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Assessment of Microbiological Quality of *Fura Da Nono* Produced in Kebbi State, Nigeria

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Abstract

Fura da Nono is a nutritious and refreshing drink made from fermented milk and ground millet grains. In this study, the microbiology of traditional and small-scale industrial production of *Fura da Nono* in Birnin Kebbi and Jega was investigated. Samples of *Fura da Nono* were collected from Birnin Kebbi emir's palace, Mini Factory JEGA and a local hawker in Jega. Food borne and spoilage pathogens were identified based on their colonial morphology, gram staining reaction and series of biochemical tests. Viable colony counts, coliform test, fungal analysis and pH test were also conducted. The results revealed the highest average count of 1.25×10^8 cfu/ml in the samples collected from local hawker while Birnin Kebbi emir's palace had the lowest average count of 8.3×10^5 cfu/ml. The bacteria identified in *Fura da Nono* were *Staphylococcus aureus*, *Salmonella spp, Lactobacillus plantarum* and *Escherichia coli*. The fungi isolated were *Aspergillus flavus*, *Aspergillus niger* and *Saccharomyces cerevisiae*. The highest pH (6.8) was recorded in the sample obtained from local hawker and the lowest (3.1) from the Birnin Kebbi emir's palace. The study showed the presence of food borne and spoilage pathogens in *Fura da Nono* which indicates poor hygienic practices during production. Therefore, in order to produce commercial *Furada Nono* either at large or small-scale quantity, it is necessary to improve the acceptability, microbiological stability and hygiene of the product.

Keywords: *Fura da Nono*, Food borne, Spoilage, Pathogens, Hygiene, Production

1. Introduction

Fura da Nono (millet cereal and fermented milk) is a highly nutritious beverage consumed often in northern Nigeria. The nutritional value of the ingredients involved in mashed millet (*Fura*) includes carbohydrate essential for energy and that of milk or yoghurt (Nono) includes protein that is essential for growth and body building. Traditionally, *Fura da Nono* is usually prepared by mashing millet grains into powdery form and mixing the powdered millet with hot water to make dough, allowing the dough to cool and solidify and finally mixing the mashed millet (*Fura*) with fermented milk (*Nono*). *Fura* is a porridge typically made from cereal such as millet or rice [1]. It is a local food commonly produced in northern Nigeria, Ghana and other parts of West African sub- region [2]. It is prepared by grinding millet grains into powder in combination with spices such as pepper, which is then made into small ball-like dough by adding little amount of water and compressing between the two palms. The ball-like dough is then cooked in boiling water for approximately one hour [2,3]. The boiled ball-like dough can be served by blending it with *Nono* and water. Alternatively, the dough can be pounded with little amount of water and prepared into a semi solid dough which again can be blended with water, milk, sugar and additional spices. *Fura da Nono* is a complete nourishing diet serving as a good source of nutrients, particularly protein and energy. Its characteristic sour taste is a special thirst quencher to the consumers.

The preparation of *Fura da Nono* from grain grinding to blending of *Fura* with milk and other ingredients, is by and large a traditional process passed on from one generation to another rather than a science-based procedure. Thus, the process is a simple process, which typically employs traditionally-available utensils such as calabash, mortar and pestle under limited hygiene practice or no hygiene precautions at all. In addition, environmental parameters such as temperature, relative humidity and poor air quality could as well negatively affect the quality of *Fura da Nono*. Moreover, poor hygienic condition under which *Fura da Nono* is sold could make the product vulnerable to microbial contamination. Similar to the fermentation of most locally-produced fermented foods, the process of *Fura da Nono* fermentation is not only uncontrolled but unmonitored, particularly with respect to the duration and product quality. Thus, production of undesirable fermentation by-products and contaminations are not checked. Despite wide acceptance *Fura da Nono* has enjoyed and the concerns about the crude processing and post-processing procedures, not much is known about the microbiological quality of the product in the study area.

The product is used as food, refreshing drink and weaning food for infants. *Fura da Nono* is in high

demand, especially in the month of July to November [4]. This leads to more producers and marketers of the product. The poor handling of *Fura da Nono* during processing and lack of proper food safety operations by most *Fura da Nono* producers and marketers results in products of variable quality lacking uniform standard. The mashed millet meal (*Fura*) is molded into balls by hand during its production; the hands of these producers could be a source of contamination.

Shehu and Adesiyun [5] reported that in order to increase the volume and improve colour of *Nono*, the female hawkers prior to sale, engage in fraudulent act of adding stream water and a milky white supernatant of water-soaked baobab tree seeds. This act could further lead to the contamination and spoilage of this product. Therefore, this study is aimed at determining the microbiological quality of *Fura da Nono* produced in Kebbi state.

2. Materials and Methods

2.1 Study location

This study was carried out in Birnin Kebbi metropolis and Jega metropolis of Kebbi State. Birnin Kebbi is located between 12.45 latitude and longitude 4.20. It is situated at 234 meters above the sea level. Jega is located between 12.22 latitude and longitude 4.38 and is situated at elevation 214 meters above sea level.

2.2 Sample Collection

Fura da Nono samples were collected from three different manufacturing brands (BLB, Birnin Kebbi Emirs palace and local *Fura* sold in jega by female hawkers). Three samples each were collected from all the brands which make a total of nine for precision. These samples were collected in sterile large screw capped bottles and selection was done at random. For each brand, three bottles of the samples were collected in order to analyze and get the average count of the microorganisms. The sterile sampling bottles were also labeled according to their contents and date.

2.3 Determination of pH

The pH of the samples was measured and recorded using pH meter by calibrating with the appropriate buffer solutions of basic, acidic and neutral pH range and electrode was put into the sample and the pH was recorded as it read on the meter

2.4 Serial dilution

Ten milliliters of each of the *Fura da Nono* sample was weighed and diluted in 90 ml of sterile water and mixed thoroughly to make a homogenate. The analysis was carried out in 3 replicates for all the samples. Serial dilution was done by pipetting 1ml of the *Fura* homogenate into a test tube with 9 ml of distilled water. From the first dilution, 1 ml was transferred to second dilution tube containing 9 ml of diluents. This was repeated using a third, fourth, fifth and sixth as the maximum desired serial dilution.

2.5 Culture

Twenty milliliters of each of the molten prepared nutrient agar (NA) and potato dextrose agar (PDA) were poured into their respective plates using pour plate method. 0.1 ml of the prepared serial diluted sample from 10^3 and 10^5 pipette into sterile Petri plates marked with date, sample type and media name. It was then mixed by rotating clockwise, anticlockwise gently to avoid spillage. About 20 ml of same media was poured into sterile plate without any sample; this represented negative control. The plates were finally allowed to solidify and were incubated at 37 ℃ for 24 h for the bacterial growth, while fungal growth incubation was done at room temperature for 4-6 days.

2.6 Sub-culture

Subculture was done by picking a distinct colony using a wire loop and streaking it into a freshly prepared solidified nutrient agar and incubating at 37 ℃ for 24 h. Fungi subculture was done by cutting the edge of the fungi growth from the plate together with a piece of agar and inserting it at the middle of a new freshly prepared solidified plate of potato dextrose agar and incubated at room temperature for 3-4 days.

2.7 Identification

Bacterial isolates were identified based on colonial morphology, Gram staining reactions and series of biochemical tests while fungal isolates were identified based on lacto-phenol staining reaction, nature of their hyphae and characteristic color on the media.

2.8 Data Collection

Prior to sample collection, a questionnaire was administered to the *Fura da Nono* producers and answers to some of the challenging and critical hygienic practices to the manufacturing were sought.

3. Results and Discussion

3.1 Results

The mean average pH of *Fura da Nono* of the three sampling locations (Jega, Birnin Kebbi Emir's palace and local hawker) measured in three experiments with three replicates at each sampling time are presented in Figure 3.1. Bacterial and Fungal isolates in three experiments with three replicates at each sampling are presented in Tables 3.1 and 3.2.

3.2 Discussion

Fura da Nono is one of the oldest and commonly consumed local foods in Africa, especially in Hausa land, but till date little work has been carried out on the microbiology of *Fura da Nono*. The results of microorganisms isolated showed that there was presence of spoilage and food-borne infectious organisms. The consumption of this product will expose consumers to certain food-borne illness and other related diseases. The result from the mean microbial count also indicated that all samples of the products after total microbial load count were out of standard range of microbial count (<100cfu/g). The pH of the samples recorded ranged between 6.8-3.1 which indicates that all the samples were acidic due to post

production fermentation even right from the stage of millet grain soaking. The implication of acidic pH in the samples was what at some point limited the growth of verse non acidophilic bacteria.

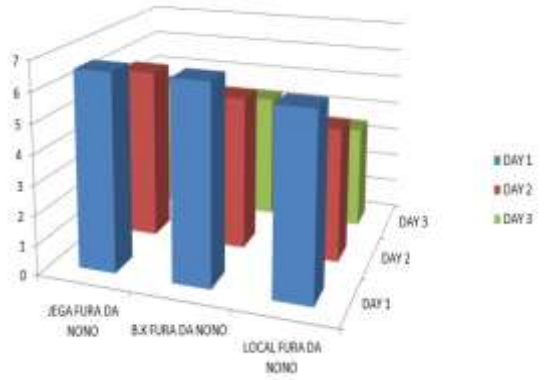

Figure 3.1: The Mean Average pH of Jega, Birnin Kebbi and Local *FuraDa Nono* Measured in Three Experiments with Three Replicates at Each Sampling Time

Table 3.1: Bacterial Isolates in Three Experiments with Three Replicates at Each Sampling.

Sample	Isolate	Identified organism
Birnin Kebbi	B.K Isolate 1	*Staphylococcus aureus*
	B.K Isolate 2	*Salmonella spp*
Jega *Fura da Nono*	Jega Isolate 1	*Bacillus cereus*
	Jega Isolate 2	*Escherichia coli*
	Jega Isolate 3	*Lactobacillus plantarum*
	Jega Isolate 4	*Lactobacillus lactis*
	Jega Isolate 5	*Enterobacter aerogens*
	Jega Isolate 6	*Staphylococcus aureus*
	Jega Isolate 7	*Staphylococcus epidermidis*
Local *Fura da Nono*	LC Isolate 1	*Staphylococcus aureus*
	LC Isolate 2	*Streptococcus lactis*
	LC Isolate 3	*Escherichia coli*
	LC Isolate 4	*Salmonella spp*

The bacteria found associated with all the *Fura da Nono* include *Bacillus cereus*, *Lactobacillus spp.*, *Staphylococcus aureus*, which have previously been implicated in food poisoning outbreak. Some of these organisms as reported by [6] can be isolated under low pH medium. Results of this comparative analysis indicate that JEGA *Fura da Nono* had the presence of *Staphylococcus aureus*, which have previously been implicated with food poisoning outbreak in some products [6]. The presence of *Enterobacter species* in the JEGA samples and the coliform test indicate that they contained certain enterobacteriaceae. This might probably be due to contamination of water used in the processing.

Table 3.2: Fungal Isolates in Three Experiments with Three Replicates at Each Sampling

Sample	Isolate	Identified organism
Birnin Kebbi	B.K Isolate 1	*Aspergillus flavus*
	B.K Isolate 2	*Aspergillus niger*
Jega *Fura da Nono*	Jega Isolate 1	*Saccharomyces cerevisae*
	Jega Isolate 2	*Aspergillus fumigates*
	Jega Isolate 3	*Aspergillus niger*
Local *Fura da Nono*	LC Isolate 1	*Aspergillus niger*
	LC Isolate 2	*Aspergillus flavus*
	LC Isolate 3	*Saccharomyces cerevisae*

However, *Lactobacillus plantarum* and other *Lactobacillus species* isolated from BLB samples are probably due to sugar (sucrose) and also the natural composition of grains used in *Fura* production which serves as a nutritional constituent of lactic acid bacteria and also the milk (*Nono*) used in the preparation which brings the pH down and favors their growth. *Staphylococcus epidermidis* and *S. aureus* isolated are probably due to poor handling by manufacturers using their contaminated bare hands. The fungi isolated in the sample were *Aspergillus niger*, *Saccharomyces cerevisae* and *Aspergillus flavus*.

The Birnin Kebbi *Furada Nono* sold at Emir's palace was found contaminated with the least bacterial count compared to the other samples. This is probably due to their manufacturing procedure and safety keeping during the production of *Fura da Nono*. Minimum average bacteria count of sample was 8.53×10^5 while the highest was 7.60×10^7 which is still a very high microbial load count anyway, but yet the least among this three compared samples (BLB, BK, and Local hawk *Fura da Nono* in Jega) the bacteria isolated were *S. aureus* and *Salmonella spp*, the presence of *Staphylococcus aureus* in the sample can cause diseases in humans [7]. It is responsible for a long list of different diseases such as folliculitis, furuncles, carbuncles, scalded skin syndrome, impetigo, pneumonia, toxic shock syndrome and food poisoning [8]. The fungi isolated were *Aspergillus flavus* and *Aspergillus niger*. *Aspergillus flavus* presence in the sample could make it harmful for consumption, because *A. flavus* produces some strains known as aflatoxin which is linked to a number of human health conditions including cancer.

The local *Fura da Nono* samples sold and hawked in Jega were found contaminated with the highest bacterial load among all the samples analysed. This

high bacteria count indicates a very poor sanitary practice and safety precaution during production and sale of the product which include processing of the sample with unsafe drinking water as reported in the previously administered questionnaire, lack of proper boiling and mashing of millet sale of the product in an open market contaminated vicinity, sale of the product in an unclean drinking bowl and spoon traditionally known as "luddai" etc. It was also found contaminated with *E. coli*. As such it is very hazardous for consumption. The presence of *E. coli* is probably due to the water used, which is unhygienic as reported in questionnaire administered.

Salmonella spp. was isolated in some of the samples. This give a safety signal in ensuring a safe product, because it is a strict pathogen and has no habitat other than human or animal body. The source of human infection is through faecally contaminated food or water. It can cause any of these three types of infections. Bacterial food poisoning, enteric fever and systemic fever (septicaemia) [9]. The fungi isolated in the sample were *Aspergillus niger*, *Aspergillus flavus* and *Saccharomyces cerevisae*. The coliform presumptive test presumed that all the samples were found contaminated with the coliforms and after the confirmatory *Enterobacter aerogens* and *E. coli* were the dominant isolated organisms.

4. Conclusion

From the results of this research, it can be concluded that locally prepared *Fura da Nono* in Jega, Birnin Kebbi and mini factory in Jega contains potential pathogenic and spoilage bacteria. Their presence indicates unhygienic handling during production. The B.K and local *Fura* were also found contaminated with fungi that secrete toxin in food such as aflatoxin hence, it can be concluded that their consumption could be of negative impact to human health.

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