Microbiological Qualities and Safety of Street Foods Vended in Anyigba Town, Kogi State, Nigeria

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ABSTRACT

Background: *There is a noticeable increase of street foods vended in Anyigba town. Despite the economic and nutritional benefits of street foods the consumption of these foods could potentially increase the risk of foodborne diseases.*

Objective: *The objective of this study was to determine the microbiological qualities and safety of street foods vended in Anyigba town.*

Materials and methods: *Ten samples of food sold in Anyigba town were obtained from popular vending points. The food samples were; plantain chips, fried yam, okpa, akara, zobo drinks, kunu, dokwa, fura, suya and soymilk. Microbiological analysis of the food samples were done according to the standard methods of analysis. The data obtained were subjected to statistical analysis.*

Results: *The results obtained for the total viable and coliform counts on all the samples exceeded the acceptable limits of $<10^5$ recommended. The microbiological contamination was highest in foods made from cereals. Escherichia coli, Staphylococcus aureus, Bacillus cereus, Salmonella spp. among other bacteria were isolated from almost all the food samples. This indicated poor hygiene and post-processing contamination. The mycological profiles of the foods tested showed fungal contamination. Aspergillus flavus, Mucor spp. and Rhizopus spp. were isolated from the samples.*

Conclusion: *It can be concluded based on the findings of this study that street foods vended in Anyigba town are microbiologically unsafe for consumption. Consumers are at risk of health hazards from street foods vended in Anyigba town.*

Keywords: Street Foods, Microbial Safety, Contamination Hazards

INTRODUCTION

Street foods are foods and beverages prepared and sold in public places for immediate consumption or later consumption without further processing. This informal food supply system is important throughout the world but has increased markedly in developing countries over recent decades in response to urbanization and population growth (1). Street foods include many types of foods ranging from cereal and fruits to cooked meats and drinks. Street food is usually sold in busy areas, su as pavements, roadways, back alleys of markets, sch premises, bus and railway stations, beaches, parks a other public spaces (2). Street foods are extrem heterogeneous food category, encompassing m drinks and snacks. They also show great variati terms of ingredients, methods of retail, processin consumption and are sold on the street from a po food booth, food cart or food truck (3).

Street foods have a number of advantages. Street food is convenient – quickly available for people on the go, cheap, this is important for poor consumers who may not be able to afford a nutritious meal somewhere else. Street foods can be eaten everywhere. There is a noticeable increase of street foods vended in Anyigba town – the commercial centre in the eastern part of Kogi State, Nigeria. Extensive street-vending of foods in Anyigba, as in most other towns, arises from multiple causes; deterioration of rural living conditions, migration to the cities, and accelerated urbanization leading to enormous urban congestion, long commuting distances between the workplace and home, unemployment, lack of cooking knowledge and absence of establishments that serve reasonably priced food close to the workplace (2).

Despite the economic and nutritional benefits of street foods, the consumption of these roadside foods has been suggested to potentially increase the risk of food borne diseases as street foods are readily contaminated from different sources (4). The potential of street vended foods to act as vehicles for food borne illness has been supported by a number of microbiological studies (1). Studies have revealed the frequent contamination of street foods in many developing countries including Nigeria. Study on the microbial safety of ready-to-eat foods; meat pie, beef sausage, egg roll, zobo drink, moi-moi roasted yam, fried plantain vended on highways: Lokoja-Abuja, North Central, Nigeria, revealed the contamination of these foods by pathogens which include *Salmonella spp. Enterobacter spp, Listeria monocytogenes, Baccillus cereus* and *Staphylococcus aureus* (1). Other researchers (6, 7) have reported contamination of street foods by pathogens in different parts of Nigeria.

There is dearth of information on the microbiological qualities of street foods vended in Anyigba town. The importance of food quality and safety cannot be overemphasized. Hence, the objectives of this study were to assess the microbiological quality of street foods sold in Anyigba in order to ascertain their level of safety.

MATERIALS AND METHODS

Collection of samples

Ten samples of street foods vended in Anyigba town were obtained from popular vending points. Food samples obtained were; Fried yam, okpa, akara, zobo, kunu, dokwa, fura, plantain chips, suya and soymilk. All samples were kept in a cool box and taken to the laboratory for microbial analysis.

Analytical methods

Aerobic plate count (APC) determination

One gram of sample was homogenized in 10ml of $^1/_4$ Strength Ringer's Solution. Dilutions were made by mixing 1.0ml of the homogenate in 9.0ml of the sterile diluent to obtain 10^{-1} dilution. The dilution was then made to 10^{-2}, 10^{-3}, 10^{-4} and 10^{-5}.

Total viable counts of bacterial were determined as described by Adegoke (7). One millilitre of serial dilution of each food sample was inoculated on nutrient agar plates and cultured at 37°C for 24 – 48 hours. The number of colony forming units (cfu). On each plate was counted using colony counter and expressed as cfu/g.

Total fungal counts were determined by poor plating on potato dextrose agar plates supplemented with 1.0% lactic acid to inhibit bacterial growth and incubated at room temperature (28±2°C) for 3 – 4 days. Coliform counts were determined by pour plating on MacConkey agar plates and incubated at 37°C for 48 hours. All the analyses were carried out in triplicates.

Characterization of the isolates

Bacterial isolates were characterized on the basis of their cultural properties, morphological properties and then subjected to biochemical test using microbact identification kit (Microbact 24E oxoid), accompanied with a computer aided identification package (Advanced Bacterial Identification Software). Bacterial colony forming on MacKonkey agar were subjected to indole, methyl red, voges proskar and lactose fermentation tests.

Fungal isolates were characterized by their cultural properties. A drop of lactophenol cotton-blue solution was applied and observation was made under low power objective lens.

Statistical analysis

All plates were prepared in triplicates. The plate coun were expressed in colony forming unit (cfu/g). Da obtained were subjected to statistical analy according to (Egbekun and Akubor) (7). Significance established by Duncan Multiple Range Test at 5% l of significance.

Table 1: Microbial Population of Vended Foods in Anyigba Town in (cfu/g)

Samples	Total Viable Counts	Coliform Counts
Fried yam	$3.30\times10^{6} \pm 0.08^{c}$	$1.01\times10^{6} \pm 0.01^{d}$
Plantain chips	$1.61\times10^{7} \pm 0.06^{d}$	$1.16\times10^{5} \pm 0.11^{d}$
Akara	$8.30\times10^{6} \pm 0.03^{a}$	N
Okpa	$1.10\times10^{7} \pm 1.05^{d}$	$2.01\times10^{4} \pm 0.00^{c}$
Dokwa	*	$3.41\times10^{7} \pm 0.09^{b}$
Fura	$8.01\times10^{6} \pm 1.12^{a}$	$5.81\times10^{6} \pm 0.06^{a}$
Suya	$1.60\times10^{7} \pm 0.04^{d}$	$4.45\times10^{5} \pm 1.13$
Zobo drink	$8.51\times10^{6} \pm 0.14^{a}$	$5.10\times10^{6} \pm 0.15^{a}$
Soymilk	$1.70\times10^{7} \pm 0.19^{d}$	$3.32\times10^{6} \pm 0.19^{b}$
Kunu	$1.21\times10^{7} \pm 1.02^{d}$	$3.14\times10^{5} \pm 0.13^{b}$

Values are means of triplicate determinations.
Means followed by the same superscript on vertical column are not significantly ($p>0.05$) different.
** = Too numerous to count.*
N = No visible growth.

The results of microbial counts are shown in Table 1. The total viable counts for *dokwa* was too many to be recorded. *Zobo* drink, *akara* and *fura* had the highest count of 8.51×10^{6}, 8.30×10^{6} and 8.01×10^{6} cfu/g respectively. *Okpa, suya,* plantain chips and soymilk had the lowest counts ranging from 1.10×10^{7} to 1.70×10^{7} cfu/g. All the ten food samples analyzed, contained viable organisms. The results of the coliform counts are presented on Table 1. No coliform organism was found on *Akara* sample. *Fura* and *Zobo* had 5.81×10^{6} and 5.10×10^{6} cfu/g respectively. Fried yam and plantain chips had the lowest counts of 1.01×10^{6} and 1.16×10^{5} cfu/g.

Table 2 shows the results of mould and yeast counts from the ten food samples vended in Anyigba town. Fried yam, plantain chips, *Akara, Okpa, Suya* and *Zobo* drink showed no visible growth for mould and yeast. *Fura* showed the highest count of 8.10×10^{5} cfu/g, followed by *Dokwa*, 3.01×10^{5} cfu/g, Soymilk and *Kunu* had the lowest count of 2.11×10^{5} and 2.00×10^{4} cfu/g respectively.

The results of bacteria isolated from the food samples are presented on Table 3. *Escherichia coli* was isolated from fried yam, plantain chips, *suya* and soymilk. *Staphylococcus aureus* was found on all the food samples except *Okpa, Akara* and soymilk. *Kunu, dokwa, fura* and *suya* contained *Bacillus cereus*. *Salmonella spp.* was isolated from *suya* but not found on other food samples analyzed. *Micrococcus spp.* Was found on fried yam, *okpa, akara* and *zobo* drink. *Psudomonas spp.* was isolated from *kunu, dokwa, fura*, plantain chips, *suya* and soymilk.

Klebsiella pneumonia was isolated from *okpa, akara, dokwa* and *fura* while *Enterobacter aerogenes* was isolated from all the food samples except *okpa* and *fura*

Table 4 presents fungi isolated from the food samples. *Aspergillus flavus* was isolated from *kunu* and *fura*. *Penicillium sp.* was isolated from *suya* meat. *Mucor sp.* was found only on *dokwa*. *Rhizopus spp.* was isolated from *kunu* drink while *Fusarium* was isolated from *kunu, dokwa* and *fura*.

Table 2: Mould and Yeast Counts on Vended Foods in Anyigba Town

Samples	Counts (cfu/g)
Fried yam	N
Plantain chips	N
Akara	N
Okpa	N
Dokwa	$3.01x10^{5} \pm 0.01^{c}$
Fura	$8.01x10^{5} \pm 0.16^{a}$
Suya	N
Zobo drink	N
Soymilk	N
Kunu	$2.00x10^{4} \pm 0.17^{d}$

Values are means of triplicate determinations.
Means followed by the same superscript on vertical column are not significantly ($p>0.05$) different.
N = No visible growth.

DISCUSSION

Table 1 indicates the microbial load of street foods vended in Anyigba town. All the food samples analyzed contained viable organism. Total viable counts (TVC) for bacteria was significantly ($p<0.05$) higher in akara, fura and zobo drinks than other food samples. Microbial safety of any food is determined by its microbiological quality (8). It Is apparent from this investigation that all the food samples analyzed were contaminated with micro-organisms. The presence of microbial contaminant on the food samples might be adduced to post-processing contamination as a result of unhygienic handling, poor packaging and poor environment where the foods are sold. Post-processing contamination is of very paramount pubic health concern.

The micro-organisms present in all the samples could also be a direct reflection of the sanitary quality of the source of materials, processing and storage of the samples (9).

Comparing the various food samples obtained from the hawkers shows that contamination was highest in dokwa – a snack produced from blends of maize and ground nut, followed by 'fura' a cereal meal and akara. The values obtained for these food samples were above the acceptable international commission on microbiological specification of food (ICMSF) limits and recommendation for products of this nature (10^{5}cfu/g) in good manufactured practice (10).

The mycological profiles of each tested product are shown in Table 3. Fried yam, plantain chips, akara, okpa, suya and zobo drink were not contaminated with fungi. The absence of mould and yeasts on these food samples is an indication of good raw materials used in processing the foods. However, dokwa, fura and kunu were infested by fungi. High number of fungi in the final product may indicate poor post-harvest handling with progressive spoilage or inappropriate transport and/or storage conditions (temperature and humidity) which allowed the growth and proliferation of these organisms (11). The fungal contaminated foods could become deleterious to human health due to toxic decomposition and formation of secondary fungal

Table 3: Bacteria Isolated from Street Foods Vended in Anyigba Town

Isolates	Fried Yam	Okpa	Akara	Zobo	Kunu	Dokwa	Fura	Plantain Chips	Suya	Soymilk
Escherichia coli	+	-	+	+	+	+	+	-	+	-
Staphylococcus aureus	+	-	-	+	+	+	+	+	+	-
Bacillus cereus	-	-	-	-	+	+	+	+	+	-
Salmonella spp.	–	-	-	-	-	-	-	-	+	-
Micrococcus spp.	+	+	+	+	-	-	-	-	-	-
Pseudomonas spp.	-	-	-	-	-	+	+	+	+	+
Klebsiella pneumonia	+	-	-	+	+	-	-	+	+	+
Enterobacter aerogenes	+	-	+	+	+	+	-	+	+	+

+ = Presence
– = Absence.

Table 4: Fungi Isolated from Street Foods Vended in Anyigba Town

Isolates	Fried Yam	Okpa	Akara	Zobo	Kunu	Dokwa	Fura	Plantain Chips	Suya	Soymilk
aspergillus flavus	-	-	-	-	+	-	+	-	-	-
Penicillium spp.	-	-	-	-	-	-	-	-	-	-
Mucor spp.	-	-	-	-	-	+	-	-	-	-
Rhizopus spp.	-	-	-	-	+	-	-	-	-	-
Fusarium spp.	-	-	-	+	+	+	-	-	-	-

+ = Presence
– = Absence.

metabolites (mycotoxins).

Table 3 shows the dominant bacteria isolated from the food samples. Isolation of these organisms is an indication of post-processing contamination; otherwise the high temperature commonly involved in the preparation of these food samples is sufficient to eliminate most of the organisms. The presence of *Staphylococcus aureus* in most of the food samples is due to contamination from the skin, mouth, nose or hair of the handlers or hawkers. Food-borne illness from *S. aureus* is well documented. *S. aureus* food poisoning can easily be prevented through proper hygiene, good sanitation and keeping food under proper temperature. The presence of *E. coli* in the food indicates that such food has been contaminated with faecal materials and such food is not safe for human consumption. Processing water could be the source of this organism.

Bacillus cereus was isolated from kunu, dokwa, fura and plantain chips. *Bacillus cereus*, an opportunistic pathogen of humans, is a frequent inhabitant of soil, leaf surfaces and wrapping materials. Its presence in the food samples might be due to the materials used in wrapping and packaging. To avoid *B. cereus* food poisoning, cooked foods should not be left at ambient temperature since the ubiquitous spores of *B. cereus* can germinate and multiply rapidly at room temperature. Foods should be thoroughly reheated before eating (12). *Escherichia coli* was found on almost all the food samples. *E. coli* is an ubiquitous, harmless commensal found in man and several animals. Its presence on food samples is an indication of post-processing contamination. *Salmonella spp.* were absent on all the food samples except on suya (meat snack). *Salmonella spp.* are widely distributed in nature and are potential pathogens of man. *Salmonella* infection can be traced to foods contaminated with faeces by an infected food processor/handler. When strict sanitary precautions is observed by food handlers, *Salmonella* infection would be reduced significantly. *Micrococcus spp., Psudomonas spp., Klebsiella* and *Enterobacter aerogenes* were isolated from most of the hawked foods on the street of Anyigba. The microbiological results of these food samples is in line with the work of Madueke *et al.* (1) who reported the presence of pathogens in ready to eat foods such as akara, fish and dodo sold along Lokoja-Abuja express way. Some of the contaminants identified include *E. coli, S. aureus, Klebsiella pneumonia* among others.

Table 4 present moulds and yeasts (fungi) isolated from the food samples. *Aspergillus flavus* was isolated from kunu and fura samples. The presence of this mould could have resulted from moulded raw materials. *Aspergillus spp.* in the food may lead to food poisoning, since many of these fungi are toxin producing organisms. *Fusarium spp.* were isolated from kunu, dokwa and fura. *Fusarium spp.* are plant pathogens and are known to produce several chemical diverse mycotoxins which are important to man. *Penicillium spp.* were absent on the food samples analyzed. *Mucor spp.* and *Rhizopus spp.* were isolated from dokwa and kunu respectively. Fungi were isolated only from foods processed from cereals. Contamination of cereals with fungi when not properly dried and stored is well documented (4).

CONCLUSION AND RECOMMENDATION

All the street foods vended in Anyigba town analyzed were microbiologically unsafe for consumption since the total viable counts exceeded the acceptable limit of $<10^5$ recommended by the International Commission on Microbiological Specification for Food (ICMSF) (10). Health hazards from street food vending may be minimized by avoiding poor handling and awareness of need for personal hygiene and care in preparation, storage and dispensing of street foods. Basic training in food hygiene is recommended to ensure that food vendors follow the required rules for proper hygiene and sanitation and provision of continuous food safety education.

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