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Culture-Dependent Characterization of Culturable Bacteria Associated with Fura de Nunu Sold in Abuja, North Central Nigeria

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Abstract

Fura de nunu is a traditional fermented dairy–cereal beverage widely consumed in Northern Nigeria due to its nutritional value, affordability, and cultural significance. Despite its popularity, the microbiological quality of the product may be compromised by traditional processing and vending practices. This study investigated the culturable bacterial community associated with fura de nunu sold in Abuja, North Central Nigeria, using conventional culture-dependent microbiological techniques. A total of 150 samples comprising fura–nunu mixtures (n = 50), nunu only (n = 50), and fura only (n = 50) were analyzed. Total culturable heterotrophic bacterial counts (TCHBC), lactic acid bacterial (LAB) counts, colonial morphology, and biochemical characteristics of bacterial isolates were determined. The TCHBC ranged from 7.3×10^6 to 9.6×10^6 CFU/mL, while LAB counts ranged from 5.4×10^6 to 7.4×10^6 CFU/mL. The highest microbial counts were recorded in the fura–nunu mixture. Morphological and biochemical characterization identified Lactobacillus spp. and Staphylococcus aureus as the predominant culturable bacterial isolates. The predominance of Lactobacillus spp. highlights their important role in fermentation, acidification, and product preservation. However, the presence of S. aureus indicates possible contamination arising from poor hygienic practices during processing, handling, or sale. The findings demonstrate that fura de nunu contains beneficial fermentative bacteria alongside potential foodborne contaminants. Improved hygienic handling, routine microbiological monitoring, and adoption of standardized processing practices are recommended to enhance product safety and protect public health.

Keywords: Fura De Nunu, Bacterial Diversity, Fermented Foods, Lactobacillus Spp., Staphylococcus Aureus, Lactic Acid Bacteria, Food Safety

1. INTRODUCTION

Fura de nunu is a traditional fermented dairy–cereal beverage commonly consumed throughout Northern Nigeria and several West African countries. The product is prepared by mixing fura, a fermented millet-based dough, with nunu, a naturally fermented milk product obtained from cow milk. The beverage is highly valued because of its nutritional composition, refreshing taste, affordability, and contribution to food security among low- and middle-income populations (Adepoju et al., 2012; Ukaefu et al., 2019).

Fermentation is one of the oldest methods of food preservation and is largely driven by naturally occurring microorganisms, particularly lactic acid bacteria (LAB). These microorganisms contribute to acid production, flavour development, texture enhancement, and inhibition of undesirable microorganisms. Consequently, fermented dairy products often contain beneficial microorganisms that may confer probiotic effects and improve nutritional quality (Halm et al., 1993; Gadaga et al., 1999). Despite its nutritional and economic importance, fura de nunu is predominantly produced under traditional conditions with minimal quality control. The use of raw

milk, non-standardized processing techniques, inadequate sanitation, and open-air vending practices may predispose the product to microbial contamination. Such contamination may result in reduced shelf life, spoilage, and the introduction of pathogenic microorganisms capable of causing foodborne illnesses (Agunwa & Odimegwu, 2019; Edem et al., 2022).

Several studies have reported the occurrence of diverse bacterial genera in fermented dairy products, including Lactobacillus, Lactococcus, Leuconostoc, Bacillus, Staphylococcus, Escherichia, and other microorganisms of public health significance (Eruteya & Eze, 2016; Ukaefu et al., 2019). The composition of these microbial communities is influenced by factors such as raw material quality, fermentation conditions, storage practices, environmental exposure, and personal hygiene of vendors.

Culture-dependent microbiological techniques remain valuable tools for the investigation of microbial communities in fermented foods. Although molecular approaches provide greater taxonomic resolution, culture-based methods facilitate the recovery of viable microorganisms and remain widely applicable in developing countries due to their affordability and accessibility (Jay, 2005; McLandsborough, 2005).

In Abuja, where consumption of ready-to-eat traditional beverages is increasing, fura de nunu is commonly sold by street vendors in markets, motor parks, and roadside stalls. These environments may expose the product to microbial contamination from handling, utensils, water sources, and the surrounding environment. Therefore, assessment of the bacterial community associated with commercially sold fura de nunu is necessary to evaluate its microbiological quality and potential public health implications. This study was conducted to characterize the culturable bacterial community associated with fura de nunu sold in Abuja, North Central Nigeria, and to evaluate its microbiological quality using culture-dependent microbiological techniques.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in Abuja, the Federal Capital Territory (FCT) of Nigeria. Abuja is a rapidly growing metropolitan city characterized by a diverse population and extensive informal food vending activities.

2.2 Sample Collection

A total of 150 freshly prepared samples were collected from randomly selected street vendors across major districts of Abuja, including Wuse, Garki, Nyanya, Kubwa, and Lugbe. The samples consisted of:

Fura–nunu mixture (n = 50); Nunu only (n = 50); Fura only (n = 50). Samples were aseptically collected into sterile containers, transported in insulated ice-packed containers to the laboratory, and analyzed immediately upon arrival.

2.3 Enumeration of Total Culturable Heterotrophic Bacteria

Ten millilitres (10 mL) of each sample were homogenized in 90 mL of sterile distilled water to obtain a 10^{-1} dilution. Serial ten-fold dilutions were prepared up to 10^{-6}. Aliquots (0.1 mL) of appropriate dilutions were inoculated onto Nutrient Agar using the spread plate method and incubated aerobically at 37°C for 48 h. Colonies were counted and expressed as colony-forming units per millilitre (CFU/mL).

2.4 Enumeration of Lactic Acid Bacteria

For LAB determination, aliquots were inoculated onto de Man Rogosa and Sharpe (MRS) agar and incubated anaerobically at 30°C for 72 h. Colonies were enumerated and expressed as CFU/mL.

2.5 Isolation and Identification of Bacteria

Distinct colonies were selected based on morphological characteristics, including colony size, pigmentation, elevation, margin, and texture. Pure cultures were obtained by repeated sub-culturing and maintained on nutrient agar slants at 4°C. Bacterial isolates were characterized using Gram staining and standard biochemical tests, including catalase, oxidase, citrate utilization, coagulase, indole, methyl red, Voges–Proskauer, motility, and carbohydrate fermentation tests. Identification was performed according to Cheesbrough (2006) and Bergey's Manual of Determinative Bacteriology.

2.6 Statistical Analysis

Microbial counts were expressed as means and converted to logarithmic values (log10 CFU/mL). Data were analyzed using descriptive statistics. Differences among sample categories were evaluated using one-way analysis of variance (ANOVA) at a significance level of $p < 0.05$.

3. RESULTS

Total Culturable Heterotrophic Bacterial Counts (TCHBC)

The TCHBC ranged from 7.3×10^6 to 9.6×10^6 CFU/mL. Sample A (Fura + Nunu) recorded the highest bacterial load, while Sample C (Fura only) had the lowest count. The higher bacterial population observed in the combined Fura–Nunu sample suggests that the interaction between fermented milk and cereal substrates provides favorable nutritional conditions for bacterial growth. The lower count in fura alone indicates that the fermented milk component contributes substantially to microbial proliferation.

Table 1: Total Culturable Heterotrophic Bacterial Counts (TCHBC)

Sample	Description	TCHBC (CFU/mL)	Log10 CFU/mL
A	Fura + Nunu	9.6×10^6	6.98
B	Nunu only	8.7×10^6	6.94
C	Fura only	7.3×10^6	6.86

Total Culturable Lactic Acid Bacterial Counts (LAB)

LAB counts ranged from 5.4×10^6 to 7.4×10^6 CFU/mL. Sample A recorded the highest LAB count, followed by Sample B and Sample C. The abundance of LAB in the mixed Fura–Nunu sample indicates a

synergistic effect of cereal and milk fermentation, creating conditions favorable for LAB growth. Since LAB are responsible for acid production and preservation, their predominance confirms active fermentation in the product

Table 2: Total Culturable Lactic Acid Bacterial Counts (LAB)

Sample	Description	LAB (CFU/mL)	Log10 CFU/mL
A	Fura + Nunu	7.4×10^6	6.87
B	Nunu only	6.0×10^6	6.78
C	Fura only	5.4×10^6	6.73

Colonial Characteristics of Bacterial Isolates

Distinct colony morphologies facilitated preliminary identification of the isolates. The golden-yellow pigmented colonies of Staphylococcus aureus are characteristic of the species, while the small white convex colonies are typical of Lactobacillus species commonly encountered in fermented dairy products.

Table 3: Colonial Characteristics of Bacterial Isolates

Bacterial Species	Morphology	Color	Texture	Size
Staphylococcus aureus	Circular, smooth, raised	Golden yellow	Moist, smooth	1–3 mm
Lactobacillus spp.	Small, circular, convex	White/off-white	Moist	<1 mm

Physiological (Biochemical) Characteristics of Isolates

The biochemical profile of Isolate I was consistent with Staphylococcus aureus, as indicated by positive catalase, coagulase, oxidase, and Voges-Proskauer reactions. Isolate II exhibited characteristics typical of Lactobacillus spp., including Gram-positive rod morphology, catalase negativity, and carbohydrate fermentation ability.

Table 4: Biochemical Characterization of Bacterial Isolates

Test	Isolate I	Isolate II
Gram reaction	+	+
Shape	Cocci	Rod
Motility	−	+
Catalase	+	−

Test	Isolate I	Isolate II
Citrate	+	+
Indole	–	–
Oxidase	+	–
Coagulase	+	–
VP test	+	–
MR test	–	–
Glucose	A/G	A/G
Lactose	A/G	–
Sucrose	A/G	A/G
Probable identity	Staphylococcus aureus	Lactobacillus spp.

4. DISCUSSION

The present investigation revealed high bacterial loads in all examined samples of fura de nunu. Such elevated microbial populations are characteristic of naturally fermented foods, where microbial growth is actively encouraged during fermentation. Similar observations have been reported in fermented dairy products across West Africa (Akabanda et al., 2010; Gadaga et al., 1999).

The highest bacterial population observed in the fura–nunu mixture may be attributed to the combined availability of carbohydrates from millet and proteins, lipids, vitamins, and minerals from fermented milk. This nutrient-rich environment provides favourable conditions for bacterial growth and fermentation activities.

Lactic acid bacteria constituted a major component of the culturable bacterial population. The isolation of Lactobacillus spp. is consistent with previous reports on fermented dairy products and confirms their central role in acid production, flavour development, preservation, and inhibition of undesirable microorganisms. LAB are widely recognized for their contribution to food safety through the production of organic acids, hydrogen peroxide, and bacteriocins (Halm et al., 1993; Akabanda et al., 2010).

The detection of Staphylococcus aureus is of public health significance. S. aureus is commonly associated with contamination from human handlers, contaminated utensils, processing equipment, and environmental exposure. Its occurrence suggests deficiencies in hygienic handling practices during production, packaging, transportation, or retail sale. Similar findings have been reported in previous investigations of commercially vended fermented dairy products in Nigeria (Eruteya & Eze, 2016; Edem et al., 2022).

The coexistence of beneficial fermentative microorganisms and potential pathogens demonstrates the complex microbiological nature of traditional fermented foods. While fermentation contributes to product preservation and nutritional enhancement, inadequate sanitation may compromise product safety. Therefore, implementation of good manufacturing practices (GMPs), hazard analysis and critical control point (HACCP) principles, and routine microbiological surveillance is essential for improving the safety of traditionally fermented beverages.

5. CONCLUSION

This study demonstrated that fura de nunu sold in Abuja contains abundant culturable bacterial populations dominated by lactic acid bacteria. The predominance of Lactobacillus spp. confirms their essential role in fermentation and preservation of the product. However, the isolation of Staphylococcus aureus indicates possible contamination arising from inadequate hygienic handling practices. Although the product possesses beneficial fermentative microorganisms, improvements in hygiene, quality assurance, and routine microbiological monitoring are necessary to minimize contamination risks and ensure consumer safety. Adoption of standardized production practices and public health education of vendors are recommended to enhance the microbiological quality of fura de nunu sold in Nigeria.

References

Adepoju, A. A., Abiose, S. H., & Adeniran, H. A. (2012). Effect of some preservation techniques on the microbiological characteristics of fura de nunu during storage. *Ife Journal of Technology*, *21*(2), 30–37.

Agunwa, I. M., & Odimegwu, E. N. (2019). Microbiological quality of a locally fermented milk-cereal mixture (fura de nunu) sold in Owerri metropolis, Nigeria. *Advances in Food Science and Engineering*, *3*, 214–221.

Akabanda, F., Owusu-Kwarteng, J., Glover, R. L. K., & Tano-Debrah, K. (2010). Microbiological characteristics of fermented milk product, nunu. *Nature and Science*, *8*(9), 178–187.

Cheesbrough, M. (2006). District laboratory practice in tropical countries (2nd ed.). Cambridge University Press.

Edem, V. E., Abubakar, A. W., Etukakpan, M. N., & Elijah, A. I. (2022). Microbial assessment of fura-nunu sold in Eiyenkorin, Kwara State, Nigeria. *International Journal of Natural Sciences Research*, *10*(1), 30–42.

Eruteya, C. O., & Eze, C. O. (2016). Proximate composition and antibiotic-resistant Listeria species in fura de nunu sold in Port Harcourt. *Journal of Advances in Biology and Biotechnology*, *11*(2), 1–7.

Gadaga, T. H., Mutukumira, A. N., Narvhus, J. A., & Feresu, S. B. (1999). A review of traditional fermented foods and beverages of Zimbabwe. *International Journal of Food Microbiology*, *53*(1), 1–11.

Halm, M., Lillie, A., Sorensen, A. K., & Jakobsen, M. (1993). Microbiological and aromatic characteristics of fermented maize doughs for kenkey production in Ghana. *International Journal of Food Microbiology*, *19*(2), 135–143.

Holt, J. G., Krieg, N. R., Sneath, P. H. A., Staley, J. T., & Williams, S. T. (1994). Bergey's manual of determinative bacteriology (9th ed.). Williams & Wilkins.

Jay, J. M. (2005). Modern food microbiology (7th ed.). Springer.

McLandsborough, L. A. (2005). Food microbiology laboratory. CRC Press.

Nebedum, J. O., & Obiakor, T. (2007). Effects of different preservation methods on the quality of nunu. *African Journal of Biotechnology*, *6*(4), 454–458.

Ukaefu, C. C., Braide, W., & Mike-Anosike, E. E. (2019). Molecular studies of prevalent bacteria isolated from unpasteurized traditional fermented dairy products sold in parts of Imo State, Nigeria. *Food*

and Nutrition Journal, *4*, 207.