Isolation and Identification of Foodborne Pathogens from Madiga Breads Sold in Selected Markets in Yenagoa Metropolis

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Abstract

The product 'Madiga' is a type of bread that is denser than normal bread, which is typically soft. Madiga, which is commonly baked in local bakeries, is widely eaten by rural dwellers and now embraced by urban settlers in the south-south region of Nigeria. This study aims to isolate and identify pathogenic bacteria from madiga bread sold in selected markets in Yenagoa, Bayelsa State. Two hundred madiga breads, commercially available, were tested for bacterial load and diversity using culture technique, Gram staining, and biochemical characterization. The results revealed that a total of 70 out of the 200 specimens had some pathogenic growths, thirty-two (32) specimens yielded S. *aureus*; 6 (18.8%) from Tombia, 8(25 %) from Swali, 4(12.4 %) from Agudama, and 6(18.8%) from Opolo market. *E. coli* grew in three specimens only in the Swali and Kpansia markets, 1(33.3%) and 2(66.7%), respectively. Coag –ve *staphylococcus* grew in specimens from all markets; 7 (20%) from Tombia market, 4(11.4%) from Swali market, 7 (20%) from Agudama market, 4(11.4%) from Kpansia market, and 13(37.2%) from Opolo market. Furthermore, the relationship between sample locations and bacterial contamination using Chi-Square on SPSS version 22 showed no significant difference. Although madiga is a popular ready-to-eat food in Bayelsa State, there are unhygienic practices in place from the point of production to the point of distribution to customers. Therefore, hygiene practice enlightenment and government policy on hygiene should be encouraged.

Keywords: Foodborne Pathogens, Madiga
DOI: 10.7176/JBAH/15-2-01
Publication date: July 30th 2025

Introduction

Madiga is a local bread product usually consumed by the people in the Niger Delta region of Nigeria. The baking of madiga bread started in the 1980s, precisely by Chief Madiga (founder) in Enekorogha community in Burutu Local Government Area of Delta State, Nigeria. It is produced from wheat flour, and it is a delicacy because of its sweet taste, ready-to-eat convenience, and low cost (Idolo, 2017). The product 'Madiga' is a type of bread that is denser than normal bread, which is typically soft. Madiga, which is commonly baked in local bakeries, is commonly eaten by rural dwellers and now embraced by urban settlers in the south-south region of Nigeria, more especially in the Niger Delta. Madiga is produced and sold in the open market in a generic state without a label, nutritional tag, or brand number (Idolo, 2017).

The majority of our daily calories come from the cereals used to make bakery products, making them an important source of nutrients. The nutrients found in bakery goods include energy, calcium, iron, vitamins, lipids, proteins, and carbohydrates (Iserliyska *et al*., 2020). Madiga bread in human nutrition is not only a source of energy, but also a supplier of irreplaceable nutrients for the human body. Madiga provides little fat, but high quantities of starch and dietary fibre as well as trace amounts of protein. It also contains the B group vitamins and minerals, which are mostly magnesium, calcium, and iron (Iserliyska *et al*., 2020).

Bacteria are microscopic living organisms that have only one cell. They are known to be ubiquitous and are found in different parts of the terrestrial environment, including various surfaces. Gupta *et al*. (2016) further highlighted that the natural environment, such as air, water, soil, and animal fluids are agent of bacteria that can affect society's health. Other means of acquiring bacteria are through the consumption of food and food products. This could occur via suspended solid materials sources, including dust, dry soil, and droplets or moisture from coughing and sneezing, or talking (Claessen *et al*., 2019).

Bacterial isolation and identification are the first steps to bacteriological studies. Isolation is done to obtain pure bacterial cultures. Most of the currently known species of bacteria have been identified using traditional microbiological techniques such as the Gram stain reaction, morphology, and metabolic reactions. Bacteria rarely live alone but in communities with other bacteria; this is true both in the environment and on our bodies (Claessen *et al.*, 2019).

Food contamination, inclusive of madiga, is becoming a serious problem worldwide, and characterization of such contaminants offers hope for the prevention of some foodborne infections (Huang, 2019). It is important to determine the nature of bacteria that could lead to outbreaks, and subsequently an epidemic. The study is therefore aimed at isolating and identifying pathogenic bacteria from madiga bread sold in selected markets in Yenagoa, Bayelsa State. The findings could be utilized as a preventive measure against foodborne diseases resulting from the consumption of madiga.

Materials and Methods

Study Area

This study was carried out in some selected markets (Tombia market, Opolo market, Kpansia market, Swali market, and Agudama market) within Yenagoa metropolis, Bayelsa State. Bayelsa is a state in the south-south of Nigeria, located in the core of the Niger Delta. Bayelsa State was created in 1996 and was carved out from Rivers State, making it one of the newest states in the federation (Agoro and Eric, 2023; Agoro and Thomas, 2023; Agoro and Ikimi, 2022; Agoro and Johnson, 2022; Agoro and Ibibo, 2021). The study spanned from November 2024 to May 2025.

Study Design/Sample Size Determination

A cross-sectional observational design was employed for the study. The sample size was determined using Taro Yaman's formulae. A total of 200 madiga breads sold in 20 different shops in Yenagoa metropolis were used for the study, as validated by Taro Yaman's formulae (Yamane,1973). The madiga was carefully handled with a high level of sterility to avoid contamination and promptly transported to the Medical Microbiology Laboratory of the Department of Medical Laboratory Science, School of Allied Medical Sciences, Bayelsa State College of Health for the microbiological study.

Fig. 1**:** A sample of a Madiga bread.

Ethical Approval

Ethical approval was obtained from the Ethical Committee of the Bayelsa State College of Health Science and Technology, Otuogidi, Bayelsa State.

Laboratory Procedure
Sample collection
A Total of two hundred (200) different madigas were bought from different shops in the Yenagoa metropolis. All the samples were wrapped separately in sterile polyethylene bags and plastic bags and transported to the laboratory for microbial analysis.

Isolation of foodborne pathogens

The samples are rinsed thoroughly with distilled water and used for the isolation of bacteria on specific media. The media used included Mannitol Salt agar, Blood, Chocolate, MacConkey agar, and Cetrimide agar at 37⁰C for 24 hours.

Phenotypic characterization of isolates

Bacteria are identified by cultural characteristics such as abundance of growth, color change in media, and morphological characteristics like form, size, margin, and elevation are studied on culture plates. Identifying an isolates by Gram's reaction- Gram's staining, motility determination- hanging drop method and soft agar stabbing (tube method), catalase, oxidase, nitrate reduction, IMVIC test, carbohydrate utilization, urease production, gelatin hydrolysis, coagulase test and DNase test were performed for the confirmation of the bacterial isolates according to the Bergey's Manual (Robert, 2019).

Statistical Analysis

Social Sciences (SPSS) program (SPSS Inc., Chicago, IL, USA; Version 18–21) and Microsoft Excel were the chosen statistical packages used for the data analysis and presentation. Chi-Square and graphical presentations were the choice tools for the data analysis.

Result

Table 1: Percentage occurrence of pathogenic bacteria in madiga bread sold in selected Yenagoa markets.

Market Organism	Tombia	Swali	Agudama	kpansia	Opolo	Total
		No (%)				
No growth	27 (20.8)	27(20.8)	29 (22.3)	26 (20)	21 (16.1)	130 (100)
Staph aureus	6 (18.8)	8(25)	4(12.4)	8(25)	6 (18.8)	32 (100)
E. coli	0(0.0)	1(33.3)	0(0.0)	2(66.7)	0 (0)	3(100)
Coag –ve	7 (20)	4(11.4)	7(20)	4 (11.4)	13(37.2)	35(100)
Total	40	40	40	40	40	200(100)

Table 2: Association of pathogenic organisms on madiga bread when compared with locations.

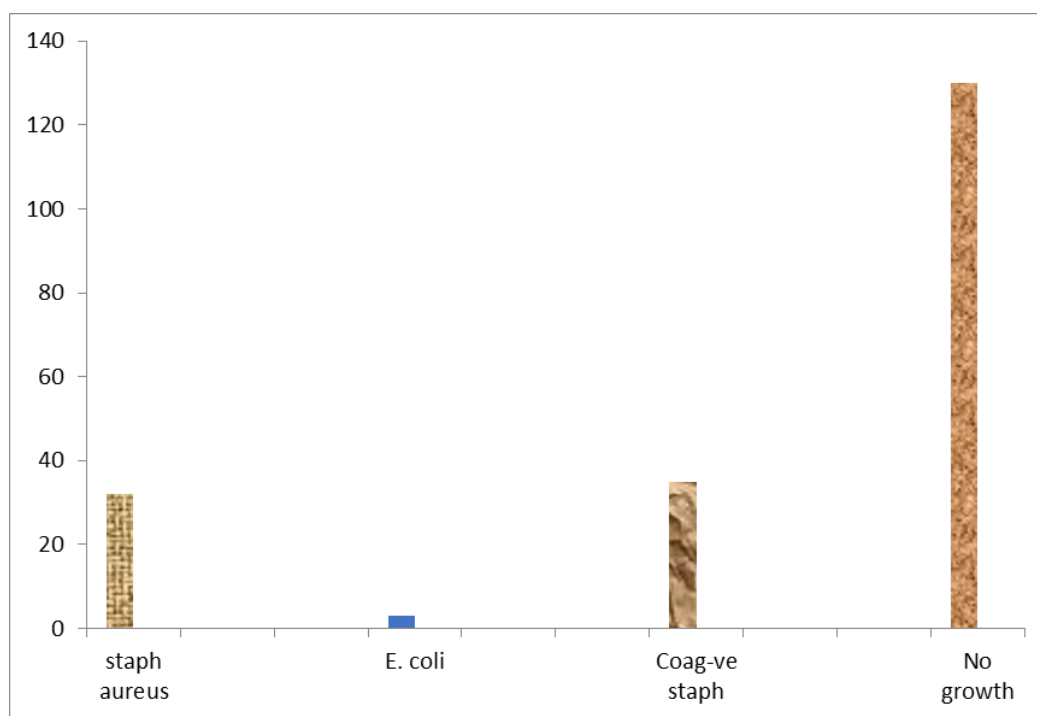| Market Organism	Tombia	Swali	Agudama	Kpansia	Opolo	Total
Staph aureus	6	8	4	8	6	32
E. coli	0	1	0	2	0	3
Coag –ve	7	4	7	4	13	35
X^2,df			11.60			
P value			0.170,8			

Figure 2: Pathogenic bacteria isolated in madiga bread in various Yenagoa locations.

Table 1 shows the percentage occurrence of pathogenic bacteria isolated in Madiga bread sold in some Yenagoa markets. It shows that a total of 70 out of the 200 specimens had some pathogenic growths. Thirty-two (32) specimen grew S. aureus; 6 (18.8%) from Tombia, 8(25 %) from Swali 4(12.4 %) from Agudama and 6(18.8%) from Opolo market. E. coli grew in three specimens only in Swali and Kpansia markets. 1(33.3%) in Swali and 2(66.7%) in Kpansia. Coag –ve staphylococcus grew in specimens from all markets; 7 (20%) from Tombia market, 4(11.4%) from Swali market, 7 (20%) from Agudama market, 4(11.4%) from Kpansia market, and 13(37.2%) from Opolo market. Table 2 shows the result when the isolation of pathogenic organisms in madiga

bread is compared with locations. In the analysis, a chi-square value of 11.60 with a difference of 8 was obtained. This gives a p-value of 0.170, revealing an insignificant association in the isolation of organisms in Madiga bread with various markets in Yenagoa metropolis. Figure 2 shows that three (3) different organisms were isolated, which include Coagulase -ve Staphylococcus, Staphylococcus aureus, and Escherichia coli in varying proportions. Furthermore, the figure revealed that out of 200 samples cultured, there was no growth for 130 of them, 32 for Staphylococcus aureus, 3 growth was recorded for E. coli, and 35 growths for Coagulase -ve Staphylococcus.

Discussion

In this study, madiga bread samples were taken from selected markets in Yenagoa, Bayelsa State, and analyzed for the presence of bacterial contamination. The study revealed a handful of contaminations in some of the madiga analysed microbiologically. A total of 70 out of the 200 specimens sampled and analysed had some pathogenic microbial growth (Table 1). The observation of bacterial growth in some of the madiga is an affirmation of the contamination resulting from either the production line, the handling, or the packaging. This portends health implications that could be deleterious, resulting in either morbidity or mortality if not contained appropriately. The findings are in line with a handful of researchers who also isolated pathogens from bakery products (André *et al.,* 2017; Chou *et al.,* 2023; Dijksterhuis, 2019).

Furthermore, the study isolated three (3) different organisms from the study locations, which included *Coagulase -ve Staph*, *Staphylococcus aureus, and Escherichia coli* in varying proportions (Table 2). The statistical analysis using Chi square resulted in a P-value of 0.170, revealing an insignificant association between the organisms in the madiga bread and the various markets in Yenagoa metropolis. This has affirmed that the contamination is not localized to a location, and could be widespread with an implication of an epidemic.

The bacteria isolated are of public health concern due to the deleterious effects on human health. Other studies have also implicated Escherichia coli and Staphylococcus aureus as the most common pathogens causing bacteremia (Poolman and Anderson, 2018; Zhao *et al.*, 2021; Mehraj *et al.,* 2016). In a similar vein, studies carried out on bread, the presence of *Staphylococcus aureus, Lactococcus acidophilus, Bacillus cereus, Enterococcus fecalis, Escherichia coli, Lactobacillus spp, Saccharomyces spp., Aspergillus spp., Fusaruim spp.,* and *Mucor spp* were observed (Jasper *et al.,*2022; Elechi *et al.*, 2022).

A total of 200 samples were cultured, of which 130 did not exhibit growth, 35 yielded *Coagulase -ve Staph,* 32 *Staphylococcus aureus*, and 3 E. coli (Figure 1). This depicts that Coagulase -ve Staph and S. aureus are the most predominant contaminants, followed at a distant by E.coli. This is quite precarious as these organisms are all of grave public health concern. Staphylococci remain the leading cause of numerous human infections. Along with S. aureus and other coagulase-positive strains, whose pathogenicity and mechanisms of virulence are well understood, the coagulase-negative species have recently garnered more attention. Though less virulent than coagulase-positive isolates, they express a restricted number of virulence factors. Infact, they are the most prevalent microorganisms within the genus, particularly in hospital settings, and also promote body invasion (Fontana and Favaro, 2018).

In a similar vein, E. coli triggers diarrhea and produces a powerful toxin that damages the lining of the small intestine. This can cause bloody diarrhea. You develop an E. coli infection when you ingest this strain of bacteria. Unlike many other disease-causing bacteria, E. coli can cause an infection even if you ingest only small amounts (Pakbin *et al.,* 2021; Yang *et al.,* 2017; Alegbeleye and Sant'Ana, 2020).

Conclusion

The study indicated microbial contamination in madiga sold in some selected locations in Yenagoa metropolis. Coagulase -ve Staph and S. aureus are the most predominant contaminants, followed at a distant by E.coli. This is quite precarious as these organisms are all of grave public health concern. The contamination could be tied to either unhygienic practices at the bakery, the sales point, or both. These findings call for enlightenment on all participants at the chain of production to sales of madiga on the essentials of hygiene, and also for the government to tighten the hygiene rules and regulations in the state.

Conflict of Interest

No conflict of interest was noted.

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