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Public Health Consequences of Pathogenic Bacterial Contamination of Ready to Eat Food/ Snacks from Some Selected Retail Outlets on Campus of Rivers State University, Port Harcourt, Nigeria.

[1*]Azounwu, Obioma; Nnenna Ihua[1] and Ikoko Ijeoma Eberechukwu[1]
[1]Department of Medical Laboratory Science, Faculty of Sciences, Rivers State University, Nkpolu, Port Harcourt, Nigeria.
[*] Correspondence author: Azuonwu, O
Department of Medical Laboratory Science, Rivers State University, Port Harcourt, Nigeria,
Email: bimajacobs@yahoo.co.uk.

Abstract

Campus lifestyle is seemingly always characterized with doing things at ease without stress thus; consumption of ready to eat food is a common life style among students on campus with much interest on convenience rather than its safety and quality. Food borne illness is a major challenge to the health of the public; it has significantly contributed to the cost of health related outcome globally. Annually, millions of illnesses across the world could literally be attributed to the consumption of contaminated foods. Ingestion of contaminated ready to eat foods has been documented to serve as a strong vehicle for transmission of numerous pathogens and food borne outbreak. An observational descriptive study was explored to evaluate the safety standard and bacteriological quality of two common ready to eat foods (meat pie and moi-moi) from four different selected retail snacks outlets on campus. This will further help to ascertain their public health implication among the unsuspected public. Samples were collected from the four selected retail points, examined using conventional microbiological methods for the isolation and identifications of the implicated pathogens. Graphpad calculator was used to analyse data for mean, standard deviation and one way ANOVA at 0.05 were also explored respectively**.** Seven bacteria isolates were identified from the ready to eat snacks. The result of the isolation based on frequency and prevalence rate revealed that *Staphylococcus aureus* was the highest and most predominant amongst the isolated organisms 65 (46.4%); followed by *Proteus spp.* 27 (19.3%), then *Escherichia spp.* 21 (15%) whereas, *Enterobacter spp.* 4 (2.9%) had the least respectively. Based on the location sampled, Location 1 had the highest prevalence rate (57.1%) while others had same rates (14.3%). ANOVA showed no indication of statistical significance difference ($p>0.05$) between the four different locations.. However, the application of hazard analysis critical control point at all stages of food preparation and handling will be helpful, as a good pathway towards enhancing food safety in our campuses and communities at large.

Keywords: *Public Health, Food Poisoning, Food Safety, Health Risk Assessment, Health Education, Ready to eat Food/Snacks, Campus, HACCP*

Introduction

Campus lifestyle is often hugely characterized with doing things at ease. It was strongly opined that the increasing trend of industrialization, economic meltdown and the increasingly quest to meet up time of appointments and career are some of the associated possibly rationale for the increased patronage of ready to eat food/snacks according to Nielson (2006). The consumption of ready to eat food is common among students on campus with much interest on convenience rather than its safety, quality and hygiene as time saving remains very critical outcome of patronage. Food borne illness is a major challenge to the health of the general public globally; it has significantly contributed to the cost of health burden across the globe especially in developed communities where time is money and very significant to manage by the citizens given their quest to survive and succeed in their political, religion and socio-economic responsibilities. Nonetheless, annually, millions of illnesses in the world have been attributed to the consumption of contaminated foods which could be linked to poor handling and lack of awareness among citizens. However, ingestion of contaminated ready to eat foods has been documented to serve as vehicles for transmission of numerous pathogens that are linked to food borne outbreak epidemics. Food borne illness remains a persistent challenge to public health and the problems of food safety remain a threat in the developed and developing countries like the case seen in Nigeria.

Nevertheless, the clinical implications of food borne illness is very massive in our society, as it could either be through the ingestion of the whole pathogen or through the release of toxins by the infectious agent which could be toxic in nature. Nonetheless, the pathogenic agents enter the body through the ingestion of the contaminated food and food products (WHO, 2007). The incidence of food borne disease worldwide is actually difficult to estimate probably due to undocumented records and undiagnosed cases especially in our remote communities, but it has been reported that in 2005 alone about 1.8 million people died from diarrheal related diseases linked to food borne pathogens. Also, in 2007 World Health Organization (WHO) in a report stated also that a significant morbidity proportion of approximately 1.5 billion episodes of cases of diarrhoea which resulted to the mortality rate of over 3 million deaths globally per annum were recorded, this results from ingestion of contaminated foods. Although, both governments and non-governmental agencies

throughout the world are attempting to improve the safety of the food/snacks supply, however, the occurrence of food borne disease still remains a significant health issue in both developed and developing countries (Jay, 2002). Nevertheless, problems of food safety in the industrialized world differ considerably from those faced by developing countries probably due to variation in the degree of health awareness amongst the subjects. However, the fact remains that microbes are ubiquitous in nature thus; the tendency for the food to be contaminated is very high in our environment. Although, food borne illness is a consequence of food borne microbes contamination of some food which can be found even in healthy animals raised for food and contaminated plants- dietary food source , even as in the manure used as fertilizer on our vegetables in our farms have also been implicated as reported by Adesiyun (1998).

The consumption of snack is common among students on campus across the globe. Campus fast food vendors make huge profit from the daily sales and more often, they dodge payment of tax from the proceed of their profits, though the setup of some of this fast food outfits in our Universities and colleges have potentially helped in providing employment opportunities to the growing teaming population in our societies as it were. It strongly evident that most time, the majority of the Colleges/Universities are most times away from home and in most hostels across the globe, students are not permitted to cook, so as to reduce the risk of fire outbreak and other related home accident/risk that might be incurred. Thus majority of the students resort and depend on ready to eat foods/snacks shops scattered on campus for daily living. Nonetheless, it is strongly believed that good majorities of the students on campus are often more interested in their convenience rather than their safety, quality and hygienic nature of what they eat. Thus, the safety, quality and hygiene of these snacks should be of utmost importance given the health implications that could be incurred, when their standard are massively compromised. Nevertheless, irrespective of the cost implication, the preparatory processes of these snacks should be based on international best practices and quality should be controlled by the routine observation of hazard analysis critical control point (HACCP) during all the process of food packaging and process of manufacturing. Furthermore, the scientific sustainability of safety operations should be highly checked and maintained at all time as this, could be

used as a major mechanism of reducing or completely removing contamination sources from ready to eat food and snacks in our society.

However, the presence of coliforms and other micro-organisms may constitute a public health hazard as posited by Robinson (1990). Given the increasing trend of emerging and re-emerging of infectious disease in our global community scale, there is potential need for continuous monitoring of the safety of ready to eat foods and snacks on campus, as there is seemingly dearth of data/ information in this direction. Thus the aims of this study is to ascertain (1) how safe is the ready to eat foods/Snacks sold on campus (2) What type of organism is most prominent (3) To highlight the Public health implications of such pathogens on food and possibly proffer solutions on the best approach of keeping the ready to eat food safe for the consumption of our students on campus.

It is strongly believed that data generated from this study, would be used to strengthen the public health policies that could be geared towards enhancing the safety of ready to eat food on campus.

Study Location

This study was conducted at the Rivers State University Nkpolu – Orowolokwo, Port Harcourt from the month of February - July 2016. It is a state owned University that satisfies the heart desire of Rivers State in term of man power development by training and re-training of the needed man power to the increasing demands of the growing industrial, government and non-governmental agency's needs. It is situated in Port Harcourt which is literally the heart of oil and gas activities in Nigeria, with massive influx of human traffic who are here basically to explore the emerging greener pasture attributes arising from the myriad of abundance of multinational companies' activities in oil and gas exploration/business.

Experimental

An observational descriptive study design was explored to give a snapshot by estimating the safety, quality and bacteriological analysis of two common ready to eat fast foods (meat pie and moi-moi) from four different selected retail snacks outlets on campus. Also, its evaluation regarding public health significance as well as the clinical implication of such ready to eat food was also considered. Samples were collected aseptically at one point, examined using

conventional microbiological methods of culture, morphological and biochemical assays for isolation and identifications as described by Cheesebrough, (2000) and APHA, (1998). The bacteriological analysis of the two ready to eat food on campus were analysed in the laboratory department of the Health Services outfit of the Rivers State University that is fully equipped with the recent state of the art diagnostic equipment for the diagnosis and analysis of clinical and industrial samples for the benefit of man.

Statistical Analysis

Graphpad calculator was used to analyze data for mean, standard deviation and one way ANOVA at 0.05 was also explored. Furthermore, frequency and prevalence rates were also determined.

Results

Seven bacteria isolates were identified from the ready to eat snacks. The result of isolation frequency and prevalence rate revealed that *Staphylococcus aureus* was the highest and most predominant amongst the isolated organisms 65 (46.4%); followed by *Proteus spp.* 27 (19.3%), then *Escherichia spp.* 21 (15%) whereas, *Enterobacter spp.* 4 (2.9%) had the least. See figure 1 and 2 below.

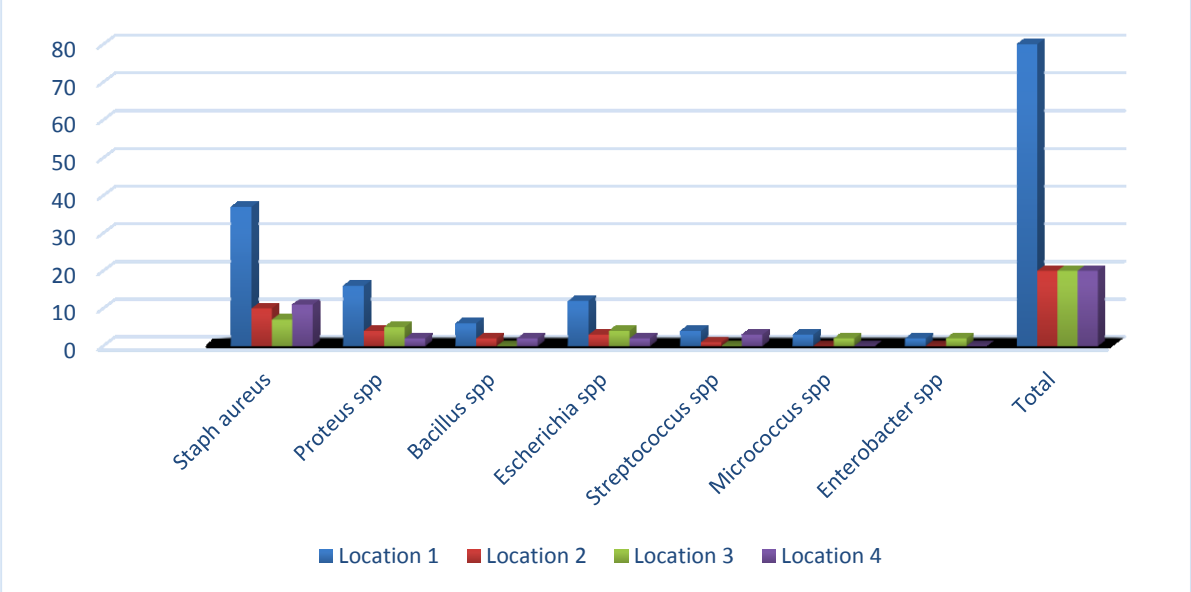

Figure 1: Frequency Distribution of Organisms Isolated

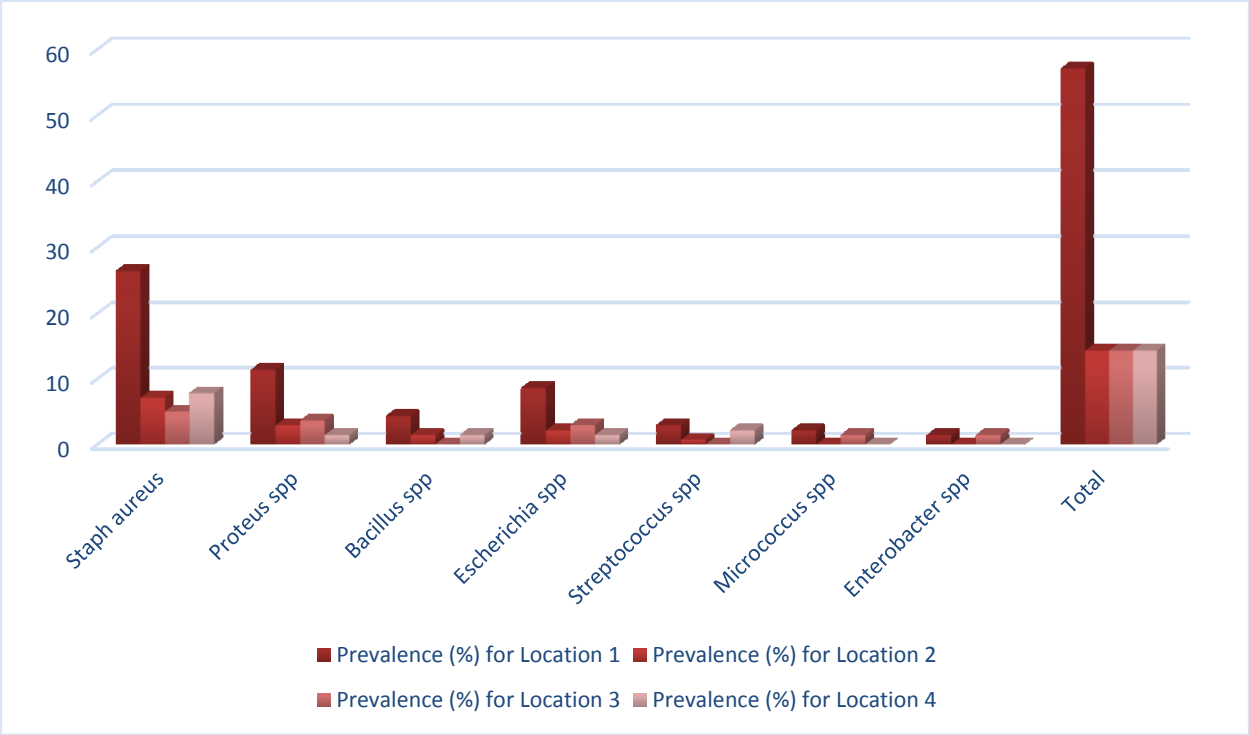

Figure 2: Prevalence Percentage (%) of Bacterial Isolates based on location

Based on the location sampled, Location 1 had the highest prevalence rate (57.1%) while others had same rates (14.3%). ANOVA showed no indication of statistical significance difference ($p>0.05$) between the four different locations.

Table1: One Way Analysis of Variance (ANOVA) of the Bacteria Isolates from Four Locations

	SS	DF	MS	F-value	P-value
Between Group	263.478	3	87.826	1.506	0.247
Within Group	1049.785	18	58.321		
Total	1313.263	21			

DF=Degree of Freedom, SS= sum of square, MS= mean square.

Discussion

Snacks have been literally referred to as light foods which are energy-rich foods which can easily be taken away (take away foods) at convenience according to Food and Agricultural organization (1991). Meat pie and Moi-Moi were the ready to eat snacks only considered in this study. Generally, these foods can be eaten out doors or can be taken away and possibly eaten in transit as a substitute before normal meals or as a food eaten in between meals; this is basically the routine within the university environment where students are far away from home made foods so, ready to eat snacks become alternative food for consumption and as a result sales of snacks has become a global phenomenon, as it is becoming very popular among the youths and the working class. Moreover, modern life style is characterized with doing things at ease (fast pace generation) industrialization, economic meltdown and quest for more wealth, are some of the underlining reasons that are associated with the increasing patronage of snacks across our communities (Nielson, 2006).

Ready to eat food has been implicated in cases of food poisoning or gastroenteritis. The contamination of food products with infectious organisms and their persistent growth, multiplication and toxin production is an important public health concern. Furthermore, based on the report from this study, it is paramount to know that food sold in the place of this present study carries high risk of transmitting bacteria thus, it is of great concern since large number of students and workers consume these foods on daily basis.

Notably, the result obtained from this study showed that the snacks examined were all contaminated. From the various sampling location examined, it was observed that the *Staphylococcus aureus* was higher in number thus, most prevalent of the organisms isolated from this study; however, the study revealed contamination in the ready to eat snacks obtained from the various centres. This is in line with the work of Chomvarin and colleague, a study done in 2006 which revealed the presence of *Staphylococcus aureus* in snack food, their report states that the presence of these organisms in food pose a serious health threat (Chomvarin *et al*. , 2006). Thus, given the implication of this organism in food poisoning and gastroenteritis cases across the globe, much care is potentially needed to protect our food/ snacks from microbial contamination.

Foods contaminated with microbes have been implicated to be vehicles for transmission of several bacterial pathogens and food-borne outbreaks as asserted by Borch & Arinder (2002). Although, Hatakka (1998) claimed that some hot foods have been the source of outbreaks of *Staphylococcus aureus, Clostridium perfringens & Salmonella enteritidis*, though the evidence based on the reason for this was not very clear in the literature in question. The main sources of pathogenic bacteria in food are contaminated raw food, food handlers, dust, water, utensils & insects (Ray, 1996). Ready to eat food has been implicated in cases of food poisoning or gastroenteritis in human according to Eley (1996). This could probably be linked to the poor hygienic environment and poor safety measures deployed during the process and subsequent handling of such foods,

Nevertheless, several factors could be attributed to contamination of ready to eat foods, Barro and colleague opined that, foods are persistently linked with diarrhoea diseases which take place due to improper use of additives, the presence of pathogenic bacteria, environmental contaminants and disregard of good manufacturing practices and good hygiene practices. Furthermore, same scholar and colleague also suggested that food retailers are often poorly educated, unlicensed, untrained in food hygiene practices, and they work under crude unsanitary conditions with little or no knowledge about the causes of food borne diseases (Barro *et al.,* 2007). Most of the foods are not well protected from flies, which may carry food borne pathogens. Safe food storage temperatures are rarely applied to street foods. Potential health risks are associated with contamination of food by *Escherichia coli, Salmonella typhi, Pseudomonas species, Staphylococcus aureus* during preparations and post-preparation stages (Barro *et al.,* 2007) and the result from this study revealed the presence of similar organisms in large quantities thus, this present study is in agreement with the work of Barro et al., (2007)

Furthermore, the preparation of ready to eat foods pass through various processes and the number of bacteria isolated in this study were probably due to unhygienic practices employed during the processing packaging and distribution of the snacks. More so, the contamination could have come from the food sources according to Jay (2002) who reported that human food sources are often derived from plants and animals and these, are naturally infected by microorganisms

which break them down for energy and production of inorganic compounds such as sulphates and Nitrates. Based on the food sources, meat pie is a savory pie while moi-moi is processed beans; both could contain filled shred meat or fish and other spicy ingredients. The shred meat is usually made of beef for the meat pie and the moi-moi is most often time is made up of egg (poultry products). These ready to eat foods been the most popular of all pastries are perishable with a very short shelf life thus; special care is needed in handling. Besides, these foods refrigeration are also the major sources of contamination in our communities because they have the tendency to spoil quickly when they are not stored in a good stable temperature that could discourage bacteria replication and multiplication. The contamination of the ready to eat food may probably be possible as a result of the preparatory process, and the characteristics and the nature of the raw materials used. Nonetheless, owing to the availability of high nutrient in the meat, egg or fish, it has been strongly reported to provide an enabling environment for micro organisms to easily thrive in these products, thereby instituting rapid spoilage of food (Emeka-Ike, Nwokorie & Anochie, 2015).

Nevertheless, wide literature search potentially suggested that studies have been done on the sources of ready to eat - food contamination arising from poor handling practice. Also, Roberts *et al.* (2003) opined that the sanitary quality of food is usually determined by the absence of pathogens or by low microbial counts per gram of the food (Roberts *et al.,* 2003). In wide-range of analysis however, the content of certain indicator organisms is used to determine the sanitary quality of foods. Although, Buttiaux & Mossel (2005) gave the characteristics of a food indicator organisms to include specifically its intestinal origin, occurrence in high number in faeces, high resistance to the external environment and easy identification even in small number.

In addition, foods have their natural flora made up of bacterial, moulds or yeast, the number and type of microbes found in any given food is therefore a reflection of either where it is grown or how it is been handled (Frazier *et al.*, 2006).

Microbial contamination of ready to eat foods may occur during various stages of production and preparations. Good and strict hygienic measures need to be taken care of at various steps in production, preparation and

storage of food to improve the quality of the product and public health concerns. Ready to eat food/Snack food are prepared using a variety of food items from animal sources such as eggs, chicken, meat, vegetables and sauces. Thus, attention should be given to these raw materials (Graffham, Zulu & Chibanda, 2005). All of these food components could be the potential source of food poisoning or food borne illnesses. Moreover, Adams & Moss (2000) opined that improper cooking, storage and poor sanitary conditions of the kitchen further deteriorate the quality of the food as well as the equipment, food handlers and raw products. Moss, (2000).

The public health implication of the bacterial load on snacks as obtained in this study is food poisoning; resulting to food borne illness which is an illness caused by eating contaminated food. However, infectious organisms include various bacteria, viruses and parasites or their toxins and are most common causes of food poisoning pathogens (Schiller *et al.,* 2010). Food poisoning is a threat to the public especially snacks which are made for public consumption, it can affect one person or a group of people who all eat from the same source of contaminated food. The carrier of such pathogens becomes a threat to the general populace as the individual could possibly be dislodging and spreading the microbes in the environment, apart from the direct effect of the microbes to the individual health. The general population might likely be at risk due to exposure and interaction of the infected subject or the carrier in our communities. Lastly, some of the organisms isolated in this study are causative agents of food borne illness due to food poisoning like *Escherichia coli*, *Staphylococcus aureus* etc. These organisms or their toxins can contaminate food at any point during its processing, production, packaging or storage (Buttiaux & Mossel, 2005)). Clinically, when this food is ingested it triggers some signs and symptoms most commonly within few hours of ingesting the contaminated food. The time may be longer or shorter depending on the cause of the food poisoning and the immunity competence of the subjects. Possible symptoms include; abdominal cramps, diarrhoea, fever and chill headache, nausea, vomiting and weakness of the body systems. However, these health implications can be averted if safe practices and precautionary measures are kept and sustained.

Furthermore, physical examination of the environment could help us depicts where these products are been displayed for sales,

thus the environment may not be so clean and hygienic for the sales of food, as some are under the staircase, some are close to the public toilets, no wash-up areas for vendors/consumers, places surrounded with insects and rodents due to lack of sanitation and disinfection as observed in this study. Furthermore, these snacks might possibly not be satisfactorily protected from flies. Mechanical transfer of pathogens by flies could be possible over time; some microbes like *Salmonella and Shigella* can multiply in the gut of the housefly and be excreted for weeks or longer. Consequently, this could enhance the risk and thus promote the contamination that are associated with the exposure of food to flies. Since these snacks are placed in show-glass (case) for sampling, a bit of contamination during the processing period could make the organisms to multiply in that warm environment, due to the bulb light in the show-glass (case) which could provide a good temperature for most microbial growth, thereby increasing the microbial load present in the snack. However, this becomes opposed to the advantage of keeping the food warm as intended by the vendor. Nevertheless, a number of previous observational studies have shown that these foods are sometimes held at improper temperatures, excessively handled by food vendors and sold at very dirty surroundings (WHO, 2001, 2003; Agbodaze *et al*., 2005; Muinde and Kuria, 2005; Ghosh *et al*., 2007). Thus, concerns have been raised by the Food and Agricultural Organization (FAO) in 1999 and others about these foods, serving as a potential source of food poisoning outbreaks (Chakravarty & Canet, 2002).

Moreover, food borne illness had been implicated to be a major global health problem and an essential cause of reduced economic growth. This concern ranges from chemical toxins contamination, infections from food borne microbes, the use of antibiotics in animal rearing and the transfer of antibiotic resistance strains to human. These pathogens and other health outcome mentioned above are all part of public health consequences of eating contaminated ready to eat food

The food vendors and those involved in preparatory process of the food as well as the environment where these foods are sold and prepared should always explore the application of hazard analysis critical control point (HACCP) so as to prevent the food from unwholesome contamination.

Conclusion

The ready to eat foods must be examined at regular intervals in order to assess their bacteriological quality, as the safety and quality of ready to eat food reflects its sanitary condition during its production and distribution. Moreover, more robust hygienic measures, necessary to reduce or prevent the contamination are also suggested for the improvement of snack/food by food handlers. The need for regular training and health education of food and ready to eat snacks sellers/handlers on campus would certainly help to improve the safety and sanitary condition of the food/ snacks in our campuses.

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