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Microbiological hazard and critical control points identification during household preparation of cooked *ogi* used as weaning food

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Abstract: This study identifies potential microbiological hazards and critical control points (CCPs) associated with cooked *ogi*- a common weaning food prepared and served in many households in Nigeria. The methods of cooking and storage of the *ogi* was observed; samples were also collected and tested microbiologically at different stages of preparation for total aerobic count, Enterobacteriaceae and Staphylococcal counts. The microbiological counts increased after adding condiments and storage (> 6hr). Irrespective of the cooking method used, the cooked *ogi* attained temperatures capable of destroying vegetative forms of food-borne pathogens. However, the risk of contamination increased by adding ingredients after heat treatment, prolonged storage at ambient temperature and using insufficiently high temperatures to reheat the food. The CCPs identified include purchase of raw *ogi* from street vendors, cooking and storage. There is a need to introduce programme to educate mothers on food safety principles as an integral part of primary health care programme.

Key words: Household, cooking, ogi, weaning, infants and critical control point

Introduction

In developing countries, the beginning of the weaning process in human infants has been associated with an increase in diarrheal episodes as a result of consumption of contaminated weaning foods (Kunene *et al.,* 1999). Reports show that children aged 4–24 months are at the greatest risk of developing diarrhea from contaminated food and water. This is because between 4 and 6 months of age, weaning food is usually introduced to babies and children are thus exposed to food-borne pathogens.

In several developing countries including Nigeria, the statistics on the incidence of food borne diseases are not available, however, the high prevalence of diarrheal diseases, particularly in infants and young children in these countries is an indication of an underlying safety problem. Although the precise extent of food borne diarrhoea diseases in young children is not documented, but a review by Esrey and Feachem (1989) concluded that indirect evidence suggested that 15% to 70% of all diarrheal episodes may be associated with practises of food preparation, handling and storage as well as feeding methods.

One of the traditional lactic acid fermented food used as weaning food in many West African countries is *ogi*; it is produced from lactic acid fermentation of maize, sorghum or millet (Adeyemi, 1993, Omemu *et al.,* 2007a). The fermented *ogi* is either boiled into a thin, smooth porridge called pap or a thick porridge known as *eko* or *agidi* before consumption. The pap is used as the first native food for weaning babies in Nigeria. It also serves as breakfast meal for school children and adults (Odunfa and Adeyele, 1985). Infants from 4 to 6 months old are introduced to *pap* by feeding twice or thrice per day as a supplement to breast milk. The low income earners use the *pap* principally as an infant food because they cannot afford imported baby foods.

Generally, most mothers in Nigeria prefer feeding their infants with food that has been prepared and served from their kitchen, as it is regarded to be warm and free from pathogens. Although this is believed to be so, Bryan *et al.* (1992) and Doyle *et al*. (2001) argue that such foods may not attain temperatures high enough to kill all pathogens and at times ingredients are added to the food after heat treatment.

The main factors which determine food hygiene include handling, preparation techniques and storage practices (Ifediora, *et al.* 2006). In Nigeria, not much work has been done to try and investigate the occurrence of pathogenic microorganisms in cooked *ogi* taking into consideration the method of preparation and storage practices. The present

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study therefore, attempts to identify potential microbiological hazards associated with cooked *ogi* - common weaning food prepared and served in many households in Abeokuta and Lagos, Nigeria; as well as documenting some of the practices that may promote contamination of *ogi*. Such information generated will help in establishing factors affecting the microbiological quality of food which is essential for the prevention of diarrheal infections and hence contribute towards the improvement of management of the diarrheal disease program in the country.

Materials and Methods

Data collection

A total of 104 households having children under the age of 24 months and fed their babies with pap as one of the weaning foods were visited and interviewed within Abeokuta and Lagos State, South-West area of Nigeria. A simple structured questionnaire was used to collect information about the socioeconomic characteristics of the mothers, the preferred weaning foods, the age of the babies at the introduction of the weaning food and the occurrence of diarrhea in the 0-24 month old children. The questionnaires was prepared in English and translated into the local language for illiterate mothers. The questionnaires were pre-tested on 10 households that were not included in the main study.

Equipment used for preparation of food, source of water for both utensil cleaning and cooking, utensil cleaning methods and hand washing were considered as food preparation and handling practices while storage of food and duration of storage were considered as food storage practices.

An unannounced visit was made to some of the mothers during which their usual way of preparing, serving and storing cooked pap was observed. Based on information obtained on-site, a flow diagram of the common method used in cooking the *ogi* was prepared to provide a clear, simple and complete description of all steps in the process.

Determination of critical control points

A Critical Control Point is a step or procedure at which control is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level and whether a loss of control could result in a potential hazard. For example, storage is a CCP if the storage time is not controlled and if food is served without reheating (Ehiri *et al*. 2001).

Preparation of liquid pap

Based on the survey, two common methods of cooking were observed. Method 1**:** Required quantity of raw *ogi* was put in a bowl and mixed with cold water to form a watery paste. Boiling water (100^{o}C) was added and stirred until a semi-solid gruel is formed.

Method 2**:** Required quantity of raw *ogi* was put in a bowl and mixed with cold water to form a watery paste. The paste was added to boiling water on an open fire, stirred well to form a semi-solid gruel and boiled further for 10-15 minutes.

Microbiological analysis

Raw *ogi* samples prepared by the mothers as well as those from street vendors patronized by the mothers were collected for analysis. Samples were also collected immediately after cooking the *ogi*, after adding condiments and after storage for 4-6hrs. Waters samples were also analysed to provide an indication of the level of contamination of the water used for cooking and or drinking. The samples were put in plastic sterile containers with tight-fitting lids. Hot food samples from households were cooled immediately in an insulated plastic box containing ice blocks and taken to the laboratory within 2h of collection for analysis.

Enumeration of micro-organisms

Appropriate serial dilutions of all the samples were carried out and 0.1ml each of selected dilutions was plated using the pour plate method (Harrigan and McCance, 1976). Enumeration of total aerobic viable count was done using plate count agar (Oxoid, CM325, UK). Eosin methylene blue (EMB) agar (Oxoid) was used for coliform count and Baird Parker agar (Oxoid) supplemented with tellurite and egg yolk emulsion for Staphylococcal counts. Yeast and mould counts were done on Sabouraud dextrose agar (Oxoid). All cultures were incubated at 37^{o}C for 24h except for coliform organism which was incubated at 37^{o}C and 44^{o}C for 24h while yeasts and mould counts was incubated at 25^{o}C for 72 h. All media used were prepared according to the manufacturers' instructions.

Characterization of isolates

Confirmation of coliform organisms were carried out by inoculating colonies into lactose broth with Durham tubes and incubating at 37^{o}C and 44^{o}C for 24h and another 24h in the absence of gas production (Speck, 1976). The presence of gas constituted a presumptive test and the broth was streaked out on EMB agar incubated at 37^{o}C for 42h. Typical colonies on EMB plates appearing bluish black with greenish metallic sheen which are characteristics

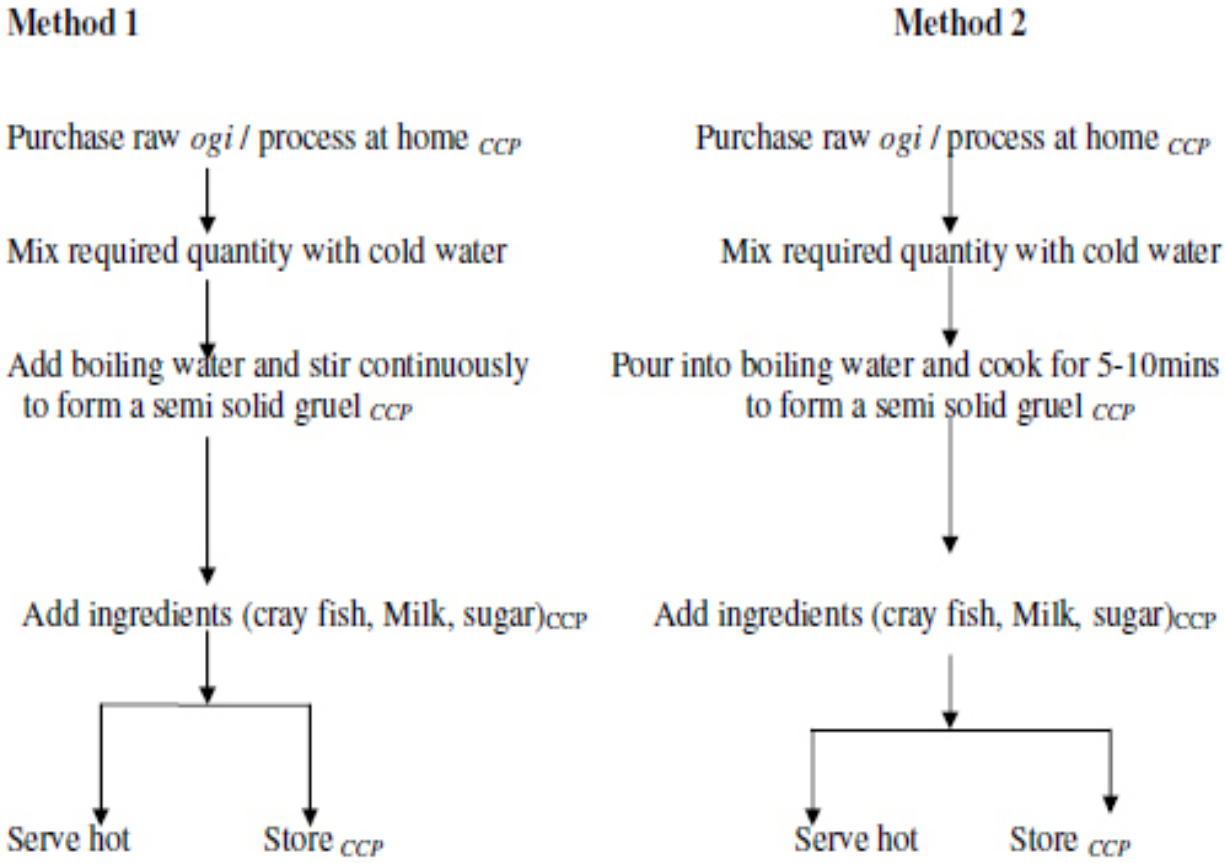

Figure 1. Flow chart of the different methods used in cooking *ogi*

of *E. coli* or brownish colonies often convex and mucoid which are characteristics of *Enterobacter aerogenes* confirmed the presence of coliform organisms. Isolates were stored on nutrient agar slants at 4°C for further confirmatory tests which included IMVIC test, carbohydrate utilization, reaction on TSI, gelatin liquefaction, nitrate reduction, urease production and motility. Large, flat, irregular, wrinkled or smooth, ground-glass colonies, 4–6mm in diameter were counted as *Bacillus*. Confirmation was as described by Yusuf *et al.* (1992). Confirmation of typical colonies of *S. aureus* on Baird–Parker agar was on the basis of the results of catalase, coagulase, phosphatase production, nitrate reduction and carbohydrate utilization (Umoh *et al.,* 1999). For isolation and confirmation of *Salmonella* and *Shigella*, procedures recommended by Speck (1976) were followed. The pre-enriched samples in lactose broth were subcultured into selenite F broth for selective enrichment, and on Salmonella–Shigella agar (SSA). Typical colonies were Gram-stained and characterized (Speck, 1976).

Statistical analysis

One-way analysis of variance and least significance difference (LSD) were used to compare means of isolates obtained from the various samples analysed.

Results

The profile of the mothers and babies presented in Table 1 showed that majority (76.9%) of the babies studied were between age 6-24 months while most (48.1%) of the mothers are between 31-40 years old. Only six (5.8%) mothers had no formal education while 43.3% had post secondary school education. About 47.1% are working with the government while 14.4% are full time housewives. Fifty (48.1%) used pipe borne water while 51.0% used well water as the source of domestic water supply. Most (63.5%) of the household used kerosene while 22.1% used gas to cook.

Table 1. Profile of the mothers and children studied (n=104)

Parameters	No observed	(%)
Gender of children		
Male	51	49.0
Female	53	51.0
Age of children		
0-6	24	23.1
6-24	80	76.9
Mother's age		
< 20	11	10.6
21-30	40	38.5
31-40	50	48.1
>40	3	2.8
Educational status of mother		
No formal education	6	5.8
Primary school	15	14.4
Secondary school	38	36.5
Post-secondary school	45	43.3
Occupation of mothers		
Government workers	49	47.1
Private sector	17	16.3
Business	23	22.1
Unemployed/house wives	15	14.4
Source of domestic water supply		
Pipe borne	50	48.1
Bore hole	35	33.7
Well	53	51.0
Type of toilet facility		
Water-carriage system	91	87.5
Pit latrine	13	12.5
None	0	0.0
Normal cooking fuel		
Firewood	15	14.4
Gas	23	22.1
Kerosene	66	63.5

Results of the food preparation and storage practices (Table 2) showed that 96.2% of the mothers used pap as the first weaning food for their babies. None of the mothers introduced weaning food to the babies before 4 months of age; most (87.5%) of the mothers introduced weaning food between 4-6 months and none waited till 10-12 months before introducing weaning food to the baby. Only 23.1% of the mothers process the raw *ogi* at home by themselves. Most of the mothers (85.6%) used method 1 which involved cooking the *ogi* for further 5-10 minutes while 14.4% used method 2 in which boiling water is poured on the raw *ogi* until a thick gruel is formed. Ninety mothers claimed that they always add one condiment or the other to the pap. One hundred (96.2%) of the mothers add milk to the pap while only 10.6% add raw eggs. Many of the mothers stored the pap for more than six hours and only 10.6% of the mothers reheat the pap more than once.

Data on the knowledge of diarrhea exhibited by the mothers shows that most mothers (84.65%) know that diarrhea involved the passage of more than three loose watery stools in a day (Table 3). About 41.3% of the mothers associated diarrhea with teething and only 50 know that enteric pathogen can be transmitted through dirty hands.

Table 2. Food Preparation and storage practises of mothers studied.

Parameters	No observed	(%)
First weaning food introduced to baby		
Pap	100	96.2
Commercial baby cereal	4	3.8
Age of first introducing pap		
<3months	0	0.00
4-6	91	87.5
7-9	14	13.5
10-12	0	0.00
Source of raw *ogi*		
from vendors	80	76.9
self processed	24	23.1
Method of cooking *ogi*		
Method 1	89	85.6
Method 2	35	33.7
Addition of condiments to pap		
Always	90	86.5
Sometimes	14	13.5
never	0	0.00
Type of condiment added to pap		
Powdered milk	100	96.2
Sugar	94	90.4
Grounded Cray fish	67	64.4
Grounded peanut	54	61.9
Raw egg	11	10.6
Storage of pap		
In bowl at room temperature	14	13.5
In the refrigerator	0	0.00
In a food warmer	90	86.5
Duration of storage		
<6hrs	10	9.6
>6hrs	94	90.4
Reheating pap more than once		
Usually	11	10.6
Sometimes	35	33.7
No	58	55.8
Hand washing practices		
Before food preparation	66	63.5
After toilet use	38	36.5
Utensil cleaning method		
Coldwater and soap always	104	100.0
Hot water and soap sometimes	6	5.8

Table 3. Knowledge of diarrhoea exhibited by the mother

Parameters	No answering correctly	%
Definition of diarrhea		
Passage of more than three loose watery stools in a day	88	84.6
Passage of stools with mucus	66	63.5
Passage of bloody stools	56	53.1
Causes of diarrhoea		
Germs	80	76.9
Teething	24	23.1
Transmission of enteric pathogens		
Dirty food	23	22.1
Dirty water	31	29.8
Dirty hands	50	48.1
Treatment of diarrhoea		
Take baby to the hospital immediately	50	48.1
Self medication	56	53.1
Give oral dehydration	31	29.8
Give teething medication	38	36.5

Table 4 shows the microbial quality and temperature of *ogi* at different stages of preparation and handling. The mean temperatures of cooked and stored *ogi* were 100°C and 56°C respectively for method 1; 78°C and 44°C respectively for method 2. Irrespective of the method used in cooking *ogi,* a marked reduction in microbial load was observed immediately after cooking. However, lower microbial load was observed with method 2 for all the steps of cooking and handling.

The mean range of bacterial counts in street vended *ogi* and *ogi* prepared in the various households is presented in Table 5. The street vended raw *ogi* had significantly ($p<0.05$) higher total aerobic plate counts, Bacillus count and Staphylococcal count. The lactic acid bacteria count however was higher in the *ogi* prepared in the house hold as compared to the street vended *ogi*.

Table 6 presents a summary of the microbiological hazards, CCPs, control measures and monitoring requirements associated with the preparation and handling of the cooked *ogi* analysed. the hazards identified in the various steps include presence of pathogens, growth and contamination by pathogenic and spoilage organism during the addition of condiments. The critical control points identified were purchasing raw *ogi* from unreliable sources, cooking, addition of contaminated ingredients after heat treatment and prolonged storage (> 4hrs) at room temperature.

Discussion

Result of the survey carried out in this study shows that most of the mothers are educated. This has significant implications for child health in general and for food hygiene behaviour in particular (Ehiri, 1993). Education is related to employment and income and these influences access to household amenities and facilities, including those related to food hygiene and environmental health (Ehiri, 1993; Togunde, 1999; Cerrutti, 2000).

Ogi is known to be one of the common weaning food in West Africa including Nigeria. In Nigeria the usual first weaning food is called pap, *akamu, ogi,* or *koko* and is made from maize (*Zea mays*), millet (*Pennisetum americanum*), or guinea corn (*Sorghum* spp.) (Cherian, 1981). Most mothers prefer purchasing raw *ogi* from food vendors because the processing method is long and tedious. However, purchasing ready-to-use foods and ingredients from market vendors poses a considerable health risk hence it is identified as a CCP in this study. Several studies conducted to assess the quality of different street foods in several countries have shown that these foods were positive vectors of food borne illnesses (Mosupye and von Holy, 1999; Umoh and Odoba, 1999; Omemu, *et al.* 2005). Similarly, street food vendors are important factor in food borne infection. Mishandling and disregard of hygienic measures on the part of the food vendors may enable pathogens

Table 4. Microbial quality and temperature of *ogi* at different stages of preparation and storage

Steps	Temp (°C)	Total aerobic counts (log10 cfu ml^{-1})	Enterobacter-iaceae (log10 cfu ml^{-1})	*S. aureus* (log10 cfu ml^{-1})
Method 1				
Raw *ogi*	28	7.65	3.44	5.91
After cooking	100	<1.00	<1	<1
After adding condiments	91	3.36	2.93	3.53
After storage (>6hrs)	56	6.72	4.54	6.52
Method 2				
Raw *ogi*	28	7.65	3.44	5.91
After adding boiling water	78	3.63	1.35	2.37
After adding condiments	71	5.41	4.51	5.46
After storage (>6hrs)	44	8.81	6.27	7.34

Table 5. Mean and range of bacteria count of street vended *ogi* and household prepared *ogi*

	Street vended *ogi*	Household prepared *ogi*
Total aerobic count		
Mean	7.68	5.67
range	4.5 – 9.2	1.2-6.4
Lactic acid bacteria count		
Mean	6.34	8.10
range	5.62 – 8.34	7.45 – 8.92
Staphyloccocal count		
Mean	6.78	4.66
range	4.62 – 7.21	2.1- 6.2
Coliform count		
Mean	2.3	1.22
range	1.60 - 4.31	<1-2.1
Salmonella count		
Mean	Nil	nil
range	nil	nil
Bacillus counts		
Mean	4.02	2.56
range	2.34- 4.7	2.01 – 3.44

Table 6. Identification of Hazards and critical control points during the cooking and storage of *ogi*

Steps	Hazards	Critical control point	Control measures	Monitoring
Purchase of raw *ogi*	Enteric pathogen	Purchasing raw *ogi* from unreliable sources.	Process at home if possible, or buy from reliable vendors with adequate protection from dust and flies.	Check hygiene behaviour of vendor with regard to processing and wrapping materials.
Cooking	Pathogen	Cooking	Heat thoroughly	Ensure cooking is thorough by checking for colour changes.
Addition of ingredients	Growth and contamination by pathogenic and spoilage organism	Addition of contaminated ingredients after heat treatment	Add condiments before heat treatment	Check the hygiene quality of condiments
Storage	Growth of pathogenic and spoilage microorganisms	Storage at room temperature for more than 4 hours	Serve as soon as prepared	If possible do not store; or limit storage time

to come into contact with foods and in some cases to survive and multiply in sufficient numbers to cause illness in the consumer (Omemu *et al.,* 2005; Omemu and Aderoju, 2008).

Although, there is a considerable body of evidence to show that lactic fermented products like *ogi* inhibits growth and survival of a number of pathogenic microorganisms, however other studies have also shown that microorganisms improper storage at household level before cooking can encourage growth of microorganisms some of which may be pathogenic (Motarjemi and Asante, 2002; Omemu *et al.,* 2007b). Cooking of food not only improves the taste, smell, appearance and digestibility, it also reduces the number of microorganisms, improves keeping qualities by inhibiting moulds, yeast and bacteria that promote decay and infection. Thus, heat treatment is a practice aimed at improving the overall safety of food hence in this study it is identified as a CCP. The data collected in this study showed relationship between microbial counts and the method of preparation of food. The higher microbial counts observed at all steps using method 1 as compared to method 2 could be associated with the processing method adopted. By using method 2, the *ogi* was cooked further for 10-15minutes as opposed to method 1 where there was no cooking at all. In situations where fuel for cooking is in short supply and in a bid to save energy, many households may adopt methods that will require minimal fuel. Although by using method 1, the pap attained a temperature of 78^{o}C and that temperature should be high enough to kill large numbers of vegetative cells, but not heat-resistant spores (Bryan *et al.,* 1988).

The method of *ogi* fermentation is accompanied by severe nutrient losses, hence there have been several attempts at improving the nutritional quality of og*i*. The common strategies used include the addition of cray fish, raw eggs, sugar and milk or the incorporation of high-protein material such as legumes or addition of fruits such as pawpaw (Akinrele *et al.,* 1970; Adeyemi and Soluade, 1993). The goal is usually to increase palatability. Some of the ingredients added also serves as source of protein and offers the greatest nutritional benefit to poor families who cannot afford more expensive sources of protein on a regular basis. However, these important ingredients are often added after heat treatment, thus increasing the potential for contamination. Addition of the ingredients before heat application may reduce the level of contamination from the ingredients.

Irrespective of the method used in preparing the pap, most households in this study stored the pap for several hours before consumption. Prolonged periods of storage of food have been shown to affect the level of contamination of foods. Where food is allowed to stand in high ambient temperatures after being prepared (due to lack of refrigeration facilities, fuel and mother's time needed to reheat foods), considerable multiplication of pathogenic bacteria may occur, increasing the risk of diarrhoea in the young child still further (Black *et al.,* 1989). This situation is particularly critical when foods are consumed without reheating and when reheating temperatures are typically well below levels capable of destroying pathogens.

Conclusion

The identification of Microbiological hazards and critical control points in this study has revealed that many factors contributed to the contamination of *ogi* pap. The CCP for *ogi* pap are purchasing raw *ogi* from street vendors, inadequate cooking, and addition of ingredients after heat application and prolonged holding at ambient temperature. Since the nutrition of infants and young children depend closely on the education of their mothers or caregivers on food safety, programmes to educate mothers on food safety principles should therefore be considered as an integral part of primary health care programme.

References

Adeyemi, I.A. 1993. Making the most of *ogi*. Food Chain 8: 5–6.

Akinrele, I.A. 1970. Fermentation studies on maize during the preparation of a traditional African starch-cake food. Journal of the Science of Agriculture 21 (12): 619-625.

Adeyemi, I.A. and Soluade, E.O. 1993. Development and quality evaluation of pawpaw – *ogi*. Plant Foods for Human Nutrition 44 (3): 213-220.

Black, R.E., Lopez de Romana, K.H.G., Brrown, N. B., Bazalar, O.G. and Kanashiro, H.C. 1989. The incidence and etiology of infantile diarrhea and major routes of transmission in Huascar, Peru. American Journal of Epidemiology 189: 785-799.

Bryan, F. L., Michanie, S. C., Alvarez, P. and Paniagua, A. 1988. Critical control points of street-vended foods in the Dominican Republic. Journal of Food Protection 51: 373–383.

Bryan, F.L., Temfel, P., Riaz, S., Room, S., Qada, F. and Malik, Z. 1992. Hazard and critical control points of street vended food "chat", a regional popular food in Pakistan. Journal of Food Protection 55: 708–713.

Cerrutti, M. 2000. Intermittent employment among married women: a comparative study of Buenos Aires and Mexico. Journal of Comparative Family Studies 31(1): 19–45.

Cherian, A. 1981. Attitudes and practices of infant feeding in Zaria. Ecology and Food Nutrition 11: 75-80.

Doyle, M., Beuchat, L.R. and Montville, T.J. 2001. Food Microbiology: Fundamentals and Frontiers. AMS Press, Washington. D.C.

Ehiri, J.E. 1993. Infant and child mortality in Nigeria: the role of socio-economic factors [Dissertation]. Swansea, University of Wales.

Ehiri, J.E., Azubuike, M.C., Ubbaonu, C.N., Anyanwu, E.C., Ibe, K.M. and Ogbonna, M.O. 2001. Critical control points of complementary food preparation and handling in Eastern Nigeria. Bull. World Health Organisation 79: 423–433.

Esrey, S.A. and Feachem. R.G. 1989. Interventions for the control of diarrhoeal diseases among young children: promotion of food hygiene. Geneva: Control of Diarrhoea disease programme. WHO, 1-22. (WHO/ CDD/89, Research Report. No. 30).

Harrigan, W. F. and McCance, M. E. 1976. Laboratory methods in food and diary microbiology. London: Academic Press p. 452.

Ifediora, A.C., Nkere, C.K. and C.U. Iroegbu. 2006. Weaning food preparations consumed in Umuahia, Nigeria: Evaluation of the Bacteriological quality. Journal of Food Technology 4(2): 101-105.

Kunene N.F., Hastings J.W. and A. von Holy. 1999. Bacterial populations associated with asorghum-based fermented weaning cereal. International Journal of Food Microbiology 49: 75–83.

Mosupye, F. M. and von Holy, A. 1999. Microbiological quality and safety of ready-to-eat street-vended foods in Johannesburg, South Africa. Journal of Food Protection 62: 1278–1284.

Motarjemi, Y. and Asante, A. 2002. Impact of small scale fermentation technology on food safety in developing countries. International Journal of Food Microbiology 75: 213– 229.

Odunfa, S.A. and Adeyele, S. 1985. Microbiological changes during the traditional production of *ogi-baba*, a West African fermented sorghum gruel. Journal of cereal Science 3 (2): 173–180.

Omemu, A. M., Edema, M. O. and Bankole, M. O. 2005. Bacteriological assessment of street vended ready to eat (RTE) vegetables and pre-packed salad in Nigeria. Nigerian Journal of Microbiology 19(1–2): 497–504.

Omemu, A.M., Oyewole, O.B. and Bankole, M.O. 2007a. Significance of yeasts in the fermentation of maize for *ogi* production. Food Microbiology 24: 571–576.

Omemu, A.M., Bankole, M.O., Oyewole, O.B. and Akintokun, A.K. 2007b. Yeasts and moulds associated with *ogi* - a cereal based weaning food during storage. Research Journal of Microbiology 2 (2): 141-148.

Omemu, A.M. and Aderoju, S.T. 2008. Food safety knowledge and practices of street food vendors in the city of Abeokuta, Nigeria. Food Control 19: 396–402.

Speck, M.L. 1976. Compendium of Methods for Microbiological Examination of Foods. American Public Health Association, Washington DC, pp. 277–328.

Togunde, O.R. 1999. Determinants of women's employment in urban Nigeria: the impact of socio-economic factors. Journal of Asian and African Studies 34 (3): 279–297.

Umoh, V. J. and Odoba, M. B. 1999. Safety and quality evaluation of street foods sold in Zaria, Nigeria. Food Control 10: 9–14.

Umoh, V.J., Adesiyun, A.A., and Gomwalk, N.E. 1999. Assay for *Staphylococcus aureus* growth and enterotoxin in three fermented milk products. Zariya Veterinary 6: 7–15.

Yusuf, I.Z., Umoh, V.J. and Ahmad, A.A. 1992. Occurrence and survival of enterotoxigenic *Bacillus cereus* in some Nigerian flour-based foods. Food Control 3:149–152.