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Original Research Article

Bacteriological status of commonly consumed foods and vegetables from food vendors in a market in Enugu, Nigeria

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Keywords

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A B S T R A C T

Safety of food is a basic requirement of food quality. A total of 25 different street foods and vegetable samples randomly purchased from five different vendors in Ogbete main market Enugu, Nigeria, were brought in ice to the laboratory for bacteriological analysis. Pour plate technique was used. Serial dilutions of the samples were used after one ml from each tube was pipetted into a nutrient agar plates and incubated for 24 hours at 37^{o}C. The plates were examined for growth. Sub-culturing of colonies from the growth was done on bacteriological agar. All screened samples had levels of bacterial growth ranging from 1.0 X 10^5 to 3.0 X 10^6 cfu/ml. Ninety percent of the samples had bacterial counts above the acceptable limits (10^4 cfu/ml). *Stapylococcus aureus, Bacillus cereus, Vibrio spp, Salmonella spp, Escherichia coli and Shigella spp.* were isolated and identified from the food samples. Two pathogenic micro organisms were isolated from each of Jollof rice and 'ugu' vegetable. One each was isolated from egusi soup and the other vegetables. This study revealed that street foods are potential vehicles for transmitting food borne illnesses in Nigeria.

Introduction

Human food is any substance that is consumed to maintain life and growth of the body (Ezeronye, 2007). Bacterial food spoilage is any sensory change (tactile, visual, olfactory or flavor) which makes the food to be unacceptable for consumption. Spoilage may occur if there is improper handling, cooking, cooling, unhygienic utensils, and unnecessary time lag between preparation and consumption (FDA, 2004, Munide and Kurai, 2005). In Nigeria, the unhygienic handling of foodstuff, health status of food vendors, poor sanitary conditions of markets, absence of adequate waste disposal facilities, use of contaminated water and kitchen equipment and poor storage affect food safety (WHO, 2001, 2003; Chosh *et al.*, 2007, Kamil, 2005). In Nigeria, selling of street foods in

markets is common but most consumers and vendors have little or no knowledge about food safety. Consumption of street food has grown over the years due to rapid population growth, unemployment, poverty and availability of relatively low cost foods. (Martins, 2006, Amoah, 1992, Chakravarty and Canet, 2002). Symptoms of food borne illnesses include: diarrhea, vomiting, abdominal cramp and nausea (Nweze, 2010); most of which are caused by *Staphylococcus aureus, Salmonella spp, Clostridium perfringens, Clostridium botulinum, Campylobacter, Vibrio parahaemolyticus, Bacillus cereus and* Entropathogenic *Escherichia coli.* Food safety depends on conditions necessary during the production, processing, storage, and preparation of food to ensure that it is safe, sound, wholesome, and fit for human consumption (FAO/WHO, 1990).

This work investigated selected foods and vegetables sold by vendors in Ogbete main market, Enugu, Nigeria for bacterial contamination. Isolated and identified bacterial species associated with food contamination and their microbial loads were determined. The public health implications of consumption of such foods were established.

Materials and Methods

A bacteriological survey was conducted in different food vending sites at Ogbete main market, Enugu State, Nigeria.

Five samples each of jollof rice (*Oryza sativa)* plates, Egusi soup (*Citrullus lanatus)*, ugu (fluted pumpkin), green spinach (*Spinacia oleracea)* and water leaves (*Talinum triangulare*) were purchased from various vendors in Ogbete market, Enugu, Nigeria and studied to determine their level of bacterial contamination and safety for human consumption.

Food samples were transported in sterile polythene bags on ice to the laboratory. 10g portion of each food sample was homogenized and serial dilution made and examined using pour plate method.

Culturing of sample (pour plate)

One militer of each dilution (10^{-1}–10^{40}) were pipetted into nutrient agar plates. Plates were incubated aerobically and anaerobically at 37^0C for 24 hours. Sub-culturing was done in fresh nutrient agar, Mac Conkey agar and Salmonella Shigella agar plates which were incubated aerobically and anerobically at 37^0C for 24 hours. Identification of isolates obtained in the cultures were carried out using colonial morphology, Gram's staining (Nester *et al.*, 2007) and biochemical tests, (Cheesbrough, 2005, Ochei and Kolhather, 2001).

Results and Discussion

A total of 25 street food samples were examined for bacterial contamination. Results showed that all the street food samples were contaminated with varying levels of bacterial counts. The results obtained are shown in Tables 1–5.

Gastroenteritis has remained a major health care problem in Nigeria both in terms of human suffering and food-borne illness. The isolation of bacteria in all the food samples from different vendors in Ogbete main market, Enugu is indicative. All the bacteria isolated are enteric pathogens. Their high frequency of isolation and bacterial loads indicates fecal-oral transmission. The isolation of *Salmonella* species from water leaves may be due to the use of manure from poultry farms. The use of poultry manure for growing vegetables is common in Enugu. *Salmonella* infections is also common in Enugu (Ohanu and Ogeneh; 2014), in Nigeria in general (Oweghe and Afe, 2011).

The high level of prevalence of *Salmonella* infections can be drastically reduced by thorough washing of vegetable before use especially as uncooked salad. Refrigeration reduces their multiplication also because as few as 15 to 20 cells can cause illness (FDA, 2004).

Jollof rice and Egusi soup had no growth on SSA but had non-lactose fermenter on MAC. On Nutrient agar (NA), Jollof rice showed white colonies with rough edges. Circular, smooth, raised and deep golden yellow colonies, egusi soup showed smooth round colonies that are opaque as shown in Table 1.

In Table 2, Ugu, water melon and green spinach on NA showed milky color colonies and smooth colonies, respectively. On MAC Ugu showed bacteria that were lactose fermenters while water leaf and green spinach did not have lactose fermenters. However, green spinach on SSA had milky smooth colonies with distinct edges while Ugu and water melon had no growth on SSA.

The high total bacterial count of $>10^4$ cfu/ml of screened food samples especially in vegetables implies extreme contamination and poses potential health risks. This high incidence was mainly due to the largely unhygienic nature of the food preparation and service areas. Majority of the street food centers are located beside waste disposal points and dusty roads. Furthermore lack of running water, sewage disposal infrastructure, inappropriate storage conditions and the presentation of these foods in the open, encouraged multiple contaminations. Results show also that Jollof rice and egusi soup have less material contamination than vegetables (Table 3). This may be due to the fact that both are cooked foods unlike the raw vegetables. Fresh vegetables should not be stored together with cooked foods in order to avoid cross contamination. The presence of the non-lactose farmenters in jollof rice, egusi and some vegetables means non fecal coliforms (Table 1&2).

There was no growth in SSA except by green spinach and water leaves. On the other hand, all the food samples showed growth on NA. Contamination of foods is usually due to faecally contaminated water and unsanitary handling by food handlers. Most deadly epidemics in developing countries are caused by them (CDC – DMBD, 2004). *Escherichia coli* isolated in ugu may be responsible for the high prevalence of gastroenteritis as ugu is a commonly used vegetable among the Igbo, in the South East Nigeria. Ingestion of the pathogenic serotype *E. coli* 0157 derived from infected meat causing colitis with bloody diarrhea, may give rise to hemolytic uremic syndrome (Elizabeth and Martin, 2003). Person to person transmission can occur via the fecal oral route. *E. coli* 0157: H7 can be found in the diarrhea stool of infected persons. The pathogens can be spread if personal hygiene and hand washing procedures are inadequate (Buzby, 2001).

When *Staphylococcus aureus* is present in food, it can produce a toxin that causes illness. Although cooking destroy *Staphylococcus aureus*, the toxin it produces is heat stable. Good personal hygiene when handling foods will keep *Staphylococcus aures* out of foods and refrigeration of raw and cooked foods will prevent the growth of these bacteria if any is present (Wagner, 2001). *Staphylococcus aureus* isolated from Jollof rice and water leaf, is a pointer to largely poor personal hygiene, improper storage facilities, use of low quality raw materials and unhygienic sales. These factors contribute to the proliferation of the bacteria and consequently the high level of microbial counts recorded in the study.

Table.1 Colonial morphology of bacteria isolated from the different food samples

Media	**Sample**	**Morphology of bacteria colonies**
NA	Jollof Rice	Whitish colony with rough edges
	Jollof Rice	Circular, smooth, raised and deep golden yellow colonies
	Egusi soup	Smooth, round colonies that are opaque
MAC	Jollof Rice	Non-lactose fermenter
	Jollof Rice	Non- lactose fermenter
	Egusi Soup	Non-lactose fermenter
SSA	Jollof Rice	No Growth
	Jollof Rice	No Growth
	Egusi Soup	No Growth

Table.2 Colonial morphology of bacteria isolated from vegetable

Media	**Sample**	**Morphology of bacterial colonies**
NA	Ugu	Milky color, circular with smooth colonies and distinct edges.
	Water leaf	Round, smooth, raised and deep golden yellow colonies
	Green (spinach)	Creamy in color, circular with smooth colonies and distinct edges.
MAC	Ugu	Lactose fermenter and smooth colonies with distinct edges
	Water leaf	Non – lactose fermenter
	Green (spinach)	Non – lactose fermenter, flat and smooth colonies
SSA	Ugu	No growth
	Water leaf	Circular milky in color, flat, smooth colonies with distinct edges
	Green (spinach)	Milky in color, circular, flat, smooth colonies with distinct edges

Key: NA=Nutrient agar, MAC=Mac Conkey agar, SSA=*Salmonella/ Shigella agar*

Table.3 Total bacteria counts (CFU/ML) of street vended food samples

No. of colonies	Dilution	Bacterial Counts	Food sample
290	10^{-4}	2.9×10^{6}	Jollof Rice
250	10^{-1}	2.5×10^{3}	Jollof Rice
100	10^{-3}	1.0×10^{5}	Egusi Soup
300	10^{-4}	3.0×10^{6}	Ugu
240	10^{-4}	2.4×10^{6}	Water leaf
290	10^{-5}	2.9×10^{7}	Water leaf
290	10^{-4}	2.9×10^{6}	Green (spinach)

Table.4 Biochemical tests on isolated bacteria on vended food samples

Food samples	Gram reaction	Cat	Coa	Ind	Cit	Mr	Vp	Ox	Mt
Jollof Rice	+ rod in chain	+	NA	-	-	+	-	+	-
Jollof Rice	+ cocci in cluster	+	+	-	-	-	-	-	-
Egwusi Soup	- rod and curved	-	NA	-	-	-	-	+	+
Ugu	- rod	+	NA	+	-	+	-	-	+
Water leaf	+ cocci in clusters	+	+	-	-	-	-	-	-
Water leaf	- rod	+	NA	-	-	+	-	-	+
Green (spinach)	- rod	+	NA	-	-	-	-	-	-

Key: CAT-Catalase test, COA-Coagulase test, IND-Indole test, CIT-Citrate test, + (Positive), - (Negative), MR-Methyl Red test, VP-Vogas Proskaeur test, OX-Oxidase test, MT-Motility test, NA-Not Applicable

Table.5 Isolated bacteria from food samples

Food samples	Associated bacterial contaminants
Jollof Rice	*Bacillus, cereus, Staphylococcus aureus*
Egusi soup	*Vibrio Spp*
Ugu	*Escherichia coli*
Water Leaf	*Staphylococcus aureus, Salmonella Spp*
Green (Spinach)	*Shigella Spp*

Key: Spp – Species

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