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RESEARCH ARTICLE

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP) OF OGI (CORNMEAL) AS AFFECTED BY HANDLER'S HYGIENE

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ABSTRACT

Ogi (cornmeal) a cereal fermented paste was produced in the laboratory and analyzed for the hazards and critical control point associated with it. Microbial counts were made at every stage of Ogi preparation ranging from the maize washing to the fermentation stage using spread plate method on appropriate agar. Similarly, bacterial growth and survival was done on appropriate media for 0, 6, 12, 18 and 24 hours respectively. Study showed an increase in microbial count at the maize washing and wet milling stage with values of 3.9 ± 0.38 and 3.93 ± 0.38 respectively, which explains the effect of exposure of commodity and commercial milling machine on food samples. However, there was a drastic reduction in the microbial growth at the fermentation stage with a value of 2.65±0.37 which shows the influence of fermentation on the quality of food. Growth and survival of pathogens enumerated in this study showed decrease in number of cells at 2.40 and 2.46 per hour for 18hours and 24hours being *Escherichia coli* and *Staphylococcus aureus* respectively. Organism could not grow but only survived for a short period of time. The critical control point does not support the growth of pathogenic microorganism which gives it a good safety record even when prepared under unhygienic conditions but measures such as HACCP should be taken to minimize incidence of pathogens in food.

INTRODUCTION

Food poisoning and safety has become a very typical issue eliciting great deal of public concern over the past few years (Mamajoro, 2009).This is as a result of emerging food borne pathogens that continue to cause outbreak of diseases in different countries. Food poisoning is therefore inevitable because the basic human requirement for the intake of food places every human being at the risk of contracting infection by food-borne pathogens. This fact is true not only in developing countries but in many developed countries (Stephen *et al*., 2008).

Improper handling of food, preparation and consumption practices by consumers (FSAI, 1998; Bryan, 1988;Gorman *et al*.,(2002), inadequate hygiene practices such as hand washing(Cogan *et al*., 2001),and use of unhygienic utensils and materials (Alterkruse *et al*.,1995; Knabel,1995; Beumer and Giffel,1999), consumption of raw or unsafe food (CAST,1994; Redmond and Griffiths,2003), as well as cross contamination through inanimate surfaces by raw food(Roberts,1982; Ryan *et al*.,1996) are some of the factors and practices that have been implicated in food borne outbreaks in the home but fermented foods generally have a very good safety record even in the developing world where food are manufactured by people without training in Microbiology or Chemistry, often in unhygienic contaminated environments(Keith,1997) but while fermented foods themselves are naturally safe, they do not solve the problem of contaminated drinking water, environments heavily contaminated with human waste, improper personal hygiene in food handlers and flies carrying disease organisms which implies that fermented food can be unsafe(Keith,1997). However, application of the principles that lead to the safety of fermented food would lead to an

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improvement in the overall quality and the nutritional value of the food supply, reduction of nutritional disease and greater resistance to intestinal and other disease in infants(Keith,1997) thereby reducing transmission of infections agent through food. Since the beginning of human civilization, there has been intimate relationship between the human being, his fare and the fermentative activities of microorganisms. These fermentative activities have been utilized in the production of fermented foods and beverages which are defined as those products that have been subordinated to the effect of microorganisms or enzymes to cause desirable biochemical changes. The microorganisms responsible for the fermentation may be the micro flora indigenously present on the substrate or they may be added as starter cultures (Harlander, 1992).

Fermented foods make up an important contribution to the human diet in a many countries because fermentation is an inexpensive technology which preserves food, improves its nutritional value band enhances its sensory properties (Bilings, 1998; Chavan and Kadam, 1998). In addition, fermentation provides a natural way to reduce the volume of the material to be transported, to destroy undesirable components, to enhance the nutritive value and appearance of the food, to reduce the energy required for cooking and to make a safer product (Simango, 1997). Several traditional fermented products have been documented in different African countries and include Non-alcoholic beverages, Alcoholic beverages, Pancakes, Porridges, Cheeses and Milks (Ashenafi, 1990; Dirar, 1993 and Steinkraws, 1996). According to Nout(1985) amongst the various factors working against traditional fermented foods are the following;

Inadequate raw material grading and contribution to the presence of foreign matter in final product
Crude handling and processing techniques employed
Lack of durability
Lack of homogeneity
Unattractive presentation
Inadequate presentations inhibit consumer to develop regular purchasing attitudes, plastic containers are replacing banana leaves as a covering for food. Fermented food products can be grouped into five categories according to the main substrates or raw material used in the processing.
Fermented starchy foods e.g. Garri
Fermented cereals e.g. Ogi
Alcoholic beverages e.g. Pinto, Burukutu, Obiolor
Fermented legumes and oil seeds e.g. Dadawa, Iru
Fermented animals proteins e.g. Furah de Nunu and Yoghurt
Significant contributions have been made in research to understand the microbiology and biochemistry of the fermentation in order to enhance their nutritional and overall food value (Eka, 1980; Okafor, 1983 and Odunfa, 1985).

Ogi (cornmeal) a fermented, cereal gruel from maize is a staple food of several communities in Nigeria. It is traditionally made from maize, sorghum or millet. Several reports had identify steeping and souring as the two fermentation stages involved in the traditional process of Ogi. It is prepared by steeping clean grains in water at room temperature(25 ± 2^0C) for 48-72hours.The steep water is decanted and the fermented grain is washed with clean water and then wet-milled. The bran is removed by wet sieving and the sieved is allowed to settle for another 24-48hours, a process referred to as souring during which time fermentation also proceeds and solid starchy matter, Ogi sediments is produced (Akingbala *et al*., 1989). The wet Ogi (cornmeal) usually has a smooth texture, a sour flavor resembling that of yoghurt and a characteristics aroma that differentiates it from starch and flour. The color of Ogi depends on the type of cereal used, cream for maize, light brown for sorghum and greenish to grey for millet (Banigo, 1993; Onyekwere *et al*., 1993). Fermentation of Ogi is by microorganism from the environment and quality control is absent in the traditional method of preparation (Onyekwere *et al*., 1989; Halm *et al*., 1993). Lactic acid bacteria, yeasts and mold are responsible for the fermentation although *Lactobacillus plantarium* is the predominant microorganism. Other bacteria such as *Corynebacterium* hydrolyzes the corn starch and then yeasts of the *Saccharomyces* and *Candida* species also contribute to the flavor development (Caplice and Fitzgerald, 1999). A lot of nutrient losses occur during processing of cereals for Ogi manufacture hence, several attempts have been made to improve the nutritional value status of Ogi b fortifying it with protein rich substrates. However, nutritional improvements of these fermented cereal gruels with proteinous foods lowered their pasting viscosities and sometimes affected their sensory attributes adversely. These factors are likely to influence acceptability (Osungabro, 2009). The wet Ogi can be boiled at 8-10% total solids into a porridge or pap(Onyekwere *et al*.,1989)which is considered the most important weaning food for infants to compliment breast milk from 4-6months of age in west Africa although it is consumed by adults(Banigo 1993;Moses *et al*., 1993;Onyekwere *et al*., 1993).Along the west Africa coastal region, the product is given other names such as Eko, Agidi, kamu, Akamu, Koko and Furah depending on the substrate used and the form in which it is eaten. The traditional fermentation systems of products like Ogi can therefore lead to microbial evolution of strains with unique technological and other beneficial properties.

Public Health Risks In Street Foods

Most handlers of street-vended foods in Africa and the developing world at large are largely ignorant of basic food safety issues. Consequently, street foods are commonly exposed to dangerous abuses often at all stages of handling. Products (from the raw materials to the finished stages) are often exposed to contamination like soil, dust and sand. Other common real risk factors include time-temperature abused involving handling prepared foods under unsafe storage temperatures and serving such foods cold or without sufficient reheating. As previously noted by Bryan *et al* (1988) for example, street vendor often use stands and cart of crude and inefficient construction and running water is seldom available at the location. Utensils washing is usually done in one or more buckets or pan and sometimes without soap, disinfection is rarely carried out. Waste water is usually discarded in streets and garbage is at times discarded near the food stand. This provides attraction to food by rodents and insects. In addition to all these, toilet facilities are seldom readily available. This

compels food handlers to pass out body wastes in nearby hidden places and often they return to business without proper washing of hands. Most traditional street foods are present and delivered in the open, without proper protective packaging(Akobundu, 1996).The picture presented above clearly shows that street foods pose a public health problem in Africa.

There are limited handlers awareness of the health risks associated with foods in Africa, they are also largely unaware of the rights of consumer proper training of food handlers using the Hazard analysis and critical control point (HACCP) approach appears to be the most important strategy for improving the safety of foods in Africa. HACCP emphasizes monitoring of critical control points by food handlers themselves. Critical risk factors can thus be rapidly and easily identified and easily identified and early corrective action taken (Etok, 1998).

Hazard Analysis and Critical Control Point (Haccp)

Hazard Analysis and Critical Control Points (HACCP) as long been internationally recognized and accepted as the system for effective food safety management(CAC,2003).It is a systematic preventive approach to food safety that addresses physical, chemical and biological hazards as a means of prevention rather that finished product inspection, it is used in the food industry to identify potential contamination and subsequently evaluation that the process is in control of those points or steps of the food chain critical to food safety and key actions known as the Critical Control Points(CCPs) is taken to eliminate risk of the hazards been realized. However, its success and effectiveness in preventing food borne diseases and reducing food safety risks to an acceptable level depends on its correct implementation and application (FAO and WHO, 2006; Lawley, 2007; Kok, 2009). The use of hygienically designed equipment and prerequisite programs as Good Manufacturing Practices (GMP), Good Hygiene Practices(GHP) and sanitation standard operational procedures need to be there prior to HACCP implementation (EHEDG, 1997; Jacxsens *et al*., 2009; Kok, 2009; Panisello and Quantick, 2001; Roberto *et al*., 2006; Walker *et al*., 2003). HACCP was conceived in the 1960s when the US National Aeronauts and Space Administration (NASA) asked Pillsbury to design and manufacture the first foods for space flights. Since then, HACCP has been recognized internationally as a logical tool for adapting traditional inspection methods to a modern, science based food safety system. Based on risk-assessment, HACCP plans allow both industry and government to allocate their resources efficiently in establishing and auditing safe food production practices (Okonko *et al*., 2009).

Codex Alimentarius Standard (Book Of Food)

The Codex Alimentarius (Latin for 'Book of Food') is a collection of internationally recognized standards, codes of practice, guidelines and other recommendation relating to foods, food production and food safety. Its name is derived from the Codex Alimentarius Austriacus (FAO, 2009). Its texts are developed and maintained by the codex Alimentarius Commission, a body that was established in 1963 by the food and agriculture organization of the United Nations (FAO) and the World Health Organization (WHO). The commissions' main aims are stated as being to protect the health of consumers and ensure fair practices in the international food trade. The Codex Alimentarius is recognized by the World Trade Organization as an international reference point for the resolution of disputes concerning food safety and consumer protection (WTO, 2008; WHO and FAO, 2006).

Factors Influencing Microbial Growth In Food

Microbial growth is controlled by factors relating to the food itself called intrinsic factors and also to the environment where the food is stored, described as extrinsic factors. The intrinsic or food-related factors include: pH, Moisture content, Water activity or Availability nutrient and the possible presence of natural antimicrobial agents. Extrinsic or Environmental factors include Temperature, Relative humidity, Gases present and the types and numbers of microorganisms present in the food (Willey *et al*., 2008).

Statement of the Problem

Ogi (cornmeal) is a staple food consumed by several communities in Nigeria which is used as weaning food for infants as well as breakfast meal for adults. However, due to the unhygienic preparation of traditionally fermented food, human especially children has been exposed to various form of food poisoning.

Significance of the Study

Effort must be made to adhere strictly to hygiene measures by following good hygiene practices and strictly implementing Hazard Analysis and Critical Control Point along the whole food chain (Powell *et al*., 2002). According to Oranusi *et al* (2003), the (HACCP) strategies identifies hazards associated with different stages of food preparation and handling, assess the relative risk and identifies point where control measures would be effective in order to ensure that the final product is safe for the consumer. The systematic approach has been described as the most effective means of controlling food borne disease (Ropkins and Beck, 2002). HACCP is used in the food industry to identify potential food safety hazards so that key actions known as (CCP) can be taken to reduce or eliminate the risk of the hazards being (Okonko *et al*., 2009) rather than finished product inspection. Processors of fermented foods will find information in this guidance that will help identify hazards that are associated with these products and help them formulate control strategies. Another purpose of this work or guidance is to help consumers and the public generally to understand food safety in terms of hazards and controls. This study is thereby of public health importance.

Aim

This is to determine the Hazard Analysis and Critical Point of Ogi and its liquor as affected by handler's hygiene.

Specific Objectives

To determine the bacteria that is associated with different stages of Ogi preparation.

To determine the growth and survival of pathogenic bacteria isolated in the Ogi and its liquor.
To assess the hazard associated with this food and identify the Critical Control Point (CCP) of the food.

MATERIALS AND METHODS

A cross sectional study was conducted from August, 2014 to October, 2014 (3months) with an overall aim to determine the Hazard Analysis and Critical Control Point of Ogi as affected by handlers hygiene which was prepared under a good hygienic condition at the Department of Science Laboratory Technology, Microbiology and Biochemistry Laboratory of the Federal College of Animal Health and Production Technology, Moor Plantation, Apata, Ibadan, Oyo state.

Study Area

The study area was located in Oyo State (Southern Nigeria), situated at 7.85^0 North latitude and 3.93^0East longitude. Samples used for the study was gotten from the Apata Market, Apata and prepared following the simple traditional method of preparation of Ogi in Oyo state.

Sample Size Determination And Sample

Collection

Since our primary goal was to identify the Hazard and Critical Control Points of Ogi, the number of sample collected is of less significance. Corn was bought from Apata Market, Apata and processed using the normal traditional method.

Preparation of Media

Suitable media was used for the counting and enumeration of microorganisms present in the Ogi sample. The media were prepared according to Manufacturer's instruction.

Preparation of Initial Suspension

Stock culture was prepared from each level ranging from maize washing to wet milling. Serial decimal 10 fold dilution was done by transfer of one millimeter of initial suspension (10^{-1}) into a tube containing 9ml of sterile 0.1% (w/v) peptone water. The mixture was then homogenized to make 10^{-2} dilution, these operations were repeated all through to 10^{-6} dilutions.

Spread Plate Method

This was done by using 0.1ml of different serial decimal dilutions which was added to the appropriate solidified plate count agar which was then spread over the entire surface of the agar plate. The plates were incubated at 37^0C for 24 – 48 hours.

Isolation of Microorganisms In Ogi (Cornmeal)

Total microbial counts were counted differently for each of the parameter used. The Aerobic Plate Count were counted on Nutrient agar, *Bacillus* was counted on Mannitol egg yolk agar, *Staphylococcus* was counted on Mannitol salt agar, Coliform count was counted on Eosin Methylene blue agar, *Salmonella* was counted on Salmonella-Shigella agar while mold and yeast count was done on Sabouraud Dextrose agar(SDA) by a duplicated surface spread method. The counts that were found to be less than 10 were termed too few to count while those above 300 were termed too numerous to count.

Characterization Of Bacterial Isolates

This was based on two criteria namely: cultural characteristics and biochemical characteristics of the colonies. All isolates were cultured in duplicate and incubated aerobically at 37^0C.The colonies were observed on the agar medium plates while the cell-morphology was observed microscopically after staining.

Growth And Survival Of Pathogens In Ogi Samples

This was carried out as described by Mamajoro (2009) with slight modification. Ogi samples were inoculated with 0.5ml of McFarland standard of each of the pathogens used (*Staphylococcus aureus, Escherichia coli 0157:117*).This was then mixed with a sterilized glass rod and incubated at room temperature. Sampling was carried out at 0, 6, 12, 18, and 24 hours intervals. The plating was done on selective media such as Mannitol Salt Agar (MSA), Eosin Methylene Blue (EMB) by surface spread method. The plates were incubated at 37^0C for 18 to 24 hours and then the number of colonies forming unit per gram (cfu/g) of sample was calculated according to surface spread method.

Statistical Analysis

The Statistical Software SPSS 16 for windows was used for statistical analysis. Microbial load was determined using Log_{10} of Colony Forming Unit per gram of sample while ANOVA was used to determine and compare the mean of the counts at various stages of Ogi preparation. The level of significance was taken as $P<0.05$. The death equation was also used to calculate the length of survival of all the pathogens using the equation below;

$$X_t = X \quad = \quad Kd = \quad \text{Log}\frac{X_t}{X_0}$$

$$T = -\ln\frac{(X_t - X_0)}{Kd}$$

Where; X_t = Final concentration of viable cells,
X_0 = Initial concentration of viable cells,
Kd = Specific death rate, T = Time

RESULTS

From the results, it shows that all the parameters examined decreased by approximately 0.05, 0.50, 0.22 and 0.38 Log unit for Aerobic Plate Count, Staphylococcal Count, Coliform Count, and Mold Count except for Bacillus count that increased by 0.621 Log unit in the " after steeping stage". All this parameters however, further increased after wet milling stage with the Aerobic Plate Count, Bacillus Count, Salmonella-

Shigella Count and Coliform Count increasing by 7%, 45%, 2%, and 30% respectively while the Mold Count remained constant. Consequently, all the examined parameters diminished by approximately 1.11,0.99, 1.31 and 1.94 log unit for Aerobic Plate Count, Bacillus Count, Staphylococcal Count and Coliform Count while Mold Count was found to be less than 1 log unit after the Ogi sample was held overnight.

Table 1 Microbial counts, processing temperature and pH at various stages of Ogi preparation.

Procedure sampling	Period of count Log_{10} CFU/ml	Temperature (^{0}C)	pH
Maize washing			
APC	3.60		
BC	1.50		
SC	3.40		
CC	3.40	27^{0}C	-
SSC	Nil		
MC	1.92		
YC	Nil		
After steeping			
APC	3.55		
BC	2.12		
SC	2.90		
CC	3.18	27^{0}C	-
SSC	Nil		
MC	1.54		
YC	Nil		
After Wet Milling			
APC	3.62		
BC	2.57		
SC	2.92		
CC	3.48	27^{0}C	4
SSC	Nil		
MC	1.54		
YC	Nil		
Holding Overnight			
APC	2.51		
BC	1.58		
SC	1.61		
CC	1.51	27^{0}C	3
SSC	Nil		
MC	< 1		
YC	Nil		

Keys; **APC**-Aerobic Plate Count, **BC**- Bacillus Count, **SC**- Staphylococcal Count, **CC**- Coliform Count**, SSC**-Salmonella-Shigella Count, **MC**- Mold Count**, YC**- Yeast Count.

Table 2 Mean and Range of microbial count of Ogi prepared

Parameters	Ogi samples Counts Log_{10} CFU/ml
Aerobic Plate Count	
Mean	3.48
Range	3.58
Staphylococcal Count	
Mean	3.02
Range	3.39
Coliform Count	
Mean	3.25
Range	3.48
Bacillus Count	
Mean	2.16
Range	2.53
Mold Count	
Mean	1.60
Range	1.86
Yeast Count	
Mean	Nil
Range	Nil
Salmonella Count	
Mean	Nil
Range	Nil

From the table above, it shows that the Coliform Count observed in this study constitutes majority of the number that makes up the Aerobic Plate Count. This was closely followed by Staphylococcal Count and then the Bacillus Count. Salmonella and Yeast were completely absent. The range of all the parameters examined in this study were from 0 log unit for Salmonella and Yeast count through 1.86, 2.53, 3.48 and 3.39 for Mold count, Bacillus count, Coliform count and Staphylococcal count to 3.58 log unit for Aerobic Plate Count

Table 3 a comparative study of the level of microbial contaminants at different level of (corn meal) Ogi preparation

Parameters	Microbial Counts Log_{10}(mean ± SD)
Maize washing	3.96 ± 0.38
After steeping	3.78 ± 0.39
After wet milling	3.93± 0.38
Holding overnight	2.65± 0.37

The sample in the table above was statistically compared using Analysis of Variance (ANOVA) and it was found that the mean microbial load was relatively higher at the "maize washing stage" compared to the remaining stages. This was closely followed by the microbial load at the "after wet milling stage" (3.93 ±0.38.The lowest microbial counts of 2.65±0.37 was observed in the "holding overnight" sample (F value = 193.4, P value = 0.05).

Table 4 media used for the presumptive bacterial pathogens in (corn meal) uncooked Ogi

Bacterial	Selective Broth	Selective Agar	Description of colonies
E. coli 0157:H7	MacConkey Broth	Eosin Methylene Blue Agar	Blue-Black Metallic sheen
S. aureus ATCC 25922	Mannitol Salt Broth	Mannitol Salt Agar	Yellow Halo-growth

Table 5 the specific death of the presumptive bacterial pathogens in uncooked Ogi

Bacterial	Period(days)	Specific death(d^{-1})	Specific death(h^{-1})
E. coli 0157:H7	0d – 1d	57.6	2.40
S.aureus ATCC 25922	0d – 18hours	59.04	2.46

In the table above, *E. coli* 0157:H7 die at a specific rate of 57.6% per day and 2.40 per hour while *S. aureus* was found dying at 59.04% per day and 2.46% per hour. This means that at a specific time *E. coli* and *S. aureus* dies at the mentioned rate per the total number of organism at that stage.

Assuming
X_t = 100 colonies at 12 hours for *E. coli* 0157:H7,
X_0 = 100,000 colonies,
Kd = $Log = \frac{X_t}{X_0}$
$T = -ln\frac{(X_t - X_o)}{Kd}$
X_t = 20 at 18hours and X_o = 100,000 at initial stage.

The Critical Control Point is the holding overnight stage. This is the stage at which all the microbial load witness a considerable reduction in counts. The likely source of contaminations were also observed to be the steeping stage while the main source of contamination no doubt the after wet milling stage.

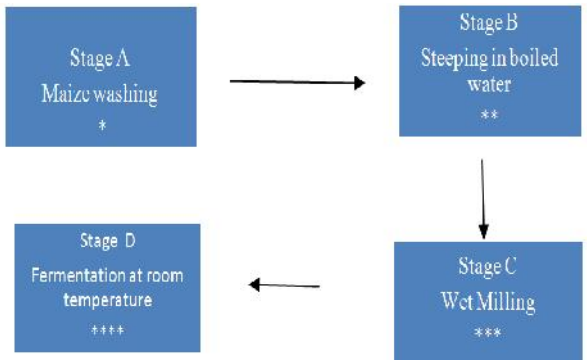

Fig I dentification of the Critical Control Point in corn meal (Ogi).

Keys

*	Probable source of contamination
***	Main source of contamination
****	Critical Control Point

DISCUSSION

This HACCP study revealed that factors such as poor hygiene, exposed and irregularly cleaned milling machine, exposed food products contributes to the contamination of Ogi prepared. The fact that all the parameters used for assessing the microbial load of Ogi sample examined decreased by approximately 0.05, 0.50, 0.22 and 0.38 Log unit of Aerobic plate count, Staphylococcal count, Coliform count and Mold count clearly demonstrates that the steeping procedure had an effect on the parameters examined except for Bacillus count that increased by 0.62 Log unit. This observation may be due to the fact that some strains of the organism cannot withstand steeping temperature while the spores of Bacillus are able to withstand heat at ambient temperature (Willey *et al*., 2008). A considerable increase was thereafter observed at the wet stage which could be as a result of contamination from the milling machine (Berghofer *et al*., 2003); Alkharaiyi and Omoya, 2008) but disagree with findings of Oyelana and Coker (2012) whose study showed a progressive decrease from the maize washing stage to the fermentation stage which could be as a result of environmental factors such as pH (Mamajoro, 2009) or difference in strains of maize used i.e. the intrinsic factors (Willey *et al*., 2008). The presence of Coliform count at a relatively high rate in this study is an indication of fecal contamination which is associated with poor environmental sanitation (Trevett *et al*., 2005) which includes genera that originate in faeces as well as genera not of fecal origin. Staphylococcal count which is also high represents a very important food hazard and some strains of this organism under a very good micro- environmental condition produces enterotoxins which are highly resistant and thought to be more heat resistant in food stuffs (Bergdoll, 1983). Bacillus which is also present at a considerable level before the fermentation stage is not surprising as this commodity is commonly with Bacillus spores, some of which produces toxic compounds or antibiotics which are inhibitory that causes periodontal diseases and other serious infections like Keratitis, Endophthalmitis (Hoffmaster *et al*., 2006 and Kotiranta *et al*., 2000). The Mold count though very low but their growth and survival in food signifies the risk of Mycotoxins contamination which is anti-nutritional factor (Cardwell, 1999). Consequently, all these microbial parameters witnessed a drastic decrease at a very significant rate when the Ogi sample was allowed to ferment itself naturally which is not surprising as fermentation has been linked with the potential of inhibiting the growth of most pathogenic organisms and some anti- nutritional factors in addition to increasing shelf life and enhancing the organoleptic quality of food (Caplice and Fitzgerald, 1999; Yasmine, 2002). The growth and survival of the *Escherichia coli* and *Staphylococcus aureus* in Ogi confirmed that Ogi sample does not enhance the growth of pathogens tested at room temperature but only support their survival for a short period of time being 24 hours as *E. coli* has been observed to survive for a longer period of time than *S. aureus* (18 hours) because of its ability to tolerate and withstand low pH and high titrable acidity condition of the food (Oshoma *et al*., 2009). The survival of these organisms for only a short period of time may be due to decrease in the pH of the food and increase in titrable acidity (Oshoma *et al*., 2009). Other mechanisms that might also contribute to the decline in population is the presence of some, micro flora such as lactic bacteria present in the Ogi which have the potential to inhibit the growth of pathogenic and spoilage micro- organisms thereby improving the hygienic quality and extending the shelf life of such food (Caplice and Fitzgerald, 1999). The Critical Control Point for the Hazard Analysis of Ogi in this study is the holding overnight stage where fermentation started which should be allowed to take place long enough to kill or inhibit pathogenic micro-organisms.

CONCLUSION

Food handlers and environment could be important reservoirs for pathogenic bacteria but studies shows that pathogens investigated cannot grow but only survive at room temperature in the antimicrobial components.

Recommendation

A strict microbiological safety measure should be employed during production period of food and post process, contamination should be avoided in order to ensure a safer product to the consumer. HACCP system should therefore be introduced and enforced in the traditional preparation of food.

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