about sustainability, cost, and local agricultural development. Although Nigeria cultivates wheat in regions such as Kano, Kaduna, Borno, and Plateau states, locally grown varieties are often underutilized due to perceived deficiencies in baking quality, including lower gluten strength and reduced elasticity compared to imported counterparts (Shittu et al., 2019).

Scientific studies have demonstrated that local wheat varieties, when properly processed and enriched, can meet the functional and nutritional standards required for diverse food applications. Proximate composition analysis of Nigerian wheat varieties reveals competitive nutritional attributes such as protein, carbohydrate, and fiber content that are crucial for human nutrition (Mustapha et al., 2021). Moreover, empirical findings suggest that the sensory characteristics of foods derived from local wheat, including taste, texture, and aroma, can align with consumer expectations when appropriate milling and enrichment processes are applied (Aliyu et al., 2020). This is particularly relevant to gurasa, which is valued not only for its sensory attributes but also for its cultural acceptability.

Addressing the gap between local production and utilization involves more than agricultural policy; it requires scientific validation of the functional suitability of local wheat for popular foods. By evaluating the proximate composition and sensory acceptability of gurasa prepared from locally grown wheat varieties, it becomes possible to bridge the disconnect between local agricultural outputs and consumer demand. Such research directly supports Nigeria's broader goals of food self-sufficiency, reduction of import dependency, and the promotion of rural livelihoods (Adepoju et al., 2021). In this context, the present study situates itself at the intersection of food science, cultural heritage, and national economic policy by examining how locally cultivated wheat varieties can be harnessed to sustain the production of gurasa without compromising quality and consumer acceptability.

Several studies have attempted to bridge this gap by exploring the suitability of local wheat for bread and related products. For instance, Onuorah and Adesina (2017) investigated composite flours made from local wheat and cassava, finding improved economic viability and comparable sensory outcomes. Similarly, Musa et al. (2020) examined the functional and sensory properties of flatbreads from Nigerian wheat varieties and concluded that locally grown wheat could be a viable substitute when processed under optimized conditions. Table 1 below summarizes some key studies that have assessed locally grown wheat in Nigeria and other developing countries, highlighting the research approaches and outcomes.

Table 1: Selected Studies on Local Wheat Utilization in Food Product

Onuorah & Adesina (2017)	Composite flour from local wheat and cassava	Bread	Improved cost efficiency; sensory acceptability comparable to imported wheat.
Hassan et al. (2016)	Nutritional profile of Nigerian wheat varieties	Wheat flour (general)	Local wheat contained comparable carbohydrate and ash content; slightly lower protein.
Musa et al. (2020)	Functional properties of wheat for traditional flatbreads	Flatbread (generic)	Locally grown wheat acceptable with slight differences in texture and color.
Usman & Gana (2021)	Cultural relevance and consumer demand for gurasa	Gurasa	Gurasa is widely consumed; limited research on use of local wheat in production.

III. EXPERIMENTATION

3.1 Materials and Equipment

The materials used for this study included crucibles, desiccators, analytical weighing balance, Petri dishes, petroleum ether, Soxhlet apparatus, autoclave, incubator, Bunsen burner, 1% hydrochloric acid, formaldehyde, formalin, sodium hydroxide, extraction thimbles, phenolphthalein indicator, 1.25% sulfuric acid solution, measuring cylinders, conical flasks, filter paper, and distilled water. Food ingredients included salt, sugar, and wheat flour. Specialized processing equipment comprised a traditional tanderu oven, a grinding roller machine, and a granulation/sieving machine. All materials and reagents were prepared in the Food Analysis Laboratory, Microbiology Laboratory, and Processing Laboratory of the host institution.

For clarity, Table 1 summarizes the major equipment and reagents used in this study.

Table 2. Equipment and reagents used in the study

Category	**Materials/Equipment**
Analytical tools	Crucibles, desiccators, weighing balance, Soxhlet apparatus, autoclave, incubator
Chemicals	Petroleum ether, HCl (1%), formalin, NaOH, phenolphthalein, H_2SO_4 (1.25%)
Food ingredients	Wheat flour, salt, sugar, yeast, water
Processing tools	Grinding roller machine, granulation/sieve machine, tanderu oven

3.2 Processing of Wheat Flour

3.2.1 Cleaning

Locally grown wheat grains were cleaned manually to remove stones, debris, and extraneous matter. In addition to external impurities, the surface dirt lodged in the crease of each grain was carefully removed to ensure purity before tempering.

3.2.2 Conditioning

Conditioning was carried out to optimize bran toughness and endosperm softness for efficient milling. The initial moisture content of the local wheat was determined as 9.7% at a weight of 2.70 kg. Moisture was raised to a target of 14.5% using the following formula:

$$= \frac{m2 - m1}{100 - m2} \times flow\ rate \ldots$$

Where:

- M1M_1M1=initial moisture (9.7%)
- M2M_2M2 = target moisture (14.5%)
- Wheat weight = 2.70 kg

$$= \frac{14.5 - 9.7}{100 - 14.5} \times 2.70$$

= 0.25 lts of water

Thus, 250 mL of water was added, thoroughly mixed, and the grain was allowed to equilibrate for 24 hours.

3.2.3 Milling and Sieving

After conditioning, the grains were milled at a Local Flour Mills, Kano, using a roller mill. Flour was fractionated by sieve analysis into defined particle sizes:

- 530 and 300 µm → bran,
- 220 µm → semolina,
- 180 and 150 µm → refined flour.

Sieving was performed for two minutes with a vibrating granulation machine to ensure uniform separation.

3.2.4 Flour Enrichment

To improve flour functionality, enrichment was performed by adding ascorbic acid and enzyme improvers (Flomod). Fifty kilograms of flour were enriched with 5 g each of ascorbic acid and enzyme improver, corresponding to 0.05 g per kilogram of flour, calculated as:

$$= \frac{5 \times 1kg}{50kg} = \frac{5}{50} = \frac{0.1}{2} = 0.05g$$

This enrichment improved gluten strength, fermentation stability, and sensory quality of gurasa.

3.2.4 Gluten Analysis

Wet gluten was determined gravimetrically. The obtained weight was multiplied by 10 to yield percentage gluten. Locally grown wheat flour yielded 24.4% wet gluten, indicating acceptable baking strength.

3.3 Gurasa Production

Gurasa was prepared by mixing wheat flour, water, yeast, sugar, and salt into dough, kneaded for 15–20 minutes, and allowed to undergo first fermentation (10–20 minutes at 27 °C) and second fermentation (40–50 minutes at 28 °C). The dough was portioned, shaped, and baked for 5–10 minutes in a traditional tanderu clay oven pre-heated with charcoal and cleaned as per local practice (Dandago, 2013). The baked products were cooled on racks for 10–15 minutes before packaging.

Table 2: Methodological Flow of Production, Proximate Composition, and Sensory Evaluation of Gurasa

Stage	Description of Activities
Wheat Selection	Selection of local wheat varieties and an imported control sample for comparative assessment.
Cleaning & Conditioning	Removal of impurities; adjustment of grain moisture to optimal levels before milling.
Milling & Flour Production	Milling of wheat into flour, sieving, and ensuring uniform particle size distribution.
Ingredient Preparation	Accurate weighing of flour, salt, sugar, yeast, and water to standard formulations.
Dough Mixing	Kneading flour and ingredients for 15–20 minutes to form elastic dough.
First Fermentation	Resting dough for 10–20 minutes at 27 °C for initial gluten development and yeast activation.

Second Fermentation	Further fermentation for 40–50 minutes at 28 °C to improve dough volume, texture, and flavor.
Cutting, Shaping & Molding	Dividing fermented dough into uniform sizes, shaping, and molding into traditional Gurasa discs.
Baking	Baking shaped dough in a tanderu oven for 5–10 minutes at ~188 °C until golden brown and fully cooked.
Cooling	Cooling baked Gurasa for 10–15 minutes at ~27 °C to stabilize structure and prevent moisture condensation.
Packaging	Hygienic wrapping and storage in airtight packaging materials for preservation.
Proximate Analysis	Nutritional composition determination (AOAC, 2019) including: – Moisture – Ash – Protein – Fat – Fiber – Carbohydrate.
Sensory Evaluation	Consumer panel evaluation using 9-point Hedonic scale for taste, aroma, texture, color, and overall acceptability.
Data Analysis	Statistical evaluation (ANOVA, SPSS v26/Excel) with significance set at $p < 0.05$.

3.4 Proximate Composition Analysis
The proximate composition of gurasa was analyzed according to AOAC (1990; 2002) methods.
Moisture content: Determined using the oven-drying method at 120 °C for 3 hours.
Ash content: Samples incinerated in a muffle furnace at 525 °C for 1 hour.
Carbohydrate content: Determined by difference: %Carbohydrate=100−(%Moisture + Protein + Ash + Fiber + Fat)
Crude fat: Extracted with petroleum ether using Soxhlet apparatus for 3 hours.
Crude fiber: Determined by sequential acid–alkali digestion (1.25% H_2SO_4, 0.313 M NaOH), filtration, drying, and ashing.
Crude protein: Determined by formal titration method (AOAC, 2002) using formaldehyde–NaOH reaction, applying a factor of 6.25.

3.5 Sensory Evaluation
Sensory evaluation was conducted using the method of Ihekorenye and Ngoddy (1985). Thirty panelists assessed local wheat gurasa, imported wheat gurasa, and a control sample for flavor, taste, texture, color, and overall acceptability. A 9-point hedonic scale was used (1 = dislike extremely, 9 = like extremely). Samples were served under controlled conditions, with water for palate cleansing between evaluations.

3.6 Statistical Analysis
All experiments were conducted in triplicate. Results were expressed as mean ± standard deviation (SD). Data were analyzed using one-way ANOVA with Tukey's post-hoc test to identify significant differences at $p < 0.05$, using SPSS (v25, IBM Corp., USA).

IV. RESULTS AND DISCUSION
4.1 Proximate Composition of Gurasa
The proximate composition of Gurasa produced from local wheat flour (Sample A), imported wheat flour (Sample B), and a control formulation (Sample C) is presented in Table 4.1.1. Moisture content ranged between **29.00±2.00% and 29.26±2.10%**, with the highest value observed in Sample A and the lowest in Sample B. These values fall within typical ranges reported for flatbread-type products, where moisture levels are influenced by the quantity of water added during dough preparation and fermentation conditions (Wilcox, 2006). The relatively high moisture content in all samples suggests shorter shelf life due to susceptibility to microbial growth, highlighting the importance of proper packaging

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and storage.

Protein content ranged from **11.00±0.55% to 11.60±0.60%**, with the highest observed in Sample A (local wheat) and the lowest in Sample C (control). These values are comparable to the standard protein content of bread wheat flour (10–14%) reported in cereal science literature (AACC, 2000). The variation in protein may be attributed to inherent differences in wheat varieties as well as postharvest handling. Protein quality is particularly significant for Gurasa, as it determines gluten strength, dough handling, and the final textural properties of the product (Olaoye et al., 2017).

Ash content ranged between **2.35±0.78% and 3.00±0.20%**, with local wheat (Sample A) recording the highest values. This suggests a higher mineral content, potentially due to differences in soil conditions where the wheat was grown, or due to additional contributions from the traditional tanderu oven baking method, which may allow ash residues to influence final mineral composition (Kara, 2014).

Crude fiber levels ranged between **1.33±0.33% and 1.83±0.33%**, which are within expected limits for wheat-based flatbreads. Dietary fiber plays an important role in gut health, and even small variations in fiber levels can influence textural properties such as chewiness and mouthfeel (Zente, 2000).

Carbohydrate content was the most abundant nutrient fraction, ranging from **49.98% to 51.42%**. This high carbohydrate concentration reflects the dominance of wheat starch in Gurasa, consistent with literature reporting that cereals provide the bulk of dietary energy in African diets (FAO, 2019).

Fat content ranged from **4.50±0.73% to 5.05±0.60%**, with the highest value in the control sample and the lowest in local wheat-based Gurasa. Although relatively low, these values are comparable to other traditional flatbreads, where fat contributes to flavor, satiety, and overall sensory quality. However, excessive fat intake is linked to increased cardiovascular risks, and therefore the moderate fat values observed are desirable for public health (Fennema, 2008).

Table 4: Proximate Composition of Gurasa Samples

Sample	**Fat (%)**	**Moisture (%)**	**Fiber (%)**	**Ash (%)**	**Protein (%)**	**Carbohydrate (%)**
A (Local Wheat)	4.50±0.73	29.26±2.10	1.66±0.70	3.00±0.20	11.60±0.60	49.98
B (Imported Wheat)	4.96±0.50	28.64±0.60	1.33±1.22	2.35±0.78	11.30±0.80	51.42
C (Control)	5.05±0.60	29.00±2.00	1.83±0.33	2.85±0.10	11.00±0.55	50.09

4.2 Sensory Evaluation of Gurasa

The sensory scores of Gurasa are shown in Table 4.1.2. Significant differences ($p < 0.05$) were observed among samples across several sensory attributes. Gurasa from local wheat (Sample A) received the **highest overall acceptability score (6.65±0.58)** compared to imported wheat (Sample B, 4.50±0.80) and control (Sample C, 4.95±1.05). This indicates that local wheat flour can produce Gurasa of superior consumer acceptability, challenging the perception that imported wheat flour always yields better baking quality.

Color scores ranged from **4.40±1.42 (Sample B)** to **6.48±0.68 (Sample A)**, with significant differences observed. Local wheat Gurasa displayed more appealing coloration, possibly due to pigment retention during milling or specific Maillard browning reactions enhanced by its protein and carbohydrate profile (Adeyemi & Idowu, 2018).

Taste scores revealed a similar trend, with local wheat (6.30±0.97) outperforming imported wheat (4.80±1.05) and control (5.20±1.15). Flavor scores followed the same pattern, indicating that inherent varietal characteristics of local wheat contributed to more desirable taste notes.

Texture was rated highest in local wheat Gurasa (5.95±1.14), while imported wheat scored the lowest (4.20±1.15). The superior texture in local wheat may be linked to gluten strength and dough rheology, which enhance chewiness and mouthfeel (Olaoye et al., 2017).

Overall, sensory analysis demonstrates that **local wheat flour is not only nutritionally comparable but also organoleptically superior to imported wheat**, a finding of significant policy relevance for reducing Nigeria's dependence on wheat imports and enhancing food sovereignty.

Table 5: Sensory Scores of Gurasa Samples

Attribute	A (Local Wheat)	B (Imported Wheat)	C (Control)
Color	6.48±0.68[b]	4.40±1.42[c]	5.55±0.88[a]
Taste	6.30±0.97[c]	4.80±1.05[a]	5.20±1.15[b]
Flavor	5.90±1.07[e]	4.25±1.02[d]	4.90±0.71[d]
Texture	5.95±1.14[d]	4.20±1.15[e]	4.30±0.80[e]
Overall Acceptability	6.65±0.58[a]	4.50±0.80[ab]	4.95±1.05[c]

Note: Different superscripts indicate significant differences ($p < 0.05$).

4.3 Implications of Findings

The combined proximate and sensory results underscore the viability of locally grown wheat for Gurasa production in Nigeria. Nutritionally, the local wheat flour-based Gurasa was comparable to imported wheat flour in protein, fat, carbohydrate, and fiber composition. Sensory evaluation further reinforced its superiority in terms of color, taste, and overall acceptability. These findings challenge the perception that imported wheat is inherently superior and highlight the potential of local wheat in promoting food security, reducing import dependency, and strengthening Nigeria's agricultural economy.

Similar studies in Ghana, Ethiopia, and Sudan have reported that locally grown wheat can perform competitively when utilized in traditional flatbread processing, provided that appropriate milling and fermentation techniques are employed (Alemu et al., 2019; Mohammed et al., 2017). Therefore, the adoption of local wheat in Gurasa production is not only technologically feasible but also aligns with global sustainable food system goals.

V. CONCLUSION

The findings of this research indicate that locally grown wheat has the capacity to support gurasa production without compromising essential nutritional properties. The proximate analysis confirmed that wheat flour from local varieties contains considerable levels of protein and carbohydrate, both of which are critical to human nutrition and food security. Moreover, the sensory evaluation demonstrated that while local wheat flour and imported wheat flour yielded products with significant differences in attributes such as taste, texture, and overall acceptability, both varieties remained within acceptable consumer preference ranges.

These outcomes suggest that local wheat not only meets nutritional expectations but also holds cultural and economic significance for communities in northern Nigeria. By reducing dependence on imported wheat, the adoption of local wheat for gurasa production could enhance food sovereignty, strengthen local agricultural economies, and reduce foreign exchange expenditure on wheat imports.

Recommendation

To build upon the findings of this study, several recommendations are proposed:

1. Nutritional Characterization: Further research should be conducted to characterize the amino acid composition and mineral profile of locally grown wheat. This would provide deeper insights into micronutrient availability and inform strategies for fortification or supplementation where necessary.
2. **Breeding and Agronomic Improvement:** Agricultural research institutes should focus on breeding high-yielding and disease-resistant wheat varieties with enhanced nutritional properties, ensuring that local wheat flour can consistently compete with imported varieties in both quality and volume.
3. **Food Processing Innovations:** Food technologists should explore optimized processing techniques to enhance the texture, taste, and sensory qualities of gurasa prepared with local wheat, thereby increasing consumer preference and market competitiveness.
4. **Policy and Economic Support:** Policymakers should prioritize investment in wheat production and processing infrastructure, as well as support farmers through subsidies, training, and market access programs. This will encourage greater adoption of local wheat in traditional food industries.

Public Health Integration: Nutritionists and public health experts should promote the consumption of gurasa made from local wheat as part of dietary diversification strategies, particularly in combating protein and carbohydrate deficiencies in rural communities.

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