East African Scholars Journal of Biotechnology and Genetics
Abbreviated Key Title: East African Scholars J Biotechnol Genet
ISSN: 2663-189X (Print) & ISSN: 2663-7286 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-1 | Issue-1 | Jan-Feb -2019 |

Research Article

Microbial Quality of Cooked and Processed Foods Sold by Food Vendors and Restaurant in Niger Delta University Community, Amassoma, Bayelsa State

Oku, I.Y[1], and Alagoa, K.J[1],

[1]Department of Biological Sciences, Niger Delta University, Amassoma, Bayelsa State, Nigeria

*Corresponding Author
Alagoa, K..J.

Abstract: This study was undertaken to examine the microbiological quality of foods sold by food vendors in Niger Delta university community (NDU), Amassoma, Bayelsa State. This was done to determine its safety and health concerns. A total of six (6) samples were collected from four (4) food vendor outlets consisting of four (4) food samples (beans, white rice, jollof rice and yam) and two palm swabs and were analyzed. Result from the study indicate that the colony forming unit (cfu/ml), for each sample ranged from 4.4 x 10^5 to 1.88 x 10^6 for beans, 8.6 x10^5 to 2.51 x 10^6 for white rice, 6.6 x 10^5 to 9.8 x10^5 for jollof rice, 9.5 x10^5 to 2.26 x10^6 for yam, 6.7 x10^5 to 9.8 x10^5 for palm swab I and 5.9 x10^5 to 9.3x10^5 for palm swab II respectively. The frequency of occurrence of bacterial isolates recorded one (1) for streptococcus sp which had the least occurrence and fifteen (15) isolates for staphylococcus aureus which had the highest occurrence. A total of five fungal species were also isolated from the samples which include; rhizopus, mucor sp, penicillum sp, fusarium sp, and aspergillus sp. The presence of these microorganisms in the various food samples show that food eaten in the Niger Delta University community contains high level of microbial load which is hazardous to the health of consumers.

Keywords: Macrobial, Cooked , food, Vendors, Niger Delta University Community.

INTRODUCTION

Throughout the globe and mostly in Africa, food security and food safety are fast becoming the two most popular buzz words. This is so because as Africa tries to feed itself, it is imperative that it must do so in a safe and sustainable manner. Food security embodies all aspects of sustainability, while food safety defines standards of food production along the lines of cultivation, storage and processing. Food security assures food for low income urban population and livelihood for a significant proportion of the population in many developing countries (Ghosh *et al.*, 2007). Food safety ensures avoidable contamination of food by chemicals and pathogens (Mead, 2004).

In Nigeria today, issues of food tainting with pesticides, herbicides and other chemicals used for weed control during cultivation and pest control during storage are issues of concern. Food safety has become a global challenge, and most countries are victims of foodborne illnesses (Akhtar *et al.*, 2014). Specifically, the issues of greatest concern here in the Niger Delta university community, Amassoma, Bayelsa State lie in the pathogenic contamination of processed/cooked ready- to- eat food by vendors in road sides and street corners. Street vended foods provide a source of inexpensive, convenient and often nutritious food for urban and rural poor; a major source of income for a vast number of persons, particularly women; and a chance for self-employment and the opportunity to develop business skills with low capital investment (WHO, 1996; Schoeder *et al.*, 2004). In spite of numerous advantages offered by street foods, there is also several health hazards associated with this sector of the economy. The problems associated with the methods of consumption of vended foods considerably arise from traditional processing and packaging, improper handling temperature, poor personal hygiene of food handlers.

Quick Response Code

Journal homepage:
http://www.easpublisher.com/easjbg/

Article History
Received: 15.01.2019
Accepted: 12.02.2019
Published: 28.02.2019

DOI: 10.36349/easjbg.2019.v01i01.001

Contamination of vended food may occur during and after processing of such food. Contamination of ready-to-eat food by organisms such as Escherichia coli, Klebsiella spp., Proteus spp., Salmonella spp., Pseudomonas spp. and Enterobacter spp. from vended foods (Oluyege *et al.*, 2009) is of primary concern because of the risk of these organisms in the outbreak of food-borne diseases such as gastroenteritis, dysentery, typhoid fever etc. and may as well serve as reservoir of genes for antimicrobial resistance in pathogenic organisms (Oluyege *et al.*, 2009).

Furthermore, some microorganisms can cause big health problems when consumed in contaminated foods or beverages. This grave concern forms the motive for this research. This study therefore seeks to investigate the diversity of microorganisms' presents in foods sold by vendors in the Niger Delta university community, Bayelsa state with the aim of assessing first hand, the microbial status of the food and its implied health implication.

MATERIALS AND METHOD

Collection of samples

Food samples were collected from food vendors in the campus of Niger Delta University, Amassoma, Bayelsa State. The food samples included cooked beans from vendor "Beans-up I", white rice from vendor "Beans up II" , jollof rice from Coca cola restaurant, cooked yam from the cafeteria and two palm swabs were analyzed from people handling the food from Beans up and Coca cola restaurant. All samples were put into sterile sample bottles and the palm swabs were put into sterile sample bottles holding 10ml of peptone water. The samples were immediately transported to the microbiology laboratory of the University.

Sterilization of materials

All the materials used were washed with detergent, thoroughly rinsed, placed in racks to dry and then autoclaved at 121^0 c for 20 minutes. They were then transferred to a hot oven to dry properly before use. The materials sterilized included all glass wares, cotton wool, nutrient media, normal saline solution etc.

Sample preparation

The samples were weighed with an electronic weighing balance, and 1g of the samples was put into sterile universal sample bottles containing 9ml of normal saline. The samples were crushed into smaller particles inside the saline solution to increase the surface area of the samples and in effect, making sure most of the microbes are suspended in the saline solution inside the universal bottle before serial diluting the samples and inoculation.

Serial dilution and inoculation

The isolation and enumeration of microbes were performed using serial dilution of all the samples carried out in up to 10^{-6} in normal saline. Samples were plated in duplicates using spread plate methods. 0.1ml of dilution factor $10^{-5}$and $10^{-6}$of the samples were poured into petri dishes, then, ready prepared nutrient media agar and potato dextrose agar) were pored over it, well swirled, and were incubated at 35^0 c for 24 hours. Total viable counts were carried out after the incubation period. The total number of colony forming unit (CFU/ml) were recorded after the incubation period.

Preparation of nutrient media

The entire nutrient media used in the study was prepared strictly on, manufacturer's instruction. They were all autoclaved and at 121^0 for 20 minutes to ensure absolute sterilization of the media. The media used for the study includes, agar, MacConkey agar, centramide agar, mannitol salt agar, and potato dextrose agar.

Biochemical Test

Indole Test

A pure bacterial culture was grown in sterile tryptophan broth for 24 hours. Following incubation, five drops of kovacs regent was added to the culture broth. A positive result is shown by the presence of a red-violet colour in the surface of the broth. A negative result appears yellow.

Catalase Test

A drop of hydrogen peroxide (H_2O_2) was placed on a clean microscope slide. A wire loop was used to pick a colony from a 24 hour pure culture. The bacteria colony was introduced into the drop of hydrogen peroxide. Immediately bubbling shows a positive result. A negative result shows no bubbling.

Coagulase Test

Two drops of normal saline were put onto a microscope slide. One saline was for control and the other for the test. The colony from the 24 hour pure culture was emulsified in the saline using a wire loop. Thereafter, a drop of plasma was placed on the saline, and then the side was rocked gently for some few seconds. Clumping on the side indicates a positive outcome. A negative result shows no clumping.

Kia Medium

Kiligier iron agar slants were prepared with each tube holding 10ml of the medium. The tubes were autoclaved together with the medium and allowed to cool and set. The test organism from a 24 hour pure culture was used to inoculate/stabbed at the butt of the tube, while a wire loop was used to streak the slant of the tube gently. A yellow slope and butt indicate lactose and glucose fermentation. A red pink slope and butt indicates no fermentation. Blackening along the stab line indicates H_2S production, while cracks and bubbles

in the medium indicate gas production from glucose fermentation.

Gram staining

A smear of each bacteria isolate was made and fixed on a sterile glass slide briefly passing it through a flame. The primary dye (Crystal violet) was used to stain the bacteria isolates and allowed to stay for a minute, before flooding it with water. Lugols iodine was then added and subsequently washed after a minute with sterile distilled water. It was decolourised for a few seconds before counterstained with neutral red for one minute. The slides were allowed with a magnification of x100 under a light microscope. Bacteria cells that retained the colour of the primary dye were grouped as gram positive, while those that retained the secondary dye as gram negative.

Motility Test

The colonies were emulsified in distilled water and placed on the slide. The preparation was sealed with molten petroleum jelly to prevent drying out. The preparation was examined microscopically for motile organisms using x40 and x40 objectives.

Fungal isolation and identification

This was carried out using 10^{-5} and 10^{-6} dilutions of the sample, and plated using pour plate method into sterile petri dishes, and 15ml of already prepared potato dextrose agar was poured over each plate. The fungal isolated were identified microscopically and macroscopically. Slide preparation of the fungi isolates were made and stained with lactophenol cotton. Cover glasses were placed over them and examined under the microscope.

Result

The result of this study is captured in Tables 1 – 7. A total of 6 samples were collected consisting of 4 food samples (beans, white rice, jollof rice and yam) and 2 palm swabs and were analyzed. The colony forming unit (CFU/ML), for each sample ranged from 4.4 x 10^5 to 1.88 x 10^6 for beans, 8.6 x 10^5 2.51 x 10^6 for white rice, 6.6 x 10^5 to 9.8 x 10^5 for jollof rice, 9.5 x 10^5 to 2.26 x 10^6 for yam, 6.7 x 10^5 to 9.8 x 10^5 for palm swab I and 5.9 x 10^5 to 9.3 x 10^5 for palm swab II respectively. The frequency of occurrence of bacterial isolates recorded 1 for *streptococcus sp* which had the least occurrence and 15 isolates for *staphylococcus aureus* which had the highest occurrence. A total of five (5) fungal species were also isolated from the samples which include: *Rhizophus, Mucor sp, Penicillium sp, Fusarium sp and Aspergillus sp.*

Table 1: Population of Bacteria from the Different Samples /Examined Dilution Factors.

NUTRIENT MEDIA	NUTRIENT AGAR	MANNITOL SALT AGAR	MACCONKEY AGAR	CENTRAMIDE AGAR	DILUTION FACTOR EXAMINED
SAMPLE 1	156	38	68	70	10^{-4}
(Beans)	219	49	94	95	10^{-5}
SAMPLE 2	212	80	78	78	10^{-4}
(Jollof Rice)	290	102	98	94	10^{-5}
SAMPLE 3	93	59	89	83	10^{-4}
(White Rice)	124	103	183	109	10^{-5}
SAMPLE 4	208	87	166	87	10^{-4}
(Boiled Rice)	243	103	183	109	10^{-5}
SAMPLE 5	93	53	74	65	10^{-4}
(Palm Swab I)	102	87	83	69	10^{-5}
SAMPLE 6	87	54	43	56	10^{-4}
(Palm Swab II)	98	63	76	79	10^{-5}

Table 2: Mean Population of Bacteria from the Different Samples / the Colony Forming Unit (Cfu/ml)

NUTRIENT MEDIA	NUTRIENT AGAR	CFU/ML	MANNITOL SALT AGAR	CFU/ML	MACCONKEY AGAR	CFU/ML	CENTRAMIDE AGAR	CFU/ML
SAMPLE 1 (Beans)	188	$1.88x10^6$	44	$4.4x10^5$	81	$8.1x10^5$	83	$8.3x10^5$
SAMPLE 2 (Jollof Rice)	251	$2.51x\ 10^6$	91	$9.1x10^5$	88	$8.8x10^5$	86	$8.6x10^5$
SAMPLE 3 (White Rice)	98	$9.8x10^5$	66	$6.6x10^5$	96	$9.6x10^5$	95	$9.5x10^5$
SAMPLE 4 (Boiled Rice)	226	$2.26x10^5$	95	$9.5x10^5$	175	$1.75x10^6$	97	$9.7x10^5$
SAMPLE 5 (Palm Swab I)	98	$9.8x10^5$	70	$7.0x10^5$	79	$7.9x10^5$	67	$6.7x10^5$
SAMPLE 6 (Palm Swab II)	93	$9.3x10^5$	59	$5.9x10^5$	60	$6.0x10^5$	68	$6.8x10^5$

Table 3: Biochemical Tests & Characterization of Bacterial Isolates from Sample 1 (White Rice)

S/N	SPECIES IDENTIFIED	GRAM REACTION	COLONY MORPHOLOGY	MOT	LAC	GLU	SLOPE	BUTT	H_2S	GAS	IND	CAT	CAG
1.	Proteus sp	-ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
2.	Bacillus sp	+ve rod	Circular smooth colony	+	+	+	Y	Y	-	-	-	+	+
3.	Salmonella sp	-ve rod	Circular smooth colony	+	-	+	R	Y	+	-	-	+	-
4.	Staphylococcus sp	+ve cocci	Circle yellow colony	-	+	+	Y	Y	-	-	+	+	+
5.	Escherichia coli	-ve rod	Circular pink colony	+	+	+	Y	Y	-	+		+	+
6.	Staphylococcus sp	+ve cocci	Circular yellow colony	-	+	+	Y	Y	-	-	+	+	-
7.	Staphylococcus sp	+ve cocci	Circular yellow colony	-	+	+	Y	Y	-	-	+	+	-
8.	Citobacter sp	-ve rod	Rhizoid rough colony	+	-	+	R	Y	+	-	-	+	-
9.	Pseudomonas sp	-ve rod	Irregular colony	+	+	+	Y	Y	-	+	-	+	-
10.	Proteus sp	-ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
11.	Proteus sp	-ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
12.	Enterobacter sp	-ve rod	Small dark colony	+	+	+	Y	Y	-	+	+	-	-

Table 4: Biochemical Tests &Characterization of Bacterial Isolates from Sample 2 (Jollof Rice)

S/N	SPECIES IDENTIFIED	GRAM REACTION	COLONY MORPHOLOGY	MOT	LAC	GLU	SLOPE	BUTT	H_2S	GAS	IND	CAT	CAG
1.	Proteus sp	-ve rod	Small rough colony	-	+	+	Y	Y	-	-	+	+	-
2.	Escherichia coli	-ve rod	Circular pink colony	+	+	+	Y	Y	-	+	+	+	+
3.	Staphylococcus sp	+ve cocci	Circular yellow colony	-	-	+	Y	Y	-	-	+	+	-
4.	Shigella sp	-ve rod	Pale coloured colony	-	-	+	R	Y	-	-	-	-	+
5.	Citrobacter sp	-ve rod	Rhizoid & rough colony	+	+	+	Y	Y	-	+	-	-	-
6.	Proteus sp	+ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
7.	Proteus sp	+ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
8.	Escherichia coli	-ve rod	Circular pink colony	+	-	+	R	Y	-	+	+	+	+
9.	Pseudomonas sp	-ve rod	Irregular colony	+	+	+	Y	Y	-	+	-	-	-
10.	Staphylococcus sp	-ve cocci	Circular yellow colony	-	+	+	Y	Y	-	-	+	+	-
11.	Escherichia coli	-ve rod	Circle yellow colony	+	+	+	Y	Y	-	-	+	+	-
12.	Pseudomonas sp	-ve rod	Irregular colony	+	+	+	Y	Y	-	-	+	+	-

Table 5: Biochemical Tests and Characterization of Bacterial Isolates from Sample 3 (Yam)

S/N	SPECIES IDENTIFIED	GRAM REACTION	COLONY MORPHOLOGY	MOT	LAC	GLU	SLOPE	BUTT	H_2S	GAS	IND	CAT	CAG
1.	Shigella sp	-ve rod	Small coloured colony	-	-	+	R	Y	-	-	-	-	+
2.	Enterobacter sp	-ve rod	Small dark red colony	+	+	+	Y	Y	-	+	-	+	+
3.	Pseudomonas sp	-ve rod	Irregular colony	+	+	+	Y	Y	-	-	+	+	-
4.	Klebsiella sp	-ve rod	Irregular colony	-	+	+	Y	Y	-	+	-	+	+
5.	Proteus sp	-ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
6.	Escherichia coli	-ve rod	Circular pink colony	+	+	+	Y	Y	-	+	+	+	+
7.	Citrobacter sp	-ve rod	Rhizoid & rough colony	+	+	+	R	Y	+	-	-	+	-
8.	Staphylococcus sp	-ve cocci	Circular yellow colony	-	+	+	Y	Y	-	-	+	+	+
9.	Proteus sp	-ve rod	small pink colony	+	+	+	Y	Y	-	+	+	+	-
10.	Escherichia coli	-ve rod	Circular pink colony	+	+	+	Y	Y	-	+	+	+	+
11.	Enterobacter sp	-ve rod	Small dark colony	+	+	+	Y	Y	-	+	-	+	+
12.	Pseudomonas sp	-ve rod	Irregular colony	+	+	+	Y	Y	-	-	+	+	-

Table 6: Biochemical Tests and Characterization of Bacterial Isolates from Sample 4 (Beans)

S/N	SPECIES IDENTIFIED	GRAM REACTION	COLONY MORPHOLOGY	MOT	LAC	GLU	SLOPE	BUTT	H_2S	GAS	IND	CAT	CAG
1.	Lactobacillus sp.	+ve rod		-	-	+	Y	Y	-	-	+	+	-
2.	Streptococcus sp	+ve cocci		+	+	+	Y	Y	-	+	+	+	-
3.	Pseudomonas sp	-ve rod	Irregular colony	+	-	+	R	Y	-	+	-	+	-
4.	Proteus sp	-ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-
5.	Shigella sp	-ve rod	Pale coloured colony	+	-	+	R	Y	-	-	-	-	+
6.	Bacillus sp	-ve rod	Circular colony	+	+	+	Y	Y	-	+	-	+	+
7.	Enterobacter sp	-ve rod	Small dark colony	+	+	+	Y	Y	-	+	-	+	+
8.	Escherichia coli	-ve cocci	Circular pink colony	+	+	+	Y	Y	-	+	+	+	+
9.	Proteus sp	-ve rod	Small rough colony	-	+	+	Y	Y	-	+	+	+	-
10.	Staphylococcus sp	+ve cocci	Circular yellow colony	-	+	+	Y	Y	-	-	+	+	+
11.	Staphylococcus sp	+ve cocci	Circular yellow colony	+	+	+	Y	Y	-	-	+	+	+
12.	Proteus sp	-ve rod	Small rough colony	+	+	+	Y	Y	-	+	+	+	-

Table 7: Biochemical Tests and Characterization of Bacterial Isolates from Sample 5 (Palm Swab)

S/N	SPECIES IDENTIFIED	GRAM REACTION	COLONY MORPHOLOGY	MOT	LAC	GLU	SLOPE	BUTT	H_2S	GAS	IND	CAT	CAG
1.	Enterobacter sp	-ve rod	Circular pink colony	-	-	+	Y	Y	-	-	+	+	-
2.	Pseudomonas sp	-ve rod	Irregular colony	+	+	+	Y	Y	-	+	+	+	-
3.	Lactobacillus sp.	+ve rod	Smooth circular colony	+	-	+	R	Y	-	+	-	+	-
4.	Staphylococcus sp	+ve cocci	Circular	+	+	+	Y	Y	-	+	+	+	-
5.	Staphylococcus sp	+ve cocci		+	-	+	R	Y	-	-	-	-	+
6.	Escherichia coli	-ve rod		+	+	+	Y	Y	-	+	-	+	+
7.	Pseudomonas sp	-ve rod		+	+	+	Y	Y	-	+	-	+	+
8.	Citrobacter sp.	-ve rod		+	+	+	Y	Y	-	+	+	+	+
9.	Salmonella sp.	-ve rod		-	+	+	Y	Y	-	+	+	+	-
10.	Enterobacter sp	-ve rod		-	+	+	Y	Y	-	-	+	+	+
11.	Proteus sp	-ve rod		+	+	+	Y	Y	-	-	+	+	+
12.	Enterobacter sp	-ve rod		+	+	+	Y	Y	-	+	+	+	-

Discussion

The result of this study revealed that food samples collected from food vendors and restaurant in Niger Delta University Community had significant amounts of microorganisms. The microbial loads of food samples obtained differed greatly from one vendor to the other. This is in agreement with the findings of Dalia *et al.,* (2013). They observed varying microbial load from food samples in different sample locations in Tanta City in Egypt. Overall, the total viable count of bacterial population in all food and palm swab samples ranged from 4.4 x 10^5 to 2.51 x 10^6 and 5.9 x 10^6 to 9.8 x 10^5 cfu/ml, respectively (Table 2). Generally, the food and palm swab samples recorded the highest values of 2.51 x 10^6 and 9.8 x 10^5 cfu/ml respectively. The high bacterial counts in cooked foods indicate that they may have been contaminated during handling procedures after cooking. This may demonstrate an overall lack of hygiene which is in consonance with the report of Kaarina, (2007). Jay (2005) also stated that the presence of these organisms in ready-to-eat food depicts a deplorable state of poor hygiene and sanitary practices employed in the processing and packaging of these foods which is in conformity with the findings in this study.

A total of twelve (12) isolates were identified in this study. They include; *Bacillus sp, Salmonella spp, Staphylococcus Sp, Klebsiella, Shigella, Lactobacillus, Stretococcus, Enterobacter, Escherichia coli, Pseudomonas, Citrobacter sp, and Proteus sp.* This agrees with the findings of previous scholars where they isolated similar organisms from sausages and seafood processors respectively (Oluwafemi and Simisaye, 2005; Okonko *et al.,* 2009).These large numbers of isolates indicate the extent of contamination and also agrees with the reports of Edema at al., (2005). The mean total viable count, show that the predominant organisms include *S. aureus, Proteus sp, E. coli, Pseudomonas sp, Enterobacter and Citrobacter*. This is also in agreement with the finding of Yah *et al.,* (2009) where they isolated similar organisms from ready to eat food (meat pie) in Benin City metropolis.

Many scholars have tried to give useful suggestions for the prevalence of these pathogenic microorganisms in food. The occurrence of *Citrobacter sp* for instance indicates food contamination from soil microbes (Ibe, 2008). It may also suggest that the foods were not properly closed, or the food handlers failed to maintain a good hand washing routine during preparation and serving of food. Rompre, (2002) stated that coliforms for example are mainly found in water, soil and fecal matter as they are widely distributed in water, soil and vegetation.

Also, Fungi and mould species were also isolated in this study. The isolates include *Rhizopus sp, Penicillium sp, Aspergillus sp, Mucor sp and Fusarium sp*. Fungi have been reportedly isolated from ready-to-eat-foods vended in Nigerian cities in other studies (Ayanbimpe *et al.,* 2007; Odu and Akano, 2012; Oranusi and Braide, 2012; Oranusi *et al.,* 2013). The presence of fungi in the samples may be due to improper storage causing these foods stuff to become humid therefore supporting the growth of these fungi in ready to eat food vended in the University community. Fungi produce important metabolite called aflatoxin, which has been shown to be highly toxic to man and all domestic and laboratory animals.

The contamination of food from bacterial and fungal origins presents a major cause of food-borne diseases given rise to acute to chronic illnesses such as E. *coli* gastroenteritis, Brucellosis and Campylobacteriosis. The presence of E. coli causes Hemorrhagic coli causes Hemorrhagic colitis, severe (often bloody) diarrhea, abdominal pain and coveting little or no fever and can lead to kidney failure (Jawetz *et al.,* 2008).While *Shigella* and Salmonella sp has potentials to cause Shigellosis or Bacillary dysentery, diarrhea, acute gastroenteritis, painful abdominal cramps and fever of 100^0F to 102^0F (Musa and Akande, 2002).

The presence of pathogenic microorganisms in vended food poses a lot of health risks to consumers. Therefore, there is need to investigate microbial quality of vended food to ascertain its quality and appraise its risk to human health and safety. The findings will provide information to ensure safety and enforce compliance to safety standards in the University community

CONCLUSION

The results obtained from this study show that foods vended in Niger Delta University Community are highly contaminated with fungi and bacteria. The consumption of such foods will result in food borne diseases. Thus the food vendors need to be educated on the importance of proper food and personal hygiene. Therefore urgent action need be taken to ensure food safety and compliance to safety standards.

REFERENCES

1. Akhtar S, Sarker MR, Hossain A. (2014). Microbiological food safety: a dilemma of developing societies. Crit Rev Microbiol, 40(4): 348–359
2. Ayambimpe, G.M., Ogbonna, C., Abiamugehe, E (2007). Fungal Contamination of Ready-to-Eat Cooked fods in Catering Establishments in the University of Jos Community. *The Journal of Medicine in the Tropics.* 9(1):29-36.

3. Dalia F. Khate1; Gamal E. Heikal1; Amal A. shehata and Fatma I. El-Hofy (2013) The Microbiological Assessment of ready-to-eat-food (liver and kofta sandwiches) inTanta City, Egypt. *Benha Veterinary Medical Journal*, vol 25, No. 2;187-197.
4. Edema MO, Omemu AM, Fapetu OM (2001). Microbiology and Physicochemical analysis of different sources of drinking water in Abeokuta Nigeria. *Nig. J. Microbiol.* 15 (1): 57-61.
5. Ibe, S.N. (2008). Microbiological Standards for Food. Are they Relevant in Nigeria? *Inaugural Lecture Series*, 60:16.
6. Jawetz, Melnick and Adelberg's Medical Microbiology (2008). In: Medical Microbiology, 24th edition, Geo. F. brooks, Karen C. Carroll, Janet S. Butel, Stephen A. Morse (edited). *McGraw-Hill;* 24 edition; pp.832
7. Jay, M.J. (2005). Modern Food Microbiology: 4th Ed. *Chapman and Hall*, New York p.187.
8. Kaarina, A (2007). Effect of maintenance routines in food processing on production hygiene: In Microbial Contaminants & Contamination Routes in Food Industry. *Gun Wirtanent & Satu Salovtt (eds), VTT Espoo, Finland.* Pp 36-38. ISBN 978-951-38-6319-7.
9. Mead, G.C. (2004) Microbiological quality of poultry meat: A review. Brazilian Journal of Poultry Science, 6, 135-142. [Citation Time(s):1]
10. Musa, O. L. Akande, T.M. (2002). Effect of Health Education Intervention of Food Safety Practice among Food Vendors in Ilorin. J. Med. 5:120 – 124.
11. Odu, N.N., Akano, U.M. (2012). The Microbiological Assessment of ready-To-Eat-Food (Shawarma) In Port Harcourt City, Nigeria. *Nature and Science.* 10(8):1-8.
12. Okonko I.O, Donbraye E, Babatunde SOI (2019). Microbiological Quality of Seafood processors and water used in two different sea processing plants in Nigeria EJEAFche 8(8): 621-629.
13. Oluwafemi F., Simisaye M. T. (2005). Extent of Microbial contamination of sausages sold in two Nigerian cities. In: the Book of Abstract of the 29th Annual Conference & General Meeting (Abeokuta 2005) on Microbes As Agents of Sustainable Development, organized by Nigerian society for Microbiology (NSM), University of Agriculture, Abeokuta, from 6-10th Nov. p. 28.
14. Oluyege, A.O., Dada, A.C., Ojo, A.M. and Oluwadare, E. (2009) Antibiotic resistance profile of bacterial isolates from food sold on a University campus in south western Nigeria African. Journal of Biotechnology, 8, 5883-5888. [Citation Time(s):2]
15. Oranusi, U.S., Braide, W. (2012). A study of microbial safety of ready-to-eat food vended on highways: Onitsha-Owerri, Southeast Nigeria. *International Research Journal of Microbiology.* 3(2): 066-071.
16. Oranusi, S. U. Oguoma, O. I., Agusi, E. (2013). Microbiological quality assessment of foods sold in student's cafeterias. Global Research Journal of Microbiology. 3(1):1-7.
17. Rompre, A., Servais, P., Baudart, J., de-Roubin M. and Laurent, P. (2002). Detection and enumeration of coliforms in drinking water: current methods and emerging approaches. *J. Microbiol. Meth.* 49:31-54.
18. Schoeder, C.M., White, D.G. and Meng, J. (2004) Retail meat and poultry as a reservoir of antimicrobial-resistant Escherichia coli. Food Microbiology, 21, 244-255.
19. WHO (1996) Risk management and food safety, report of the joint FAO/WHO consultation. FAO Food and Nutrition Paper, WHO, Geneva, 65.
20. Yah S. Clarence, Nwinyi C. Obinna, Chinedu N. Shalom (2009). Assessment of bacteriological quality of ready to eat food (Meat pie) in Benin City metropolis, Nigeria. *African Journal of Microbiology Research:* Vol. 3(6) pp. 390-395.