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Bacteriological Analysis of Selected Street Vended Fried Foods Sold in Wudil Town Along Maiduguri Road, Kano State- Nigeria

B.A. Jido[1*], A.A. Shehu[2], F.U. Salisu[2], A. Yahaya[1], M. Ali[2]

[1]Department of Biological Science, Kano University of Science and Technology Wudil, Kano, Nigeria

[2]Department of Microbiology, Kano University of Science and Technology Wudil, Kano, Nigeria

[*]**Corresponding author:** Bello Adamu Jido, Department of Biological Science, Kano University of Science and Technology Wudil, Kano, Nigeria. Tel: +23407032967252; Email: bellojido@gmail.com

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Abstract

A bacteriological analysis of four selected street vended fried ready-to-eat food types (Yam, sweet Potato, Akara and Masa) sold freely and openly at various location in Wudil town along Maiduguri road Kano, Nigeria was conducted from April, 2017 to August, 2017. The food samples collected were cultured on a Nutrient agar and MacConkey agar plates for isolation and identified using gram staining and motility test and subsequently subjected to various biochemical tests which include; catalase, coagulase, indole, methyl red, Voges - Proskauer, citrate utilization urease and oxidase tests. From the total of 200 samples examined, 183 (91.5%) were contaminated by different bacterial agents, total of 191 bacterial isolates were recovered, in which 89(46.6%) were *Staphylococcus aureus,* 45(23.6%) *Escherichia coli,* 38(19.9%) *Pseudomonas aeruginosa* and 19(9.9%) *Klebsiella pneumoneae* but statistically there is significant difference (P> 0.05). Analysis of the food samples revealed mean total bacterial count ranging from 1.6 x 10^3 cfu/g (yam) to1.0 x 10^2 cfu/g (potato), where fried beans ball (Akara) had a mean bacterial count of 1.5 x 10^3cfu/g and fried rice masa with 1.06 x 10^3 cfu/g, therefore, mean bacterial count were high in fried yam, followed by fried Akara, rice masa and fried potato has less prevalence. It is recommended that food vendors should be enlighten on food contamination by food regulatory agencies since most of them are not aware of microbial invasion.

Keywords: Bacteriological analysis; *Escherichia coli*; Kano; *Staphylococcus aureus*; Wudil

Introduction

Ready to eat foods are foods that can be bought directly from street vendors or hawkers or at local markets and eaten immediately i.e. foods are defined as ready to eat foods and beverages prepared and or sold by vendors and hawkers especially in street and other similar public places [1]. These are very popular worldwide and provide readily available delicacies at a cheaper rate [2]. Street vended foods are prepared and/or sold by vendors on the street and in other public places for immediate consumption or for consumption at a later time without further processing or preparation [3]. Since these foods are prone to contamination because they are sold in the open and are often not covered. Street vendors prefer to take their products to their customers they often operate from places such as bus terminal, industrial areas, schools, market places and streets. Such locations usually do not meet food and safety requirements [3].

These foods can endanger public health by causing various acute and chronic food borne diseases through pathogenic microbes or toxic substances produced. Most of the studies done on street food in Nigeria and foreign countries had indicated that these foods are not meeting the microbiological standards and are contaminated with various pathogens viz *Escherichia coli*, *Staphylococcus* specie, *Salmonella* specie, *Vibrio* sp, *Listeria* sp. etc [4].

sale of food in the streets is very controversial from a health standpoint, the main health hazard associated with street foods is microbial contamination [1]. A number of observational studies have shown that street foods are sometimes held at improper temperatures, excessively handled by food vendors and sold at very dirty surroundings which make them prone to contaminations [5,6]. In addition, most of the vendors had either no formal education or few years of schooling and therefore, they are unaware of improper

food handling and their role in the transmission of pathogens [7]. Knowing the microbiological quality of street vended foods is important factor to appreciate the safety problems related to street foods so that concerned bodies may take appropriate steps to improve safety and sanitation with respect to this economic sector [8]. It becomes common practice to observe them around school's bus stations and other places where several people found. In Nigeria and other countries almost all categories of people are consuming street foods; while some are protected from using these foods fear of contamination. Different researchers have shown various level of contamination of the street foods [3]. The establishment of validated methodologies for the determination of food shelf-life is currently demanded by both food industries and Health Authorities at national and international scale [9]. It is well known that most foods are perishable, since they are subjected to modifications in their structure, composition and properties during storage before consumption [10]. These changes are of physico-chemical origin attributed to food composition together with the action of intrinsic and extrinsic environmental factors, and also microbiological, where spoilage flora, play an important role [11]. The study was aimed to determine the bacteriological quality of selected street vended fried foods sold in Wudil town along Maiduguri road, Kano State- Nigeria.

Material and Methods

The Study Area

This research was carried out at Wudil town, along Maiduguri road Kano state, Nigeria. Where travelers stop over to buy foods by the road side (street food), Wudil is situated at 11.81°N latitude 8.85°E longitude and 375 meters above the sea level [12]. Five different vending sides were used for the study (from Wudil bus-stop, along Maiduguri road to Kano University of Science and Technology Wudil mini-market). These sides were chosen due to the level of commuters and other people patronizing.

Sample collection

A total of 200 samples comprising of four different fried food types, i.e. Yam, sweet potato, beans ball (Akara), and rice masa collected in batches, were collected using random sampling technique [13]. The five sampling sites were visited on different occasions for sample collection within the period of this study in Wudil town (from bus-terminal along Maiduguri road to KUST, mini- market) in same quantity. Fifty (50) samples of each food type were purchased in sterile brown bag envelopes directly from sellers and immediately brought to laboratory of the Department of Microbiology, KUST Wudil for analysis. Each fried food samples were purchased in batches (10 pieces per batch for ten weeks i.e. two weeks' interval per each sampling). (Table 1).

Sampling site	Code	Yam	Potato	Akara	Masa	Total
Opposite KUST Wudil	A	10	10	10	10	40
Opposite General Hospital	B	10	10	10	10	40
Near Amana Hospital Wudil	C	10	10	10	10	40
Wudil Motor Park	D	10	10	10	10	40
KUST, Wudil Mini-Market	E	10	10	10	10	40
Total		**50**	**50**	**50**	**50**	**200**

Table 1: Samples collection points and different types of fried food.

Isolation, Enumeration and Identification of Bacteria

The samples were initially cultured on a Nutrient agar, and MacConkey agar plates. All plates were incubated aerobically and anaerobically at 37°C for 24 hours and plates reading were conducted according to method described by Cheesbrough [14]. Discrete colonies were identified based on standard bacteriological methods described by Cheesbrough [14] and Uchei, [15].

The organisms were differentiated by gram staining and motility test and subsequently subjected to various biochemical tests for evidence of confirmation, which include; catalase, coagulase, mannitol salt agar incubation, indole, methyl red, Voges-Proskauer, citrate utilization urease and oxidase tests.

Statistical Analysis

Data were analyzed using One-Way Analysis of Variance (ANOVA) and t- test using statistical software openstat version 08.12.14. Probability level was set at $p<0.05$

Results

The mean bacterial count per gram of food sample according to the sample is presented in table 2. Fried yam has the highest mean bacterial count of 1.6×10^3 while fried potato has the least mean bacterial count of 1.0×10^2

Food items	Mean Bacterial Count (cfu)	Log. Number
Fried yam	1.6×10^3	3.2
Fried potato	1.0×10^2	2.0
Fried beans ball (Akara)	1.5×10^3	3.1
Fried rice masa	1.06×10^3	3.0

Table 2: Mean bacterial count per gram of food sample according to food type**.**

The type of bacteria isolated from the food samples is presented in table 3. The result shows that 4 bacterial Genera were recovered from 200 samples of different fried food types examined; the isolates include; *Staphylococcus, Escherichia*, *Pseudomonas* and *Klebsiella*.

Food sample	Types of bacteria isolated	Bacteria isolated
Fried yam	4	*S. aureus, E. coli, P. aeruginosa* and *Klebsiella*
Fried potato	2	*S. aureus* and *P. aeruginosa*
Akara	4	*S. aureus, E. coli, P. aeruginosa* and *Klebsiella*
Masa	3	*S. aureus, E. coli* and *P. aeruginosa*

Table 3: Types of bacteria isolated from the food samples.

The distribution of bacterial isolates according to food samples examined is presented in table 4. The result indicated that 191 bacterial isolates were identified, the genus *Staphylococcus* has the highest isolates obtained from the total number of food samples with 89 (46.6%) among which fried Yam had the highest number of bacterial isolates 31 (34.9%), followed by fried akara 28 (31.5%), fried rice masa 17(19.1%) and fried potato was the least with growth of 13 (14.7%) isolates.

Bacterial species	Yam	Potato	*Akara*	*Masa*	Total
Staphylococcus aureus	31^a	13^c	28^a	17^b	89 (46.6%)
Escherichia coli	18^a	0^c	16^a	11^b	45 (23.6%)
Pseudomonas aeruginosa	11^b	6^c	15^a	6^c	38 (19.9%)
Klebsiella pneumoniae	6^b	0^c	13^a	0^c	19 (9.9%)
Total	66 (34.6%)	19 (9.9%)	72 (37.7%)	34 (17.8%)	191 (95.5%)
Key: Values having different superscript along the same row are considered significantly different at $p<0.005$.					

Table 4: Distribution of bacterial isolates according to selected street vended fried food samples examined.

The distribution of bacterial isolates according to sampling sites is presented in table 5. The result indicated that site B had the highest bacterial contamination with 50 isolates (26.2%), followed by site C, with 47 isolates (24.6%), which is also very close to site B. Site D had 35 isolates (18.3%) while Site E with 30 isolates (15.7%) and site A had a slightly low bacterial contamination of 29 isolates (15.2%).

Food items	Site A	Site B	Site C	Site D	Site E	Total
Yam	10^b	15^a	14^a	9^b	8^b	56(29.3%)
Potato	6^b	9^a	7^b	7^b	6^b	35(18.3%)
Akara	7^b	16^a	14^a	10^b	9^b	56(29.3%)
Masa	6^c	10^a	12^a	9^b	7^b	44(23.0%)
Total	**29(15.2%)**	**50(26.2%)**	**47(24.6%)**	**35(18.3%)**	**30(15.7%)**	**191(100%)**
Key: Values having different superscript along the same row are considered significantly different at $p<0.05$.						

Table 5: Distribution of Bacterial isolates according to sampling sites.

The distribution of bacterial isolates according to the source of the food sample is presented in table 6. The result showed that fried foods purchased from uncovered source are contaminated with total of 140 bacteria isolates which accounted for 76.5% while those purchased from covered source contain a total of 43 isolates (23.5%).

Food Type	Covered food	Uncovered foods	Total	t-value
Yam	15(27.2%)	40(72.7%)	55(28.8%)	5.2551*
Potato	8(19.0%)	34(81.0%)	42(22.0%)	
Akara	6(12.0%)	44(88.0%)	50(26.2%)	
Masa	15(34.1%)	29(65.9%)	44(23.0%)	
Total	44(23.0%)	147(77.0%)	191(100.0%)	

* The calculated t-value is 5.2551 and the critical value at n= 4 and df = 3 is 2.353 showed significant difference in the number of isolated obtained from covered and uncovered food at $p<0.05$.

Table 6: Distribution of bacterial isolates according to the source of street vended fried foods examined.

Discussion

The study was aimed to assess the bacteriological quality of selected street vended fried foods sold in Wudil town along Maiduguri road, Kano state- Nigeria. A total of 200 street vended fried food samples were collected in different batches (10 samples for each batch), 40 samples per sampling site of 5 different locations and total of 50 samples for each food type sold in Wudil town were examined (fried yam, fried sweet potato, Akara and Masa). The results found that four different bacterial genera were isolated (*Staphylococcus, Escherichia*, *Pseudomonas* and *Klebsiella*). The highest bacterial count occurred in fried yam with mean total bacterial load of 1.6×10^3, followed by fried beans ball (akara) with the mean total bacterial count 1.5×10^3 while least mean total bacterial count was found in fried potato (1.0×10^2). This result conformed to the work of Ochei et al. [16], and also in agreement with research of Maduake et al. [17] and Ochei et al. [16]. The mean count shows bacterial contamination in the food samples which may probably be as a result of improper processing, handling/serving, or consumption and also sold at very dirty surroundings [5,6]. Low bacterial load in fried Potato may likely be as a result of low moisture content of potato among all the samples examined.

The finding of this study shows 4 bacterial isolates were recovered from 200 samples of different fried food types examined. Out of the 200 samples analyzed, 183 yielded bacterial growth while 17 had no significant growth. From 183 samples that yielded significant growth, some of them are in pure culture growth, while others yielded mixed culture growth.

The bacterial species were; *Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa* and *Klebsiella pneumoniae. Staphylococcus aureus* shows the high frequency of bacterial isolates from the 200 Samples of the 4 selected street vended fried food types examined in Wudil town, Kano Nigeria, the presence of *Staphylococcus aureus* in the samples is because it is found in about 20% to 40% healthy individuals nose [15], and is an indicative of human contamination after production, this could be from direct human contact such as fingers or indirectly through additives or utensils, hence sale of food in the street is very controversial from a health standpoint, the main health hazard associated with street foods is microbial contamination [1]. The organism is associated with endotoxin characterized by short incubation period (1-8 hours), violent nausea, vomiting and diarrhea [18]. The subsequent bacterial prevalence was *Escherichia coli*, *Pseudomonas aeruginosa*, and followed by *Klebsiella pneumonia* such organisms may likely be from the feacal origin even though, members of *Enterobacteriaceae* encountered in the study, including *Escherichia coli* and *Klebsiella* pneumonia can be attributed to environmental contamination by unwholesome materials like feaces. This finding supported the work of Bukar et al. [19] who reported that about 5 (10.0%) of 50 food handlers in three small-scale food industries in Kano metropolis investigated contained *E. coli* on their hands.

On the basis of sample sites, site B had the highest bacterial contamination with total of 50 isolates (26.2%), this may probably be because hospital is a place where people with different aliments which could be communicable or non-communicable are attending regularly in which all the food types sampled yielded high bacterial growth. This is followed by site C, with 47 isolates (24.6%), Site D had 35 isolates (18.3%). Most of the vendors had either no formal education or few years of schooling and therefore, they are unaware of improper food handling and their role in the transmission of pathogens [7]. Site E (KUST Mini market) with 30 isolates (15.7%) and site A (opposite KUST, Wudil) had a slightly low bacterial contamination of 29 isolates (15.2%), such two vending sites had low bacterial contamination because they are patronized by almost same literates individual (students) and high number of covered food samples were obtained from the two vending sites. Table 4.6 of this study showed that food samples purchased from uncovered source are contaminated with total of 140 isolates accounted for 76.5% while those purchased from covered source contain a total of 43 isolates (23.5%). This implies that uncovered foods are more contaminated. It is possible that foods prepared in our locality could be contaminated especially when not covered with air borne microorganisms mostly at the point of selling. Some microorganisms on the surface of the skin, mouth, nose of the vendors can be introduced directly into the foods, or by coughing and sneezing [20,21].

Conclusion

A total of 200 street vended fried food samples were collected in different batches (10 samples for each batch), 40 samples per sampling site of 5 different locations and total of 50 samples for each food type sold in Wudil town were examined. Based on the finding

of this study, it has been concluded that *Staphylococcus aureus* was found to be the most prevalent bacterial isolate obtained from the samples examined. The incidence of the isolates according to sampling sites showed that high isolates were recovered in site B and C where vendors lack formal education. Certainly uncovered street fried food type has the highest bacterial contamination than the covered samples. It is recommended that food vendors should be enlighten on the issue of food contamination by food regulatory agencies since most of them are not aware of microbial invasion.

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