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Hygiene Practices of Food Handlers and their Health Implications in Fast Food Resturants in Port Harcourt, Rivers State, Nigeria

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Abstract

The trend in global food safety production, processing, distribution, and preparation is creating an increasing demand for food safety research in order to ensure a safer global food supply. The aim of this study is to assess the level of food hygiene practises of food handlers and their health implications in fast food restaurants in Port Harcourt, Rivers State. The study employed a cross-sectional descriptive survey to investigate the hygiene practises of food handlers. Also, an experimental method of analysis was used to determine the microbial quality of food served in restaurants. The data were also collected with the aid of a well-structured questionnaire through face-to-face interviews. A Statistical Package for Social Sciences (SPSS, version 20.0) was used to analyse the collected data. Descriptive statistics were used to display the results of the study, and the statistical association was ascertained with the chi-square test. From the results, 105 (66%) reported having good knowledge of food hygiene practises. 70 (36.8%) received training and had a certificate in cooking, while 120 (63.2%) did not. The respondents were assessed on their means of food preservation; 140 (73.7%) reported they stored food in refrigerators. Personal observation from the restaurants showed that adequate protection of food from flies and dust scored 40 (44%), while no protection scored 50 (56%). In conclusion, there is relatively low knowledge among respondents about the health implications of fast food restaurants. The majority of restaurant owners are not well or fully aware of the HACCP system in formal setups. The Ministry of Health, through the public health authorities in the urban centre, should adequately educate all restaurant owners, managers, staff, and other stakeholders on system implementation.

Keywords: Hygiene Practices, Food Handlers, Health Implications, Fast-food, Port Harcourt, Rivers State, Nigeria.

INTRODUCTION

Food safety plays a significant role in the economic and health of nations by safeguarding the nation's health, enhancing tourism and international trade, and facilitating the production, distribution, and consumption of safe food (WHO, 2000). Despite the importance of food safety, there seem to be few quality control systems to guard against food- related illnesses in developing countries, some of which may be fatal

while others can lead to expensive medical care. Illnesses from food-related diseases outnumber illnesses from all other environmental factors combined. Over 66% of foodborne illnesses are caused by bacteria or pathogens (Byran, 1992).

Worldwide, the indices of diarrhoea disease alone have been estimated to be 1.7 million cases per year, which indicates a serious underlying food safety problem (WHO, 2004). The direct cost of a foodborne outbreak can approximate $75,000 per food service establishment, and this can include investigation clean-up, re-staffing, restocking products, product loss settlement, and increased regulatory sanctions (Hanington, 1992).

In Nigeria, the incidence of foodborne illness has not been properly documented, but diarrhoea, intestinal worms, and typhoid are among the top leading causes of hospitalisation (Federal Ministry of Health (FMOH), 2014). There is only limited data on food contamination and foodborne illness (WHO, 2003), and this is attributed to the lack of understanding of the regulations and measures for the food industries by consumers and stalk holders in society.

FAO/WHO's (2002) main objective is to ensure nutritional and safe food for all people at all times for a productive and healthy life. Food service operators have a major responsibility since their actions can affect the health of many people. Food and waterborne diseases in developing countries are prevalent, and epidemiological examinations have indicated a large proportion of foodborne diseases that result from poor food sanitation and hygienic handling of foods in restaurants and other eating outlets (Antoria, 2002).

Foodborne diseases are increasing in both developed and developing countries. Diarrhoeal diseases, mostly caused by food-borne microbial pathogens, are leading causes of illness and death in developing countries, killing an estimated 1.9 million people annually at the global level (WHO, 2002).

In Nigeria, food expenditure by states and commodity types has shown that Nigerians spend double (N110,300,796) on food as against non-food items (N59,190,093) such as clothing, footwear, rent, fuel/light, household goods, health, transport, education, entertainment, and drinks. The highest number of food cases was 17.48% in 2009 and 1.94% in 2003 (FMOH, 2014).

Port Harcourt had many registered hotels and school cafeterias, but hundreds of eating houses, food canteens, food kiosks, and other food vending stalls were scattered in and around the city. An acute onset of gastrointestinal symptoms among people was estimated to have occurred in 600 cases and resulted in 3 deaths in Port Harcourt (RMOH, 2014).

An estimated 76 million food-borne illnesses occur annually in the United States. These food-borne illnesses result in an estimated 325,000 hospitalisations and 5,000 deaths every year in the United States. Between 1998 and 2002, an average of 1329 foodborne disease outbreaks was reported to the Centre for Disease Control and Prevention (CDC) each year.

This study assessed the hygiene practises of food handlers and their health implications in fast food restaurants in Port Harcourt, Rivers State.

MATERIALS AND METHODS

Study Design

This study used a cross-sectional descriptive survey to investigate food safety and hygiene practises. Also, an experimental method of analysis was used to determine the microbial quality of food served in restaurants and derive conclusions based on laboratory and statistical methods.

Area of Study

Port Harcourt is located in the Niger Delta region, lying along the Bonny River 41 miles (66km) upstream from the Gulf of Guinea. It is divided into the urban area with an estimated population of 2.7 million and the greater rural area with a population of 3.7 million. The urban area of Port Harcourt is the Port Harcourt town in the Port Harcourt city local government area, which is made up of the old government reservation area (GRA) and new layout areas (Nigerian News Online, 2013). The Port Harcourt urban area (Port Harcourt metropolis) is made up of the city itself and part of the Obio/Akpor Local Government Area. It is highly congested as it is the only major city in the state. The climate of Port Harcourt is temperate almost throughout the year, with daily temperatures averaging 300 °C and rainfall measuring an average of over 210nm.

Port Harcourt is the heart of the Nigerian oil industry, with virtually all major multinational oil companies represented. The economic activities of Port Harcourt include manufacturing such as food processing, paints, petroleum product refining, etc. Other than militancy and congestion, Port Harcourt is largely a peaceful and sociable city, with many restaurants, recreational centres, and fun spots. These restaurants provide meals to a large number of workers and visitors who take their lunch and sometimes supper in town. This creates public awareness about providing safe food to avoid food-borne disease outbreaks.

Study Population

The target population comprises eating houses classified as restaurants. These were structured with a separate kitchen and dining area for serving meals

within the town. 37 restaurants were tested, representing 10% of the whole population of the municipality.

Sampling Size and Sampling Methods

Simple random sampling was done. Since the restaurants had similar characteristics, the researcher first enlisted all the restaurants on different ballot papers and randomly selected one of the ballot papers, and the selected one was used as the representative.

Sample Size

From the simple random sampling, the required number of 37 restaurants was conveniently chosen for the study. Port Harcourt has a total of 364 formal restaurants (Port Harcourt business directory, 2013). A total of 37 restaurants were used in the research. Therefore, 10% of 364 equals 36.4, which is equivalent to 37 restaurants. Since the study population is less than ten thousand, the 10% formula was applied (Mugenda & Mugenda, 2004).

Instruments for Data Collection

The questionnaire was closed-ended and administered to the restaurant owners, managers, staff, and public health officers. A working relationship with the respondents prior to conducting the interview was established by a prior visit. The researcher developed the questions in the instrument as guided by the research questions and literature review.

An observation schedule was used to supplement data from questionnaires and interviews, which covered the receipt of food materials, storage, preparation, production, and service. Since the research is experimental, laboratory and other bimetallic instruments were used.

Validity of the Instrument

According to Parlon (2002), validity is the quality attributed to propositions or measures of the degree to which they conform to established knowledge or truth. An attitude scale is considered valid, for example, to the degree that its results conform to other measures of attitude. Validity therefore refers to the extent to which an instrument asks the right questions in terms of accuracy in order to achieve the study objectives. The validity of the content of the instrument was determined in two ways. First, the content validity of the instrument was determined through piloting, where the responses of the subject were checked against the research objectives. For a research instrument to be considered valid, the content selected and included in the questionnaire must be relevant to the variable being investigated (Neuman 2002).

The researcher performed a pilot test outside the areas of study but in restaurants using the HACCP system. Appropriate changes were made to the research instrument depending on the responses. Secondly, the researcher discussed the items in the instrument with the supervisors and lecturers from the department. The advice given by these people helped the researcher determine the validity of the research instrument. The advice included suggestions, clarifications, and other inputs.

Reliability of the Instrument

Reliability is a measure of the degree to which a research instrument yields results after repeated trials (Mugenda and Mugenda 1991). Reliability is a quality attributed to a proposition or measure to the degree to which they produce consistent results, for example, to the degree to which the same respondent or very similar respondent receives the same or very similar score upon repeated testing. To establish the reliability of a questionnaire, pretesting through piloting was done. The reliability of the items was based on estimates of the variability of staff respondents to the items. The reliability confidence was determined by the test-retest technique. The instrument was then administered to the same subject after an intervening period of one week. This technique was used because it determines the stability of the research instrument. The reliability was calculated and found to be 0.76 between the two tests. A reliability of at least 0.5 was considered high enough for the instrument to be used for the study.

Data Collection and Procedures

Field sampling was done in two categories upon receiving food samples: storage, processing, and service. The samples were transported in cool boxes to the laboratory for testing and analysis. Microbiologically, sensitive raw materials and ingredients were arranged as follows: beef stew, salads, and cooked vegetables (+) if they exhibit hazard characteristics and (-) if they do not have or exhibit hazard characteristics. The six-characteristic ranking system was applied only for microbiological analysis. The second step is to assign risk categories (0–iv) based on the food's microbial sensitivity, raw materials, and ingredients.

Laboratory Sampling Plan and Procedures

As suggested by the International Commission for International Testing of Food in Food Safety Management (Tavakoli, 2008), the procedure for microbial testing of food was carried out. 250 g of each identified sample was collected as a representative of each sample, and the product temperature was maintained to protect the sample from contamination or damage. The food samples were then taken to the laboratory for microbiological analysis. The decision criteria for microbial analysis were based on three plans (n, c, m, and M) by Jay (1996).

Where n = number of sample units, c = maximum number, m=maximum level of bacteria, and M=quantity to separate (marginal).

Microbial Analysis

As suggested by the International Commission for Microbial Testing in Food Safety Management (Tavakoli, 2008), the procedure for microbial testing of food was carried out.

Enumeration of Micro-Organics

The enumeration of microorganisms was done by preparing food sample homogenates, performing serial dilution, plating on agar plates for the isolation and counting of organisms, and then sub-culturing the isolated organism to get a purer culture.

Preparation of Food Homogenate

A 1:10 dilution of a well-mixed liquid sample was made by aseptically transferring 1 ml of the sample into 9 ml of distilled water.

A 1:10 dilution of solid and semi-solid samples was made by weighing 25 grammes of sample into a sterile stomacher bag containing 225 ml of distilled water. This was then placed in the stomacher blender to blend for 2 minutes at a low speed of approximately 8000 revolutions per minute.

Dilution

1 ml of food homogenate was aseptically transferred into a tube containing 9 ml of distilled water. From the first dilution, 1 ml was also transferred into the second dilution tube, which contained 9 ml of distilled water. This was repeated using the third, fourth, and fifth tubes. Each dilution was shaken 25 times in a 30cm arc to mix properly, and for each dilution, a fresh sterile pipette was used.

Plating

All Petri dishes were labelled with the sample name, dilution, and date. 0.1 ml of food homogenate from 102–105 was plated into the Petri dish in duplicate. Pour plates, spread plates, and streaking methods were used.

Pour plating was done by pouring 0.1 ml of the food homogenate into each petri dish containing the molten media (cooled to 42–45 °C) within 15 minutes from the time of preparation of the original dilution. Then mix the dilutions by gently swirling them clockwise and anti-clockwise to and fro three times, taking care that the contents do not touch the lid. The mixture was then allowed to set. The prepared dishes were then inverted and incubated at 37 °C for 48 hours.

For the isolation of mould and yeast, the spread plate method was used. This was done by inoculating 0.1 ml of the food homogenate into the dish containing already-set media. The prepared dishes were then inverted and incubated at room temperature for 72 hours.

Streaking was used to culture the swabbed sample. The equipment, staff hands, and working surfaces were swabbed using sterile swab sticks. The culturing was done by streaking the swab sticks containing the sample on the petri dishes containing the already set media, then inverting and incubating at 37 °C for 48 hours.

Counting of Organisms

This was done by plating aliquots of food samples on the required agar plates and incubating at the required temperature for growth. The counting was done using the formula:

Population = (overall total in second sample (5) x total number marked (2))/(total number of marked individuals in second sample (5a))

Total Plate Counts

The determination of the total viable count was done by the aerobic plate count method using plate count agar (PCA). Aliquots of 0.1 ml of sample dilutions were poured onto the molten form of PCA and mixed properly. The dishes were then inverted and incubated at 37 °C for 48 hours.

Total Coliform Counts

The enumeration of total colonies was done by the pour-plate method using Eosin Methylene Blue agar (EMB). The molten media was mixed with 0.1 ml of sample dilution and allowed to set. It was then inverted and incubated at 37 °C for 48 hours.

Total Staphylococcal Counts

The total staphylococcal count was done using Baird-Parker agar. Aliquots of 0.1 ml of sample dilution were poured into the molten agar, mixed properly, and allowed to set. They were then inverted and incubated at 37 °C.

Total Yeast and Mould Counts

The total yeast and mould count was done on sabouraud dextrose agar. 0.1 ml of sample dilution was spread into a pre-dried SDA using a sterile glass rod. The dishes were then inverted and incubated at room temperature for 72 hours.

Sub-Culturing

The sub-culturing was done by transferring the microbial mixture from the colony of cultured plates to the edge of the plate of an already prepared nutrient medium and streaking it over the surface. The streaked plates were then inverted and incubated at 37 °C for 48 hours.

Characterization of Organisms

The characterization of organisms was done using the pure cultures from the subcultured organisms. The characterization process involved Gramme staining and biochemical tests.

Gramme Staining

This was done by aseptically transferring a minute amount of the colony from the petri dish into a clean glass slide containing a drop of distilled water with an inoculating loop, spreading the culture with the loop to an even thin flam over a circle of 1.5cm in diameter, air drying the culture, and fixing it over a gentle flame. The staining was carried out using the Gramme staining procedure. The stained slide was then examined under the microscope for the identification of the organisms.

Biochemical Tests

The different biochemical tests carried out for identification were:

***Catalase Test*:** This was done to differentiate catalase-positive Staphylococcus spp. from catalase-negative Staphylococcus spp. Staphylococcus spp. This was done by inoculating the organism into a microscopic slide placed inside a petri dish using a wire loop, also placing a drop of 3% hydrogen peroxide on the organism without mixing, and immediately covering the petri dish with a lid to limit aerosols and observe for immediate bubble formation.

***Coagulase Test*:** This was done to differentiate strains of Staphylococcus aureus from other strains of coagulase-negative species. This was done by preparing a suspension of the bacterial cells mixed into a drop of plasma on a microscopic slide and observing for the clumping of bacteria cells, as visible clumping of bacteria cells on a microscopic slide indicates a positive result.

***Lactose fermentation test*:** This was done for the identification of coliform, which can ferment lactose. This was performed by aseptically transferring an inoculum of the test organism into a sterile tube containing lactose broth. The tube was then incubated at 37 °C for 24 hours. After which, the broth was observed for colour change.

***Indole Test*:** This was done for the identification of coliforms that have the ability to degrade the amino acid tryptophan and produce indole. This was done by inoculating a tube of tryptophan broth with a pure amount of the test culture and then incubating at 37 °C for 24 hours. After which, 5 drops of Kovac's reagent were directly added to the tube, which was then observed for colour change. The formation of a pink to red colour in the reagent layer on top of the medium indicates a positive change.

***Citrate Test*:** This was done for the identification of coliforms that have the ability to utilise citrate as their carbon and energy source. This was done by streaking the test organism on the surface of Simon's citrate agar slant in a test tube and incubating at 37 °C for 24 hours. After which, the slant surface was observed for growth and colour change. The presence of visible growth on the surface and a colour change from green to Prussian blue indicate a positive reaction.

Method of Data Analysis

Descriptive statistics were used for the quantitative analysis. The use of means, standard deviation, frequency distribution, and percentages was applied. The response from structured interviews was quantified and interpreted.

Ethical Consideration

An introduction letter from the postgraduate studies programme enabled the researcher to obtain a research permit. The work plan budget and confidentiality of responses were considered.

RESULTS

Socio- Demographic Characteristics of the Respondents

The Table 1 presented the results of Socio-Demographic Characteristics of the respondents obtained in this study, with age group of 33-40 years that had highest percentage (49%) of those that practiced food hygiene in the study area. Among all the age group, 1(4.2%) said they did practice food hygiene within their restaurant. Out of 190 respondents assessed on the knowledge of food hygiene, 105(66%) of female agreed they practice it while 25(83%) said no to that view from female. Therefore, 55(34%) of male said yes, they practice it also while 5(17%) was against it. Majority of the respondents were married 75(42%) that engaged in food hygiene practice, followed by single 65(36%). On the influence of education in food hygiene practice, out of 15(7.9%) that had no education, 13(8.5%) engaged in food hygiene practice while 2(5.4%) did not. 80(42.1%) of them had primary education and 50(33%) involved food hygiene practice. 90(47.4%) was the highest found in secondary education and 85(56%) agreed they practice it while 5(14%) did not. For the tertiary level of education, 5(2.6%) agreed to the practice of food hygiene.

Table 1: Socio-Demographic Characteristics of the respondents

Variables	Practice food Hygiene	Not practice food hygiene	Total
Age of respondents			
18-25 years	8(4.8%)	1(4.2%)	9(4.7%)
26-32 years	50(30%)	11(46%)	61(32.1%)
33-40 years	81(49%)	9(38%)	90(47.4%)
41-48 years	19(11%)	2(8.3%)	21(11.1%)
49 years above	8(4.8%)	1(4.2%)	9(4.7%)
Total	**166(100%)**	**24(100%)**	**190(100%)**
Sex of the respondents			

Variables	Practice food Hygiene	Not practice food hygiene	Total
Male	55(34%)	5(17%)	60(31.6%)
Female	105(66%)	25(83%)	130(68.4%)
Total	**160(100%)**	**30(100%)**	**190(100%)**
Marital status of the respondents			
Married	75(42%)	5(50%)	80(42.1%)
Single	65(36%)	0(0%)	65(34.2%)
Separated	23(13%)	2(20%)	25(13.2%)
Divorced	4(2.2%)	1(10%)	5(2.6%)
Widow/widower	13(7.2%)	2(20%)	15(7.9%)
Total	**180(100%)**	**10(100%)**	**190(100%)**
Educational level of the respondents			
Primary	50(33%)	30(81%)	80(42.1%)
Secondary	85(56%)	5(14%)	90(47.4%)
Tertiary	5(3.3%)	0(0%)	5(2.6%)
No education at all	13(8.5%)	2(5.4%)	15(7.9%)
Total	**153(%)**	**37(100%)**	**190(100%)**

Knowledge of Respondents on Food Safety Control System

The Knowledge of respondents on food safety control system as table 2 depicted, the respondents were assessed on any quality control measure for food hygiene, 180(94.7%) had knowledge of food safety control system while 10(5.3%) had no knowledge. The available measures were HACCP 159(83.7%) and GMP 31(16.3%). The measures were learnt from public health staff(s) 100(52.6%), WHO/FAO 40(21.1%), Mass media 30(15.8%) while customers was 10(5.3%). These measures were applied on receiving 10(5.3%), storage 140(73.7%), kitchen 40(21.1%) and others 0(0%).

Table 2: Knowledge of Respondents on Food Safety Control System.

Variables	Frequency (N)	Percentage (%)
Any quality control measure for hygienic food control		
Yes	180	94.7
No	10	5.3
Total	**190**	**100.0**
If yes, the available measure		
GMP	31	16.3
HACCP	159	83.7
Total	**190**	**100.0**
These measures learnt from		
Public health staffs	100	52.6
Council staff(s)	5	2.6
Customers	10	5.3
Mass media	30	15.8
WHO/FAO	40	21.1
Don't know	5	2.6
Total	**190**	**100.0**
Stages of application of quality control system on Food		
Receiving	10	5.3
Storage	140	73.7
Kitchen	40	21.1
Others	-	-
Total	**190**	**100.0**

Knowledge of Respondents on Food Preparation and Hygiene

Table 3 presented the knowledge of respondents in food preparation and hygiene, the restaurant was designed as read-to-eat 150(78.9%), prepare as you wait (25(13.2%) and 15(7.9%) said they don't know. Quantities of perishable food (meats, milk and vegetables) received per day by the respondents were bulk 150(78.9%) while 10(5.3%) said not bulky. The respondents were assessed on the frequency of receiving perishable foods, 161(84.7%) said on daily basis, 25(13.2%) said fortnight while 4(2.1%) was on weekly basis. After receiving the supplied food, the food preparation processing the cook employ were as

follows; storing 140(73.7%), sorting and weighing 30(15.8%) while 20(10.5%) said nothing. The main process in food before eating was cooking 180(94.7%). The most common type of food supplied in your restaurant was perishable and non-perishable foods 130(68.4%), only perishable food was 50(26.3%) while 10(5.3%) said they don't know.

Table 3: Knowledge of respondents on food preparation and hygiene

Variables	Frequency (N)	Percentage (%)
The restaurant was designed as		
Read- to- eat	150	78.9
Prepare as you wait	25	13.2
Don't know	15	7.9
Total	**190**	**100.0**
Quantities of perishable food received per day		
Bulky	150	78.9
Not bulky	10	5.3
Can't tell	30	15.8
Total	**190**	**100.0**
Frequency of received perishable foods		
Daily	161	84.7
Weekly	4	2.1
Fortnight	25	13.2
Total	**190**	**100.0**
After receiving the supplied food what food preparation processing do the cook employ?		
Storing	140	73.7
Sorting and weighing	30	15.8
Nothing	20	10.5
Total	**190**	**100.0**
Main process in food before eating		
Cooking	180	94.7
Serving it raw	1	.5
Don't know	9	4.7
Total	**190**	**100.0**
Most common type of food supplied in your restaurant		
Perishable and non-perishable foods	130	68.4
Only perishable food	50	26.3
Don't know	10	5.3
Total	**190**	**100.0**

Knowledge of Respondents on Food Preservation and Hygiene

The knowledge of respondents in food preservation and hygiene as table 4 depicted, the respondents were assessed on the means of food preservation, 140(73.7%) said stored in refrigerator, 30(15.8%) said stored them in dry place while leave them intact and don't know have same frequency 10(5.3%). Methods employed to ensure that the preservation works were as follows; observe chilling and freezing temperature was 130(68.4%), Defrosting and washing was 40(21.1%) and aeration of the recorded15(7.9%). Place to keep the prepared food; 140(73.7%) said in cold temperature

Table 4: Knowledge of respondents on food preservation and hygiene

Variables	Frequency (N)	Percentage (%)
Means of food preservation		
Store in refrigerator	140	73.7
Store them in dry places	30	15.8
Leave them intact	10	5.3
Don't know	10	5.3
Total	**190**	**100.0**
Method to ensure that the preservation is working		
Observe chilling and freezing temperature	130	68.4
Defrosting and washing	40	21.1
Aeration of the store	15	7.9

Variables	Frequency (N)	Percentage (%)
Cleaning the store	5	2.6
Total	**190**	**100.0**
Places to keep the prepared food		
Store in high temperature	10	5.3
Store in cold temperature	140	73.7
Nothing	40	21.1
Total	**190**	**100.0**

Sanitation Standard Operation Procedures Observed From Food Handlers

Hygienic practices observed from food handlers as table 5 indicated, adequate protection of food from flies and dust scored 40(44%) while no protection was 50(56%). The observation in dishing out food by the food handlers with spoon had 100%. Presence of debris on handler's hand was 55(61%) while no debris was 50(39%). Clean fingernails recorded 50(56%) while unclean was 40(44%). For the protection of hair among the respondents; 30(33%) agreed while 60(67%) do not protect their hairs. In working or cooking the restaurant; 51(57%) said they put apron while 39(43%) did not. Hand washing facilities were available for 50(56%) food handlers and it was not available for 40(44%) (Table 5).

Table 5: Sanitation Standard Operation Procedures observed from Food Handlers

Observed conditions	Responses	Frequency (N)	Percentage	Total
Adequate protection of food from flies and dust	Yes No	40 50	44% 56%	90(100%)
Dishing out food	Spoon	90	100%	90(100%)
	Bare hand	0		
Presence of debris on handler's hand	Yes No	55 35	61% 39%	90(100%)
Finger nails	Clean	50	56%	90(100%)
	Unclean	40	44%	
Hair protection	Present	30	33%	90(100%)
	Absent	60	67%	
Use of apron	Yes	51	57%	90(100%)
	No	39	43%	
Hand washing facilities	Available Not Available	50 40	56% 44%	90(100%)

Relationship between Various Educational Level and Food Hygiene

The relationship between various educational level and food hygiene; protection of food from flies and dust was well understood among the respondent that secondary school had 90(47.4%). Dishing out food with spoon has equal percentage among the secondary level and no education 30(81%). Observing the Presence of debris on handler's hand recorded higher among secondary level 85(56%). Cleaning of fingernails was highest among tertiary level of education 5(14%). For the protection of hair, the tertiary level also had the highest 30(81%). In working or cooking with apron, the percentages were equal in all level of education. Therefore, there is statistical relationship between education and food hygiene where x^2 =69, df= 5 at significance level of 0.05 (table 6).

Table 6: Relationship between various educational level and food hygiene

Variables	Highest level of education				
Food hygiene variables	**Primary**	**Secondary**	**Tertiary**	**No education**	**X^2**
Protection of food from flies and dust	80(42.1%)	90(47.4%)	5(2.6%)	15(7.9%)	
Dishing out food with spoon	50(33%)	30(81%)	5(14%)	30(81%)	
Presence of debris on handler's hand	5(14%)	85(56%)	5(3.3%)	30(81%)	
Finger nails	13(8.5%)	2(5.4%)	5(14%)	2(5.4%)	
Hair protection	5(14%)	5(14%)	30(81%)	30(81%)	
Use of apron	5(14%)	5(14%)	5(14%)	5(14%)	**69**

X^2 =69, df= 5 at significance level of 0.05.

Bacterial Counts in the Cooked Food Samples

In Table 7, the standard deviation measures the difference in the concentration of organism on food type tested for contamination. With fried rice, the standard deviation of Aerobic/Total plate counts (APC) was higher 0.582 than TSC (*S.aureus***)** and *E.coli*. With

vegetable soup, TSC (*S.aureus*) was higher 0.712 than others. APC on Moi moi (0.805), Hamburgar (0.79) and Salad (0.872) recorded highest while with Jolof rice, TSC (*S.aureus*) was higher. Therefore, the Aerobic/Total plate counts (APC), total coliforms and *Escherichia coli* counts and *Staphylococcus aureus* counts yielded bacterial load levels which showed that all samples were microbiologically contaminated.

Table 7: Bacterial counts in the cooked food samples

Types of food	APC	TSC(*S.aureus* CFU/g)	*E.coli*CFU/g
Fried rice			
Mean (CFU/gm)	$1.8x10^4$	$2.4 x10^2$	$5.5 x10^2$
Range	$1.5 x10^4$-$6 x10^4$	$3.0 x10^1$-$3.1 x10^4$	$3.5x10^2$-$7.3 x10^3$
SD	0.582	0.121	0.31
Vegetable soup			
Mean(CFU/gm)	$3.4x10^4$	$5.8x10^5$	$2.6x10^2$
Range	$1.0 x10^5$-$9 x10^4$	$1.0 x10^6$-$6.2 x10^6$	$3.3 x10^2$-$4 x10^3$
SD	0.65	0.712	0.6612
Moi moi			
Mean(CFU/gm)	$7.6x10^3$	$6.7x10^3$	$2.6x10^3$
Range	$1.0 x10^3$-$8 x10^4$	$3 x10^3$-9 x10	$1.6x10^1$-$3.7 x10^3$
SD	0.805	0.786	0.56
Hamburgar			
Mean(CFU/gm)	$7.3x10^3$	$5.6x10^5$	$4.3x10^3$
Range	$0.8 x10^3$-$4 x10^5$	$2.0 x10^5$-$8 x10^5$	$2.3 x10^2$-$7 x10^3$
SD	0.79	0.512	0.80
Salad			
Mean(CFU/gm)	$10x10^6$	$3.2x10^6$	$4.5x10^2$
Range	$2.6 x10^5$-$9 x10^5$	$4.0 x10^5$-$8 x10^5$	$9.2 x10^2$-$3 x10^3$
SD	0.872	0.532	0.71
Jolof rice			
Mean(CFU/gm)	$5.1x10^4$	$8x10^2$	$4.5x10^2$
Range	$4.6 x10^3$-$9 x10^4$	$1x10^3$-$9 x10^2$	$3.6x10^2$-$3.7 x10^3$
SD	0.674	0.732	0.61

Bacterial Counts in the Non-Cooked Food Samples

In table 8, the non-cooked samples, workplace had the highest bacterial counts with $8.1x10^3$CFU/gm and this could be because of staff not cleaning their work places after every task completed on food preparation and cooking.

The standard deviation measures how concentrated the bacteria were on type of sample tested, with the APC test the standard deviation on Personnel was higher 0.75 than TSC and E.coli. In working area, APC was higher 0.78 than others. TSC test on plates was (0.70) while water recorded (0.67). Water was a contributor to the highest number of counts in other foods because it had all the bacteria with a total mean of E.coli$8.1x10^3$CFU /ml. Sampled water was from the taps directly supplied and treated by the Municipal Council. The average counts for all the bacteria were relatively available though not very high to an alarming stage.

Table 8: Bacterial counts in the non-cooked food samples (CFU/gm)

Type of sample	APC	*S. aureus*	*E.coli*
Personnel			
Mean	$4x10^3$	$3.1x10^3$	$6x10^2$
Range	$2.0 x10^3$-$6 x10^4$	$1.3 x10^2$-$4.8 x10^3$	$2.8 x10^2$-$14 x10^3$
SD	0.75	0.59	0.64
Working area			
Mean	$9.0x10^2$	$3x10^2$	$8.1x10^3$
Range	$5.2 x10^3$-$11 x10^4$	$2.0 x10^2$-$5 x10^3$	$6 x10^2$-$8 x10^3$
SD	0.78	0.65	0.79
Plates			
Mean	$3.0x10^3$	$3.0x10^1$	$2.8x10^2$
Range	$1.8 x10^2$-$6.5 x10^3$	$1.6 x10^1$-$5 x10^2$	$1 x10^2$-$3x10^3$
SD	0.5	0.70	0.51
Water			

Mean	$1.4x10^4$	$2.9x10^4$	$4x10^2$
Range	$1.0\ x10^4$-$3x10^4$	$2\ x10^4$-$8x10^4$	$1.8\ x10^2$-$6\ x10^3$
SD	0.58	0.67	0.611

DISCUSSION

Most of the studied restaurants had been issued food trade licences from the River State Public Health Authorities. The demographic data and understanding of quality control strategies in food establishments of the respondents were gathered, and the frequency and percentage values were tabulated to determine how informed they were on the issue of food hygiene standards and quality control. The sex distribution of staff working in these restaurants was mostly female as compared to male; this shows that most restaurants prefer engaging female staff in their operations. This could be because women are more flexible and can handle more restaurant labour like washing and cleaning than men can. Most restaurants had more female than male staff workers, and after a serious inquiry from the management, the reason was that female workers are more flexible to work with than male workers. They also do not have a complicated social style compared to women. The education aspect of the collected data confirmed that most restaurant workers, managers, and owners are trained in catering management. Those with a secondary education had a higher level of education than others. This shows that the level of formal education is relatively high among the staff in the restaurants in Port Harcourt, Rivers State.

The analysis indicates that the workers are trained to handle food and are therefore most likely aware of the HACCP system. The trained staffs who work in the studied restaurants do not have all the basic formal training relevant to food production or catering, and therefore they need more experience in the food industry. When staffs are properly trained and well-experienced, they become flexible to change and therefore adapt easily to any change in production and service systems. The fact that most of the respondents were untrained could explain the high rates of microbial loads in foods since it means they are not aware of the different ways they are supposed to handle food to avoid contamination.

Among all the managers interviewed, 31% knew about food hygiene and quality control measures, and it was the same population that was implementing the strategy at one point or another in their establishments. Most restaurants sort and weigh their raw food materials after reception. This was attributed to 60% of the total restaurants, which applied this as a critical control point. Similar studies by the Ministry of Health found that foods collected from farmers can be contaminated.

On the preservation of perishable foods, 75% of the restaurants considered it a critical point. Proper food storage after preparation was fairly well done and quite evident in most premises because this was stored at very high temperatures. This contradicts a study done in some cities in some developed countries, which found that most people who ate food prepared on the premises were served with cold foods, which led to food poisoning. A study in China (2005) showed that most people served in some restaurants were served with cold foods, which led to food poisoning.

According to CDC (2002) reports, food-borne diseases are among the most important health problems in both developed and developing countries. This study demonstrated that all samples had a contamination load according to the total coliform count and the presence of other bacteria. Lengthy gaps between the preparation and consumption of foodstuffs and a lack of attention to the essential temperature required for cooking foods are among the most common causes of food contamination.

With regard to training, the proportion of untrained (56.5%) food handlers in this study is concerning as it implies that, despite the existence of regulations on training, some food handlers have been certified or registered with the municipal council to prepare and sell food without undergoing any training. The findings of this study are slightly better than the findings of two studies conducted by Chukuezi (2010) in Nigeria, in which he investigated the food safety knowledge and practises of street food handlers in two different geographical locations and reported that only 5% of food handlers had been exposed to formal training, whereas Omemu *et al.*, (2008) findings established it at 12% of food handlers.

Most of the liquid and solid waste was fairly managed. The availability of hot water was lacking in some restaurants, and therefore, the cleaning of crockery and utensils was poorly done. A similar study was done in China, which showed that some customers had food poisoning after being served with poorly washed equipment in a restaurant (WHO, 2004). It is necessary to use the HACCP system in restaurants for the prevention of food-borne diseases.

CONCLUSIONS

The majority of restaurant owners are not well or fully aware of the HACCP system in formal setups. All food service owners did not have a HACCP programme in place, and many were unsure of what it was or how to apply the principles to their operation. There appeared to be challenges to implementing these programmes and efforts need to be made to overcome

the challenges. There is little knowledge of HACCP as a strategy for quality control among the proprietors, managers, and staff of the restaurants. This has made the food procedures and processes so routine that they do not document any facts about the food chain. The management of the restaurants does not observe adequate precautions in the entire food processing process, and therefore programmes and materials related to HACCP need to be presented in a practical, realistic, and step-by-step manner. A key focus area would be motivating employees to follow standard operating procedures related to food safety. Most of the food waste in the restaurants is poorly managed; utensils and crockery are badly cleaned, and the kitchen and dining floor are not well cleaned. Most customers are not keen on hygiene standards, which was quite evident in some restaurants where you could find many customers despite the premises being dirty. Just like street-vended foods may pose significant public health problems, restaurant foods can follow suit if poorly handled. One of the key findings of the WHO survey of street-vended foods was that infrastructure developments were relatively limited in relation to access to portable water, toilets, refrigeration, washing, and waste disposal facilities.

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