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Enteropathogenic Bacterial Contamination of Some Ready to Eat Foods Sold in Jos Metropolis, Nigeria

KEYWORDS: Enteropathogenic, Bacteria, Read-To-Eat Foods,

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ABSTRACT *This study assessed the occurrence of enteropathogenic bacteria in six types of ready-to-eat (RTE) foods sold in Jos Metropolis. A total of 50 samples of "Awara", "Kunum zaki", "Masa", fried groundnut and "Zobo" drink were collected from the street food vendors. Enumeration and Identification of enteropathogenic bacteria was conventionally carried out using standard bacteriological procedures. The result shows varying level ($p < 0.05$) of bacterial contamination with total aerobic plate count ranging from 5.16 x104 to 1.17 x 105CFU/unit of food. Comparatively, highest mean count of 5.16x 105 CFU/g was observed in "Awara", while "Zobo drink" had the least microbial load of 6.69 x 104 CFU/g. Predominant bacterial contaminants of the food samples were; Salmonella typhi, Shigella dysentariae and E. coli. Comparatively, E. coli (40%) was the most occurred, followed by Shigella dysentariae 16(32%) and Salmonella typhi 13(26%). Out of the 49 bacterial isolates, 28.57% of them were from "Awara", followed by "Masa", and the least from "Zobo" drink (6.12%). This study showed that food were bacteriologically unfit and could serve as a source of diseases outbreak. Therefore, vending of ready to eat food necessitates proper education of food handlers on good personal hygiene, manufacturing and post-handling practices.*

INTRODUCTION

In Nigeria, there is a growing popularity of ready to eat foods among consumers as an integral part of convenient preparation patterns. These categories of foods are normally prepared for immediate purchase and consumption at the point of sale as raw or cooked, hot or chilled. Therefore the consumers of RTE foods are at risk of infection by the contaminating organisms, since these foods are consumed without further heat-treatment.

Currently, researches into food-borne human pathogens have identified RTE foods as a veritable source of food borne pathogens (Akinyemi et al., 2012; Oranusi and Braide, 2012: Isibor et al., 2013). In Nigeria, the upsurge of ready to eat products poses a managerial challenge to the food safety authority for continuous surveillance of the quality of this category of food. This is predicated on lack of good manufacturing practices among most of the processors during the production and distribution system. Commonly, these categories of foods are hawked at public places such as motor parks, streets and market areas with glaring deviation from sanitary practices. In most cases poor handling methods such as the use of contaminated water and un-sanitized processing equipment are traditionally apparent (Shamsudden and Ameh, 2008; Abdoma, 2008). Inappropriate holding temperature that characterized the itinerant handling of ready to eat foods could also be a major factor in the increased microbial load (Barro et al., 2006).

Consequently, street food safety has remained a major public health concern globally, and more importantly in Nigeria were the regulation of this critical sector is virtually non-existent. Due to these, great concern had been raised among co-workers on its increased consumption and human infections (Yah et al., 2009; Akinyemi et al., 2012; Isibor et al., 2013). This is coming from consistent global reported incidence of food borne illnesses that account for approximately 3.3 - 12.3 million cases and a record of 3900 deaths each year in developed countries such as in United States (Buzby and Roberts, 1997). Predominantly, a list of 10 of the biggest U.S. outbreaks in 2013 reported E. coli O157:H7, Salmonella with 35 - 416 sick and foodborne parasite due to Cyclospora from salads and cilantro with 631people sick (James, 2013). A survey in Lagos-Nigeria 1999 – 2008, reported a total of 85,187 confirmed cases of Salmonellosis associated food borne infections with 880 deaths (Akinyemi et al., 2012). Similarly, a higher occurrence of 24.7% associated infection due to ready-to-eat salad had been reported in Calabar (Udo et al., 2009). Commonly, Salmonella spp., L. monocytogenes, and Y. enterocolitica are responsible for most frequent outbreaks associated with consumption of contaminated meat products (Pesavento et al., 2010; Odey et al., 2013). Over the years, Escherichia coli 0157:H7, Listeria monocytogenes, Campylobacter jejuni, Clostridium perfringes, Salmonella spp., Staphylococcus aureus and Toxoplasma gondii are incriminated (Buzby and Roberts, 1997). Therefore to provide current knowledge and possible future developments in increasingly important area of food safety, this study investigates the bacteriological quality of some of the most popular local ready-eat foods sold in Jos metropolis.

MATERIAL AND METHODS

Study Area

The study was conducted in Faringada, Gada Biyu, Terminus and Bauchi road located in the most densely populated and high commercial parts of Jos metropolis of Plateau State.

Description of Foods

Ready-to-eat (RTE) food products purchased are Awara (fried soya beans cake), kunun zaki (a millet drink), Masa (fried maize cake), fried groundnut and Zobo drink (made from (Hibiscus sabdariffa calypes)

Sample Collection

A total of 50 samples, 10 of each type of food were obtained from the street food vendors. The samples were collected in

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sterile universal containers and clean low density polythene bags. Samples were appropriately labeled and immediately transported to the Department of Microbiology University of Jos laboratory for analysis.

Microbiological Analysis
Aerobic plate count was determined using pour plate according to standard microbiological procedures as adopted by Bukar et al. (2010). For solid food samples, 25g was homogenized in 225mls sterile 0.85% (NaCl w/v) physiological saline, using a laboratory blender (Lab. Blender 400; Seward Medical, London, UK) at maximum speed for 60 sec. Stock solution of liquid foods were prepared by homogenizing 10ml sample in 90ml sterile 0.85% (NaCl w/v) physiological saline and serially diluted to 10^{-5}. For each sample, 1ml was inoculated into 19ml of molten Plate count agar and MacConkey agar, properly mixed and poured into a sterile Petri dish. The agar was then allowed to set, and incubated at 37^0C for 24hours. Distinct colonies formed were counted and result expressed as CFU/ml.

Identification of Bacterial Isolates
Identification of the bacterial isolates was performed using classical methods based on their morphological, physiological, and biochemical characteristics with reference to Systematic Bacteriology Manuals (Cheesbrough, 2006). Colonial characteristics such as size, shape, colour, elevation, edge and consistency were noted and further characterization based on the following test, Gram staining, motility, catalase, Voges-Proskauer and Methyl-Red test, Triple Sugar Iron-Agar, utilization of citrate, formation of indole and sugar fermentation .

Statistical Analysis
All data were analyzed using Microsoft Excel program. ANOVA tests were used to determine the existence of statistically significant differences at $p \leq 0.05$ between microbiological qualities of various types of foods from different markets.

Results
The result of total aerobic plate count on ready to eat foods (Table 1) ranged from 5.16 x10^4 to 1.17 x 10^5CFU/unit of food. Comparatively, highest mean aerobic plate count (5.16 x 10^5 CFU/g) was observed on "Awara" a milk based product, while "Zobo drink" had the least ($p \leq 0.05$) microbial load of 6.69 x 10^4 CFU/g.

Presumptive identification of bacterial isolates shows that Salmonella typhi, Shigella dysentariae and E. coli were predominant contaminants of the food samples (Table 2.). Occurrence of the bacteria showed that E. coli 20(40%) was the most occurred, followed by Shigella dysentariae 16(32%) and Salmonella typhi 13(26%). Generally out of the 49 bacterial isolates, majority (28.57%) of them was isolated on "Awara", followed by "Masa" and the least number (6.12%) of isolates was obtained from "Zobo" drink.

Discussion
It is evident from this study that the foods showed high bacterial contamination and differed ($p \leq 0.05$) among themselves. Since the processing of these foods normally involve a form of heat treatment, it is obvious that considerable number of bacteria associated with raw materials would have been killed. Afterward, the reason for high microbial load might be attributed to presence of heat resistance and post handling contamination. This agrees with the fact that immense microbial contamination of food is linked to poor post processing handling practices (Clayton, et al., 2002). Therefore the microbial load on the foods is an index of poor sanitary conditions during preparation, storage and personal hygiene of the food handlers (Aboloma, 2008; Kawo and Abdulmuni, 2009). Apparently RTE foods are usually vended around crowded and intense traffic centers of the streets, with uncontrolled hand handling. Majority of the street centers are located beside waste disposal points and dusty roads or streets with human and vehicular traffic and could encourage its deposition to bioaerosol. These distributing habits can serve as an important source of pathogens gaining access into foods. Therefore, high incidences of bacterial contamination are mainly due to the unsanitary and largely unhygienic nature of the food preparations and post handling environment (Omemu and Aderoju, 2008).

Comparatively, this study showed that the solid products 'Awara', 'Masa' and 'Kosai' are more contaminated to the liquid foods. The variation in contamination level could be attributed to the reason that 'Awara', 'Masa' and 'Kosai' are not package in containers immediately after production, but normally vended in opened trays, coupled with other direct exposure of product such as usage of unwashed hands at every serving. The liquid foods although normally vended in bottles however, the sanitary conditions cannot be attested due lack of standard cleaning and disinfection procedures during reuse of this bottles. The result of this study therefore showed unacceptable total bacterial count of $\geq 10^4$ CFU/g (FEHD, 2001; NSWFA, 2012) established in all of screened foods, implying potential health risk of these street foods. The findings affirmed earlier reports that RTE foods sold in our environment are microbiologically below standards and the need for urgent control (Mensah et al., 2002; Yeboah – Manu et al., 2010).

Members of the family Enterobacteriaceae; Salmonella typhi, Shigella dysentariae and E. coli isolated in foods that are fully cooked is an indicator of post-processing contamination. The bacterial genera encountered in this study correlated with earlier reports and continue to be a major contributor to produce-associated food-borne illnesses (Yeboah- Manu et al., 2010). These entropathogenic bacteria had been reported to contribute approximately 97% of foodborne illnesses in food service establishments and homes (Clayton, et al., 2002). In USA food-associated outbreaks, the bacterial species were responsible for 60% of outbreaks (Sivapalasingam et al., 2004). These bacterial species suggests the possibility that other intestinal pathogens like Campylobacter spp., Listeria spp., protozoan like Giardia lamblia, Entamoeba histolytica may also be present in the food samples (James, 2005).

Generally, studies had revealed similar vast group of microorganisms of public health concerns in street vended foods (Oyeyi and Lum-Nwi, 2008; Udo et al., 2009). Consequently, the reports on RTE foods had raised great worries among many researchers in Nigeria particularly with the growing consumption of street food witnessed over the years. Comparatively, the 25% prevalence of Salmonella spp on the food samples is relatively higher than 7.2% and 10% reported earlier by Rihab et al. (2010) and Bukar et al. (2010) respectively. A wide spectrum of produce vehicles have been associated with Salmonella infections accounting for nearly half of the outbreaks due to bacteria (Sivapalasingam et al., 2004). Earlier reported cases of E. coli contamination established in 100% of sampled foods (Ossai, 2012) conform to the finding of this study. Waite and Arbuthnot (1999) reported a prevalence of 50% E. coli in ready-to-eat minced meat, sausages, rolls and pies. Similarly occurrence of 24.7% of E. coli in ready-to-eat salad in Calabar and 27.7% E. coli in street vended foods in Bayero University Campuses, Kano had been reported (Oyeyi and Lum-Nwi, 2008;Udo et al., 2009). This finding suggests food was exposed to faecal or sewage contaminants via the use of contaminated water or contamination from the unsanitary environment, equipment and hand carriage (Bukar et al., 2009). Therefore poor hygiene meals such as the vended RTE foods could be underlying factor responsible for food-borne infection such as diarrhoea, fever, nausea, and cramps in children and adult (Motarjemi et al., 1993). In conclusion, the foods examined are unfit and do not meet microbiological quality standards and safety for human consumption. This investigation suggests the serious need to frequently evaluate the microbiological profile of these categories of street foods. In view of this finding, stiffer regulatory administration geared

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towards awareness creation on handling and hygiene practices that will prevent post production contamination of ready to eat foods is necessary to reduce incidences of food borne disease and their associated illness.

Table 1: Mean Bacterial Counts of Ready to Eat Food Sold in Jos metropolis

Sample area	No. of samples	Total Viable Count (cfu/unit)/ Food Type					
		Awara (CFU/g)	Fried Groundnut (CFU/g)	Kunun Zaki (CFU/ml)	Masa (CFU/g)	Zobo Drink (CFU/ml)	Mean Bacterial Count (x 10^5 CFU/g)
Farin-gada	13	1.03 x 10^5	1.08 x 10^5	1.08 x 10^5	1.17 x 10^5	7.70 x 10^4	5.16 ± 0.012
Gada-biyu	12	9.82 x 10^4	9.60 x 10^4	7.20 x 10^4	7.60 x 10^4	5.20 x 10^4	2.76 ± 0.040
Terminus	12	1.04 x 10^5	1.02 x 10^5	1.05 x 10^4	1.01 x 10^5	5.64 x 10^4	4.62±0.010
Bauchi road	13	1.08 x 10^5	1.15 x 10^4	9.80 x 10^4	1.10 x 10^5	6.50 x 10^4	2.60 ± 0.002
Mean Count (x10^5)	-	9.82 ± 0.010	1.64 ± 0.055	9.00±0.026	9.60±0.029	6.65±0.015	-

Table 2: Frequency of Occurrence of Bacteria species Associated with Ready to Eat Food sold in Jos metropolis

Food Samples	Number of Samples	Bacterial isolates / % Occurrence			
		E. coli	Salmonella typhi	Shigella dysentriae	Total
Awara	10	6(60)	4 (40)	4 (40)	14(28.57)
Fried Groundnut cake	10	3(30)	2 (20)	3 (30)	8(16.33)
Kunun zaki	10	5(50)	2 (20)	4 (30)	11(22.44)
Masa	10	4(40)	4 (40)	5 (50)	13(26.53)
Zobo drink	10	2(20)	1 (10)	-	3(6.12)
Total	50	20(40.00)	13(26.00)	16(32.00)	49(98.00)

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