



RESEARCH ARTICLE

Microbial evaluation of cooked fufu sold in some major markets in Owo metropolis, Ondo state, Nigeria

Ogunoye, O. A^{*1}., Adesina, J. M²., Ayodeji, M. S¹., Johnson, T. A²., Bolarinwa, S. A²., Okpewho, O. P³., and Goodluck, T. O²

¹Department of Pest Management Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

²Department of Crop Production Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

³Department of Botany, Delta State, Abraka, Delta State, Nigeria.

Edited by:

Dr. M. Karthik,
TNAU, Coimbatore, Tamil Nadu, India.

Reviewed by:

Dr. A. Bansa,
Federal Polytechnic Bida, Niger State, Nigeria.

Article history:

Received: November 19, 2023

Accepted: December 21, 2023

Published: December 29, 2023

Citation:

Ogunoye, O. A., Adesina, J. M., Ayodeji, M. S., Johnson, T. A., Bolarinwa, S. A., Okpewho, O. P., & Goodluck, T. O. (2023). Microbial evaluation of cooked fufu sold in some major markets in Owo metropolis, Ondo state, Nigeria. *Journal of Current Opinion in Crop Science*, 4(4), 185-189.

<https://doi.org/10.62773/jcoocs.v4i4.220>

*Corresponding author e-mail address:
ooda4life@rocketmail.com (O. A. Ogunoye).

ABSTRACT

Fufu (Cassava dough-like food) is one of Nigeria's most consumed staple foods, particularly in the Southern parts of the country. This study aims to detect and quantify the microorganisms in cooked fufu sold in major Owo, Ondo State marketplaces. Freshly cooked fufu samples of about 50/gram wrapped in nylon were aseptically collected from sellers in three major Owo markets and transported to the Federal University of Technology, Akure (FUTA) Crop, Soil, and Pest Management Department lab for analysis. For bacteria, Nutrient Agar (NA) plates were incubated at 37+2°C for 24 hours, whereas PDA plates for yeast and mould were incubated at 27+2°C for 48 hours. Count and record the colonies generating spores (cfu/g) from viable bacterium cells and fungal spores per gram of each fufu sample after incubation. Purified cultures of each isolate were obtained through subcultures and stored at 4°C for biochemical testing. Cooked fufu samples found mostly lactic acid bacteria like *Lactobacillus plantarum*, *L. fermentum*, *L. brevis*, *Leuconostoc mesenteroides*, *Streptococcus thermophiles*, *S. mutans*, *Pediococcus cerevisiae*, *Staphylococcus hominis*, *Bacillus pumilus*, *acidophilus*, *L. lactis*, *Micrococcus spp.*, *B. subtilis*, *Diplococcus spp.*, *S. epidermidis*, and *Bifidobacterium* and two yeasts include *Saccharomyces cerevisiae* and *Zygosaccharomyces spp.* Some main markets in Owo metropolis sold cooked fufu samples with bacterial loads ranging from 0.2 to 2.3 × 10⁷ CFU/g, and yeast loads from 1.6 to 4.55 × 10⁷ CFU/g. Good hygiene can increase the safety and quality of cooked fufu sold at Owo main markets and lower the danger of food-borne illnesses.

Keywords: bacteria, fufu, yeast, microbes, microbial load.

INTRODUCTION

Food being an essential part of human life plays functions such as the production of heat and energy; building, replacement, and mending of body tissues; protection against diseases, and body processes regulation. Since foods prepared or eaten outside the home are less expensive, easily accessible, and affordable by low-income earners; a lot of Nigerians treasure fermented foods as part of their dietary constituents (Tawiah et al., 2019). Fufu (Cassava dough-like food) is one of Nigeria's most consumed staple foods, particularly in the Southern parts of the country. Fufu being a product of fermented Cassava tubers is estimated to afford about 70% of the everyday calorie requirements of around 50 million Nigerians (Adebayo et al., 2014; Adegbehingbe et al., 2019; Tawiah et al., 2019). Cooked fufu can be in the form of a wet mash or processed to dry powder form that can be stirred in boiling water or cooked and pounded to form a dough. The process of fufu preparation differs from place to place and this greatly influences the finished product's quality. The cooked fufu can be eaten hot or cold and has a lifespan of about 3 days (Odom et al., 2012; Adegbehingbe et al., 2019). It is usually sold in transparent nylon bags or sold in restaurants and taken with favorite soup. Fufu is ranked next to garri among the fermented cassava products in the southern part of Nigeria (Adegbehingbe et al., 2019; Dike-Ndudim et al., 2022).

Regardless of these advantages, fufu is usually highly contaminated or confronted with a greater threat of contamination. Several countries' surveillance and monitoring team shows that food-borne diseases is increasing all over the world. Fufu, like other food products, has the potential to encourage the growth of both non-pathogenic and pathogenic organisms (Odom et al., 2012; Dike-Ndudim et al., 2022). These microbes may be introduced directly via; poor personal hygiene, inadequately sterile and cleaned cooking utensils and equipment (such as scoop [igbako in Yoruba], mortars, and pestles), storage and cooking temperatures, flies and other insect pests perching on uncovered parts and hawking; are sources and practices that can introduce contaminants to fufu. These could lead to changes in quality, taste, form, and smell, and a decrease in the satisfactoriness and safety of the product (Odom et al., 2012; Adegbehingbe et al., 2019; Tawiah et al., 2019). It was the aforementioned concerns coupled with the prevalence of food-poisoning reports in the metropolis that necessitated this research.

Therefore, the objectives of this study were to isolate and identify the microorganisms present in cooked fufu sold in some major markets in Owo, Ondo State; to determine the microbial load and qualities of "fufu" sold in each market.

MATERIALS AND METHODS

Study area: The study was Owo in Ondo State, Nigeria. It has a total population of 222,262 as of the last census conducted in 2016 and is located on latitude 07°11'46"N, longitude of 05°35'11"E.

Samples collection

Freshly-cooked fufu samples of about 50/gram each rapped in nylon were collected aseptically from the sellers in three (3) different major markets (Oja Oba, Oja Ikoko, and Ehinogbe market) in Owo, Ondo State, Nigeria. It was brought to the laboratory of the Crop, Soil, and Pest Management Department at the Federal University of Technology, Akure (FUTA) for analysis.

Microbiological analysis

About 1 gram of cooked fufu samples was aseptically transferred into the sterile 20 cm² beaker, 9 ml of sterile distilled water, and thoroughly mixed with glass rod to form a homogeneous suspension or aliquote. 1 ml of the aliquot of the sample was pipetted into a sterile test tube containing 9 ml of distilled water. Each suspension was serially diluted in another 8 sets of test tubes each to a dilution ratio of 10⁻⁸ about 0.1 ml portion of the sample aliquots from the 6 and 7 dilution factors were aseptically pipetted separately into different sterile Petri dishes and thoroughly mixed with 20 ml of the cool molten Agar medium. The plates were gently swirled for even distribution of the sample aliquots with the media, allowed to set, and incubated at optimum temperature.

For bacteria, Nutrient Agar (NA) plates were incubated at 37±2°C for 24 hours, whereas PDA plates for yeast and mould were incubated at 27±2°C for 48 hours. Count and record the colonies generating spores (cfu/g) from viable bacterium cells and fungal spores per gramme of each fufu sample after incubation. Purified cultures of each isolate were obtained through subcultures and stored at 4°C for biochemical testing. Physiological and biochemical tests (Gram's reaction, Catalase test, Motility test, oxygen-relation, Spore staining, Fermentation of sugars (carbohydrates), Indole production, Oxidation-fermentation (O/F) Test, Methyl Red Test, Voces-Proskauer Test, Starch

Hydrolysis, etc.) were used to characterise and identify bacteria isolates. Cultural characteristics were stained with cotton blue lactophenol solution and viewed under a low-power objective lens for fungal isolates (Odom et al., 2012; Adebayo et al., 2014; Adegbehingbe et al., 2019).

RESULTS

The microorganisms isolated from the cooked fufu samples were predominantly lactic acid bacteria and yeasts. Bacteria isolated are *Lactobacillus plantarum*, *Lactobacillus fermentum*, *Lactobacillus brevis*, *Leuconostoc mesenteroides*, *Streptococcus thermophiles*, *Pediococcus cerevisiae*, *Streptococcus mutans*, *Staphylococcus hominis*, *Bacillus pumilus*, *Lactobacillus acidophilus*, *Leuconostoc lactis*, *Micrococcus* spp., *Bacillus subtilis*, *Diplococcus* sp, *Staphylococcus epidermidis*, and *Bifidobacteria* spp.; while the yeasts include *Saccharomyces cerevisiae* and *Zygosaccharomyces* spp. The highest-occurring

genera of bacteria include *Lactobacillus*, *Bacillus*, *Staphylococcus*, *Streptococcus*, *Leuconostoc*, and *Bifidobacterium* while the least occurring genera are *Micrococcus* and *Diplococcus*. *Saccharomyces* genera occurs most frequently in yeast while the least is *Zygosaccharomyces* spp. However, *Lactobacillus* and *Saccharomyces* have the most occurring species for bacteria and yeasts respectively (Table 1). Ehinogbe market has the highest number of isolates as compared to other locations.

The highest average bacterial count of 2.21×10^7 cfu/g was detected in samples from the Oba market while the least (0.22×10^7 cfu/g) was observed in samples from Ehinogbe market (Figure 1). Moreover, the highest average yeast count of 4.25×10^7 cfu/g was obtained in cooked fufu samples from Oba market, followed by samples from Ikoko market (2×10^7 cfu/g); with the least (1.62×10^7 cfu/g) coming from Ehinogbe market.

Table 1. Isolated and identified micro-organisms (bacteria and yeast)

Location	Bacteria	Yeast
A	<i>Lactobacillus plantarum</i> , <i>Lactobacillus fermentum</i> , <i>Lactobacillus brevis</i> , <i>Leuconostoc mesenteroides</i> , <i>Bifidobacterium</i> spp, <i>Streptococcus thermophilus</i>	<i>Sacharomyces cerevisiae</i>
B	<i>Lactobacillus brevis</i> , <i>Lactobacillus fermentum</i> , <i>Pediococcus cerevisiae</i> , <i>Streptococcus mutans</i> , <i>Staphylococcus hominis</i> , <i>Bacillus pumilus</i>	<i>Saccharomyces cerevisiae</i> <i>Zygosaccharomyces</i> spp.
C	<i>Lactobacillus acidophilus</i> , <i>Leuconostoc lactis</i> , <i>Micrococcus</i> spp., <i>Bacillus subtilis</i> , <i>Diplococcus</i> sp, <i>Staphylococcus epidermidis</i> , <i>Bifidobacteria</i> spp., <i>Streptococcus thermophiles</i>	<i>Saccharomyces cerevisiae</i>

Note: A, Oba market; B, Koko market; C Ehinogbe market

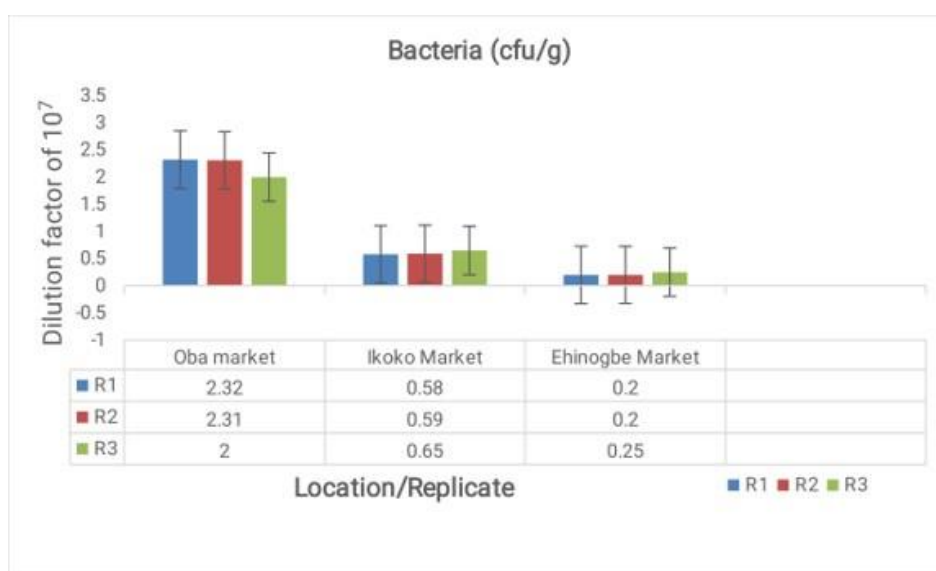


Figure 1. Shows the microbial count of Bacteria (cfu/g) present in the samples at a dilution factor of 10^{-7}

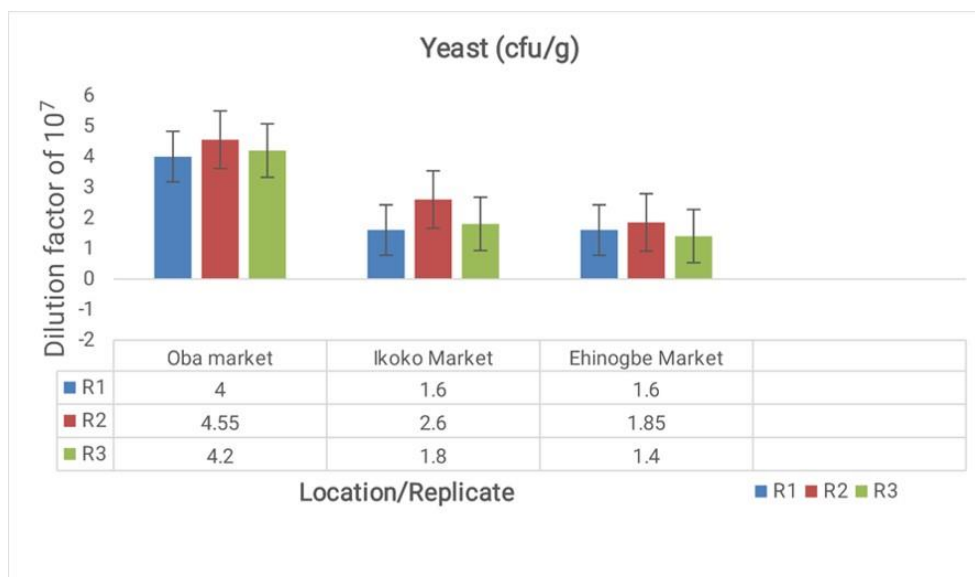


Figure 2. Microbial count of Yeast (cfu/g) present in the samples at a dilution factor of 10^{-7} .

DISCUSSION

The study on microbial evaluation was carried out to detect the microorganisms present in, and to determine the microbial load of the cooked fufu sold in some major markets in Owo metropolis. A total number of 20 bacteria strains and 4 strains of yeasts belonging to 9 and 2 genera respectively were identified. The number of bacteria and yeast isolates identified in this study is higher than that reported by Adebayo et al. (2014); Adegbehingbe et al. (2019) and Dike-Ndudim et al. (2022). The microorganisms identified from the cooked fufu samples from all the markets included: *Lactobacillus plantarum*, *Lactobacillus fermentum*, *Lactobacillus brevis*, *Leuconostoc mesenteroides*, *Streptococcus thermophiles*, *Pediococcus cerevisiae*, *Streptococcus mutans*, *Staphylococcus hominis*, *Bacillus pumilus*, *Lactobacillus acidophilus*, *Leuconostoc lactis*, *Micrococcus* spp., *Bacillus subtilis*, *Diplococcus* sp, *Staphylococcus epidermidis*, and *Bifidobacteria* spp., *Saccharomyces cerevisiae*, and *Zygosaccharomyces* spp (Odom et al., 2012; Adebayo et al., 2014; Adegbehingbe et al., 2019; Dike-Ndudim et al., 2022).

Lactobacillus, *Streptococcus*, and *Saccharomyces* were isolated from all markets, and similar findings have been reported by investigators working on different cassava products from Nigeria (Adetunji et al., 2017; Adegbehingbe, 2019; Dike-Ndudim, 2022). They are frequently linked to market workers' cleanliness (Adetunji et al., 2017). Due to mixing, kneading, and ecological agent exposure of the mortar and pestle before pounding fufu, moulding, and hawking, microbial contamination is significant.

Washing mortar with dirty hands can also contaminate fufu (Odom et al., 2012; Adetunji, 2017; Ewanfo, 2017; Tawiah, 2019).

Some main markets in Owo metropolis sold cooked fufu samples with bacterial loads ranging from 0.2 to 2.3×10^7 CFU/g, and yeast loads from 1.6 to 4.55×10^7 CFU/g. Market A had the largest bacterial load (2.3×10^7 CFU/g) and market C had the lowest (0.2×10^7 CFU/g). The bacterial load in this investigation was larger than that reported by Adebayo-Oyetero et al. (2013), who found 8.1×10^6 CFU/g in fermented cassava flour samples from various markets. Additionally, the yeast count in this study was higher than the fungus and yeast count (3.5×10^6 CFU/g) found in fermented cassava food products sold in Oyo town, Oyo State, Nigeria (Oyeyiola et al., 2014).

CONCLUSION

Based on the results of the microbial analysis of cooked fufu samples in the Owo metropolis, it can be concluded that there is a likelihood of post-contamination resulting from poor handling during preparation, kneading, moulding, and hawking; which may make the samples generally unsafe for consumption. By applying good hygienic practices, the safety and quality of cooked fufu sold in Owo major markets can be improved; and the risk of food-borne ailments associated with its consumption can be reduced. This study has thus given insight into the quality of cooked fufu sold in Owo, Ondo State, Nigeria.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interest.

AUTHORS' CONTRIBUTIONS

The work was carried out in collaboration between all authors.

REFERENCES

- Adebayo, C. O., Aderiye, B. I., & Akpor, O. B. (2014). Assessment of bacterial and fungal spoilage of some Nigerian fermented and unfermented foods. *African Journal of Food Science*, 8(3), 140-147. Doi: 10.5897/AJFS2013.1059
- Adebayo-Oyetoro, A. O., Oyewole, O. B., Obadina, A. O., & Omemu, M. A. (2013). Microbiological safety assessment of fermented cassava flour "lafun" available in Ogun and Oyo States of Nigeria. *International Journal of Food Science*, 1, 1-5.
- Adegbhingbe, K. T., Adeleke, B. S., Bello, M. O., Adejoro, D. O., Ojo, O. R. and Fasanmi, T. T. (2019). Microbiological assessment of fufu produced from Akoko area of Ondo State. *International Journal of Research and Scientific Innovation*, 6(6), 85-91.
- Adetunji, C. O., Akande, S. A., Oladipo, A. K., Salawu, R. A., & Onyegbula, A. F. (2017). Determination of the microbiological quality and proximate composition of fermented cassava food products sold in Ilorin-west local government area, Nigeria. *Ruhuna Journal of Science*, 8, 76-89.
- Dike-Ndudim, J. N., Nwachukwu, R. C., Amah, H. C., Ndubueze, C. W., & Ndudim, V. C. (2022). Determination of starter cultures (organisms) in the fermentation of cassava (*Manihot esculenta*), used for Fufu production. *Asian Journal of Biology*, 14(3), 33-44.
- Ewanfo, I. J., James, I. M., & Ugueri, U. (2017). Microbiological Quality of Commercially Ready-to-Eat Fufu Sold in Benin City, Nigeria. *American Journal of Food, Nutrition and Health*, 2(5), 26-30.
- Odom, T. C., Nwanekezi, E. C., Udensi, E. A., Ogbuji, C. A., Ihemanna, C. A., Emecheta, R. O., & Aji, R. U. (2012). Biochemical qualities of cassava fufu sold in Imo and Abia States of Nigeria. *Global Advanced Research Journal of Environmental Science and Toxicology*, 1(7), 178-182.
- Odom, T. C., Udensi, E. A. and Nwanekezi, E. C. (2012). Microbiological Qualities of Hawked Retted Cassava Fufu in Aba Metropolis of Abia State. *Nigerian Food Journal Official Journal of Nigerian Institute of Food Science and Technology*, 30(1), 53 - 58.
- Oyeyiola, G. P., Oyenyi, O. R., Arekemase, M. O., & Ahmed, R. N. (2014). A comparative study on the microbiological and nutritional properties of stored chips and flours. *World Journal of Biological Research*, 6(2), 1-6.
- Tawiah1, J., Annoh, P. O., & Darkwah, G. A. (2019). Sources of Microbial Contamination of Fufu Production in Ghana: Selected Licensed and Non-licensed Chop Bars in Cape Coast Metropolis. *American Journal of Food Science and Health*, 5(3), 112-125.



Copyright: © 2023 by authors. This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.