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Bacteriological quality of commercially prepared fermented Ogi (Akamu) sold in Some Parts of Afikpo Area in Ebonyi State

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Abstract

In this study ogi (akamu) prepared from fermented maize sold in Enohia, Afikpo and Unwana were subjected to bacteriological test together with the laboratory prepared ogi for bacterial quality using the standard microbiological method. The commercial purchased ogi from the markets of (Enohia, Unwana and Afikpo) showed total bacterial growth of 5.6×10^7 , 2.0×10^3 , 4.2×10^2 and 3.6×10^6 respectively. Staphylococci growth count of 4.2×10^2 , 2.9×10^2 and 3.5×10^2 were recorded respectively, while Coliform count recorded 2.0×10^3 , 1.2×10^3 and 1.5×10^3 and Lactic acid bacterial loads of 3.6×10^6 , 2.7×10^6 and 3.2×10^6 respectively. The bacteria isolated from the commercial and laboratory fermented pap were *Lactobacillus* sp, *Staphylococcus* sp, *Leuconostoc* sp, *Micrococcus* sp, *Salmonella* sp, *E. coli*, *Citrobacter* sp and *Klebsiella* sp. *Lactobacillus* sp *Leuconostoc* sp and *Citrobacter* sp were present in all the samples, *Micrococcus* sp and *Klebsiella* sp were isolated from Enohia and Unwana markets ogi respectively, while *E. coli* and *Staphylococcus* sp were present in Enohia, Unwana and Afikpo markets. *Salmonella* sp were isolated from the three markets. No pathogenic bacteria was isolated from the laboratory Prepared ogi (Akamu). Hence, there are chances of contracting food borne diseases from commercially prepared ogi in the local areas of study. Therefore, there is need for sanitary measures in the production of fermented cereals such as ogi so as to minimize the rate of food borne pathogens during processing and storage of such cereals.

Keywords: Fermentation, Maize; Ogi; Bacterial quality

1. Introduction

Ogi is known to be consumed by most adults and children as breakfast meal in developing countries, and it also serves as a weaning diet which supplies nutrients [1]-[2]. When approaching 5-6 months, breast-feeding is no longer sufficient to satisfy the nutritional requirements of the growing infant hence there is need for an alternative means of feeding. Starting from this period, the child needs solid foods to meet the increasing nutritional needs [3]. This period is known as the weaning period and in Nigeria, Ogi (alternatively called pap or akamu is introduced gradually as the child's diet to supplement the required nutrients. Fermented maize is widely utilized as food in African countries and used as infant cereals which amount to about 77% of total caloric information [4]. Pap meal is served in Nigeria as a weaning food for infants between the ages of (1-3 years old) and as morning breakfast food for children and adults. Most preparation of pap meal is from cereals such as maize, guinea corn or millet readily available in all parts of the country. These cereals have similar chemical compositions of carbohydrates (68-88%), protein (9-15%), fat (3-5%) and vitamin B [5]. In the tropics, food poisoning is common and is among the major causes of death among children. In Nigeria alone, from 1971-1976, there were 2.5 million reported cases of food-borne infection and in Lagos alone, from 1971-1975 there were 53,260 reported deaths of which 6,900 originated from food-borne diseases and 66.6% of which were children under 5 years of age [5]. In most parts of Africa especially in Nigeria, children are fed with mashed adult foods. These foods are bulky and this therefore reduces food intake by a child, often resulting in malnutrition. The development of nutritionally balanced calorie dense, low bulk and easily digestible weaning food becomes mandatory. This involves the use of simple

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but time consuming traditional fermentation technology [6]. The traditional fermentation technology employed in Ogi production is a wild process where microorganisms are not controlled. Microbiological analyses have shown the presence of several genera of bacteria, moulds and yeasts in the fermented maize product [7]-[8]. Maize is rich in carbohydrates and minerals, including potassium and magnesium. It contains trace amounts of lysine and tryptophan, contributing to the low content of protein and trace elements of B-vitamins [8]. The major problems behind the processing of fermented maize (Ogi) in different parts of Afikpo/ Ebonyi State is based on: inadequate storage facilities, inadequate supply of portable water and unhygienic environment which is the main source of microbial contamination and source of water too so once it is well taken care of, such products will come out safe and wholesome for consumption.

Fermentation process serves as a means of providing source of nourishment for large rural populations. Fermentation also enhances the nutrient content of foods through the synthesis of proteins, vitamin and essential amino acids [9]. Pap (akamu) is a porridge prepared from fermented maize. It is a popular breakfast cereal and infant weaning food among the Igbo – speaking people of Nigeria. Akamu is similar to Ogi, a lactic acid fermented food made from maize, sorghum or millet which may be fortified with legumes [10]. Akamu is prepared by soaking clean maize grains in water for 2-3 days. The grains are washed and ground to a paste. The paste is sieved to smooth slurry which is allowed to settle and the supernatant decanted. The slurry is mixed with hot water while stirring is done until it forms a gel which serves as food. Fermented foods have become a major source of diarrheal. [8] reported that maize porridge prepared for infants in Ghana were contaminated with pathogenic bacteria including *Aeromonas*, *Bacillus cereus*, *Salmonella*, *Staphylococcus aureus* and *Vibrio cholerae*. Ogi is fairly acidic having a pH 4.8 which tends to inhibit the growth of some bacteria. Its spoilage however, is enhanced by some extrinsic factors amongst which are storage temperature. Extension of the shelf life of Ogi is carried out using various techniques, which include refrigeration, freezing and drying (dehydration) to reduce the microbial load and consequently spoilage [11]. The microbiology of many of these products is quite complex and unexploited. In most of these fermented products the fermentation method adopted is natural and involves mixed cultures of yeasts, bacteria and fungi. Some microorganisms may participate in parallel, while others act in a sequential manner with a changing dominant biota during the course of fermentation. The common fermenting bacteria are species of *Leuconostoc*, *Lactobacillus*, *Streptococcus*, *Pediococcus*, *Micrococcus* and *Bacillus*. The fungal genera are mainly representatives of *Aspergillus*, *Paecilomyces*, *Cladosporium*, *Fusarium*, *Penicillium* and *Trichothecium* whereas the most common fermenting yeast species is *Saccharomyces*, which contributes to alcoholic fermentation [12]-[13]. Yeasts have been reported to be involved in several different types of indigenous fermented foods and beverages [14]. The most dominant yeast species associated with African indigenous fermented foods and beverages is *Saccharomyces cerevisiae* [15]. Therefore, the aim of this study is to compare the bacteriological qualities of commercially and laboratory based fermented ogi (akamu) prepared from maize.

2. Materials and methods

Grains of yellow maize (*Zea mays*) variety were purchased in sufficient quantity from Abakaliki market in Ebonyi State, Nigeria. The yellow maize grains were used for the production of Ogi at the Central Laboratory of the National Root Crops Research Institute, Umudike, Abia State and this Ogi served as the control in this study. Pap (Ogi) were purchased from three (3) different market locations in Ebonyi State, Nigeria; namely: Enioha, Unwana and Afikpo. The Ogi produced at the Central Laboratory of the National Root Crops Research Institute was labeled Sample A while the purchased Ogi from Enioha, Unwana and Afikpo were labeled Sample B, C and D respectively. These commercial samples were wrapped in clean transparent polythene bags to prevent further contamination and taken to the Central Laboratory of the National Root Crops Research Institute, Umudike, Abia State for bacteriological analysis.

3. Processing of Maize Ogi

The method described by [16]-[17] was used for the processing of Ogi. The maize grains were sorted, cleaned and steeped in water for 72 hrs. The softened corn was washed and ground in a mechanized mill. The ground materials was rinsed with water and passed through a sieve (muslin cloth) to remove parts of the hull. The filtrate of pure starch was placed in pots of water to settle and was covered up completely for laboratory analysis.

4. Bacterial Analysis

4.1. Enumeration of Bacteria

The commercial ogi samples were subjected to bacteriological analysis at the Central Laboratory of the National Root Crops Research Institute, Umudike, Abia State, to determine their safe state for consumption. Furthermore, wet pastes

of ogi that served as control was also prepared at the same Central Laboratory and analyzed bacteriologically for comparison. Exactly 10 g of each ogi sample was added to 90 ml of sterile physiological saline in a test tube and ten-fold serial dilutions were made. Then 1 ml of each serially diluted ogi sample was aseptically transferred to plates of Nutrient Agar (oxid), Mannitol Salt Agar (oxid), MacConkey Agar (oxid) and DeMannRogosa-Shrape (MRS) agar (Oxid) (all prepared according to manufacturer's instruction) and was spread using a sterile bent glass rod. The culture plates were incubated at 37°C for 24 hrs with the exception of MRS which was incubated for 48 hrs. At the end of the incubation, the plates were examined for bacterial growth and counted. Nutrient agar, Mannitol salt agar, MacConkey agar and MRS agar was used for enumeration of total viable count, for the following organisms' *staphylococcus* and *micrococcus species*, coliform bacteria and lactic acid bacteria respectively.

4.2. Isolation of Bacteria

On the establishment of growth, each cultured plate was examined closely for the presence of distinct colonies. Then inoculation was taken and sub-cultured in fresh sterile medium. The sub-cultures were incubated at 37°C for 24 h and observed for pure cultures.

5. Results and discussion

The present study was carried out to evaluate the bacteria quality of ogi (akamu) prepared from maize. This was achieved by comparing the laboratory prepared ogi of both (white and yellow) variety of maize. The bacterial loads of the laboratory prepared ogi of both white and yellow variety of maize showed total bacterial growth (CFU/g) of 4.0×10^3 and 3.9×10^3 respectively was recorded. No Staphylococci and Coliform growth was observed, while Lactic acid bacterial load of 3.5×10^6 and 3.0×10^6 was recorded respectively (Table 1).

Table 1 Bacterial Loads of Laboratory Prepared White Variety of Ogi (Akamu)

Growth medium	White variety (cfu/g)	Yellow variety (cfu/g)
MacConkey agar	No Growth	No Growth
Mannitol salt agar	No Growth	2.0×10^3
Nutrient agar	4.0×10^3	3.9×10^3
M.R.S	3.5×10^6	3.0×10^6

MRS= De Man, Rogosa and Sharpe Agar, NBG = No bacterial growth; CFU/g= Colony forming unit per gram.

Table 2 Bacterial loads of laboratory prepared ogi and samples of ogi purchased from the markets of (Enohia, Unwana and Afikpo).

Sample	Nutrient agar	MacConkey agar	Mannitol salt agar	MRS agar
A	4.4×10^7	No Growth	No Growth	3.1×10^6
B	5.6×10^7	2.0×10^3	4.2×10^2	3.6×10^6
C	5.0×10^7	1.2×10^3	2.9×10^2	2.7×10^6
D	5.2×10^7	1.5×10^3	3.5×10^2	3.2×10^6

Sample A= Laboratory prepared ogi, B= Ogi purchased from enohia, C= Ogi purchased from Unwana, while D= ogi purchased from Afikpo. MRS= De Man, Rogosa and Sharpe Agar, NBG = No bacterial growth; CFU/g= Colony forming unit per gram.

The commercial purchased ogi from the markets of (Enohia, Unwana and Afikpo) showed total bacterial growth of 5.6×10^7 , 2.0×10^3 , 4.2×10^2 and 3.6×10^6 respectively. The Staphylococci growth count of 4.2×10^2 , 2.9×10^2 and 3.5×10^2 respectively, while the Coliform count of 2.0×10^3 , 1.2×10^3 and 1.5×10^3 and the Lactic acid bacterial loads of 3.6×10^6 , 2.7×10^6 and 3.2×10^6 respectively as shown in (Table 2).

Table 3 Occurrence of the Bacterial Isolates on Laboratory and Commercial Fermented Ogi (Akamu) in Enohia, Unwana and Afikpo areas.

Microorganisms	Enohia	Unwana	Afikpo	Lab
<i>Lactobacillus</i>	+	+	+	+
<i>Leuconostoc</i> species	+	+	+	+
<i>Micrococcus</i> species	+	-	-	-
<i>Salmonella</i> species	+	+	+	-
<i>E. coli</i>	+	+	+	-
<i>Citrobacter</i> species	+	+	+	+
<i>Klebsiella</i> species	-	+	-	-
<i>Staphylococcus</i> species	+	-	-	-

+ = Positive, - = Negative

The microbial counts of the commercially purchased ogi from the markets of (Enohia, Unwana and Afikpo) were significantly high. The white variety of ogi purchased from Unwana market had lesser bacterial count when compared with the other markets (Enohia and Afikpo). The high bacterial counts found in this study might be due to the presence of microorganisms already inhabiting the maize grains from which the ogi was obtained, the milling method, water used during cleaning and the machine used in blending the grains. These organisms now continue to multiply in the product. The presence of the high bacterial counts generally shows food processor information regarding raw materials, processing conditions, storage conditions and handling of the processed products by fermentation [18]- [19]. The bacteria isolated from the commercial and laboratory fermented pap were *Lactobacillus* species, *Staphylococcus* species, *Leuconostoc* sp, *Micrococcus* sp, *Salmonella* sp, *E. coli*, *Citrobacter* sp and *Klebsiella* sp. *Lactobacillus* sp, *Leuconostoc* sp and *Citrobacter* sp were present in all of the samples, *Micrococcus* sp and *Klebsiella* sp were isolated from Enohia and Unwana markets ogi respectively, while *E. coli* and *Staphylococcus* sp were present in Enohia, Unwana and Afikpo markets. *Salmonella* sp were isolated from the three markets. No pathogenic bacteria was isolated from the laboratory Prepared ogi (Akamu). However, the presence of pathogenic organisms (*Escherichia coli*, *Salmonella* sp and *Klebsiella* sp) observed in the commercially prepared/purchased ogi sold in the open markets could be attributed directly to the unhygienic state of the water having traces of fecal substances or contaminants not leaving out the environment at large, the mode of preparation of the ogi, storage method, contamination of the water used to prepare the ogi (akamu) as a result of the exposure during sales of the ogi in the various markets which may not be unconnected with high human activities in the markets this is in accordance with the report of [20]. This study is in line with [21]- [22] who studied the microbial quality of ogi prepared from cereals like maize sold in Bauchi markets, Nigeria who isolated *Klebsiella*, *Staphylococci*, *Lactobacillus* and *E. coli* bacteria. The contamination of the commercially available ogi in the area of study could be from poor water quality, prolonged stored raw material which was not properly taken care of and poor handling by the handlers or those processing the ogi product for commercial purposes.

6. Conclusion

This study has shown that the chances of contracting food borne diseases from commercially prepared ogi (akamu) are very high. Therefore, there is need for sanitary measures to be taken in the production of fermented cereals so as to minimize the rate of contamination during processing and storage.

Compliance with ethical standards

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Disclosure of conflict of interest

There are no conflicts of interest in connection with this paper, and the material described is not under publication or consideration for publication elsewhere.

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