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Evaluation of Microbiological Quality of Ogi Produced From Fermented Sprouted and Unsprouted White Sorghum Grains

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ABSTRACT

Microbial characterization of Ogi is essential to distinguish beneficial fermenters from harmful contaminants, especially when comparing sprouted and unsprouted sorghum. Traditional Ogi fermentation is spontaneous and governed by naturally occurring microorganisms. The study evaluated the microbiological quality of Ogi produced from fermented sprouted and unsprouted white sorghum grains. Three samples were analysed: sprouted (SPS1), unsprouted (USPS2), and a control sample (CTS), microbial isolates were identified using standard methods. A progressive decline in pH was observed during fermentation, with SPS1 showing the most pronounced reduction from 6.51 to 3.60 after 72 hours, indicating lactic acid fermentation. Total aerobic plate counts ranged from 2.5×10^3 to 2.2×10^5 CFU/mL. Coliforms were detected only in SPS1 at 3.0×10^2 CFU/mL, while USPS2 and CTS showed no detectable coliform growth. Yeast counts ranged from 4.8×10^5 to 3.2×10^6 CFU/mL, The higher yeast population observed in CTS and SPS1 reflects the availability of fermentable substrates that favor yeast proliferation, while the absence in USPS2 suggests reduced fermentative activity. Lactic acid bacteria counts ranged from 7.6×10^5 to 1.7×10^6 CFU/mL. The dominance of Lactobacillus in SPS1 demonstrated enhanced lactic acid fermentation associated with sprouting, which contributes to acid production, microbial stability, and improved safety of the Ogi. Predominant microorganisms identified included *Lactobacillus plantarum*, *Pediococcus pentosaceus*, *Saccharomyces cerevisiae*, *Candida albican, Enterobacter* spp and *Escherichia coli*. The result indicated that sprouting and fermentation significantly improve microbial safety, making sprouted sorghum Ogi more suitable for infant feeding and potential industrial applications.

1.0 INTRODUCTION

Fermented cereal foods play a critical role in African diets, particularly in West Africa where sorghum (*Sorghum bicolor*) is widely cultivated and consumed. It is ranked the fifth among world food grain the annual world production is over 60 million tons, of which Africa produces about 20 million tons. About 45 million hectares of sorghum are cultivated in the world and USA is the number one producer followed by Nigeria. Sorghum is a good source of energy, proteins, carbohydrates, vitamins and minerals including the trace elements, particularly iron and zinc, except calcium. Sorghum grain contains minerals such as phosphorus, potassium and magnesium in varying quantities (Ogodo *et al.*, 2019). Traditional treatments such as soaking, cooking, germinating and fermenting have been used to improve nutritional quality of the sorghum.

Fermentation increases the starch and protein digestion of the most important sorghum-based fermented foods. Ogi ,is a traditional sour porridge produced from maize, millet, or sorghum. It remains a major weaning food and breakfast meal due to its affordability, digestibility, cultural acceptance, and nutritional benefits (Adebiyi *et al*., 2022). Sorghum is valued for its resilience to drought and poor soils, making it an essential raw material for traditional foods. Fermentation is a key processing step in Ogi production and involves steeping, milling, sieving, and spontaneous fermentation. This fermentation process is driven mainly by lactic acid bacteria (LAB) and yeasts, which enhance food safety, improve sensory properties, and increase nutrient bioavailability (Mokoena, 2020). Lactic acid bacteria (LAB) such as *Lactobacillus plantarum* and *Pediococcus* spp. produce lactic acid and antimicrobial metabolites that suppress spoilage organisms, while yeasts contribute to aroma and flavor development.

Sprouting (malting) is another traditional technique used to improve cereal quality. It increases enzymatic activity, enhances vitamin content, improves mineral bioavailability, and reduces anti-nutritional factors. However, sprouting also alters the microbial ecology, potentially influencing the safety and quality of Ogi (Rodríguez-Pérez *et al*., 2021). Comparing sprouted and unsprouted sorghum Ogi is therefore essential to determine the safest and nutritionally superior method. Given the popularity of Ogi among infants and vulnerable populations, microbial quality is a major concern. Studies have shown that traditional cereal fermentations may contain both beneficial fermenters and undesirable contaminants such as *Escherichia coli* or *Staphylococcus aureus* when hygiene is poor (Tamang *et al*., 2020).

. Despite the nutritional and cultural significance of Ogi, its traditional preparation is largely artisanal and depends on spontaneous fermentation, which may lead to inconsistent microbial profiles. Inadequate hygiene practices can result in contamination by pathogenic microorganisms, posing risks to consumers, especially infants who rely on Ogi as a primary weaning food

(Omemu *et al*., 2020). Additionally, sprouting is known to enhance nutrient bioavailability, little research has compared the microbial quality of sprouted versus unsprouted sorghum Ogi, particularly in Nigeria. This creates a gap in knowledge on how sprouting affects microbial diversity and potential safety. Therefore, this study is aimed at evaluation of the microbiological quality of Ogi produced from fermented sprouted and unsprouted sorghum grains by isolating and characterizing microorganisms present, which is crucial for ensuring food safety, and supporting potential industrial applications.

2.0 MATERIALS AND METHODS

2.1 Sample collection

Healthy white sorghum (*Sorghum bicolor*) grains were purchased from Wukari main market, Taraba State, Nigeria. The purchased sorghum were transported under hygienic conditions to the Microbiological Laboratory, Federal University Wukari, for processing and analyses.

2.2 Experimental design

Comparative experimental design was used to evaluate the effect of sprouting on the microbiological quality of Ogi produced from white sorghum. The experiment consisted of two treatments: sprouted Ogi (SPS1) and unsprouted Ogi (USPS2), with a control sample (CTS) included for comparison. All treatments were prepared and analysed in duplicate.

2.3 Sample Preparation for Sprouted and Unsprouted Sorghum

The Sorghum grains were carefully selected by removing stones, dirt's and broken kernel. A total of one thousand, one hundred and fifty grams (1250g) of clean white sorghum grains were washed with sterile water and divided into two equal portions, 625 g each for Sprouted and Unsprouted Ogi production.

Sprouting (malting) was carried out following the method of Adelekan *et al*. (2022) with slight modifications .Six hundred and twenty five grams (625g) of the grains were steeped in 500 mL of sterile distilled water for 24 hours at room temperature (28 ± 2 °C), with the water being changed every 12 hours to reduce microbial contamination. After steeping, the grains were spread on moistened jute sacks, covered with a damp muslin cloth, and allowed to germinate for 72 hours under dark, humid conditions. The sprouted grains were then washed thoroughly, oven-dried at 50 °C for 12 hours, and stored in sterile containers prior to Ogi preparation.

The second 625 g portion of cleaned white sorghum grains was steeped directly in 500 mL of sterile water for 48 hours at room temperature (28 ± 2 °C),water being changed after 24 hours.

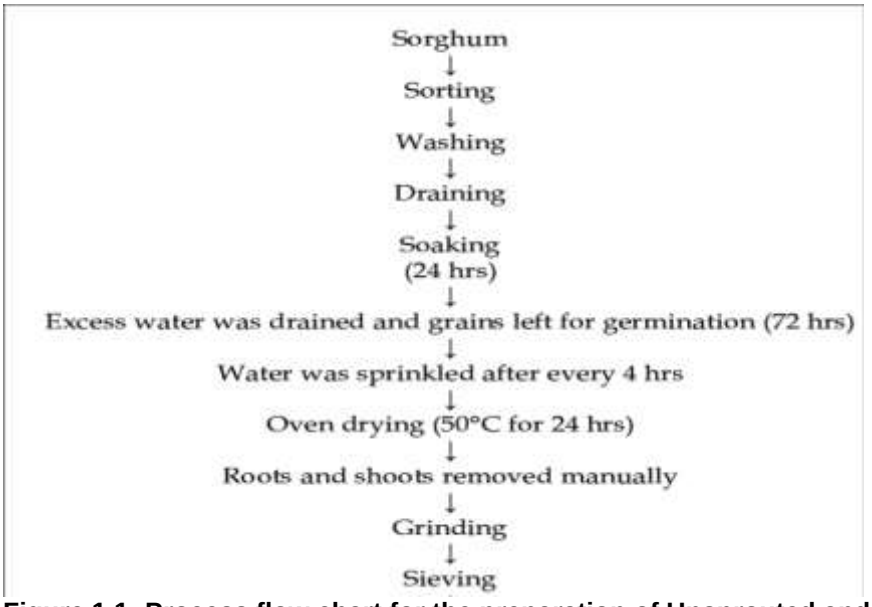

Figure 1.1: Process flow chart for the preparation of Unsprouted and sprouted ogi
Source: (Omemu *et al*., 2020).

Plate:1 Unsprouted Sorghum

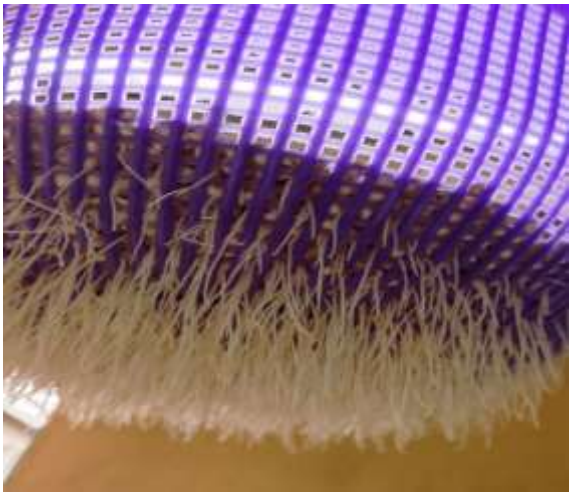

Plate:2 Sprouted Sorghum

2.4 Production of Ogi from Sprouted and Unsprouted Sorghum

Ogi production process was carried out using the traditional method as described by Okoye and Onyekwere (2021): Steeped (sprouted and Unsprouted) grains were wet-milled into a fine paste using a sterile blending machine, the paste was mixed with sterile water and sieved through a muslin cloth to separate the starch slurry from bran and filtrate was left undisturbed to sediment at room temperature in sterile containers. After that the water was decanted and the samples used for analyses.

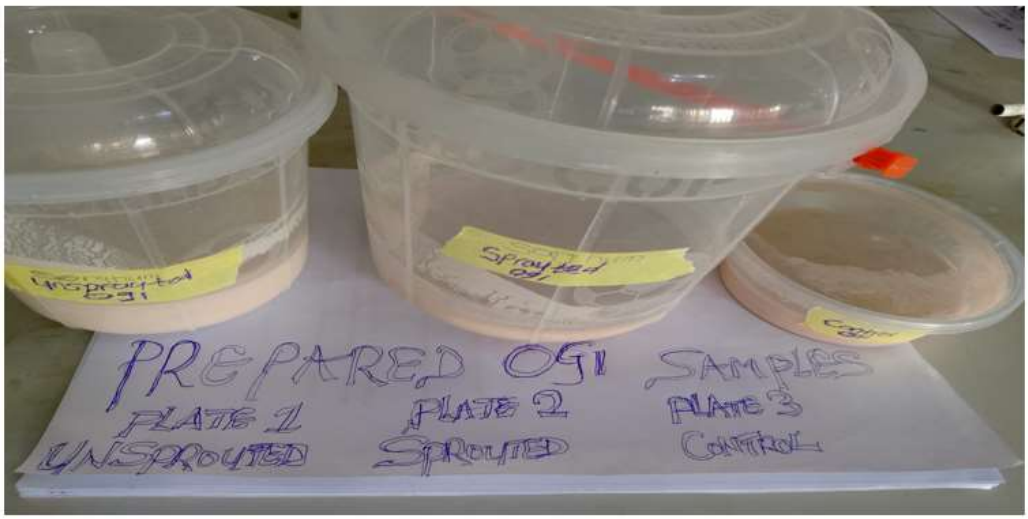

Plate 3: Samples of Ogi sprouted, unsprouted and control.

2.5. Microbiological analysis

2.5 .1 Preparation of Media

Culture media were prepared in accordance with the manufacturer's instructions. The culture media were Nuutrient Agar 2.8g, MacConkey Agar 5.5g, 1.5g of Peptone water, Potato Dextrose Agar 3.9g and de Man Rogosa Agar 3.3g was weighed and dissolved in 100mL each of peptone water and sterilized by autoclaving at 121^0c for 15minutes Pounds per Square Inch (PSI)

2.5 .2. Enumeration and Isolation

Total bacterial count was determined using the method as described by (Obasi *et al*., 2019). The stock solution was prepared by dissolving 1g of the of Ogi samples in 9mL of sterile Peptone water, serial dilution (10 fold) were carried out (1:10,1:100,1:1000…10,000). 1.0 mL of appropriate dilution (10^{-2} and 10^{-4}) was plated on various Agar plates using pour plate method and incubated at 37^0c for 18—24hours for total bacteria, coliform and lactobacillus. Fungi was incubated at room temperature (28 ± 2 °C) for 72hours. The actual

number of bacterial and fungi count was calculated as colony-forming unit (CFU/g)

2.5.3. Purification and Maintenance of Microbial Isolates

Microbial isolates obtained from the fermented Ogi samples, including sprouted, unsprouted, and control samples, were purified to obtain pure cultures. Purification was carried out using the streak plate method on appropriate selective and differential media. Nutrient agar was used for general bacterial isolates, De Man, Rogosa and Sharpe (MRS) agar was used for lactic acid bacteria, Sabouraud Dextrose Agar (SDA) was used for yeast and mold isolates, and MacConkey agar was used for the isolation of coliform bacteria. Individual colonies exhibiting distinct morphological characteristics were carefully selected and re-streaked onto fresh agar plates.

2.5.4 Identification and Characterization of Microbial Isolates

The Identification and characterization of microbial isolates obtained from fermented Ogi samples were carried out based on morphological, microscopic, and biochemical tests following standard microbiological procedures (Martin, 2022; Hafezi and Khamar, 2024).

2.5.5. Colony Morphology

Growth features on plates as observed on Nutrient Aga, MacConkey Agar, de Man Rogosa Agar and potato Dextrose Agar are shown below:

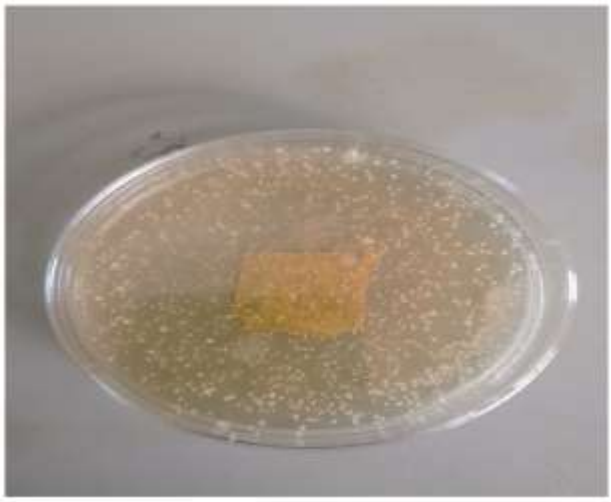

Plate: 4. de Man Rogosa Agar (MRS) plate.

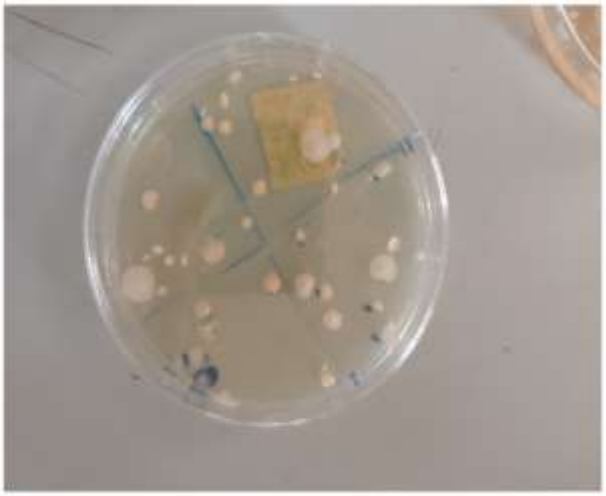

Plate: 5. Potato Dextrose Agar (PDA)

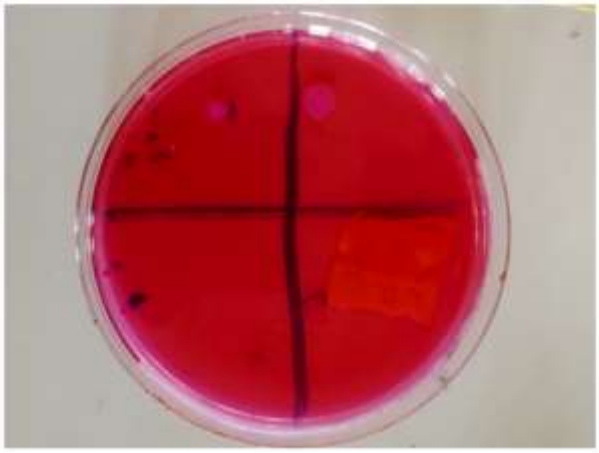

Plate.6 MacConkey Agar plate

Plate: 7. Nutrient Agar plate

2.5.6 Biochemical Tests

Plates with growth features on the bacterial isolates subjected to biochemical tests such as:, Oxidase, Methyl Red Voges–Proskauer (MRVP), and Triple Sugar Iron (TSI) agar tests following standard microbiological identification protocols are shown below:

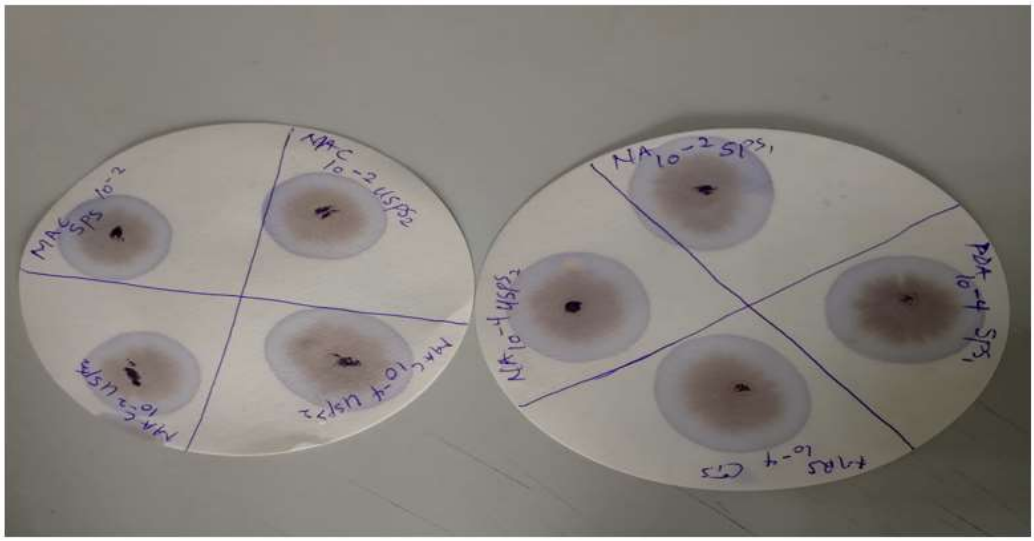

Plate: 8. Oxidase test

Plate: 9. Methyl Red Voges–Proskauer (MRVP) test

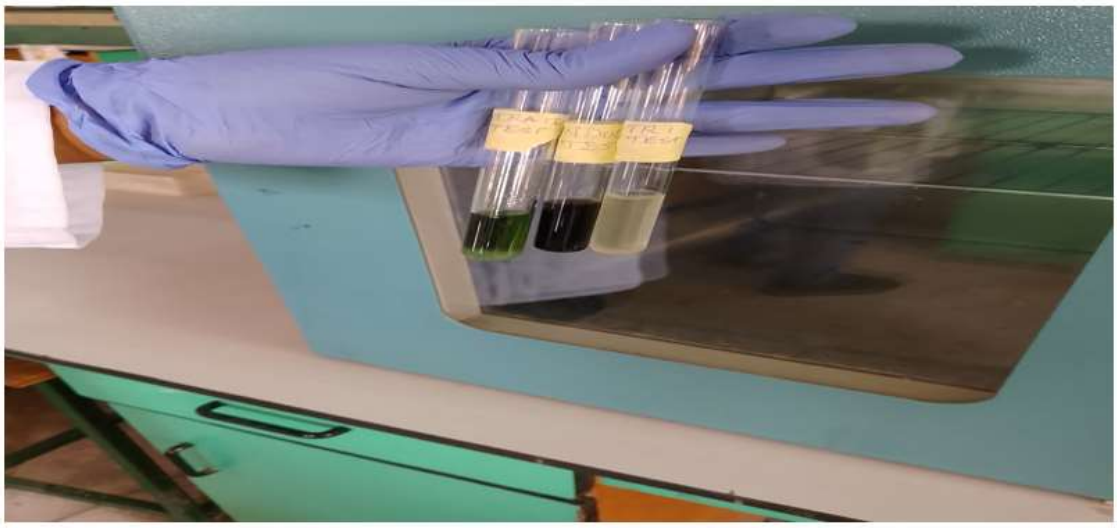

Plate: 10. Triple sugar ion test (TSI)

Data Analysis

Data obtained from the samples were statistically analyzed using the Statistical Package for Social Sciences (SPSS), version 17.0. Data were subjected to analysis of variance (ANOVA) to determine significant differences among the samples. Duncan's Multiple Range Test (DMRT) was used to separate the means at $p < 0.05$.

RESULTS AND DISCUSSION

3.0. Aerobic plate count of bacterial cells, coliform, Lactobacillus and fungi (cfu/g)

Table 3.1 shows the aerobic plate count of bacterial cells, coliforms, fungi (yeasts), and Lactobacillus (CFU/g) of fermented Ogi samples produced from sprouted (SPS1), unsprouted (USPS2), and control (CTS) white sorghum grains.

Total aerobic bacterial Count: The total aerobic bacterial count ranged from 2.5×10^3 CFU/g (CTS) to 2.2×10^5 CFU/g (SPS1), while no detectable growth (ND) was observed in USPS2. The higher bacterial load in SPS1 indicates that sprouting enhanced nutrient availability, thereby supporting increased microbial growth during fermentation, whereas the absence of growth in USPS2 suggests limited microbial activity.

Coliform count: Coliform counts ranged from not detected (USPS2 and CTS) to 3.0×10^2 CFU/g (SPS1). The very low coliform presence in SPS1 suggests minimal contamination, while the absence in USPS2 and CTS indicates improved hygienic quality and the inhibitory effect of fermentation acids on coliform survival.

Fungal (Yeast) count: Yeast counts ranged from not detected (USPS2) to 4.8×10^5 CFU/g (CTS), with SPS1 showing 3.2×10^6 CFU/g. The higher yeast population observed in CTS and SPS1 reflects the availability of fermentable substrates that favor yeast proliferation, while the absence in USPS2 suggests reduced fermentative activity.

Lactobacillus count**:** Lactobacillus counts ranged from not detected (USPS2) to 1.7×10^6 CFU/mL (SPS1), with CTS recording 7.6×10^5 CFU/g. The dominance of Lactobacillus in SPS1 demonstrates enhanced lactic acid fermentation associated with sprouting, which contributes to acid production, microbial stability, and improved safety of the Ogi.

Table 3.1: Total aerobic plate count of bacterial cells, coliforms, Lactobacillus and yeast count (CFU/g) from Sprouted and unsprouted ogi produced from white sorghum grains

Sample code	Bacterial count	Coliform	Yeast	Lactobacillus
SPS1	2.2×10^5	3.0×10^2	3.2×10^6	1.7×10^6
USPS2	ND	ND	ND	ND
CTS	2.5×10^3	ND	4.8×10^5	7.6×10^5

Key: ND= not detected

3.2.: Morphological and Biochemical Characteristics of Microbial Isolates

The result in Fig.1.2 shows the microbial isolates identity from fermented sprouted (SPS1), unsprouted (USPS2), and control (CTS) Ogi samples. Based on the observed characteristics, the isolates were presumptively identified as *Enterobacter spp*, *Micrococcus spp*. and *Staphylococcus spp*., organisms commonly associated with fermented cereal foods and processing environments.

The unsprouted Ogi (USPS2) sample showed greater microbial diversity compared to the sprouted sample. These included *Bacillus spp*. Escherichia coli. Isolates obtained from the control (CTS) E*nterobacter aerogenes*, Lactic acid bacteria were isolated from all samples sprouted, unsprouted and control (SPS1, USPS2, and CTS). *Lactobacillus plantarum* and *Pediococcus pentosaceus*, which are known to play a significant role in cereal fermentation by producing organic acids that enhance product safety, shelf stability, and sensory quality.

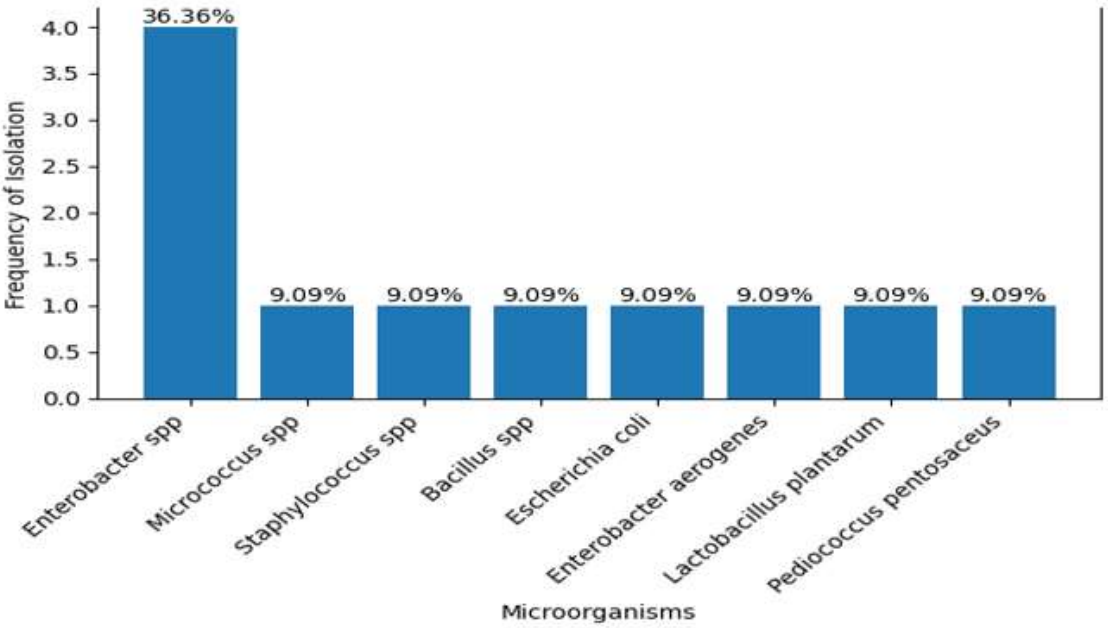

Fig 1.2: Prevalence of Microorganisms Isolated from Fermented Ogi Samples (SPS1, UPS2 and CTS)

3. 3 Microbiological Quality

The dominance of lactic acid bacteria in SPS1 is consistent with Mokoena (2020), who identified LAB as the principal microorganisms responsible for acid production, pathogen inhibition, and overall safety of fermented cereal foods. This observation also agrees with Achi and Asamudo (2021), who reported that traditional Nigerian fermentations are characterized by LAB-dominated ecosystems that enhance preservation and nutritional value. The detection of yeasts alongside LAB aligns with Teniola and Odunfa (2019), who found that yeasts coexist with LAB in cereal fermentations and contribute to flavour development and fermentation efficiency.

The higher occurrence of opportunistic organisms in USPS2 supports the findings of Nwachukwu and Odu (2020), who reported that inadequate fermentation permits survival of contaminating bacteria due to insufficient acidification. Likewise, Lau *et al*. (2021) emphasized that failure to achieve rapid pH reduction in fermented foods increases the risk of Enterobacteriaceae contamination, which explains the poorer microbial quality of USPS2. Furthermore, the improved microbial safety observed in SPS1 agrees with Akinyemi and Jimoh (2023), who demonstrated that sprouting combined with fermentation enhances LAB dominance and suppresses undesirable microorganisms in sorghum Ogi.

3.4 Combined Effect of Sprouting and Fermentation

The synergistic improvement observed when sprouting was combined with fermentation in this study is in alignment with Adebo and Njobeh (2022), who concluded that germination followed by fermentation significantly enhances microbial safety, and functional properties of African cereal foods. Similarly, Jideani *et al*. (2021) highlighted that such processing strategies are essential for improving the nutritional quality of cereal-based complementary foods in developing countries, reinforcing the relevance of SPS1 as a superior product.

4. CONCLUSION

The sprouted sample (SPS1) exhibited improved quality attributes such as faster acidification, higher lactic acid bacteria (LAB) counts, and better fermentation performance. In contrast, the unsprouted sample (USPS2) showed relatively higher pH and lower fermentation efficiency. The combination of sprouting and fermentation enhanced microbial quality, making sprouted sorghum Ogi more suitable for infant feeding and potential commercial application.

4.1 Recommendations

1. Traditional processing methods should emphasize sprouting and controlled fermentation to enhance nutritional quality and microbial safety.
2. Post-fermentation drying and hygienic storage are essential to maintain product stability and minimize contamination.
3. Future research should explore the use of LAB starter cultures to standardize fermentation and optimize sensory qualities.
4. Studies should also assess functional health properties, such as probiotic activity, antioxidant

capacity, and prebiotic potential, of fermented Ogi.

5. Training programs for local food processors on safe fermentation practices should be promoted to improve public health outcomes.

Disclosure of Conflict of Interest

There is no conflict of interest, all authors agree to the subject.

REFERENCES

Achi, O. K., and Asamudo**, N. U.** (2021)**.** Microorganisms involved in fermentation of Nigerian indigenous foods. In O. A. Adebayo and A. S. Bamigboye (Eds.), Microbiology of traditional African fermented foods (pp. 65–87). *Springer.* https://doi.org/10.1007/978-3-030-67306-2_4.

Adebiyi**, J.** A., Obadina, A. O., Adebo, O. A., and Kayitesi, E. (2022). Fermentation of cereals: Impacts on nutritional quality, bioactive compounds and functional properties. *Fermentation,* 8(2), 63. https://doi.org/10.3390/fermentation8020063

Adebo, O. A., and Njobeh, P. B. (2022). Cereal fermentation and nutritional improvement: Advances in African foods. *Food Research International,* 156, 111127.

Adelekan, O., Akinyemi, O., and Jimoh, S. (2022). Comparative analysis of sprouted versus unsprouted sorghum Ogi: Microbial, physicochemical, and sensory properties. *Food Science and Nutrition,* 10(5), 1234–1248.

Akinyemi, O., and Jimoh, S. (2023). Sprouting and fermentation effects on sorghum Ogi: Microbial safety and nutritional profile. *Journal of Cereal Science*, 110, 103547.

Hafezi, A., and Khamar, Z. (2024). The method and analysis of some biochemical tests commonly used for microbial identification: *A review. Comprehensive Health and Biomedical Studies,* 3(2), e160199. https://doi.org/10.5812/chbs-160199

Jideani, V. A., Kayitesi, E., and Ndungu, J. (2021). Fortification of cereal porridges for infant nutrition: Approaches and challenges. *Food and Nutrition Research,* 65, 1–15. https://doi.org/10.29219/fnr.v65.6141

Lau, K., Leung, W., and Wong, M. (2021). Microbial safety in fermented cereals: Challenges and perspectives. Food Control, 130, 108378.

Martin, J. G. P. (2022). Methods applied in studies about fermented foods. *Journal of Microbiology and Experimentation*, 10(2),59–63. https://doi.org/10.15406/jmen.2022.10.00354

Mokoena, M. P. (2020). Lactic acid bacteria in cereal-based fermented foods and beverages. *Frontiers in Microbiology*, 11, 121. https://doi.org/10.3389/fmicb.2020.0012

Nwachukwu, E., and Odu, N. (2020). Microbial contamination and safety issues in Ogi. *African Journal of Microbiology Research*, 14(5), 215–225.

Obasi, B.C, Sunday, B. A & T.C Brown (2019) Enumeration of microbial Quality of Yoghurt Incorporated with moringa Oleifera seed flour during storage. *FUW. Trends in Science and Technology Journal* volume. 4(3):703-706.

Ogodo, A. C., Ugbogu, O. C., Onyeagba, R. A., and Okereke, H. C. (2019). Microbiological quality, proximate composition and in vitro starch/protein digestibility of *Sorghum bicolor* flour fermented with lactic acid bacteria consortia. *Chemical and Biological Technologies in Agriculture,* 6, 7. https://doi.org/10.1186/s40538-019-0145-4

Okoye, F., and Onyekwere, E. (2021). Traditional production and nutritional value of Ogi in Nigeria. *Journal of Food Science and Nutrition*, 9(3), 101–115.

Omemu, A. M., Oyewole, O. B., and Nsa, I. Y. (2020). Microbiological and nutritional assessment of Ogi during fermentation. *Scientific African,* 9, e00510. https://doi.org/10.1016/j.sciaf.2020.e00510

Rodríguez-Pérez, C., Hernández-Mendoza, A., and Chaves-López, C. (2021). Sprouting effects on cereals: Nutritional and microbial implications. *Food Research International,* 143, 110249.

Tamang, J. P., Watanabe, K., and Holzapfel, W. (2020). Review: Fermented foods and beverages of the world. *Frontiers in Microbiology*, 11, 1516.

Teniola, O., and Odunfa, S. (2019). Yeasts in African cereal fermentations. *Journal of Applied Microbiology*, 127(2), 353–367.

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