



DETERMINATION OF MICROBIOLOGICAL QUALITY OF BREAD AND SANITATION CONDITIONS OF LOCAL BAKERIES IN ALIERO TOWN, KEBBI STATE

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Abstract

Various changes and variations can occur during the bread-making and storage process that affect the safety, quality characteristics, and acceptability of the bread. The present study was aimed at the determination of the microbiological quality of bread and sanitation conditions of local bakeries in Aliero town, Kebbi State. A total of 16 bread samples (3 from each bakery) were collected. Sociodemographic and sanitation condition data were collected through interviews and using an observational checklist. Standard microbiological methods were used for the enumeration, isolation, and identification of bacteria and fungi. The result of sanitary conditions shows that four bakeries (66%) use boreholes as source of water supply, two (33%) use well and none of them use pipe borne. In addition, zero (0%) use a flush system of latrine, and 66% have a pit-latrine while 33% have no latrine facility. All (100%) have stored refuse properly and also use open surface/ditch as a waste disposal method.

Keywords : Bread contamination, Sanitary condition, Microbiological quality, Total bacterial count.

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Introduction

Bread is a loaf prepared by baking dough made from flour, salt, sugar, yeast, and water. Other components may include fat, milk, milk solids, egg, and anti-oxidants, among others. Bread is an essential staple in Nigeria, with a stable and rising consumption. It is, however, quite costly due to the usage of imported wheat flour (Edema *et al.*, 2004). Bread is widely consumed in both developed and developing cultures (Abdelghafor *et al.*, 2011). Bread has become one of the most popular nonindigenous meals in India, while bread has surpassed rice as the second most popular nonindigenous diet in Nigeria (Das *et al.*, 2012). It is popular in most households, restaurants, and hotels. (Emeje and colleagues, 2008) White bread is the most popular bread in Nigeria. This bread is baked using refined whole wheat flour, commonly known as all-purpose flour, and it has a characteristic white color since the wheat bran has been removed. Protein meals are usually costly and out of reach for the majority of people in developing countries like Nigeria (Malomo and his associates, 2012).

Various changes and variations can occur during the bread-making and storage process that affect the safety, quality characteristics, and acceptability of the bread. One of these changes is microbial spoilage, such as that caused by mold, bacteria, and yeast. *Aspergillus*, *Fusarium*, and *Penicillium* are the most common molds that spoil bread (Gerez and colleagues, 2009). Other spoilage molds have been described and identified in wheat bread products, including *Cladosporium*, *Mucorales*, and *Neurospora*

(Pateras, 2007). The main source of mold rot is post-processing contamination, as loaves of bread are free of mold or mold spores due to heat inactivation shortly after baking (Pateras, 2007; Wang *et al.*, 2017).

Bacillus spp., especially *B. subtilis* and *B. licheniformis*, can contribute to the bacterial spoilage of bread (Cizeikiene *et al.*, 2013). A delayed cooling period or storage above 25 °C, a pH above 5, a high spore content, and moist bread are mentioned as environmental variables that can promote bacterial bread contamination (Pateras, 2007; Soboleva *et al.*, 2016). Such bacterial Contamination is typically caused by raw dough ingredients, wheat having the greatest impact, or equipment (Pateras, 2007). Bacterial spores affect the quality of the finished bread product because they are difficult to eliminate and can germinate and multiply within 36 to 48 hours after baking to produce a soft, stringy, brown dough in the bread that has the smell of an overripe melon or Valerian mimics (Puckova *et al.*, 2005; Soboleva *et al.*, 2016).

Despite significant modernization of bread making, fundamental problems remain, mainly due to its perishability, with a limited mold-free shelf life of 4 to 10 days affected by storage and treatment factors due to the high water activity of bread, which is typically around 0.95 (Cauvain, 2012). Concerns about the safety of bread have increased as a result of the indiscriminate use of potassium bromate, although the storage and handling process, the condition of the bread processing environment, and the health of workers in the industry are important factors to ensure consumer safety (Isong *et al.*, 2013). Furthermore, despite best efforts to

ensure that residents receive quality bread, there are several pathways in the production chain through which bread can become contaminated, particularly during packaging and in the factory by sellers (HPA, 2009).

Materials and Methods

Study Area

Kebbi State in northern Nigeria has the town of Aliero. located at 12°16'42"N 4°27'6"E, southeast of Kebbi State. The town serves as the local government area's administrative centre. The town is a significant producer of onions in Nigeria and is home to the largest onion market in northwest Nigeria.

Informed Consent

A total of six different bakeries were identified in the town of Aliero. The population for this study consisted of all Aliero bakery businesses, regardless of their legal status. The bakery owners gave their informed consent.

Samples Collection

Six bakeries provided samples of freshly made bread. The manufacturers provided a total of sixteen bread samples (three each). Bread samples were collected in sterilized polyethylene bags. They were labeled and taken to the laboratory for microbiological analysis.

Assessment of Managers' Socio-demographics and the Factory's Sanitary State

To obtain data on managers' socio-demographic variables, a structured researcher-administered questionnaire was employed. In addition, an observation checklist was employed to collect data on hygienic conditions. Water supply, toilet availability, waste disposal, refuse management, and waste disposal were all evaluated. The presence relevant item received a value of "1," while its absence received a score of "0."

Determination of Microbial Load

The spread plate technique was used to determine the total plate count using nutrient agar medium. The plates were inoculated and incubated at 37 degrees Celsius for 24 hours. The total number of bacteria cfu/g of each sample was calculated and recorded. In addition, the samples were inoculated into SDA medium supplemented with chloramphenicol (40 mg/l) using the spread plate technique. The plates were incubated at 25 degrees Celsius for 5 days. Visible colonies were counted and the total number of fungi was calculated and recorded as cfu/g (Cheesbrough, 2005).

Identification of Bacterial and Fungal Isolates

Bacterial isolates were characterized using the methods provided by Cheesbrough (2002) to determine the morphological and biochemical properties of the bacteria. The fungal cultures were subjected to macroscopic and microscopic examinations. The physical properties of mycelia, such as color and structure, were noted. The growing fungus was placed on a slide, stained with lactophenol cotton blue, covered with a coverslip, observed under a microscope, and identified by colony shape and spore characteristics (ICMR, 2019; Humber, 1994).

Data Analysis

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Data were analyzed using SPSS version 16 and provided as mean+SD of triplicate determinations. Ms. Excel was utilized for graphical representation.

Results

Socio-demographic Characteristics of Managers of Bakeries

Table 1 shows the sociodemographic information of the six bakery managers who took part in the study. The findings indicated that all of the managers (100%) are male, with 5 (83%) falling between the ages of 19 and 34, and 1 (16%) falling between the ages of 35 and 50. In addition, four managers (66%) have no formal education, while just two (33%) have tertiary education. Marital status indicated that all of the managers (100%) are married. All of the managers have had no hygiene or sanitation training, and their licenses have not been renewed by an authorized agency.

Table 1 : Socio-demographic Characteristics of Managers of Bakeries

Variable	Characteristics	Frequency (N=6)	Percentages (%)
Sex	Male	6	100
	Female	0	0
Age	19-34	5	83
	35-50	1	16
	>50	0	0
Educational status	No formal education	4	66
	Primary	0	0
	Secondary	0	0
	Tertiary	2	33
Manager's training on hygiene and sanitation	Yes	0	0
	No	6	100
License renewal by the authorized body	Yes	0	0
	No	6	100

Sanitary Conditions of Bakeries in Aliero

According to the findings, four bakeries (66%) utilize borehole water as a source of water supply, while just two (33%) use well water, and none use piped water. Similarly, none of them utilize a flush kind of latrine, and 66% have pit-latrine facilities, while 33% do not. All (100%) have properly stored their refuse and disposed of it in an open surface/ditch as shown in table 2.

Table 2: Sanitary Conditions of Bakeries in Aliero

Variable	Characteristics	Frequency (N=6)	Percentages (%)
Water supply	a.Piped borne	0	0
	b..Borehole	4	66
	c.Well	2	33
Latrine availability	a.Flush	0	00
	b.Pit latrine	4	66
	c.Not available	2	33
Waste disposal	a.Open surface/ditch	6	100
	b.Septic tank/latrine	0	0
	c.Not available	0	0
Refuse management	a.Proper refuse stored	6	100
	b.Improperly stored	0	0
	c.Not available	0	0
Refuse disposal	a.Munipal container	0	0
	b.Onsite disposal	6	100

	c.Burning	0	0
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Total Bacterial Count of bread

The total bacterial count of bread sold at Aliero town Kebbi State is given in table 3 below. The result revealed that sample code FB has the lowest bacterial count 7.4×10^5 , while the highest bacterial count is 14.4×10^5 .

Table 3: Total Bacterial Count of bread

Sample code	No.Colonies	Cfu/g	Mean±SD
SB	144	14.4×10^5	144±33.94
IB	106	10.6×10^5	106±19.80
HB	108	10.8×10^5	108±50.91
FB	74	7.4×10^5	74±25.46
WB	116	11.6×10^5	116±28.28
AB	112	11.2×10^5	112±45.25

Total fungal count of bread

Table 4 shows the colony count of fungi isolated from bread sold at Aliero town kebbi state. Based on the result the highest fungal count is 9.0×10^3 , while the lowest fungal count is 1.1×10^3 .

Table 4: Total fungal count of bread.

Sample code	No.Colonies	Cfu/g	Mean±SD
SB	90	9.0×10^3	90±7.0
IB	15	1.5×10^3	15±35.35
HB	70	7.0×10^3	70±2.21
FB	12	1.2×10^3	12±2.28
WB	11	1.1×10^3	11±3.35
AB	13	1.3×10^3	13±1.14

The Identification of Bacterial and Fungal Isolated from the Bread

As shown in figure 1, the bacteria identified include *Escherichia coli* (29.4), *Pseudomonas spp.* (14.7), *Proteus spp.* (20.6), and *Bacillus spp.* (35.3). In addition, figure 2 the shows fungi isolates that includes: *Fusarium spp.* (20%), *Rhizopus spp.* (28%), *Aspergillus spp.* (8%), and *Penicillium spp.* (44%).

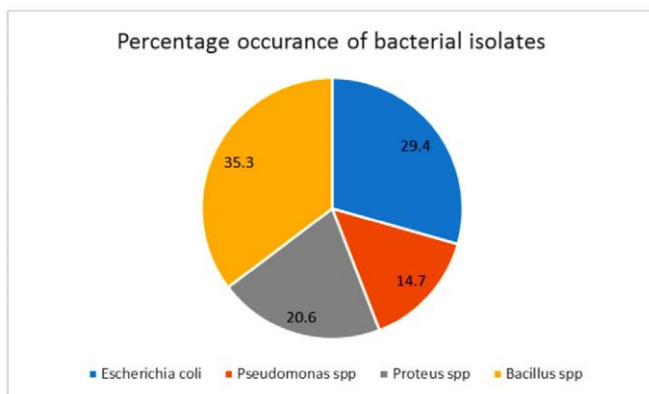


Fig. 1: Bacterial isolates by percentage of occurrence

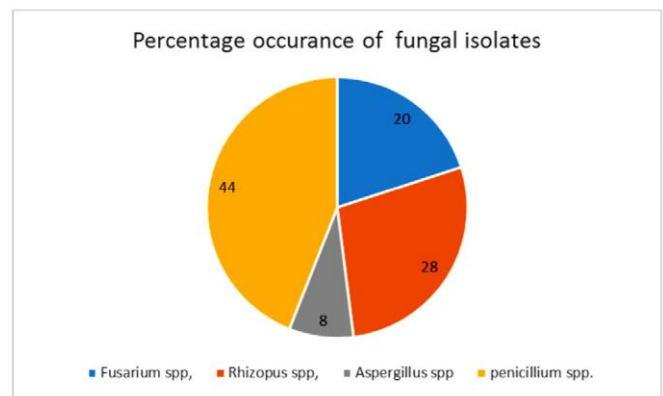


Fig. 2: Fungal isolates by percentage of occurrence

Discussion

This study deals with the microbiological quality of bread and the hygienic conditions of bakeries in the city of Aliero, Kebbi State, Nigeria. Socio-demographic information from 6 bakery managers who took part in the study revealed that all managers are men (100%). The role of gender in socioeconomic development is often influenced by cultural

orientation and varies from one geographic location to another. Furthermore, 4 (66%) of managers have no formal education, while only 2 (33%) have tertiary education. All employees involved in bread-making must have appropriate basic education, and training/experience (NAFDAC and FSAN, 2018).

The results of this study revealed that all the managers have no training on hygiene and sanitation even though the presence of trained food handlers and managers can reduce foodborne disease and enhance sanitation and hygiene practices of food establishments (Boro *et al.*, 2014). The reason may be training activity on hygiene and sanitation was not organized in the study area by the concerned authority.

The study result showed that the percentage of food bakeries that held a renewed formal license certificate was 0%. The main reason could be the inefficient efforts of the regulators involved, and the unwillingness of managers to renew their licenses could be a secondary factor. This is in contrast to the results of (Girmay *et al.*, 2020) who reported that 28.1% of food establishments had a renewed formal license certificate. In addition, the study results showed that all bakeries are missing very important sanitary parameters (lack of running water and on-site waste disposal). It has been suggested that food should be prepared in places far from sources of contamination such as garbage, sewage, and animals (Alimentarius, 1995; NAFDAC and FSAN, 2018).

The mean total bacterial count (7.4×10^5 – 14.4×10^5) in the present study is higher than that reported by Daniyan and Nwoku (2011) between 4.5 and 6.8 log CFUg⁻¹ minced bread. The overload of total bacterial counts in bread samples could be due to poor hygiene of the bakery, bread vendors, and transport materials (Adesetan *et al.*, 2013). Ehavald (2009) also reported that more than 90% of bread contamination occurs during the chilling, transport, slicing, and packaging processes. Most processed foods are considered harmful if they contain large populations of mesophilic aerobic microorganisms, even if the organisms are not known to be pathogenic (Sudershan *et al.*, 2009). The

mean range of fungal counts in the present study was 9.0×10^3 – 1.1×10^3 . This is higher than in the studies by (Shiferaw *et al.*, 2018) who reported mean counts ($\log \text{CFUg}^{-1}$) of molds and yeasts of 4.0 and 3.0, respectively. Typically, molds and yeasts are the predominant microbial group contaminating bread during processing and handling (Lai and Lin, 2007). The presence of a high fungal count could be due to litter in the environment. Preventing mold growth in food is difficult, but its level can be reduced by maintaining hygienic conditions during food processing and storage. Mold spores can be carried by the wind and thus easily find their way into the food sample (Viljoen and von Holy, 1997).

The microflora isolated in the present study were *Bacillus spp.* followed by *Escherichia coli*, *Proteus spp.*, and *Pseudomonas spp.* This is in consistent with the report by (Shiferaw *et al.*, 2018) in which *Bacillus spp.* *Pseudomonas spp.* have been isolated, but differs in isolation of *Staphylococcus spp.*, *Micrococcus spp.*, *Acinetobacter spp.*, and *Aeromonas spp.* The prevalence of *Bacillus spp.* among isolates could be due to the ability of *Bacillus* species to resist desiccation, allowing them to survive in dry products such as grain and flour. *B. cereus* is widespread in the environment and can be isolated from soil, water, and vegetation (Adams *et al.*, 1995). Vegetative bacteria, as well as molds and viruses, are easily killed during baking, but post-baking contamination from air, equipment, and handling devices can occur (Dale, 2003). One of the limitations of this work is that it did not consider the food handling practices of food processors in bakery operations.

Conclusions

Different types of pathogenic and non-pathogenic microorganisms were found to contaminate bread samples in bakeries. Therefore, regulators, state departments of health, and local environmental health units must ensure that bakeries comply with regulations and guidelines, and requirements for breadmaking. In addition, educational programs aimed at changing the attitudes of food managers and processors have been recommended. Future studies should focus on the count of bacteria from food utensils, food processors, and bacteriological testing of water used to bake bread.

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