



## THE HYGIENE AND MICROBIAL QUALITY OF PAP SOLD IN MANDALLA MARKET, FEDERAL CAPITAL TERETORY, NIGERIA

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### Abstract

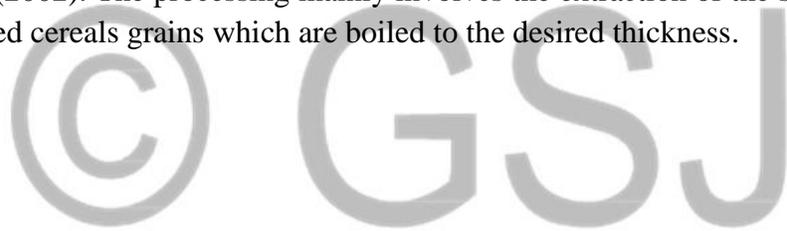
Pap is a product of fermented cereal such as maize (*Zea mays*) that is widely consumed in Nigeria because it is an easily digestible weaning food with many valuable nutrients brought into it as microbial metabolic products during fermentation process. Despite the numerous benefits of this important weaning food, it could become a vehicle for the transmission of many important human disease-causing microorganisms because the production steps involve the use of wild and spontaneous process. Therefore, the main objective of this study was to determine the diversity and quality of the microbiological contamination of pap sold in Mandalla Market, FCT, Abuja. This was done by randomly collecting 40 samples of pap, wrapped in polythene and transported to the laboratory for analyses using standard microbiological and biochemical methods. One gram of each sample was homogenized in 9ml of sterile peptone water and the serial dilutions were made up to 10<sup>6</sup>. Appropriate dilutions 10<sup>2</sup>, 10<sup>4</sup> and 10<sup>6</sup> were plated on Nutrient agar, PDA and other selective media. The inoculated media plates were incubated at 37<sup>0</sup>C overnight for bacteria and at 28<sup>0</sup>C for 48 hours for fungal growth and development. After the incubation period, discrete colonies that developed were carefully picked, purified by re-culturing on new sterile media and finally stored at 4<sup>0</sup>C till further needed for other characterization. The results revealed the presence of the bacteria *Escherichia coli*, *Pseudomonas* sp., *Staphylococcus aureus*, *Klebsiella*, sp., *Streptococcus* sp. The fungi isolated were *Mucor* sp., *Rhizopus* sp., *Penicillium* sp., *Aspergillus* sp. and *Fusarium* sp. The high occurrence of the microorganisms encountered could be due to poor production hygiene of the handlers and the process. The health of the population at risk is high due to the number that is likely to be consuming this important product.

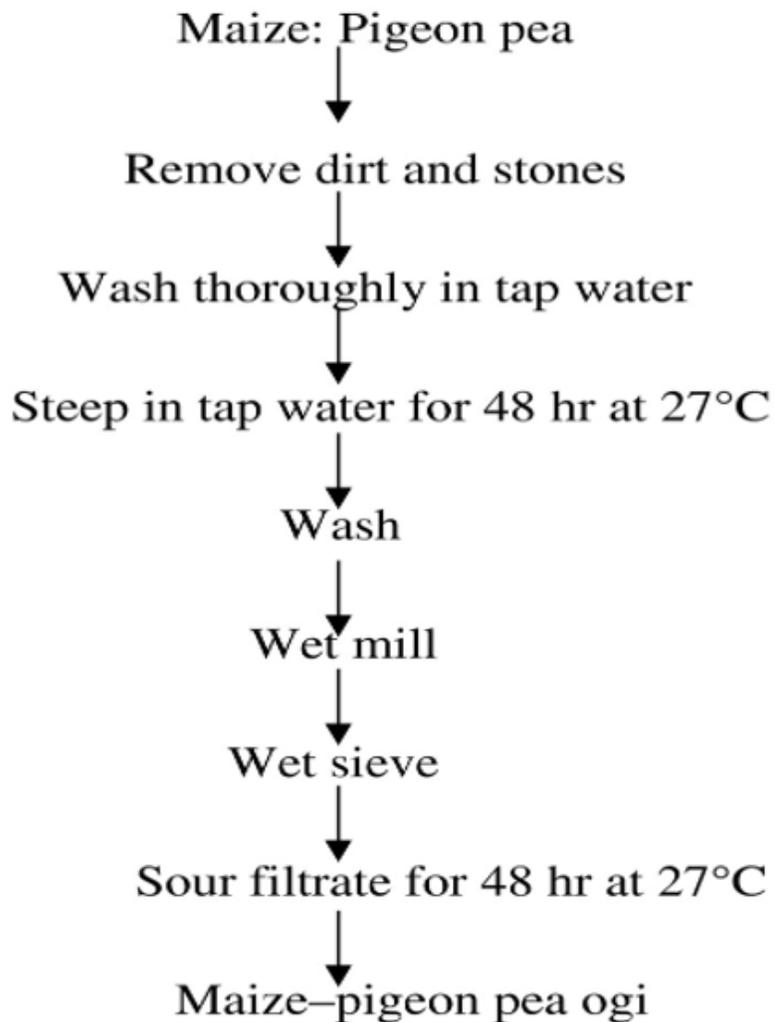
Therefore, good manufacturing practice and basic knowledge of hygiene should be disseminated among the handlers and the consumers.

**Keywords: Health, Population, Fungi, contamination, quality and Ogi**

### **Introduction**

In Nigeria and generally in the world over, cereals are one of the major food crops grown and consumed. It estimated to constitute about 43% of total calorie intake in the country according to reports (Wingertzahn *et al.*, 2011). One of the most utilized fermented cereals in Nigeria is the fermented and often sour-taste slurry starchy product processed exclusively from cereals such as maize, millet, corn or sorghum. It is popularly referred to as Akamu generally, but called ogi in the Western Yoruba and Northern Hausa locals of Nigeria. It is characterized by smooth texture when boiled into porridge referred to as pap before being served ready for consumption (Amusa and Ashaye, 2007). It has a satisfactorily mild to strong sour flavour and the colour ranges from cream to white and red colour but mostly depends on the cereal used. The product is also reported to be a popular breakfast and infant weaning food in Nigeria according to several authors (ICSMF (2002)). The processing mainly involves the extraction of the starchy endosperm from the fermented cereals grains which are boiled to the desired thickness.





Over the years and due to consumers preferences, the products have severally been supplemented with other taste and nutrients-enhancing food products such as soyabeans and cowpea in order to increase the nutrition values and acceptance (Odunfa, 1984). As such, the product has recently been reviewed to have some therapeutic advantages due to its tested abilities to control child ailments associated with dehydrative diarrhea. This property, combined with the presence of available lysine makes the product worthy of further studies and processing into dry forms that can be stable over a longer time at shelf temperatures (Talbert *et al.*, 2012). The process of ogi production basically involves soaking corn or the cereal used in water for 1-3 days, followed by milling and sieving through screen mash. The sieved outcome is then allowed to sediment and undergo spontaneous fermentation which is thus marked as wet cake. The quality of the fermented product depends on the qualities of water, utensils used as well as the environment where the production takes place which invariably determine the kind of microorganisms involved in both the spontaneous fermentation, spoilage and as contaminants (Odunfa, 1984). The microorganisms in the food products generally will affects the keeping quality and the possibility of it spreading diseases (Roy *et al.*, 2011). Therefore, the main

objective of this study was to determine the diversity and quality of the microbiological contamination of pap sold in Mandalla Market, FCT, Abuja.

### Materials and Methods

Forty samples of pap were purchased from hawkers randomly at the studied market (Mandella) and were labeled P1-P8 respectively in clean polythene materials and transported to the microbiological laboratory for analysis within one hour of collection using standard microbiological and biochemical methods. One gram of each sample was homogenized in 9ml of sterile peptone water and the serial dilutions were made up to  $10^{-6}$ . Appropriate dilutions  $10^{-2}$ ,  $10^{-4}$  and  $10^{-6}$  were plated on Nutrient agar, PDA and other selective media. The inoculated media plates were incubated at  $37^{\circ}\text{C}$  overnight for bacteria and at  $28^{\circ}\text{C}$  for 48 hours for fungal growth and development. After the incubation period, discrete colonies that developed were carefully studied, picked, purified by re-culturing on new sterile media and finally stored at  $4^{\circ}\text{C}$  till further needed for other characterization and identification (Omume and Adeosun, 2010).

### Results and Discussions

**Table 1: The mean temperature, pH and the Microbial Total Counts (Cfu/ml) of the Freshly Prepared and Marketed Ogi from the Studied Area**

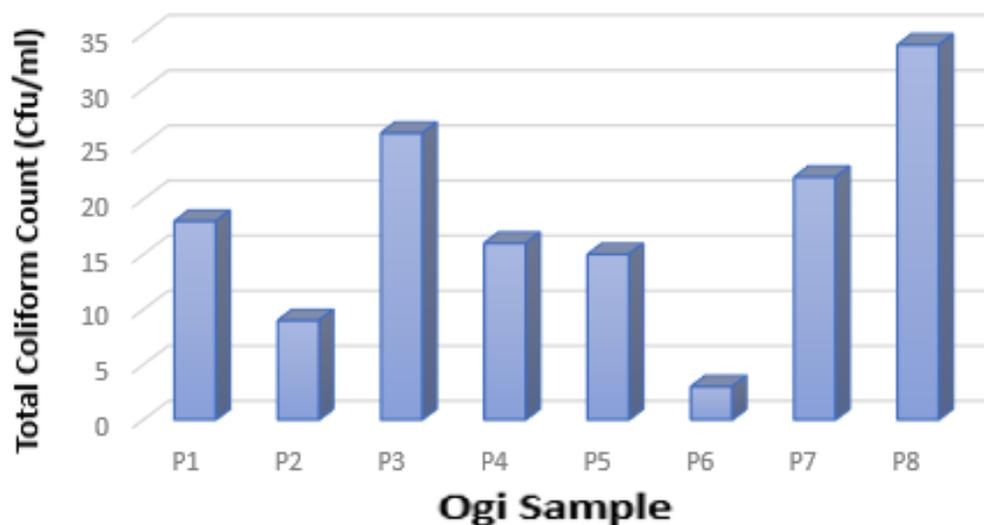
Sample	T <sup>0</sup> C	pH	TBC	TFC	TCC
P1	30.7	3.63	2.21x10 <sup>6</sup>	1.32x10 <sup>4</sup>	18
P2	32.9	3.87	1.32x10 <sup>6</sup>	2.23x10 <sup>4</sup>	9
P3	36.4	3.80	2.11x10 <sup>7</sup>	1.52x10 <sup>4</sup>	26
P4	37.0	3.92	1.42x10 <sup>7</sup>	1.89x10 <sup>5</sup>	16
P5	31.3	3.91	1.51x10 <sup>6</sup>	1.37x10 <sup>4</sup>	15
P6	31.5	3.90	1.33x10 <sup>7</sup>	1.82x10 <sup>5</sup>	3
P7	33.5	3.73	2.13x10 <sup>6</sup>	1.42x10 <sup>4</sup>	22
P8	32.6	3.84	1.41x10 <sup>6</sup>	1.56x10 <sup>4</sup>	34

P1-P8 = sample Collection Sites; TBC = Total Bacteria Count; TFC = Total Fungal Count; TCC = Total Coliform Count; Cfu = Colony forming unit

From table 1 above, the minimum temperature and pH of the pap samples at retailed conditions were  $30.7^{\circ}\text{C}$  (P1) and 3.63 (P1) respectively while the highest were  $37.0^{\circ}\text{C}$  (P4) and 3.92 (P4). Therefore, all the samples were acidic. Ogi production requires first steeping of the washed and cleaned grains for between 1 to 3 days. It is during this time that desirable microorganisms develop and dominate by natural selection. The selection often favours acid production microorganisms such as lactic acid bacteria (Liu *et al.*, 2014). The observation in this work therefore agrees with several documented ogi production as being acidic food product (Osungbaro, 2009). The total microbial count varied from the lowest  $1.32 \times 10^6$  Cfu/ml in sample P2 to the highest,  $2.11 \times 10^7$  Cfu/ml in sample P7. The diversity of microbial components has been attributed to the water and general hygiene status of the production processes and the environments (Ozoh and Kuyanbana, (2006). This is attributable to the fact that one of the processing steps involves grounding the soaked grains with water which also added to the

microbial compositions of the final products. The observation in this work agrees with the reports of Adebolu *et al.*, 2007. The optimum pH for *ogi* has been reported to be between 3.6 to 3.7. The report of this work however reported higher pH of 3.9. This might be due to high concentration of lactic acid bacteria during fermentation as high concentration of the group of bacteria are reported to increase the acidic contents of the final products (Adebolu *et al.*, 2007). It has been reported that the concentration of lactic acids may reach 0.65 percent and that of acetic acid 0.11 percent during fermentation. It has been reported that if the pH of the final *ogi* products falls to 3.5 and below, they tend to be less acceptable. Therefore, all the samples collected and used in this work were of acceptable quality in terms of the pH. The fungi growth ranged from  $1.32 \times 10^4$  to  $1.89 \times 10^5$ . Fungi are also both contaminants and part of the fermentation of several fermented products (Jay, 2005). The presence of fungi in the samples could be attributed to the quality of the environment and the water used (Awada *et al.*, 2005).

This study revealed high total coliform plate count (TCPC) as shown in figure I with highest occurrence from sample P8 and lowest from sample P6. This might be attributable to availability of some easily metabolizable nutritional components of the grains, which are often essential for the growth of microbes. Grains as well as the quality of the water used for the processing. Higher total fungi count has also been observed in *ogi*. However, such reported products are indication of high potential hazard to consumers. Generally, the fungi count in this work are however, lower than  $1.0 \times 10^8$  cfu/ml count normally considered as potentially hazardous but these values were too high for foods meant for the immune-compromised individuals.



## Conclusion

Cereals, like other agriculture food products are better utilized when processed to add value. *Ogi*, is one of the Nigerian cereal-based food products with unique smooth-textured, sour and flavor. The spontaneous fermentation often involves the presence and domination of lactic acid bacteria with consequential improvement and enhancement of the overall nutritive value. This

researched observed the presence of acceptable levels of acid as well as the microbial contents. The high presence of coliform bacteria in the hawked pap samples, though it is expected due to the nature of well water used in Mandella metropolis, could be a potential source of health hazard through the consumption of the hawked pap in the study area.

### **Recommendation**

Coliform has been reportedly associated with community water supply in many parts of the rural areas of Nigeria. The contamination of the products could also be as a result of the containers and the dirty processing environment. There is therefore the need for sensitization program to educate the pap producers on basic hygiene giving the pattern of microbial contamination observed in this work. This is because, despite being within the microbiological acceptable limits for the consumption of hawked food, the mere presence and the types of microorganisms present in the work already suggest a high public health risks. It is also recommended that considerable level of awareness is needed by the consumers to strictly adhere to the demands and principles of food hygiene and storage of foods at appropriate temperature. The heating for the production of these food should be high enough to eliminate all the microorganisms associated with standard and good pap production process. It is highly necessary to ensure that necessary measures are taken to ensure food safety knowledge is passed to the marketers of ready-to-eat foods and foods with minimal cooking like pap to avoid contacting enter-pathogenic bacteria.

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