MICROBIOLOGICAL ANALYSIS OF STREET FOODS ALONG LOKOJA- ABUJA EXPRESS WAY, LOKOJA

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ABSTRACT

Samples of street foods: fried yam, fried potato, fried plantain, akara, fish and suya retailed in two locations along Lokoja-Abuja express road were analyzed for their microbial load. The samples were analyzed for bacteria and fungi using standard procedures. Analysis of the food samples revealed mean total bacterial count ranging from 5.0 x 10^4cfu/g (akara) to 2.08 x 10^7cfu/g (fish). Mean coliform count ranged from 5.0 x 10^4cfu/g (yam) to1.0 x 10^7cfu/g (suya), and fungal count ranged from 1.5 x 10^5cfu/g (yam) to 6.0 x 10^5cfu/g (fish). The organisms encountered included: *Bacillus cereus, Staphylococcus aureus, Streptococcus* sp., *Enterobacter* sp, *Escherichia coli, Shigella dysenteriae, Klebsiella, Pseudomonas, Micrococcus, Flavobacterium, Mucor, Penicillium* sp., *Aspergillus niger, Aspergillus flavus, Fusarium* sp. *and Rhizopus stolonifer*. The coliform counts were high ($\geq 10^5$) in most of the samples; this can be due to post production contamination as the entire food samples involved use of heat during manufacturing.

Keywords: Food safety, Street foods, Microbial quality of foods

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Introduction

Street foods are “ready-to–eat” foods and beverages prepared and sold by vendors and hawkers especially in the street and other similar public places (FAO, 1997).

Street foods are an extremely heterogeneous food category, encompassing meals, drinks, and snacks. They also show great variation in terms of ingredients, methods of retail, processing and consumption and are sold on the street from "pushcarts or baskets or balance poles, or from stalls or shops having fewer than four permanent walls" (FAO, 2007).

Nigeria had a history of developed supermarket industry until social and economic changes in early 1980s diminished the country’s middle class significantly, since then most Nigerians shop at traditional open-air markets or purchase their goods from traders and street vendors (Nzeka, 2011). Extensive street-vending of foods in Nigeria, as in most other areas, 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, changes in family cohesion and a shortage or absence of establishments that serve reasonably priced food close to the workplace (Tinker, 1997, Maxwell, 2000;). Street-vended food provide a major source of income for a vast number of persons, particularly women; a chance for self-employment and the

opportunity to develop business skills with low capital investment; least expensive and most accessible means of obtaining a nutritionally balanced meal outside the home for many low income people (WHO, 2002; Dipeolu *et al*., 2007).

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 (Tambekar *et al*., 2008). In fact, street foods have often been associated with travellers' diarrhea and other foodborne diseases.

Studies have revealed the frequent contamination of street food in many developing world including Nigeria. Studies by Rath and Patra, 2012, Suneetha *et al*., 2011, and Arijit *et al.,* 2010 have reveal high loads of bacterial pathogens on popular street foods in different part of India.

In Africa, Mensah, *et al., (*2002) reported the presence of *Bacillus cereus, Staphylococcus aureus, Shigella sonnei, Escherichia coli,* and *Salmonella arizonae* on different foods sold on streets of Accra. El-Shenawy *et al., (*2011) reported the contamination of Street-vended ready-to-eat food sold in Egypt, with *Listeria* species which include *Listeria monocytogenes* and *Listeria innocua.* Nyenje *et al*., (2012) investigated the microbiological quality of ready to eat foods sold in Alice, South Africa and reported the contamination of these foods by *Listeria* spp., *Enterobacter* spp. , *Aeromonas hydrophila* , *Klebsiella oxytoca* , *Proteus mirabilis, Staphylococcus aureus* and *Pseudomonas luteola* .

Study on the microbial safety of ready-to-eat foods; meat pie, beef sausage roll and egg roll, pealed orange, walnut and apple vended on highways; Onitsha-Owerri, South east, Nigeria, revealed the contamination of these foods by pathogens which include; *Salmonella* spp., *S.*

aureus, E. coli, B. cereus, Shigella spp., *Enterococci, A. niger* and *Pseudomonas* (Oranusi and Braide, 2012). Other researchers including Ossai, (2012), Falola *et al*. (2011) and Mbah *et al*. (2012) have reported contamination of street food by pathogens in different parts of Nigeria.

This work examined the microbiological quality of some foods sold at Nataco Park along Lokoja-Abuja express road in Lokoja. The park was chosen due to its strategic location on a road that is the major link that connects southern parts of the country to the capital and the northern part of the country, and because of the large number of commuters that patronize the spot on the daily basis.

Materials and Methods

Study Area and Sample collection

The study took place at Nataco Park, along Lokoja-Abuja express road, Lokoja Kogi State; where travelers stop over to buy foods sold by the road side (street food). Lokoja is situated at 7.8^{O} North Latitude, 6.74^{O} East Longitude and 55 meters elevation above the sea level. Two vending points at the locations were used for the study: vending points beside a popular park; site 1 and a popular restaurant site 2. The two sites were selected due to the level of commuter's patronage.

Food samples; fried yam, fried potato, fried plantain, suya, akara and fish samples were aseptically collected from the two vending points. All samples were kept in a cool box, transported to the laboratory and analyzed within 12 hours.

Sample Processing

Ten grams of the food samples were homogenized in 90ml of sterile distilled water and stomached using a stomacher at 360rpm for 1min, after which the homogenized samples were serially diluted to 10^5 (Clarence *et al*., 2009).

Physicochemical analysis

Titratable acidity and moisture content of the food samples were determined as described by Cole (2002). The pH was measured using a digital pH meter (Hannah model: HP 2211 pH/ORP meter).

Isolation and enumeration of microorganisms

One milliliter of 10^{-5} dilution of each food sample was inoculated on Nutrient agar (for total Viable bacteria), MacConkey agar (for coliform) and Potato dextrose agar containing 0.1% streptomycin (for fungi) using pour-plate technique. The plates were prepared in duplicates and incubated under aerobic condition at 37°C for 24 - 48 hours, with the exception of Potato dextrose agar plates which was incubated at 25^{O}C for 3-5 day. The number of colonies in each plate were counted using the Quebec colony counter (Reichert, USA) and expressed as colony forming unit per ml of sample homogenate (cfu/ml) (Clarence *et al*., 2009).

Identification of isolates

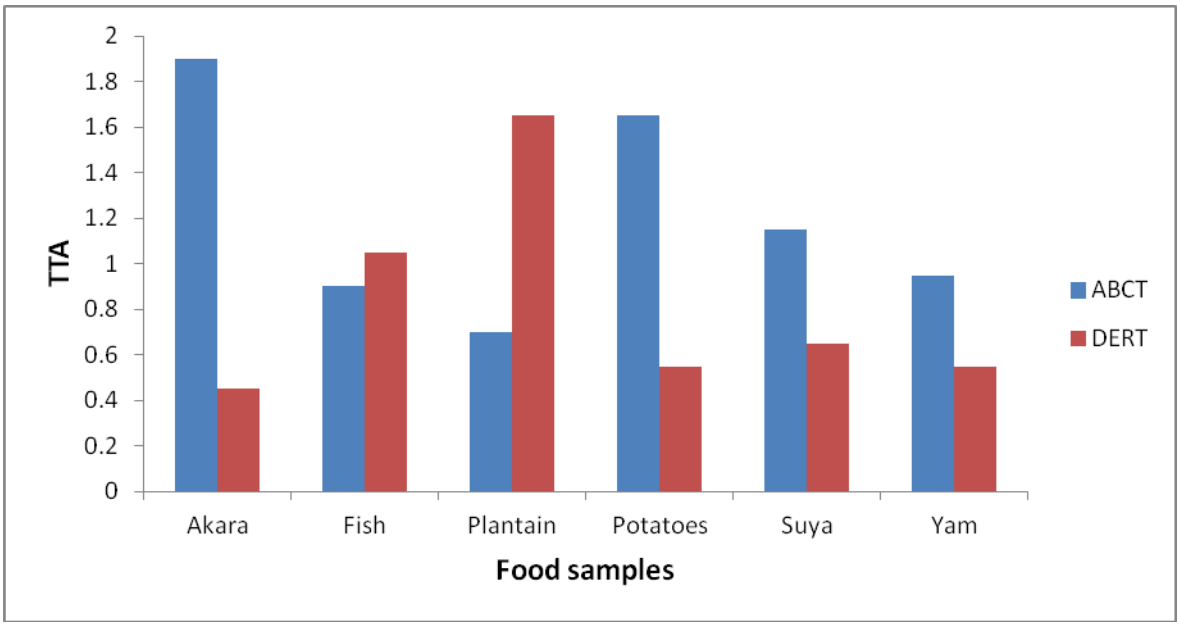
The isolates were purified by sub culturing and characterized based on colonial morphology, cellular morphology, staining and biochemical reactions and identified using Bergey's Manual of

determinative bacteriology (Holt *et al*., 1994). The fungi were characterized based on colonial morphology and cellular morphology was identified as described by Cooper (1995).

Results

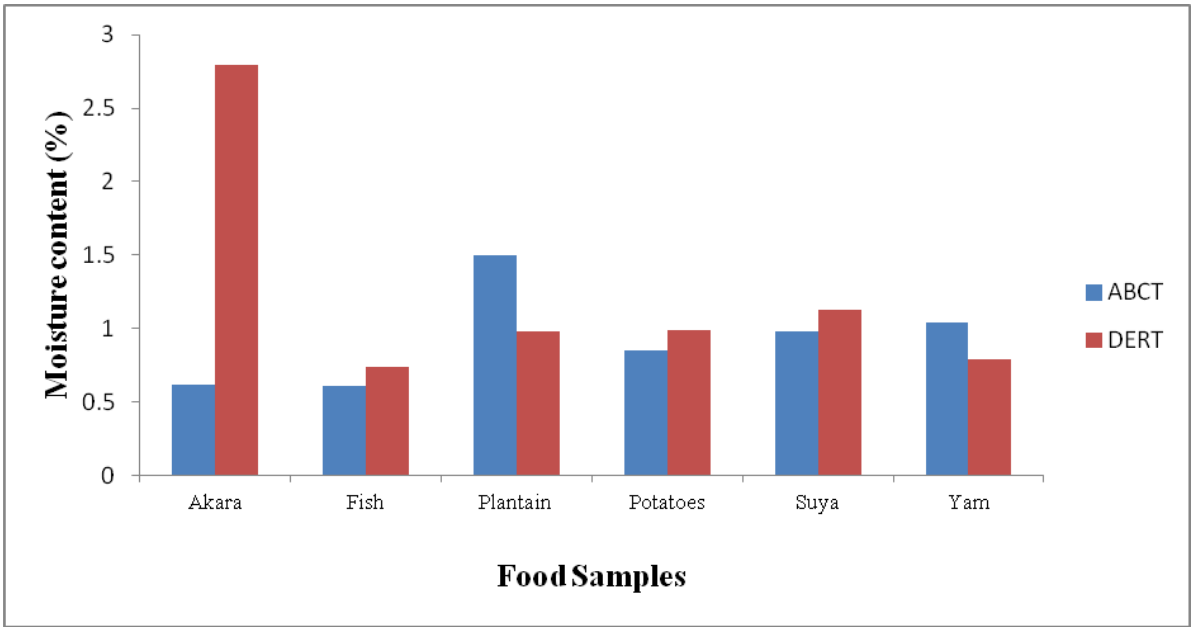
The mean titratable acidity, moisture content and pH of the samples are shown in Figure 1, 2 and 3 respectively. The pH ranged between 6.02 (plantain) and 6.93 (akara), Titratable acidity ranged between 0.25 (akara) and 1.90 (akara), while the moisture content ranged between 0.61% and 2.79%. The mean bacteria, coliform and fungi count of the food samples is shown in figure 4, 5, and 6 respectively. The mean bacterial count ranged between 5.0×10^4 cfu/g (akara) and 2.08×10^7 cfu/g (fish), coliform count ranged between 5.0×10^4 cfu/g (yam) and 1.06×10^7 cfu/g (suya) and fungal count ranged from 1.5×10^5cfu/g (yam) to 6.0×10^5cfu/g (fish).

A total of six fungi species were isolated from the food samples, and they were identified as *Aspergillus niger*, *Aspergillus flavus*, *Penicillium* sp, *Mucor*, *Rhizopus stolonifer* and *Fusarium* sp. The bacterial isolated include; *Staphylococcus aureus*, *Streptococcus* sp, *Flavobacterium* sp, *Bacillus cereus, Klebsiella pnuemoniae, Shigella dysenteriae, Micrococcus* sp, *Pseudomonas* spp, *Enterobacter* sp and *Escherichia coli*. The distribution of isolates within the food samples from the different locations are shown in Table 1. *Escherichia coli* have the highest frequency in food samples from site 1 followed by *Streptococcus* sp., while *Staphylococcus* has the highest frequency in food samples site 2. *Klebsiella*, *Shigella* and *Micrococcus* sp. were not found in food samples from site 2 *Flavobacterium* sp. was not present in food samples from the site 1.



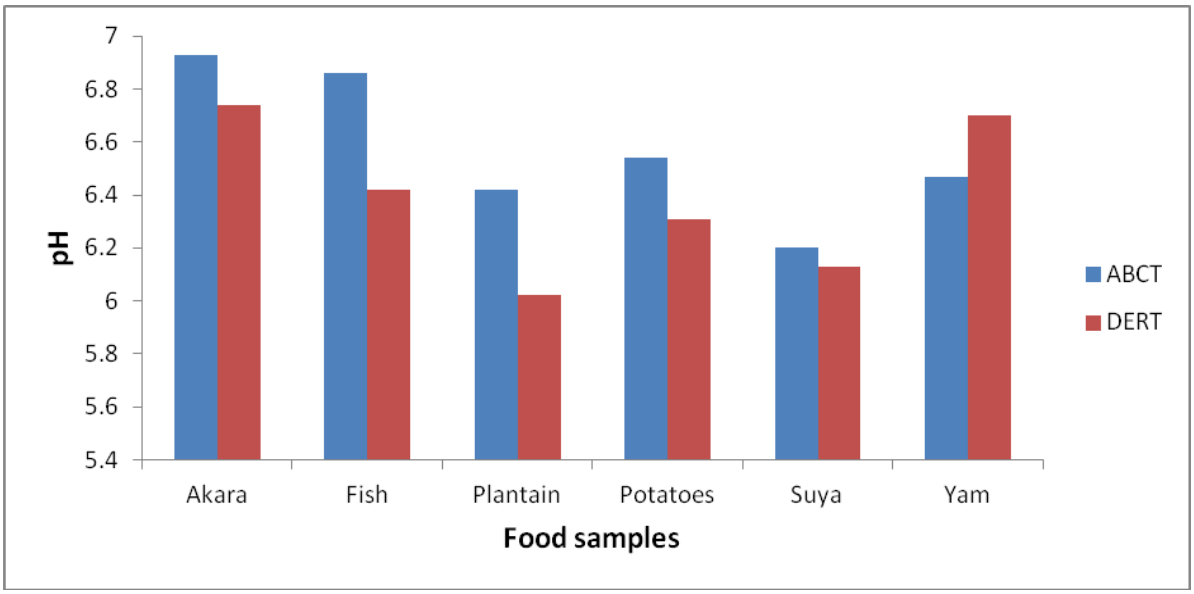
Key: ABCT= Site 1, DERT = Site 2

Figure 1: TTA of food samples from different locations.



Key; ABCT= Site 1 DERT= Site 2

Figure 2: Moisture content of food samples from different locations.



Key: ABCT = Site 1, DERT = Site 2

Figure 3: pH of food samples from different location.

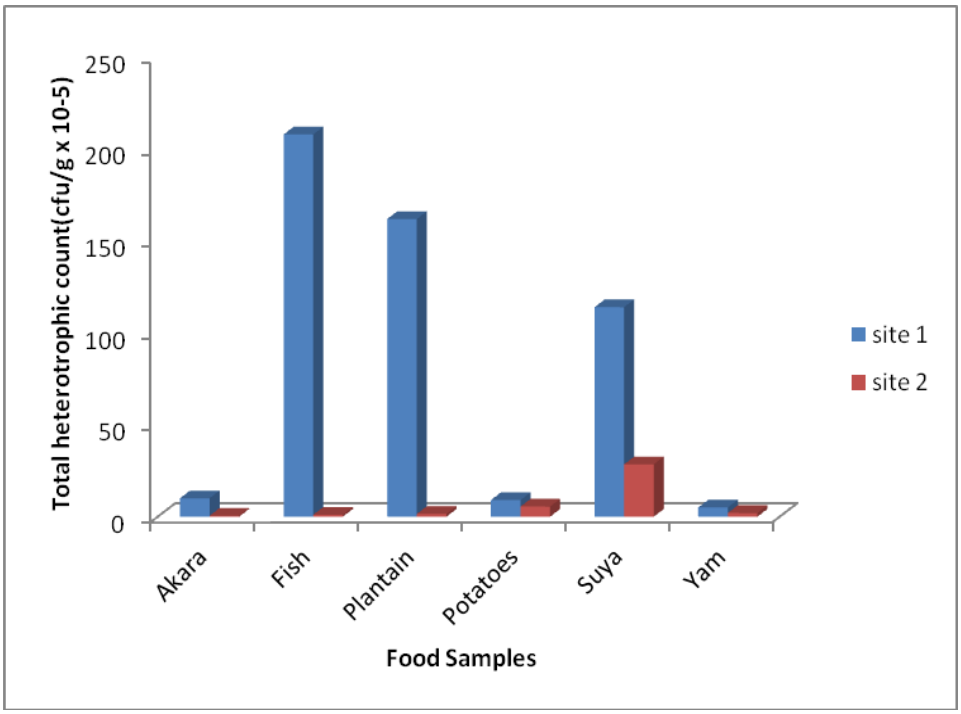


Figure 4: Mean heterotrophic count of food sample from different locations.

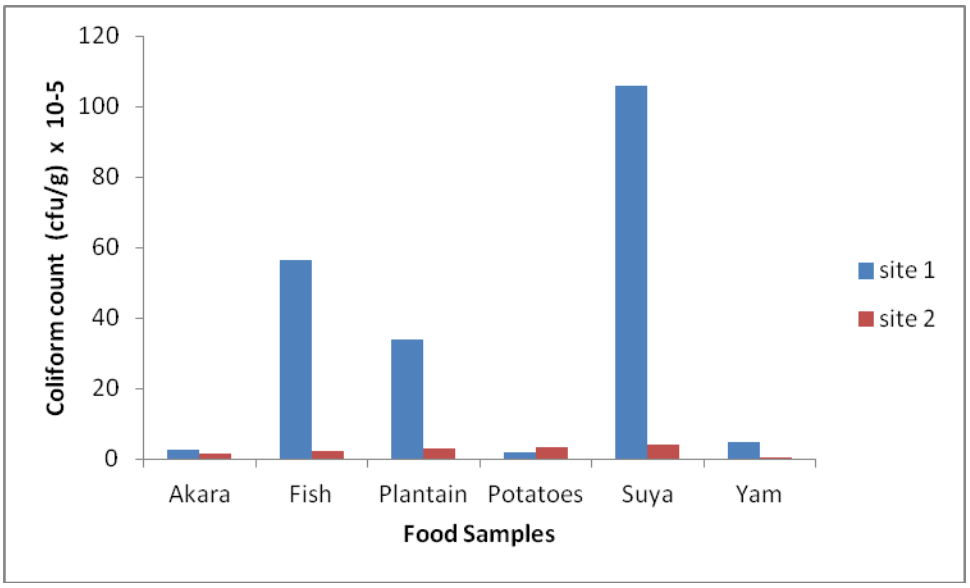


Figure 5: Mean coliform count of food sample from different locations.

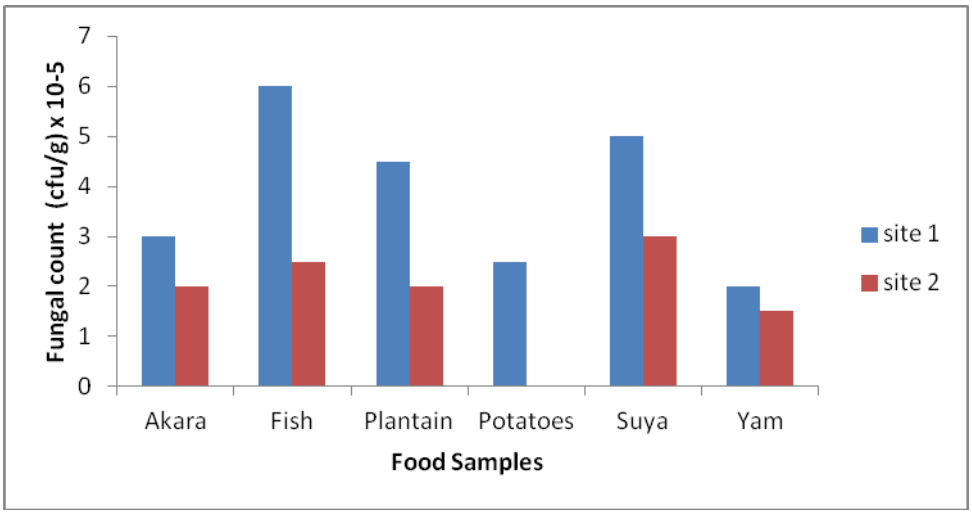


Figure 6: Mean fungal count of food sample from different locations.

Table 1: Distribution of bacteria isolates in food samples from different locations

Bacteria Isolates	Sources of samples															
	Site 1								Site 2							
	Akara	Fish	Plantain	Potatoes	Suya	Yam	Air	Desk	Akara	Fish	Plantai	Potatoe	Suya	Yam	Air	Desk
Staphylococcus aureus	+	-	-	+	-	-	-	-	+	-	+	+	-	-	-	+
***Streptococcus* sp**	-	+	+	+	-	-	-	-	-	-	-	-	-	-	+	-
***Flavobacterium* sp**	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Bacillus cereus	-	-	-	-	-	-	-	-	-	+	-	-	+	+	-	-
Klebsiella pnuemoniae	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Shigella dysenteriae	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-
***Micrococcus* sp**	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
***Pseudomonas* sp.**	-	-	-	-	-	-	+	-	-	+	-	-	-	-	-	-
***Enterobacter* sp**	+	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-
Escherichia coli	+	+	-	+	+	-	-	+	-	-	-	+	-	-	-	+

Key: + = present
- = Absent

Discussion

High moisture content accelerates food spoilage and generally provides a good media for the growth and proliferation of microorganisms especially bacteria (Prescott *et al*., 2008). The moisture content obtained from the samples is generally low 0.61% to 2.79%. If these foods with low moisture content are held under humid condition, growth of moulds will be supported and as water absorption continues to raise bacteria will be able to grow.

The pH values 6.09 to 6.93 obtained indicate that the food were slightly acidic to neutral, this favour the proliferation and survival of bacteria. The bacteria count obtained are indicative of post contamination in the light of the amount of heating that goes into food production, similar post treatment contamination has been reported by Ogugbue *et al*. (2011). This can occur during cooling and exposure to the air which has been identified as the main source of microbial contamination of most street foods.

This work revealed that all the food samples are contaminated with different bacteria and fungi species. These include *Staphylococcus aureus, Streptococcus* sp, *Flavobacterium* sp, *Bacillus cereus, Klebsiella pnuemoniae, Shigella dysenteriae, Micrococcus* sp, *Pseudomonas* sp, *Enterobacter* sp, *Escherichia coli, Aspergillus flavus, Aspergillus niger, Penicillium* sp, *Fusarium* sp, *Rhizopus stolonifer and Mucor* sp. The finding is in agreement with the work Ajao and Atere (2009) and Oranusi and Braide, (2012).

The presence of *Staphylococcus aureus* in the samples is indicative of human contamination after production. This could be from direct human contact such as fingers or indirectly through additives or utensils. The organism is associated with endotoxin characterized by short incubation period (1-8hours), violent nausea, vomiting and diarrhea.

Bacillus cereus is another isolate that is associated with the production of toxin; diarrheal and emetic in food which causes food poisoning. It is found in dust, soil and raw food and can survives normal cooking as a heat resistant spore (Rajkowski and Bennett, 2003).

The presence of *E. coli, Shigella dysenteriae, Streptococcus* sp, *Klebsiella*, and *Enterobacter* suggested fecal contamination. Although some *E. coli* are harmless, Enterohaemorrhagic *E. coli* (EHEC) are capable of producing one or more toxin and a particular serotype O157:H7 have been associated with haemorrhagic colitis, haemolytic uraemic syndrome and thrombotic

thrombocytopaenic purpura. Also Enterotoxigenic *E. coli* (ETEC) is associated with traveler's diarrhea. Similarly, *Shigella dysenteriae* have been associated with severe bacillary dysenteriae, while *Streptococcus* sp, have been frequently associated with acute sore throat (Adams and Moss, 2008).

The presence of *Mucor* sp, *Penicillium* sp., *Aspergillus niger, Aspergillus flavus, Fusarium* sp. *and Rhizopus stolonifer* in the food sample is not surprising as they disperse in the form of spores which is abundant in the environment and can be introduce through dust and soil (Apinis, 2003). Their presence in these food samples is of serious public health concern as these fungi have all been implicated with the production of mycotoxin (Makun *et al*., 2009).

Microbial guideline for cook food stipulated that "the plate count must be < 10^7cfu/g, for meat <1.0 x 10^4 cfu/g, for plant products < 10 x 10^5cfu/g, for ready to eat frozen meals < 1.0 x 10^4 cfu/g and for coliforms, the plate count must be <10cfu/g" (Gilbert *et al*., 2000). The microbial load of the food samples was higher than stipulated, hence their presence constituted a health risk; it can be adjudged that the street food retailed in most location at Lokoja- Abuja road, as obtained in this study are not bacteriological fit for consumption. The food contamination may have been due to unhygienic production practices and prolong exposure to the environment.

Conclusion

Most food pathogens are of soil or intestinal origin and are transmitted through poor food preparation, personal hygiene or public sanitation practices. Therefore to ensure the safety of the foods, producer and hawkers must maintain a clean environment, minimize contact with the food samples after production and also maintain a high level of personal hygiene. Also, utensils should be properly clean at all stages of production.

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