Microbial Evaluation of Garri Sold In Ijebu Community

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Abstract: The sale and distribution of garri in local markets is associated with practices such as display of product in open buckets, bowls and mats at points of sale and the use of bare hands during handling and sales. These unhygienic practices may lead to the microbial contamination of garri. This study was carried out to evaluate the microbial quality of garri sold in Ijebu community. Six garri samples were randomly collected from six retail sellers in three towns of Ijebu-Igbo, Ago-Iwoye and Oru Ijebu in Ijebu-North Local Government Area of Ogun State. Samples were serially diluted to 10^-2 and inoculated on agar plates for Total aerobic plate count (TAPC), Coliform count (CC) and Fungal count (FC) respectively. The TAPC counts ranged from 3.0 x 10^2 to 3.0 x 10^4 CFU/ml and Fungal counts ranged from 3.0 x 10^2 to 4.0 x 10^3 CFU/ml. The pH ranged from 4.78 to 4.90. A total number of fourteen (14) bacterial isolates belonging to five genera were isolated. The occurrences were Escherichia coli (4), Staphylococcus aureus (3), Klebsiella pneumoniae (3), Bacillus spp. (2) and Pseudomonas aeruginosa (2). A total of nine (9) fungal isolates were Aspergillus flavus I(11.11%), Aspergillus niger 2(22.22%), Penicillium sp. 2(22.22%), Fusarium sp. I(11.11%), Candida albicans 2(22.22%) and moulds I(11.11%). Application of good manufacturing practices (GMP) in garri handling post-processing is important.

Key words: Garri samples, Coliform counts, Fungal counts, Contamination and GMP

I. Introduction

Garri is the most popular fermented food product made from cassava (Mannihot esculenta) and is widely consumed as processed by millions of people in West Africa where it forms a significant part of their diet (Edemet al., 2001; Kostinek et al., 2005; Oduro et al., 2000; Ogiehor et al., 2007). It is preferred by urban consumers irrespective of ethnicity and socio-economic class as it is a pre-cooked food product with good flavour (JekayinaFaad Olajide, 2007). The dry form of post processed garrias obtained in markets is commonly consumed without further cooking (soaked in water) with sugar, smoked fish, roasted groundnuts, cooked cowpea and coconut, and sometimes with milk and beverages as complements. It can also be prepared into a stiff paste called ‘Eba’ by adding the granules into hot water and stirring to make a paste of varied consistency which can be consumed with local soups or stews of various types by chewing or swallowing in morsels (Asegbeleyin and Onyimonyi, 2007).

Garri processing covers a series of procedures such as peeling, washing, grating and packing into closely knit bags. A heavy object is placed on top of the bag to express some of the juice and the contents of the bag are then left to undergo spontaneous solid state fermentation for several days at ambient temperatures (Huch et al., 2008; Ray and Sivakumar, 2009). Fermentation of the grated tubers helps in product preservation, flavour development, cyanide reduction and changes in functional properties (Akindahunsi et al., 1999). The fermented pulp is then dried to about 10% moisture content by frying at high temperatures which probably results in partial dextrinization of starch (Osho and Dashiell, 2002), destruction of enzymes and microorganisms and the expulsion of cyanide gas from the product (Asegbeleyin and Onyimonyi, 2007; Harbord and Ogundu, 2009).

The fermentation of cassava to produce garri provides an enormous scope for value addition and preserves this starchy food in a wide diversity of flavours, aromas and textures that enrich the human diet (Ray and Sivakumar, 2009; Steinkraus, 1997), and helps to ensure distribution and storage of the product without the need for refrigeration. However, post-process problems of garri still persist and include loss of microbial stability and spoilage during storage, distribution and marketing.

In Nigeria, the sale and distribution of garri in local markets is associated with practices such as display of product in open buckets, bowls and mats at points of sale and the use of bare hands during handling and sales. These unhygienic practices, which may lead to microbial contamination due to deposition of bioaerosols on exposed products, transfer of microbes from dirty hands and utensils and frequent visits by animals and fomites (which may carry infectious agents), can contribute to the post-process problems of this product.
Previous reportshave revealed high bioload and a vast array of microorganisms in market samples of garri (Agbonlahor et al., 1997; Amadi and Adebola, 2008; Ijabadeniyi, 2007; Ogiehor et al., 2007). The microorganisms isolated from these market samples include: Bacillus spp., Pseudomonas spp., Clostridium spp., Salmonella spp., Klebsiella spp., Aspergillus spp.; Penicillium spp.; Rhizopus spp., Fusarium spp.; Cladosporium spp., etc.

II. Aims and objective of the study

This study is aimed at assessing the microbial quality of garri sold in Ijebu community with a view to enlightening the public on the importance of proper food handling in food safety which will help in reducing or eliminating potential health hazards that could arise as a result of consumption of contaminated garri.

III. Materials And Methods

Study Area
Ijebu North is a Local Government Area in Ogun State, Southwest, Nigeria. It consists of three main regions, Ijebu-igbo, Ijebu-Oru and Ago-iwoye.

Collection of Samples
A total of six garrisamples, two from each market were randomly collected from six retail sellers in three towns of Ijebu-igbo, Ago-Iwoye and Oru Ijebu in Ijebu-North Local Government Area, Ogun state. The samples were well labelled to indicate the name of the market and sample code and stored in sterile polyethylene bags and at ambient temperature to prevent the entrance of spoilage agents before laboratory analysis.

Microbial Analysis
Microbial analysis was carried out according to the method of Ojokoh and Gabriel (2006). 1 g of sample was weighed and crushed to powder with sterile mortar and pestle. It was then placed in a sterile test tube and homogenized with 10 ml of sterile distilled water to make the stock. Homogenate was serially diluted to 10^{-2}, also in sterile distilled water. About 0.1 ml aliquot of appropriate dilutions were inoculated onto Nutrient agar, MacConkey agar and Potato Dextrose agar plates, for total aerobic plate count, coliform count and fungal counts respectively. plates using the pour plate method. The plates were allowed to set and subsequently incubated at 37°C for 48 h. Potato Dextrose agar (PDA) plates were however incubated at 25°C for 72 h. At the end of each incubation period, the culture plates were examined for enumeration and identification of colonies counted.

Enumeration and Identification of microbial Isolates
Colony count at the end of each incubation period was done with digital colony counter, total microbial load was expressed as colony forming units per gram of sample. Pure cultures of isolates obtained by repeated subculturing were stored on slants at 4°C until characterized. Bacterial isolates were characterized one basis of their Gram-stain reaction and biochemical test and the identification was according to Bergey’s Manual of Determinative Bacteriology. Fungal isolates were identified based on morphological characteristics and microscopy (Tsuneo, 2010).

Determination of pH content of garri samples
The pH of the samples was determined following the method described by Ogiehor and Ikenebomeh (2005). Tengrams of each sample were homogenized in 10 ml of distilled water and the pH of the suspension determined using reference glass electrode pH meter.

IV. Results and discussion

Table 1 shows the mean total coliform count of garri samples from the three different markets. The counts ranged from 3.0 x 10^2 CFU/ml to 3.0 x 10^7 CFU/ml, with Ijb sample having the highest count and Agi with no count. This difference in counts may be attributed to difference in food safety adherence or personal hygiene by the food handlers. The result reveals that coliform was present in most of the garri samples at high counts. This generally signifies poor sanitary conditions in the post-process handling of garri via food handlers and the environment. The ICMSF (1996) and the African Organisation for Standardization recommended absence of coliforms in ready to eat foods. The presence of coliforms in most of the garri samples therefore make it of poor quality and unsafe for human consumption.

Fungal counts of garri samples ranged from 3.0 x 10^2 to 4.0 x 10^7 CFU/ml as shown in Table 1. This count is within acceptable limits. Ready to eat food with plate counts ~< 10^7 are acceptable 10^5 to 10^7 are tolerable, while count ~> 10^6 unacceptable.
Furthermore, the pH contents of garri samples were of the acidic range with pH values ranging from 4.78 to 4.90 as shown in Table 1.

A total of fourteen (14) bacterial isolates belonging to five genera were isolated: Klebsiella pneumoniae (3), Bacillus spp. (2) and Pseudomonas aeruginosa (2). The presence of Escherichia coli and Staphylococcus aureus calls for serious concern considering the fact that garri is sometimes eaten without further cooking coupled with the fact that some strains of these organisms are toxigenic and have been implicated in food-borne intoxication (Oranusi et al., 2007). Staphylococcus aureus and Escherichia coli are of human origin, their presence therefore could be as a result of poor hygienic practices.

Moreover, the frequency of occurrence of isolated organisms is shown in Table 2. It reveals that the garri samples were contaminated by a diverse microbial population, both bacteria and fungi. This is in line with the previous findings of Idowu (2006), Taulo et al. (2008), Oranusi et al. (2013) and Olopade et al. (2014). The fungi isolated include species of Aspergillus, Penicillium, Fusarium, and Molds. Molds are common environmental contaminants due to their ability to produce spores; this could explain their presence in garri. They have been implicated in ready to eat foods and in unregulated/ mixed fermentation. Species of Aspergillus, Penicillium and Fusarium known to produce delerious mycotoxins under favourable conditions (Sweeney and Dobson, 1998; Kabak et al., 2006; Oranusi et al., 2013), their presence in garri could therefore be of potential risk to public health. Post-process contamination of garri by diverse microbial populations is specifically associated with sieving of products after heat treatment and the spreading of products in the open to aidry, coupled with the practice of leavings garri open for sales could have accounted for the diverse microbial population contaminating the product.

The current findings suggest that the current unhygienic yet acceptable mode of sale of garri may pose potential risk for public health. There is need for strict adherence to GMP, which include proper packaging of garri immediately after processing to curtail the level of contamination and thus improve the microbial quality of this basic staple food.

### Table 1: Mean total Coliform count, Fungal Count, pH Contents of garri samples

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Mean total Coliform count</th>
<th>Fungal Count</th>
<th>pH Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ijb 1</td>
<td>$2.0 \times 10^3$</td>
<td>$4.0 \times 10^2$</td>
<td>4.81</td>
</tr>
<tr>
<td>Ijb 2</td>
<td>$3.0 \times 10^3$</td>
<td>$3.0 \times 10^2$</td>
<td>4.90</td>
</tr>
<tr>
<td>Or 1</td>
<td>$2.7 \times 10^3$</td>
<td>$3.0 \times 10^2$</td>
<td>4.87</td>
</tr>
<tr>
<td>Or 2</td>
<td>$3.0 \times 10^3$</td>
<td>$4.0 \times 10^4$</td>
<td>4.82</td>
</tr>
<tr>
<td>Ag 1</td>
<td>No Growth</td>
<td>$4.0 \times 10^2$</td>
<td>4.78</td>
</tr>
<tr>
<td>Ag 2</td>
<td>$2.7 \times 10^3$</td>
<td>$3.0 \times 10^4$</td>
<td>4.81</td>
</tr>
</tbody>
</table>

**Decoder**

Ijb = Ijebu-Igbo
Or = Oru Ijebu
Ag = Ago-Iwoye

### Table 2: Frequency Occurrence of Isolated Organisms

<table>
<thead>
<tr>
<th>Isolates recovered</th>
<th>Frequency</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacteria</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>4</td>
<td>28.6%</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>3</td>
<td>21.4%</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>3</td>
<td>21.4%</td>
</tr>
<tr>
<td>Bacillus spp.</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>2</td>
<td>14.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>14</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Fungi</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fusarium</td>
<td>1</td>
<td>11.1%</td>
</tr>
<tr>
<td>Mold</td>
<td>1</td>
<td>11.1%</td>
</tr>
<tr>
<td>Aspergillus flavus</td>
<td>1</td>
<td>11.1%</td>
</tr>
<tr>
<td>Aspergillus niger</td>
<td>2</td>
<td>22.2%</td>
</tr>
<tr>
<td>Penicillium</td>
<td>2</td>
<td>22.2%</td>
</tr>
<tr>
<td>Candida albicans</td>
<td>2</td>
<td>22.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9</td>
<td>100%</td>
</tr>
</tbody>
</table>
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References


