

Full Length Research Paper

Safety of bread for human consumption in an urban community in Southwestern Nigeria

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Bread is an important staple food that does not require further processing before consumption. Despite the awareness created and efforts of government to ensure that quality bread are available for consumption of all, there are several routes through which bread is being contaminated. The aim of the study was to assess the hygiene involved from the point of production to sale of bread and document pathogens isolated from bread. This was a descriptive cross-sectional study with 10 out of the 30 registered bakeries spread across wards randomly selected and only six consenting to participate (60% response rate), and a total of 10 representative bread sellers were purposively selected with respect to their spread in Ile Ife. Observational checklist was used to assess environmental and personal hygiene while microbiological specimens taken from bread were assessed for pathogenic contamination. Only a third of bakeries assessed had good hygiene while hygiene of bread sellers was suboptimal. Bread samples from bakeries and bread sellers yielded *S. aureus* in 33 and 90%, respectively. Several points of contamination were identified and poor bread handling practices documented. Existing laws should be enforced and bread sellers educated on proper handling of bread to prevent outbreaks of food borne illnesses.

Key words: Bread, food safety, hygiene, food-borne.

INTRODUCTION

Globally, access to safe food is a basic human right. It is so important that this year the World Health Organization has made food safety the theme of the World Health Day 2015. The food sector is broad and diverse, with different regulations guiding practices of stakeholders from micro to macro sector players. Due to rapid rural urban

migration, several urban dwellers depended on ready to eat food to satisfy their food requirements. In this regard, ready to eat food (RTE) refers to food that could be eaten as purchased and does not require further significant processing other than reheating or completion of a cooking process (Singh et al., 2014).

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One of the readily available RTE food is bread, which is a staple food that do not require further processing before consumption. It is produced in various forms and eaten in homes, restaurant and hotels in Nigeria (Emeje et al., 2010). In addition, the consumption of bread cut across socio-cultural and religious barriers and is a food of choice for both rich and poor in Nigeria (NAFDAC, 2010). The dough of bread is usually baked but in some eateries is steamed, fried or baked on an un-oiled platform. Bread is prized for its taste, aroma, quality, appearance and texture and, retaining its freshness is important to keeping it appetizing and appealing to consumers. Bread is made from low protein flour made from wheat or cassava and contains several ingredients that improve its quality. Some of the ingredients added to bread are table salt, sugar, flavour and at least an efficient oxidising additive to assist in the raising process and to produce a texture in the finished product that is appealing to the consumers (Emeje et al., 2010).

In Nigeria, commercial bread making is regulated by guidelines, through the National Agency for Food and Drug Administration and Control (NAFDAC), through the 4-point safety standards that bread bakers should comply with in Nigeria, as follows:

1. Consistent' production of flour fortified with Vitamins A&C and other " safe enhancers in approved quantities to prevent bakers from adding dangerous chemicals like potassium bromate as flour/bread improvers,
2. Compliance with set standards of Good Manufacturing Practice (GMP) and Hazard Analysis Critical Control Points (HACCP) guidelines and requirements of the Agency,
3. Stop the use of dangerous ingredients which are not on the list of substances generally regarded as "safe" and
4. Bakers should stop the habit of distributing loaves of bread to consumers without proper packaging and in unhygienic conditions (NAFDAC, 2010).

Nigeria has several food safety legislations, food is prepared in diverse socio and environmental settings and frequently contaminated with naturally occurring pathogenic microorganisms (Abdalla et al., 2008). In addition, concern on safety of bread have increased following the indiscriminate use of potassium bromate while the storage, handling process, the condition of the bread processing environment and health of the workers in the cottage industries and street hawkers are important considerations in ensuring the safety of consumers (Isong et al., 2013). Moreover, despite the awareness created and efforts to ensure that quality bread is available for citizens, there are several routes through which bread could be contaminated in the processing chain, especially during packaging, respectively at the factory and by vendors in containers to reduce dessication (HPA, 2009). Bread contamination and growth of pathogens alter its quality and a potential source of infection to consumers since improper handling and poor personal hygiene of food, and in particular

during packaging is implicated in most food-borne illnesses through cross contamination and poor personal hygiene of bread handlers (Ehaval, 2009).

When food handlers do not practice safe personal hygiene, they may become vehicle for transmission of pathogens, through hands, mouth, skin, among others (HPA, 2009). Therefore, the aim of the study was to assess the hygiene involved from the point of production to sale of bread and document pathogens isolated from bread.

MATERIALS AND METHODS

The study was a descriptive, cross sectional design. The study was carried out in Ile-Ife, an urban city in Nigeria. The city is inhabited by 167,204 people, comprising 88,403 male and 78,801 females (NPC, 2009). Ile Ife has 11 wards and thirty registered bakeries.

Ten (10) out of the thirty registered bakeries spread across wards were randomly selected with only six consenting to participate (60% response rate) and all bakers on duty in each of the bakeries, totaling 40 were assessed for the study. Also, a total of 10 representative bread sellers were purposively selected with respect to their spread in Ile Ife from the following locations Mayfair, Campus gate, Sabo, General phase 1, Owode, Ilode, Arubiidi, lyekere, Idi-omo and road 7, respectively.

Ten (10) different brands of bread produced by the bakeries were purchased from 10 market vendors at Ile Ife after being supplied and packaged. Observational checklist was used to assess hygiene in bakery houses and bread sellers while interviewer-administered questionnaires was employed to assess personal hygiene of bakery workers and swabs were taken from freshly baked breads, cutting tables, baking pans and mixing table while loaves of bread were collected as samples from the bakeries for laboratory analysis.

Microbiological assessment of bread samples

Swab samples obtained using sterile materials were collected from various baking surfaces, cultured into MacConkey and Chocolate agar and incubated at 37°C and 20% Carbon dioxide gas for 24 h. Also, 20 g of various bread samples were weighed and inoculated into sterile peptone (broth) and incubated for 24 h after which the growths were examined and isolates were identified by colony characteristics, Gram stain, catalase and coagulase tests as described by Monica Cheesbrough (1984).

Hygiene assessment of bakery houses in the study area

In assessing the level of hygiene in bakeries, a score of one (1) was assigned to correct hygienic practice and zero (0) for each wrong practice in each bakery which yielded a maximum score of 13. A composite score was graded as follows; less than 50% (<7), between 50-70% (7-9) and 70% (>9) and above signifies poor, fair and good level of hygiene, respectively in each of the six bakeries assessed.

Data analysis

Data were analysed using SPSS version 16 and presented using tables and charts as appropriate.

Informed consent

The informed consent of the bakery owners, workers and

Table 1. Socio-demographic characteristics of Respondents.

Variable	Characteristics	Bakery workers		Bread vendors	
		Frequency (N=40)	Percentage (%)	Frequency (N=10)	Percentage (%)
Age (years)	18-24	9	22.5	2	20
	25-31	17	42.5	5	40
	>31	14	35.0	3	30
Gender	Male	28	70	0	0
	Female	12	30	10	100
Educational status	Primary	9	22.5	3	30
	Secondary	27	67.5	7	70
	Tertiary	4	10.0	0	0

Table 2. Environmental hygiene characteristics of selected bakeries in Ile-Ife.

Variable	A	B	C	D	E	F
Is the bakery close to a residential area	1	1	1	1	1	1
Is the bakery close to any refuse dumping ground	1	0	0	0	0	0
Are there any unsanitary drainages around the bakery	1	1	1	0	0	1
Does the bakery have a proper refuse disposal system	0	1	0	0	1	0
Does the bakery have adequate space for storage of raw materials	0	1	1	1	1	0
Is the bakery surrounding bushy	0	0	0	0	0	0
Does the bakery have a toilet	0	1	1	1	1	1
If yes is the toilet separated from the processing area	0	1	1	1	1	1
Does the bakery have adequate supply of potable water	0	1	0	1	1	0
Are the doors and windows of the storage room protected against insects/pests	0	1	0	0	1	0
Does the bakery have handwashing facilities	0	0	0	0	1	0
Are the equipment cleaned regularly	0	0	1	1	1	0
Is the bakery premises cleaned regularly	0	1	0	1	1	1
Total score (%)	3 (27)	9 (70)	6 (46)	7 (55)	10 (75)	5 (40)

Key: 0=No; 1=Yes.

commercial bread vendors were obtained while ethical approval was given by the ethics committee of the Institute of Public Health.

RESULTS

The socio demographic information of 40 bakery workers and 10 randomly selected bread vendors that participated in the study is presented in Table 1. The result revealed that 65% of the bakery workers age ranges between 18-31 years with 24 years as the median age. 70% of them were males and majority of the bakers (77.5%) completed at least secondary schools education whilst, 70% of the bread vendors had ages ranging between 18

and 31 years with a median age of 26 years. Interestingly, all the bread sellers were females and most of them (70%) had educational attainment up to secondary school level.

The level of hygiene in the bakeries assessed was suboptimal with only two of the six facilities assessed having good level of hygiene with 1 having fair hygiene while three had poor hygiene (Table 2).

Though the use of head gear by bakery workers is mandatory, the study shows that 6% of the respondents had never use head gear while only 30% always wear it and only 10% use face mask. About two-thirds (65%) of bakery workers wear aprons regularly while only 45% wear hand gloves regularly. Hand washing before

Table 3. Personal Hygiene of Bakery workers and commercial bread sellers.

Hygiene practice	Bakery workers			Commercial bread sellers	
	Always N (%)	Sometimes N (%)	Never N (%)	Yes N (%)	No N (%)
Use of head gear	12(30)	4 (10)	24 (60)	10 (100)	0 (0)
Use of face mask	4 (10)	0 (0)	36 (90)	-	-
Use of foam to clean bread	-	-	-	10 (100)	0 (0)
Use of apron	26 (65)	8 (20)	6 (15)	2 (20)	8 (80)
Washing of hands	38 (95)	0(0)	2 (5)	4 (40)	6 (60)
Use of hand gloves	18 (45)	4 (10)	18 (45)	-	-
Adequate covering of bread	-	-	-	10 (100)	0 (0)
Cutting of finger nails	38 (95)	2 (5)	0(0)	10 (100)	0 (0)

Table 4. Microbiological isolates from bakery surfaces and bread samples.

Surface	A	B	C	D	E	F
Finishing table	+\$	-	+\$	-	-	-
Baking pan	-	-	-	-	-	+\$
Cutting table	+\$	+\$	-	-	+\$	+\$
Mixing table	-	+\$	-	-	-	-
Bread sample	+	+\$	+\$	+\$	+\$	+

* -pathogenic organism (*Staphylococcus aureus*)
 §-nonpathogenic organism (aerobic spores).

processing bread was almost universally reported by bakery workers.

Among the commercial bread sellers, use of head gear was universally practiced. Only 60% reported washing their hands before handling or packaging bread with use of apron practiced by 20% of bread sellers. The study further revealed that all bread sellers use” foam” to clean bread before packaging (Table 3).

The study further assessed the microbial contamination of various surfaces in use in bakeries, namely the finishing table, baking pan, cutting table and mixing table of the six bakeries assessed. The analysis of the swab samples collected from each of the surfaces revealed that the cutting tables in most of the bakeries (66.7%) developed growth of non-pathogenic aerobic spores of bacilli while a significant 17.6% of the swab samples from bakeries finishing table, mixing table and baking pan respectively revealed growth of non-pathogenic aerobic microbes. A third of bread samples collected from the bakeries grew pathogenic organism (*S. aureus*) (Table 4).

The widespread handling of bread from point of transportation to point of sale is depicted in Figures 1 to 3. Figure 1 showed the supplier handling bread with bare hands while Figure 2 showed the bread sellers handling bread with bare hands and “cleaning” the bread with foam and Figure 3 shows the bread uncovered whilst



Figure 1. Handling practice of bread supplier and seller.



Figure 2. Bread seller using foam to clean bread.

the seller was “cleaning” the bread.

Similarly, the study further revealed that most bread



Figure 3. Bread seller cleaning bread with foam while bread left exposed.

Table 5. Microbiological analysis of bread samples from commercial bread vendors.

Bakery	Gram reaction	Isolated Micro-organism
C1	Gram +ve Cocci	<i>Staphylococcus spp.</i>
D1	Gram +ve Bacilli	<i>Aerobic spore(NP)</i>
E.	Gram +ve Cocci	<i>Staphylococcus aureus</i>
F	Gram +ve Cocci	<i>Staphylococcus aureus</i>
A1	Gram +ve Cocci	<i>Staphylococcus aureus</i>
B1	Gram +ve Cocci	<i>Staphylococcus spp.</i>
A2	Gram +ve Cocci	<i>Staphylococcus aureus</i>
B2	Gram +ve Cocci	<i>Staphylococcus aureus.</i>
C2	Gram +ve Cocci	<i>Staphylococcus aureus</i>
D2	Gram +ve Cocci	<i>Staphylococcus aureus.</i>

samples collected from vendors (80%) were contaminated by pathogenic *S. aureus* while 20% showed growth of non-pathogenic aerobic spore (Table 5).

DISCUSSION

Living organisms in this environment are always looking for food to stay alive, therefore food safety is very important to ensure wholesomeness of food for human consumption. Studies have shown that poor handling practice tend to cause food borne illness (Clayton et al., 2002). Bread being a meal that is usually eaten without further processing makes it a good source of food borne illness if improperly handled.

This study reveals that over 60% of bread sellers do not wash their hand before packaging bread, which is contrary to ideal hygiene practice as stated by Ehavald (2009). This finding is much higher than reported findings by Ileadike et al. (2014), Isara et al (2013), Altekruze et

al. (1996), Yang et al. (1998) and Shiferaw et al. (2000). This finding may be attributed to the fact that respondents may not necessarily refer to bread as raw food and thus little risk of contamination. Placing this finding in perspective of the frequent handling of bread by sellers it is imperative to note that whilst only a third of the bread sampled from the bakery were contaminated by *S. aureus*, almost all the bread sampled from the bread sellers were contaminated with *S. aureus*. This buttresses the assertion from studies on Hazard analysis and critical control points (HACCP) that shows that most foods are contaminated along the processing chain (Daniyan and Nwokwu, 2011, Adesetan et al., 2013).

The unwholesome practice of cleaning bread with foam has never been reported in literature and is a major mechanism for contamination of bread as it provides ample opportunity to expose the bread to handling with hands that are rarely ever washed before handling bread; the hands that are used to receive money in between transactions which has been reported in a study by Nurudeen et al. (2014).

Food hygiene is the set of basic principles employed in the systematic control of the environmental conditions during production, packaging, delivery/transportation, storage, processing, preparation, selling and serving of food in such a manner as to ensure that food is safe to consume and is of good keeping quality. Hygiene of the bread sellers was assessed and in this study it was discovered that use of head gear among bread sellers is universally practiced perhaps due to the fact that they were majorly female and it is culturally and religiously inappropriate for most women to leave their head uncovered.

This finding is however at variance with less than half (47%) reported by Nurudeen et al. (2014). Use of apron was reported by none of the bread sellers and by 65% of bakery workers which is similar to reports from study by Nurudeen et al. (2014).

The bread sellers often left their bread exposed granting access to flies which are common in a humid, hot environment. These flies have been shown by various studies to transmit food borne pathogens which can cause food borne illnesses such as Cholera, Campylobacteriosis, *E. coli* gastroenteritis, Salmonellosis, Shigellosis, Typhoid and paratyphoid fevers, Brucellosis, Amoebiasis, and Poliomyelitis (De Jesus et al., 2004; Keiding 1986; WHO, 1997).

Hygiene of bakeries assessed was poor as only a third of bakeries assessed had good hygiene which is similar to findings by Huq et al. (2013) in Bangladesh. This seems to be a common occurrence in developing countries where quality of bread for human consumption is doubtful as premised by the fact that not much is published in literature from developed countries.

Among the bakery workers, 45% wears hands gloves regularly while 15% uses it occasionally and 45% do not see any reason why they should use it. This is also similar

to findings by Chukuezi (2010) where 47% of bakers uses bare hands while working in bakeries, against the standard practice but much higher than the 16.7% reported by Huq et al. (2013). However, the use of gloves should protect the hands of workers during packaging and sealing the nylon and is expected to minimize direct hands contact with finished bread. At Ile lfe, most of the bakeries utilize manual processes of feed, to slicing and packaging. Therefore, non-use of hand gloves compromises bread quality safety and health of people who eat them since bread post production is sold to the residents and travelers having stopovers at Ile lfe.

Conclusions

The hygiene conditions in bakeries, handling of bakeries processes by bakers and attitude of bread vendors is suboptimal and predisposes bread to contamination by pathogenic and non-pathogenic microorganisms. Therefore, regulatory agencies, States ministries of health and environmental health units of local government areas should ensure compliance and adherence of bakeries and bread sellers to the regulations and public health ordinance guiding the approval and monitoring of bakeries as a regulated premise.

There is need for re-orientation of bakeries on the basic ideal practice which has to be enforced to sound the seriousness of government to entrench sound bakery operations and practice in Nigeria. Therefore, all bakery workers should receive training in food hygiene and handling. This should be supported by country-wide health education, training and registration of formal bread vendors to promote compliance with best practices globally.

Conflict of interests

The authors did not declare any conflict of interest.

REFERENCES

- Abdalla MA, Sihanm ES, Alian YYHA, Amel OB (2008). Food safety knowledge and practice of street food-vendors in Khartoum city. *Sud. J. Vet. Sci. Anim. Husb.* 47:126-136.
- Adesetan TO, Ilusanya OAF, Sobowale AA, Jumani UP (2013) Bacteria commonly associated with bakery equipments in selected areas around Olabisi Onabanjo University environ, Ago-Iwoye, Nigeria. *Adv. Environ. Biol.* 7(1):177-188.
- Altekruse SF, Street DA, Fein SB, Levy AS (1996). Consumer knowledge of food-borne microbial hazards and food-handling practices. *J. Food Prot.* 59:287-294.
- Cheesbrough M (1984) Medical laboratory manual for tropical Countries Vol 2 Microbiology. Cambridge, Kentshire. Tropical Health Technology/ Butterworth Heinemann.
- Chukuezi CO (2010) Food safety and hygiene practices of street food vendors in Owerri, Nigeria. *Stud. Sociol. Sci.* 1(1):50-57
- Clayton DA, Griffith DJ, Price P, Peters AC(2002). Food handlers' beliefs and self-reported practices. *Int. J. Environ. Health Res.* 12:25-39.
- Daniyan SY, Nwokwu OE (2011) Enumeration of microorganisms associated with the different stages of bread production in FUTMIN bakery, Nigeria. *Int. Res. J. Pharm.* 2(7):88-91.
- De Jesus AJ, Olsen AR, Bryce JR, Whiting RC (2004) Quantitative contamination and transfer of *Escherichia coli* from foods by houseflies, *Musca domestica* L. *Int. J. Food Microbiol.* 93(2):259-62.
- Ehavalid H (2009). Food safety risk management in bakeries. Presentation at the 3rd SAFOODNET seminar St Olav's Hotel, Tallinn, Estonia; May 4-6, 2009.
- Emeje MO, Ofoefule SI, Nnaji AC, Ofoefule AU, Brown SA (2010). Assessment of bread safety in Nigeria: Quantitative determination of potassium bromated and lead. *Afr. J. Food Sci.* 4(6):394-397.
- Health Protection Agency (HPA) (2009) Guidelines for assessing microbiological safety of ready- to- eat foods. Available from www.gov.uk/government/publication/ready-to-eat-foods-microbiological-safety-assessment-guideline [accessed January 15 2015].
- Huq AKO, Uddin JM, Haque KMF, Roy P, Hossain MB (2013). Health, hygiene practices and safety measures of selected baking factories in Tangail region, Bangladesh. *Int. J. Curr. Microbiol. Appl. Sci.* 2(10):68-75.
- Ifeadike CO, Ironkwe OC, Adogu PO, Nnebue CC (2014) Assessment of the food hygiene practices of food handlers in the Federal Capital Territory of Nigeria. *Trop. J. Med. Res.* 17:10-5.
- Isara AR, Aigbokhaode AQ, Onwuso OV, Onyeulo EC, Orumwense SO (2013). Food hygiene and safety practices of food service staff in University of Benin Teaching Hospital, Benin city, Nigeria. *J. Med. Biomed. Res* 12:2.
- Isong NB, Akpan MM, Udota HI, Barber L (2013). Antibacterial and microbial assessment of breads in Abak local government area, Nigeria, West Africa. *J. Microbiol. Biotechnol. Res.* 3 (3):155-159.
- Keiding J (1986). The housefly biology and control. Training and information guide (advanced level). Geneva, WHO (WHO/VBC/86.937) accessed 14th January 2015.
- NAFDAC (2010). NAFDAC Okays New Safety Standard for Bread Producers. Archived in "This Day live" (27th November, 2010). <http://www.thisdaylive.com/articles/nafdac-okays-new-safety-standard-for-bread-producers/73242/> accessed on 15th June, 2014
- Nurudeen AA, Lawal AO, Ajayi SA (2014). A survey of hygiene and sanitary practices of street food vendors in the Central State of Northern Nigeria. *J. Public Health Epidemiol.* 6(5): 174-181.
- Singh S, Rana T, Kaur N, Parihar R, Kumar R, Kumar S, Kumar R (2014). Studies on Microbiological Quality of Ready to Eat Food from Solan City of Himachal Pradesh. *Int. J. Univ. Pharm. BioSci* 3(3):181-189.
- WHO (1997) Vector Control: methods for use by individuals and communities. Available from www.who.int/resources/vectoritoxii [accessed January 5 2015].
- Yang S, Left MG, Mctague D, Horvath KA, Jackson-Thompson J, Muray T, Boeselager GK, Melnik TA, Gildemaster MC, Ridings DL, Altekruse SF, Angulo FJ (1998). Multistate surveillance for food-handling, preparation, and consumption behaviors associated with food borne diseases: 1995 and 1996. *MMWR Morb. Mortal Wkly. Rep.* 47:S33-57.