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ORIGINAL RESEARCH ARTICLE

Microbial Analysis of Street Food Samples from Bichi Central Market, Kano State, Nigeria: Implications for Food Safety and Public Health

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ABSTRACT

One fundamental prerequisite for food quality is food safety. Twenty samples of street food-fried rice, rice and beans, spaghetti, and jollof rice were randomly chosen from five separate sellers in the Bichi Central Market, Kano. The samples were taken in sterile polythene bags on ice to stop the growth of bacteria. The samples were sub-cultured and subjected to the pour plate procedure for bacteriological analysis. To use pour plate techniques, the sample was serially diluted. The first and last tubes were chosen, and 1 ml of each sample was pipetted into the Nutrient agar plate and incubated for 24 hours at 37°C before being checked for growth. The amounts of bacterial growth in each of the screened food samples ranged from 1.0 X 10^5 to 2.6 X 10^6 cfu/ml. Bacterial counts in 90% of the food samples exceeded the acceptable threshold (10^4 cfu/ml), and bacterial counts in 10% showed low counts. The food samples identified five distinct varieties of bacteria, including *Salmonella spp., Escherichia coli, Shigella spp., Staphylococcus aureus, and Vibrio spp.* Multiple harmful microorganisms were isolated from spaghetti and jollof rice. The results showed that street food has the quality to spread food-borne illnesses, which highlights the need for workable solutions focused on street food safety.

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INTRODUCTION

A basic human right is access to safe food. However, a lot of foods are regularly tainted with pathogenic microorganisms that are present in nature. Despite their inability to be detected organoleptically (i.e., by sight, smell, or taste), these pathogens can cause various illnesses. Therefore, concerns about food safety are crucial to global health (WHO, 2001). Small concentrations of pathogens found in food might also infect persons with compromised immune systems, whereas healthy individuals may not experience any negative effects. Food is any substance that humans, animals, or plants consume or absorb to survive and thrive. Food is a collection of chemical molecules that heterophilic living things absorb while carrying out metabolic activities. According to the World Health Organization, food-borne diseases that have microbial roots are among the most common issues facing society today and account for around one-third of all fatalities. Infectious diseases can also hurt economic growth. Most local markets have unhygienic circumstances, and the atmosphere is heavily contaminated and full of pathogenic flora and spoilage. These factors are probably the main causes of the contamination of these vendors' food (Oweghe et al., 2001). It is well-recognized that unsanitary circumstances in a food setting can promote the growth of harmful microorganisms in food (Egeonu, 2002). As a result, information about unprocessed food's nutritional value and its processing's hygienic conditions may be obtained by microbiological analysis of foods and food contact surfaces (Michael et al., 2001). Microorganisms are mobile in the kitchen, easily attaching quickly to food, people, and appliances. When food is not thoroughly washed and sterilized before being used to produce another dish, bacteria can spread from equipment to food. This suggests that food for human consumption should be pure and devoid of contaminants, particularly harmful and rotting germs. Illness could result from a failure to guarantee the general public's food safety and cleanliness. Regular monitoring and examination of the raw materials are necessary to achieve good quality and minimize the amount of microbial contamination. Food service establishments must be very careful about food contact surfaces to stop the spread of food-borne diseases. Surfaces like tables and bench tops may harbor bacteria

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from human contact, contact with raw food, soiled equipment, or other sources like cartons left on the floor.

Food-borne disease from ingesting contaminated food is a significant global public health concern, particularly in underdeveloped nations where it is recognized as a primary cause of diarrheal illnesses (Mensah, 1997). Nevertheless, several research investigations have demonstrated that these items are occasionally kept at incorrect temperatures, mishandled excessively by food sellers, and served in extremely unhygienic conditions (WHO, 2001, 2003; Ghosh et al., 2007). Additionally, there are several cases of food sellers transmitting enteric fevers and acting as possible transmission sources. The majority of the vendors are ignorant about safe food handling practices and their part in the spread of infections as they have either never attended school or just attended for a short time (Mensah et al., 1999). In addition, most consumers of these meals are more concerned with the ease of consumption than with the hygiene and cleanliness of the food. The Food and Agriculture Organization (FAO) and other organizations have shown worry that these items might cause food poisoning epidemics (Chakravarty and Canet, 2002). The primary cause of death and disability in Nigeria continues to be frequent cases of illness caused by food alongside signs of digestive problems such as loose stool, cramping in the abdomen, and nausea. This is true even though epidemiological research data on the number of cases of food-borne diseases are insufficient, and outbreaks are frequently not looked into (Nweze, 2010). Since lots of pathogenic bacteria in food are typically required to cause sickness, it is possible to prevent disease by limiting the number of bacteria that are present, stopping the growth of the small amount that is present, thoroughly cooking the microbes to destroy them, as well as preventing cross-contamination (De Boer and Beuner, 2001) Inadequate personal cleanliness, untidy storage, cooking spaces, and contaminated food that has been cooked or raw are all contributing factors. Microorganisms can proliferate when uncooked and cooked meals are handled improperly. Most microorganisms can thrive at temperatures around 41^0 C and 135^0 C. Food products, both processed and unprocessed, shouldn't be stored in this risk environment for a longer period than necessary. One common method of assuring the integrity and quality of food is t to detect harmful and spoiling microorganisms (De Boer and Beuner, 2001). The categories of food individuals eat, the suppliers of those foods, and a likely loss in public understanding of proper food preparation methods are all variables influencing food-borne illness rates. To stop the spread of germs, every tool that comes into contact with food must be thoroughly cleaned and sterilized before use (James, 2005). Consumption of food with pathogens directly affects health. Hence, those handling food and producers are responsible for protecting food against harmful microbes, particularly when that food is intended for consumption without extra preparation (Munide and Kuria, 2005). There is a time lag until food-related disease symptoms appear after consuming food contaminated with dangerous germs. The food hygiene research field focuses on using effective and high-quality food manufacturing and preparation techniques. It addresses more than how to handle food and beverages properly, but also how to handle tools and other equipment that come into contact with food during the preparation, serving, and eating. It also handles how to avoid contaminating food with organisms that can cause food poisoning. (Umoh and Odibo, 1999). These include over-cooling food, the interval between preparation and serving, inadequate personal hygiene, and contaminating cooked and uncooked food. According to Munide and Kuria (2005), food service employees have the potential to transfer infections from one food to another, from dirty floors or hands infected with gastrointestinal tract microbes. Abuse of Time-Temperature Relationship. A possibly significant way for pathogenic organisms to enter the food supply is through hand contact with ready-to-eat food (Munide & Kuria (2005). Salmonella is a collective term for around 2,000 biochemically similar strains that cause food-borne diseases. Globally, salmonellosis is a significant contributor to diseases caused by food. An estimated 800 persons are affected by the ailment each year, frequently linked to travel abroad (Mead et al., 1999).

Staphylococcus aureus is a bacteria that can cause food-borne disease in certain circumstances. Food-borne disease occurs when humans eat foods infected with pathogens from the Staphylococcus aureus bacterium. Cross-contamination of food can occur when people harbour germs such as Staph fail to properly wash their hands before handling food. These meals are sometimes kept at room temperature for extended periods, which encourages the growth of bacteria and the production of toxins. If there are any Staphylococcus aureus in food, they will not thrive if food handlers practice proper personal hygiene and raw and cooked items (Wagner, 2001). Bacteria belonging to the genus Shigella are responsible for causing Shigellosis (Bryan, 1979). Shigella often inhabits the human and other primates' digestive tracts. According to Feldman and Riley (1985), the fecal-oral pathway serves as the main means for transmitting disease between individuals. Uncooked vegetables, livestock, milk, other dairy products, and chicken are the main foods linked to Shigella.

To ascertain the study area's food coliform count and the potential effects of eating such foods on public health, this study aims to isolate and identify the bacteria linked to the food.

MATERIALS AND METHOD

Study sites

Twenty (20) street food vending sites in the Bichi Central Market were sampled for the study. Residents who visit

these restaurants highly recommend these vending locations, which is why they were selected.

Sample Collection

A bacteriological survey was conducted at several Bichi Central Market, Kano street food vending sites. Twenty (20) street food samples including Jollof-rice, spaghetti, rice and beans, and fried rice, were bought from different sites in Bichi Central Market, Kano, and their levels of bacterial contamination and suitability for ingestion by humans were assessed. The purchased samples were transported in sterile polythene bags on ice to stop the growth of bacteria to the department's laboratory for analysis. Media was prepared according to the manufacturer's instructions, weighed accordingly, and autoclaved at 121^0C for 15 minutes. After pouring the media into Petri plates, they were left to cool and solidify. The food was served on sterile, covered dishes that were kept clean. A quantity of 10g was macerated for every food sample. A test tube was filled with nine millilitres of sterile distilled water. The test tube holding nine millilitres of sterile distilled water was filled with one millilitre of each macerated sample. Fourthly, the pour plate method was used to investigate fold serial dilutions from 10^1 to 10^4.

Culture of Sample (Pour Plate)

In brief, nutritional agar plates were pipetted with 1 ml of each dilution from 10^1 – 10^4 after each plate was meticulously labelled on top. As soon as the agar was added, these plates were shaken to help the bacteria stay apart while they grew. After allowing the medium to settle on a flat top bench, the plates were incubated for 24 hours at 37^0 C in anaerobic and aerobic conditions.

Sub-Culturing of the Culture

Salmonella shigella agar, Mac Conkey agar, and fresh nutrient agar plates were used to subculture the colonies once they had been isolated in the culture. The plates spent a full day at 37 degrees Celsius in anaerobic and aerobic conditions.

Identification of Various Isolates

Bacterial samples were identified using normal microbiological procedures. As a preliminary test, the catalase, coagulase, citrate, indole, Voges-Proskauer, methyl red, motility, and oxidase were used as described by Speck (1976) and Jolt et al. (1994). The organisms were identified and characterized using the biochemical tests listed below.

Gram's staining

The procedures described by Nester et al. (2007) were followed for these tests. The most popular method for staining bacteria and dividing them into two main groups; Gram positive and Gram negative. Apply a thin layer of the specimen overly a thin layer of the specimen over a, then let it air dry. Three passes over a Bunsen flame should fix it. After dousing the film in crystal violet, let it sit for 60 seconds. After washing the discolouration off the slide, apply a liberal amount of Lugol's Iodine and mordant and let it sit for 60 seconds. After removing the iodine, wash the slide and train with safranin for 60 seconds, then wash off the acetone decolorizer. After that, let the slide air dry and dry the back. Use the x 100 oil immersion lens to examine. Purple denotes Gram (+) positive, while red in safranin denotes Gram (-) negative.

Statistical analysis

The total bacteria and coliform count results were analyzed using the variance method (Snedecor and Cochran, 1976).

RESULTS

In this study, the presence of bacteria was detected in 20 street food samples. The street food samples were all infected with different amounts of germs, according to the results. Table 1 displays the characteristics of bacteria separated from the food samples.

Table 1: Characteristics of the bacteria separated from the various food samples.

Media	Samples	Morphology of bacteria
Nutrient agar	Fried Rice	White colony
	Fried Rice	Yellow and creamy colonies
Mac Conkey agar	Jollof Rice	Colourless colonies
	Rice and Beans	Colourless and transparent
	Rice and Beans	Non-lactose fermenter
Salmonella Shigella agar	Jollof Rice	**Smooth and colorless**
	Spaghetti	Opaque

Table 2: Total bacterial count (CFU/ML) of the samples

Number of colonies	Bacterial Counts	Food Samples
260	2.6×10^5	Rice and Beans
210	2.1×10^3	Fried Rice
100	1.0×10^5	Fried Rice
200	2.0×10^7	Jollof Rice
260	2.6×10^6	Rice and Beans
180	1.8×10^8	Spaghetti
270	2.7×10^5	Jollof Rice

Table 3 below shows the identification of the suspected organism (E.coli, Staphylococcus aureus, Shigella spp., Salmonella spp.) from different biochemical tests.

Table 3: Biochemical Test

Food samples	Gram staining	Catalase	Coagulase	Indole	Citrate	Methyl red	Voges Proskauer	Oxidase	Motility
Rice and Beans	-	+	+	+	-	-	-	-	-
Fried Rice	+	+	+	+	-	-	-	-	-
Fried Rice	+	+	NA	+	-	-	-	+	-
Jollof Rice	-	-	+	-	-	+	-	+	-
Rice and Beans	+	+	+	+	-	-	-	-	-
Spaghetti	+	+	NA	+	-	+	-	-	+
Jollof Rice	+	+	+	-	-	+	-	-	+

Based on the microbiological isolates from the food samples, Table 4 indicates that the most common organisms are Staphylococcus aureus, Bacillus species, Escherichia coli, and Vibrio species. The table additionally demonstrates that every food sample contained a mixture of microorganisms.

Table 4: Food samples with related Microorganism

Food Samples	Bacteria
Fried Rice	Staphylococcus aureus
Rice and Beans	Salmonella spp
Jollof Rice	Salmonella spp, Bacillus cereus
Spaghetti	Vibrio spp, Escherichia coli

Key: spp - Species

DISCUSSION

In Nigeria, gastroenteritis continues to be a significant health concern in terms of food-borne diseases. A presence of germs in every sample (n = 20). Salmonella spp was more significant in rice and beans 2.6 X 107 CFU/ML and not in fried rice 2.1 X 10^3 CFU/ML. A total bacterial count of $>10^4$ CFU/ML in the examined food samples indicates unacceptable contamination and potential health risks. Olawale et al. (2015) found varying levels of virulence genes in Enterococcus faecalis isolated from RTE foods. The prevalence of Aspergillus spp. and Penicillium spp. could be attributed to the foods' contact with the surrounding atmosphere and packing materials (Oranusi et al., 2011). The preparation of food and serving areas is typically unsanitary, contributing to this study's high prevalence of bacterial contamination. Most street food vendors' locations are next to dusty roads and trash cans. Additional factors that contribute to many contaminations include the absence of tap water and inadequate food safety training. Isolates derived from Jollof-rice have the highest colony-forming unit/ml. The increased aerobic bacterial count may be due to exposure to the unclean environment of the market utilized in the study (Oje et al., 2016). According to the results, Salmonella spp., known to cause food-borne gastroenteritis and typhoid fever, was the source of the considerable or unacceptable colony-forming unit found in rice and beans. Faeces from the manure utilized may have contaminated rice and beans, leading to the isolation of Salmonella spp. Food-borne illness caused by Escherichia coli is common in children and adults who have eaten contaminated food. Staphylococcus aureus is isolated from fried rice. It usually indicates inadequate personal hygiene, inappropriate storage conditions, and low-quality raw materials. This result agrees with previous studies in the literature (Oranusi and Braide, 2012).

CONCLUSION

In Nigeria, the street food industry has remained largely uncontrolled despite its significance to the country's food security. Food security can benefit from eating healthy, well-balanced street food, but eating food that falls short of minimum safety standards might negatively affect one's health. The results of this investigation show that rice and beans, fried rice, spaghetti, and Jollof-rice sold in Bichi Central Market are contaminated with bacteria. To minimize food contamination and lower the bacterial load, food sellers must constantly clean and sanitize surfaces that come in touch with food and properly cook and store food. The presence of these microbes in food leads to food deterioration and illness. Food should be both nutritionally balanced and microbiologically safe. Good hygiene should be ensured during preparation and sales of these foods, to prevent illness from consuming contaminated foods. It may be impossible to eradicate the vending of ready-to-eat foods around motor parks in Nigeria. As a result, the government should enforce strict food safety regulations for street vendors. Street food vendors should also be educated on food safety and hygiene practices. This will help to prevent food-borne illnesses. Because these bacteria are hazardous and linked to food-borne illnesses, an elevated E. coli, S. aureus, and B. cereus indicates a potential threat to human health (Granum, 2005; Wagner, 2009; CFIA, 2009). As the world is moving towards a greener environment and economy, addressing food safety issues in food production is critical.

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