

## EVALUATION OF MICROORGANISMS AT DIFFERENT STAGES OF PRODUCTION OF OGI IN ALIMOSHO COMMUNITY, AREA SOUTHWEST, LAGOS, NIGERIA

**\*\*O.M. Akinleye<sup>1</sup>, I.O. Fajolu<sup>1</sup>, A.K. Fasure<sup>1</sup>, O.S. Osanyinpeju<sup>1</sup>, A.O. Aboderin<sup>1</sup>, O.O. Salami<sup>2</sup>**

<sup>1</sup>Department of Medical Microbiology and Parasitology, Faculty of Basic Medical Sciences, College of Health Sciences, Olabisi Onabanjo University P.M.B 2002; Ago-Iwoye, Ogun State, Nigeria

<sup>2</sup>Department of Microbiology Unit, Federal College of Animal Health & Production Technology, Ibadan, Oyo State, Nigeria

**\*\*Corresponding Author:** Oludele. M. Akinleye, Department of Medical Microbiology & Parasitology, Obafemi Awolowo College of Health Sciences, Olabisi Onabanjo University, P.M.B. 2002, Sagamu. Ogun State, Nigeria. +234-(0)-803-361-9845;

Email: [akinleye.mathew@yahoo.com](mailto:akinleye.mathew@yahoo.com)

### ABSTRACT

Traditional method of preparation was simulated in the laboratory fermentation of maize to produce Ogi. The maize grains were steeped for 72hr; wet milled, sieved and fermented for 48hr separately at 32±2°C by the maize natural microflora. The mould and bacterial isolated were identified using standard cultural, microscopic and biochemical methods. The pH of Ogi was determined using pH meter while titratable acidity was determined by titration method. The moulds isolated were *Aspergillus niger*, *Aspergillus flavus*, *Fusarium oxysporium* and *Penicillium* species. The yeasts isolated during the fermentation period include *Mucormucedo*, *Saccharomyces cerevisiae*, *Rhizopus stolonifer* and *Candida albicans*. Seven bacterial were also isolated with *Lactobacillus plantarum* has the highest isolation rate 10.31%, followed by *Lactobacillus fermentum* and *Staphylococcus aureus* 9.28% each respectively. *Escherichia coli* 6.19%, *Klebsiella* spp 5.15%, *Pseudomonas aeruginosa* 4.12% and *Corynebacterium* spp 2.06%. The temperature of fermenting maize

remained relatively constant between 28<sup>o</sup>c to 32<sup>o</sup>c throughout the fermentation.

The pH decreased and titratable acidity increased during fermentation.

Despite the unhygienic wet-milling and wet sieving processes involved in the traditional preparation of Ogi, the low pH of the fermented products would make them safe for consumption. Appropriate safety measures and good manufacturing practices will ensure good quality of product.

**Key words:** Ogi, fermentation, moulds, maize, Lactic acid bacteria and yeasts.

{**Citation:** O.M. Akinleye, I.O Fajolu, A.K Fasure, O.S Osanyinpeju, A.O Aboderin, O.O Salami. Evaluation of microorganisms at different stages of production of Ogi in Alimosho Community, Area Southwest, Lagos, Nigeria. American Journal of Research Communication, 2014, 2(10): 215-230; [www.usa-journals.com](http://www.usa-journals.com), ISSN: 2325-4076.

## INTRODUCTION

The traditional preparation of maize Ogi involves soaking of maize in water for 1 to 3 days followed by wet milling and sieving to remove bran, hulls and germs (Akinrele et al; 1970, Akingbala et al., 1981; Odunfa, 1985). The pomace is retained on the sieve and later discarded as animal feed while the filtrate is fermented (for 2-3 days) to yield Ogi, which is sour, white starchy sediment (Odunfa, 1985).

Maize products are the cheapest and readily available fermented foods for infants and young adults in most tropical countries (Torre et al, 1991). They are important energy food rich in carbohydrates and with traces of vitamins,

proteins and minerals (Achternberg et al., 1994; FAO, 2009) and are natural antioxidants (Eaton and Nelson, 1991). The importance of vitamins as antioxidants was aptly discussed by Singh and Sachan (2011).

Fermented foods are of great significance because they provide and preserve vast quantities of nutritious foods in a wide diversity of flavours, aromas and textures which enrich the human diet. Fermented foods have been with us since humans arrived on earth. They will be with us far into the future as they are the source of alcoholic foods/beverages, vinegar, pickled vegetables, sausages, cheeses, yogurts, vegetable protein, amino acid/peptide sausages, cheese, yogurts, vegetables protein amino acid/peptide sauces and pastes with meat like flavours, leavened and sour-dough breads (Steinkraus, 1997).

Nigeria is endowed with a wide range of fermentable indigenous staple foods that serve as raw materials for agro allied-cottage industries. These industries utilize small-scale equipment and provide alternative equipment for rural communities while adding value to such local porridge (Latunde -Dada, 2000). One common example of indigenous fermented foods in Nigeria is Ogi.

The wet fermented porridge is prepared and consumed as Ogi; Akamu and Akassan among the Yorubas, Ibos and Hausas in the west, east and northern Nigeria, respectively (Praveen and Hafiz, 2003). These maize products are common in seemingly poor and impoverished communities across the developing countries (Inyang and Idoko, 2006). These fermented products are largely from zea mays, *Oryza Sativa*, *Sorghum Valgare* and *Triticum aestivum*. Their production is often by small-scale enterprise undertaken by unskilled female attendants (Aminigo and Akungbale, 2004).

The inclusion of Fumonisin and aflatoxins in maize (Jespersion et al., 1994) and other cereal products (Fandohan et al; 2005, Shepherd et al; 2002) has been linked to certain species of fungi including *Aspergillus*, *Penicillium*, *Rhizopus* and *Fusarium* by Omemu et al; (2005).

The cinogenic effects of this contamination were extensively discussed by Shepherd et al., (2002). Few of these toxins including FBI are associated with

high degree of cancer in rats and humans. Hendricks (1999) and Barug et al. (2004) warned of the health implication of consuming mycotoxins contaminated maize products. Fandohan et al. (2005) Warned of the danger of using the supernatant of Ogi as solvent to extract active ingredients from traditional herbal plants because of probable high level of Fumonis. A positive correlation between the level of aflatoxins and the incidences and severity of kwashiorkor in infants Adhikari et al., 1994 has been established. They also discovered a significantly low hemoglobin level, longer oedema and increased infection rate in children that were positive for aflatoxins.

Ogi is either consumed as porridge (pap) or as a gel-like product (Agidi) by a very large number of Nigerians. Pap however is the most important traditional food for weaning infants and the major breakfast cereal for adults especially the low income earners that cannot afford imported baby food (Onyekwere et al., 1989).

The objective of this study is to determine the critical points of contamination in the preparation of Ogi, isolate and characterized microorganism associated with indigenous fermentation of the different maize varieties.

## **MATERIALS AND METHODS**

**Collection of samples:** This study was carried out in Alimosho Local Government in Lagos State between March, 2013 to June, 2014. There varieties of maize were purchased at the two difference local government markets, they were brown local, white local and yellow farmers.

For this study, three difference water reservoirs were used plastic tanks, drums and metal tanks maize grains, steep water from mashed grains, paste, filtrate from paste and fermented slurry (wet pap).

Swaps from fungi nails, clothes and cooking utensils were collected using most sterile swab stick.

The maize grains were sieved to remove pebbles and dirt and subsequently soaked in water for 3 days. The soft grains were mashed, milled and sieved using Muslin cloth. The solid paste was diluted with water and left to ferment for 48-72 hrs. The surface water was decanted and the sediment (wet slurry) was collected in a bowl and allowed to stand for 10-12hrs to sufficiently solidify.

The solidified slurry was portioned into small units or cubes and wrapped in leaves or polythene bags ready for sale.

**Media preparation:** The number and type of microorganisms (bacteria, yeast and fungi) per ml, of the fermenting substrate was estimated daily for 72hrs by pour plate method using the serial dilution technique. The techniques described by Arora and Arora (2008) and Willey et al., (2008) were employed in preparing the Potato Dextrose Agar (PDA) and Mueller Hinton Agar to obtain pure cultures of the fungal and bacterial isolates, respectively.

The isolated organisms were characterized by using conventional methods (Cowan and Steel, 1985; Barnett and Hunter, 1972). The pH of the fermenting substrates was measured daily on a Jenway pH meter standardized with the appropriate buffers.

The pH of the Ogi samples were determined manually, using JENWAY 3016 digital pH meter; Standardization (calibration) of the pH meter was done using buffer solution of pH 7 and 4. The samples were determined at 72hrs intervals.

The titratable acid (TA) of Ogi samples were analyzed at the same time interval by titrating 0.1M NaOH solution and methyl red as an end point indicator. The titre value of each homogenate was determined as percentage lactic acid consuming definite volume of 0.1M NaOH.

**Biochemical tests analysis:** The techniques described by Cheesbrough (2000) were employed for the Gram staining while the citrate utilization, hydrogen sulphide production test and sugar fermentation and oxidase tests were as, respectively described by Mac Williams (2009) and Cowan and Steel (2002). The

isolates were later identified using Bergey's manual described by Brenner et al; (2005). Confirmation of coliforms was as described by Willey et al; (2008), using selective and differential media such as Mac Conkey and Mannitol salt agar to analyses for *E. coli* and *Klebsiella* spp and *Staphylococcus aureus*, respectively. The presumptive test in broth was streaked out on Mueller Hilton agar and incubated at 37°C for 48hrs, for morphologically characterize the isolates.

## RESULTS

Seven bacterial and eight fungi species were identified in this study:

In case of bacterial isolate, *Lactobacillus plantarum* has the highest value (10.31%) while *staphylococcus aureus* and *lactobacillus fermentatum* were (9.28%) each respectively. *Aspergillus niger* has the highest occurrence in fungi isolated (13.4%) followed by *Aspergillus flavus* (11.4%) while *Fusarium oxysporium* and *Pencillium* spp were (10.3%) and (5.2%) respectively (table 1).

The bacteria isolated were *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* species and *Corynebacterium* species. *Lactobacillus plantarum* and *lactobacillus fementum* were the only bacteria identified during secondary fermentation.

Eight different fungal species were isolated during primary fermentation (steeping). The fungi were *penicillim* spp., *Rhisopus stolonifer*, *Mucor mucedo*, *Aspergillus niger*, *Candida albicans*, *Aspergillus flavus*, *Saccharomyces cervisiae* and *Fusarium oxysporium*.

Table 2 shows the biochemical characteristics of bacteria isolated from the fermenting substrates.

Table 3 shows the duration of storage, pH and titratable acid of fermented different Ogi. As the titratble acid increase the pH value decreases. Table 4 and 5, show the total bacteria and fungi count during the steeping of maize varieties.

**Table 1: Percentage of microorganism isolated from the three varieties of maize**

Group	Microorganism	Number	%
Bacteria	Lactobacillus fermentum	9	9.28
	Lactobacillus plantarum	10	10.31
	Pseudomonas aeruginosa	4	4.12
	Staphylococcus aureus	9	9.28
	Escherichia coli	6	6.19
	Klebsiella spp Kl.ebs	5	5.15
	Corynebacterium spp	2	2.06
Fungi	Aspergillus flavus	11	11.34
	Aspergillus niger	13	13.40
	penicillum spp	5	5.15
	Fursarium oxysporium	10	10.31
	Rhizopus stolonifer	3	3.09
	Mucor mucedo	3	3.09
Yeasts	Saccharomyces cervisiae	3	3.09
	Candida albicans	4	4.12
Total		97	100%

**Table 2: Morphological and biochemical characteristics of bacteria from fermenting substances**

Bacteria isolated	Cit	Ur	NiRed	Ind	Xul	Sor	Fru	Arab
Corynebacterium spp	ND	*	+	*	*	+	+	+
Lactobacillus fermentatum	ND	ND	*	*	*	*	*	+
Lactobacillus plantarum	ND	+	+	*	*	+	+	+
Staphaureus aureus	*	+	+	*	*	+	+	
Kleb spp								
Esherichia coli								
Pseudmonas aeruginosa								

Bacteria isolated	Lac	Mal	Su	Man	Glu	G/a	G/A	Ca
Corynebacterium spp	*	+	*	*	+	TAG	*	+
Lactobacillus fermentatum	+	+	+	*	+	TAG	+	*
Lactobacillus plantarum	+	+	+	+	+	TAG	+	*
Staphaureus aureus								
Kleb spp								
Esherichia coli								
Pseudmonas aeruginosa								

Corynebacterium

Rod – Shape

Lactobacillus fermentatum

Rod – Shape

Lactobacillus plantarum

Rod – Shape

Staphylococcus aureus

Cocci Shape

Cit = Citrate; Ur = Urease; NiRed = Nitrate Reduction; Ind = Indole; Xyl = Xylose;

Sor = Sorbitaol, Fru = Fructose; Arab = Arabinose, Lac = Lactose; Mal = maltose;

Su = Sucrose; Man = Mannitol; Glu = Glucose; G(a) = Glucose (Acid); G/A= Growth in air; Ca = Catalase.



**Table 3: Duration of storage, pH and titratable acid of fermented Ogi**

Duration of storage for days	0	3	6	9	12	15
pH	6.4	6.1	6.0	5.1	5.2	5.0
Titratable	0.13	0.14	0.17	0.24	0.33	0.39

Mean pH value =  $5.0 \pm 1$

Mean titratable acid value =  $0.01 \pm 1$

**Table 4: Total bacteria counts during the steeping of maize varieties ( $10^5$  CFC – ML<sup>-1</sup>)**

Time (h)	White maize	Maize varieties yellow maize	Brown maize
0	$6.0 \times 10^5$	$4 \times 10^5$	$2 \times 10^5$
24	$8.0 \times 10^5$	$6 \times 10^5$	$4 \times 10^5$
48	$15.0 \times 10^5$	$14 \times 10^5$	$11 \times 10^5$
72	$17.0 \times 10^5$	$16 \times 10^5$	$15 \times 10^5$

**Table 5: Total Fungai counts during the steeping of maize varieties ( $10^3$  CFC MI<sup>-1</sup>)**

Time (h)	Maize varieties		
	White maize	yellow maize	Brown maize
0	$2.0 \times 10^3$	$1.0 \times 10^3$	$1.0 \times 10^3$
24	$3.5 \times 10^3$	$2.5 \times 10^3$	$2.0 \times 10^3$
48	$4.0 \times 10^3$	$3.5 \times 10^3$	$3.0 \times 10^3$
72	$4.5 \times 10^3$	$4.0 \times 10^3$	$3.0 \times 10^3$

## DISCUSSION

The outbreak of infections and communicable diseases in tropical parts of the world is primarily as a result of food poisoning due to microbial contamination (Jay, 2005). They are often responsible for acute gastroenteritis, abdominal discomfort, pain and diarrhea in infants and young adults (WHO; 2010, Kimmonon et al; 1999). A total of 15 micro-organisms were obtained from fermenting maize steep for Ogi production, seven bacterial and eight fungi, *Lactobacillus plantarum* 10 (10.31%), *Lactobacillus fermentum* 9 (9.28%), *Staphylococcus aureus* 9 (9.28%), *Aspergillus niger* and *Aspergillus flavus* were 13 (13.40%) and 11 (11.34%) respectively. The isolates were subjected to various morphological, physiological and biochemical characterization. The characterization exhibited by the isolates were compared with those of standard strains for their identification (Sneath et al; 1986; Sharpe; 1997). The presence of moulds at the initial stage of fermentation of maize for Ogi production and the subsequent elimination had been reported previously (Jespersen et al., 1994; Omemu et al; 2007a). mucoracea fungi have roles in initial phase of fermentation mostly in sacharification of the substrates (Thapa and Tamang, 2004). The researchers also confirmed the major involvement of *Lactobacillus* bacteria in Ogi fermentation. They were obligatory or facultative heterofermentative rods and cocci which were present throughout the process. From the beginning to the end of the fermentation, their number increased 2-4 log units. Their growth was followed by the acidification of the product.

An interesting finding in this study is the fact that, in this work the *L. plantarum* and *Aspergillus niger* had the highest percentage of 10.31% and 13.40% respectively, which is in line with other studies on other types of fermented products reported that *Lactobacillus* bacteria were the predominant micro-organisms involved in the fermentation of products like Kenkey, Gari, Agbelima, with *L. plantarum* being identified most often (Amoa-Awua et al;1996; Kostinek et al; 2005).

The pH of fermenting maize grains dropped from 6.4 to 5.0 by the end of the 15 days. Correspondingly, the titratable acidity increased from  $0.13 \pm 0.01$  to  $0.39 \pm 0.01$  after 15 days. The cause of the increase in acidity and consequent drop in pH during fermentation of cereal was likely due to utilization of free sugars by yeast and lactobacillus bacteria (Efiuvwevwere and Akona, 1995; Zvauya et al; 1997). The total sugar contents decrease significantly ( $P < 0.05$ ) throughout the fermentation. This due to a maximum break down of starch substrates to reducing sugars by amylolytic enzymes produced by some of the fermenting organisms (Nout and Aidoo, 2002).

The initial count of bacteria (immediately after steeping) was highest in white maize (WM) (Table 4), with  $6 \times 10^5$  CFU ml<sup>-1</sup> while it was  $4 \times 10^5$  and  $2 \times 10^5$  CFU ml<sup>-1</sup> for yellow maize (YM) and Brown maize (BM), respectively. After 24<sup>th</sup> of steeping or primary fermentation, WM still had the highest bacterial load of  $8.0 \times 10^5$  CFU ml<sup>-1</sup>. The bacterial load after 48h in both YM and WM was  $14 \times 10^5$  and  $15 \times 10^5$  CFU ml<sup>-1</sup> respectively. Generally, a sharp increase in bacterial load was obtained after 24h of steeping, this slowed down after 48hr in both YM and WM was  $14 \times 10^5$  and  $15 \times 10^5$  CFU ml<sup>-1</sup> respectively. Generally, a sharp increase in bacterial load was obtained after 24h of steeping, this slowed down after 48hr and a slight difference in bacteria load was observed after 72hr of steeping or primary fermentation.

Table 5 shows changes in fungal counts during the 72h of steeping or primary fermentation of the three maize varieties. For BM was,  $1.0 \times 10^3$ ,  $2.0 \times 10^3$ ,  $3.0 \times 10^3$  and  $3.0 \times 10^3$  CFU ml<sup>-1</sup>, for YM, it was  $1.0 \times 10^3$ ,  $2.5 \times 10^3$ ,  $3.5 \times 10^3$  and  $4.5 \times 10^3$  CFU ml<sup>-1</sup> at zero hour and after 24, 48, 72h respectively.

The yeast count also increased during the fermentation of maize for Ogi-production. The coexistence and symbiotic association between Lactic acid bacteria and yeast in Africa traditional fermented products have been reported by several authors (Jespersen et al., 1994; Omemu et al., 2007a). Besides their role in the build up of typical flavour of fermented product. Some yeast has been reported to show enzymatic ability may contribute to

breaking down maize starch and also allow better access to nutritionally essential minerals (Amoa-Awua et al., 1996; Omemu et al; 2007b).

## CONCLUSION

Water samples were major sources of microbial contamination of products at all the stages of production. Despite the unhygienic wet-milling and wet-sieving processes involved in the traditional preparation of Ogi, the low pH of the fermented products would make them safe for consumption. Appropriate safety measures and good manufacturing practices will ensure good quality of product.

## REFERENCES

1. Achterberg, C.E Mc Dowell and R. Badby, 1994. How to put the food guide pyramid into practice .J. Ani. Diet Association., 94:1030-1035.
2. Adhikari, M.G. Ramfee and P. Berjak, 1994, Aflatoxi, Kwashiorkor and morbidity-natural toxins, 2:1-3.
3. Akingbala, J.O, L.W. Rooney and J.M Faubion, 1981. A laboratory procedure for the preparation of Ogi, a Nigerian fermented food, J. food Sci., 46:1523-1526.
4. Akinrele, I.A, O Adeyinka, C.C.A Adwards, F.O Olatunji, J.A Aina and A.O Koleoso, 1970. The development and production of Soy-Ogi a corn based complete food FIIRO, Research Report No 42.
5. Aminigo, E.R. and J.O Akingbala, 2004. Nutritive composition and sensory properties of Ogi fortified with Okra seed meal .J. Biotechnol., 8:23-28.
6. AmoA-Awua WK, Ngunjiri P. Anlobe J, Kpodo K, Halm M, Hayford A.E and Jacobsen M. The effect of applying GMP and HACCP to traditional food processing at a semi-Commercial Keneky production plant in Ghana food control 1996. 18:1449-1457.
7. Arora, D.R and B. Arora, 2008. Textbook of microbiology, 3<sup>rd</sup> edi., CBS publishers and distributors, new Delhi, India, pages:771

8. Barnett, H.L and B.B Hunter, 1972. Illustrated General of imperfect fung 3<sup>rd</sup> edition, Mmnesota Burgles Publishing company, Mmneapolis, pp: 241.
9. Barug, D.H.Van Enmond, R, Lopez-Garcia, T. ran Oscibruggen and A. Visconti; 2004. Meeting the mycotoxin menace wageningen Academic Publishers, The Netherlands ISBN: 9076998280, pages:320
10. Brenner, J.R Kreig and T. Stanley, 2005. Bergey's manual of systematic bacteriology. The Pro bacteria, Part A. Introductory Essay, 2:587-848.
11. Cheebrough, M., 2002, District Laboratory Practice in Topical Countries Cambridge University Press, Cambridge, pp:97-182.
12. Cowan, S.T and K.J Steel, 2002. Manual for the identification of medical bacteria. 2<sup>nd</sup> edi., Cambridge University press. Cambridge, UK., pp51-120.
13. Cowan, S.T and K.J. Steel, 1985. Manual for the identification of Medical Bacteria. Bacteria Cambridge university press. Pp: 45-60.
14. Eaton, S.B and D.A Nelson, 1991 Calcium in evolutionary perspective. Am. J. Clin. Nutri., 54:2815-2875.
15. Efiuvwenwere Bjo, Akona O. the microbiology of Kunuzaki, a cereal beverage from northern Nigeria during the fermentation (production) process. Woihd J. microbial. Biotechnol 1995. 11:491-493.
16. Fandohan, P.D Zoumenou, D.J Hoimhoisgan, W.F.O Marasas, M.J Windfield and K. Hell, 2005. Fate of aflatoxins and Fumonsim during the processing of maize into food products in benin into J. food microbial., 98:249-259.
17. FAO, 2009, maize, rice and wheat; area harvested, production quantity, yield. Food and Agriculture organization of the United Nations, Statistics Division 2009.
18. Hendricks, K., 1999 Fumonisms and neural tube defects in South texas. Epidemiology, 10:198-200.  
<http://www.microbelibrary.org/component/resource/laborartory-test/3203>.

19. Inyang, C.D and C.A, Idiko, 2006, assessment of the quality of Ogi made from matted Millet afr. J. Biotechnol., 5:2334-2337.
20. Jay, J.M; 2005. Modern food microbiology, 4<sup>th</sup> Edn; CBS Publishers and Distributors, New Delhi, India, ISBN: 81-239-0475-4, Pages: 701
21. Jespersen, L., M. Halm, K. Kpodo and M. Jacoben, 1994. Significance of yeasr and moulds occurring in maize dough fermentation for Kenkey production int. J. food microbial., 24:234-248.
22. K.H. Steinkraus, "fermentations in World food processing,: Comprehensive Reviews in food science and food Technology. Vol 1, No 1, 2002, pp. 23-32.
23. Kimmons, J.E; K.A.H Brown, A Lartey, E. Collison, P.P.A Mensah and K.E. Dewey, 1999. The effects of Fermentation and/or Vacuum Flask storage on the preseence of coliforms in complementary foods prepared for Ghanian children. Int. J. Food Sci. Nutr., 50:195-201.
24. Kostinek M. spent I. Edward V.A Schillinger U, Hertel C and Holzapfel WH diversity and technological properties of predominant Lactia Acid bacteria from fermented cassava used for the preparation of gari, a traditional Africa food systematic and applied microbiology, 2005. 28:527-540.
25. Latunde-Dada, 2000-fermented foods and cottage industrial in Nigeria .J. food sci., 20:1-13.
26. M.E Sharpe, "identification methods for Microbiologists," 2<sup>nd</sup> Edition, Acad. Press soc., 1997, pp. 233-259.
27. Macwilliams, R.T., 2009. Citrate test protocols. Microbe Liberary, American Society of Microbiology.
28. Odunfa, S.A, W.A Olasupo and D.K Olukoya, 1985 Potential of Bateriocius in Food Safety in the Latic fermented Cercal Ogi. In: Traditional fermented food processing in Africa, Halm, M and M Jakobsen (Eds), FRI, DANAIDA, KUL., PP:27-32.
29. Omeme, A.M, O.F, Adeosun, 2005. Evaluation of Hazards and critical control points of Ogi in small scall processing centres in Abeokuta, Nigeria. J. applied Biosc., 29:1799-1773.

30. Omemu AM, Oyewole OB and Bankole MO. Significance of yeast in the fermentation of maize for Ogi production food microbiology 2007b. 24. 571-576.
31. Omemu AM, Oyewole OB, Bankole MO and Akintokun AK yeast and moulds associated with Ogi-a cereal base waning food during storage. Research Journal at Microbiology 2007a.2 (2) 141-148.
32. Onyekwere, O.O., I.A Akinrele and A.O Koleoso, 1989. Industrialization of Ogi fermentation.
33. P.H.A Sneath, N.S. Mair, M.E Sharpe and J.G. Holt, "Bergey's manual of Systematic Bacteriology". Williams Wilkins, Battimore, 1986.
34. Parveeu, S and F. Hafiz, 2003. Fermented cereal from indigerious raw material. Pak. J. Nutr., 2:289-291.
35. Shepherd, G.S., N.L leggott, S. Stockentrom, N.I.M. Sondyala and W.F.O. Marasas, 2002. Preparation of South African maize porridge: Effect on Fumonism Mycotoxin level S. Afri. J. sci., 98:393-396.
36. Singh, V.P and N. Sachan, 2011, vitamin B<sub>12</sub>-a vital vitamin for human health: A review Am. J. food tech., 6:857-863.
37. SteinKraus, K.A., 1997 Classification of fermented foods; Worldwide review of household fermentation technique-food control, 8:311-317.
38. Thapa S and Tamang Jp. Product characterization of Kobo ko jaani: fermented finger millet beverage of the Himalayas food Microbioal. 2004 21:617-622.
39. Torre, M., A.R Rodriguez and F. Saura-Calixto, 1991. Effects of dietary fiber and phytiz acid on mineral availability food sci. Nutri., 1:1-22.
40. WHO, 2010. Nigeria: 2010 Cholera outbreaks-more than 1, 500 Fatalities.  
<http://www.outbrackers.com/forum/showthread.php?t=139473>.
41. Willey, J.M., L.M Shorwood and C.J. woolverton 2008. Prescott, Harley and Wein's Microbiology, 7<sup>th</sup> edi., Mcgraw-Hill Higher Education USA., Pages:1088
42. Zuauya R, Mygoti T and Parawira S. Microbial and biochemical changes occurring during production of Masuusi and Margisi,

traditional Zimbabwean beverages plants food Human Nutrition 1997-51:43-51.