Susceptibility of Restaurant Foods Contamination in Obio/Akpor Local Government Area of Rivers State, Nigeria

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Abstract: **This study aimed at assessing the susceptibility of restaurant foods to contamination in Obio/Akpor Local Government Area of Rivers with a view to unraveling various food pathogens and recommending sustainable strategies to curb the menace. A random survey research design was adopted and the opinion on quality and standard of foods from 400 adult respondents were sampled. Statistical application of simple percentages proved significantly that high level of restaurant food contamination as well as poor health standard was occasioned by poor handling by the operators of restaurants. It concluded that unhygienic practices such as the use of unsafe water; unhealthy food exposure and underage service personnel predispose restaurants food to contamination. Recommendations include: restaurant operators and their employees should be made to undergo at least minimum standard training on catering and be issued with authorized license; and education and training of restaurant operators on good hygiene practices.**

Keywords: **Restaurant foods, contamination, food hygiene, health implication, Obio/Akpor.**

I. INTRODUCTION

The food and Agricultural Organization (FAO, 2008) of the United Nations specifies 2,500 calories as the requisite minimum daily consumption level. The average consumption in the developing countries is however less than 2000 calories, while the advanced economies have an average consumption of over 3,700 calories intake. In Nigeria, the data available shows a gradual decrease in daily calories consumption from 2000.5 to 1875.5 between1995 and 2016 (CBN, 2016), which is far below the United Nation's specification.

According to Poronakie and Arokoyu (2014), low calories intake is associated with lack of dietary balance, reflecting an inadequate supply of the range and amount of food nutrients (Carbohydrates, proteins, fats, vitamins and minerals) needed for optimum physical and mental development, and maintenance of health. Besides, third world countries experienced food shortage and food insecurity problems in quantity and quality and are thus, vulnerable to not only adverse health risks but also pervasive poverty. Corroborating this submission is Adeyemo in Poronakie and Arokoyu (2015) who opined that in Nigeria, the chronically ill and physically handicapped are those hit by high rate of poverty and inequality, as ill-health and low human capital cannot earn enough to buy decent food, clothing, shelter and other welfare facilities.

In recent times, food consumption patterns have dramatically changed across the world. The common consumption pattern that is mostly shared by developing countries is the increasing expenditure on different types of fast food and quick restaurant outlets within our immediate surroundings/environment.

The word restaurant first meant "a cup of soup" before the modern day notion of a restaurant existed in Western Europe (Kiefer, 2002). Restaurant is a place where people pay to sit and eat meals that are cooked and served on the premises. It is a business which prepares and serves food and drinks to customers in exchange for money, and the meals are generally served and eaten on the premises but many restaurants also offer take out and food delivery services. Kiefer (2002) stated that Revolutionary Paris is widely cited as the birthplace of modern day restaurant as it was the dominant commercial and cultural center at the time of the emergence of restaurant in Europe. Now restaurants vary greatly in appearance and offerings, including a wide variety of cuisines and service models ranging from inexpensive fast food restaurants and cafeterias, to mid-priced family restaurant, to high – priced luxury establishments. Restaurant serves as an alternative source of food supply to home cooked meals for people on-the-go, or travelers on the move.

Food is any substanceconsumed to provide nutritional support for an organism. It is usually of plant or animal origin, and contains essential nutrients such as carbohydrates, fats, proteins, vitamins, or minerals. The substance is ingested by an organism and assimilated by the organism's cells to provide energy, maintain life and stimulate growth. Food is fundamental to human survival in several ways. It is basic for averting hunger and maintaining health for every human being. Food also creates emotional and social satisfaction as well as constitutes a form of cultural expression. The food we eat should be safe, palatable, affordable, and of the quality that can maintain mental, emotional, psychological and physical health. In other words, the population without adequate consumption of safe food materials, including water

is less able to carry on productive lives, and this undermines social, economic and health development (Nwaogazie, 2006).

Statement of the Problem

There is growing evidence today that Gastro-intestinal pathogens are also important in transmission of airborne disease, and not just respiratory pathogens as primarily believed (Mohapatra, 2008). It has been reported that in 2005 alone 1.8 million people died from diarrheal related diseases linked to food borne pathogens (WHO, 2007). Also in 2007 World Health Organization (WHO) in a report stated that a significant morbidity proportion of approximately 1.5 billion episodes of cases of diarrhea which resulted to the mortality rate of over 3million deaths globally per annum were recorded. This results from ingestion of contaminated foods. (WHO, 2007).

In Obio/Akpor LGA, a lot of occupational health cases or complications are related to common bowel disorders - diseases which have been scientifically proven to be caused by existence of microbiological pathogens such as fecal Coliform bacteria, Hepatitis "A" viruses,Salmonella and Reta Viruses. According to Ezekwe & Edoghotu (2015), the presence of these bacteria most times result to suchhealth issues as diarrhea, typhoid and cholera and various infections of the skinas wellas infections within the eyes, nose, ears and throat mucous membranes. This calls for an effective survey, monitoring and preventive measures for achieving a healthy situation among the populace due to food exposure and its associated contamination/poisoning in the restaurants located along the roads/streets in the study area.

In order to address the health challenges associated with the provision and consumption of restaurant food materials in the study area, we ask the following research questions:

1. What are the factors that make restaurant food in Obio/Akpor LGA prone to contamination?
2. What are the impressions of the consumers about the quality of restaurant food materials in the study area?
3. What food pathogens are discovered in restaurant foods within Obio/Akpor LGA?
4. How can the health threat posed by eating restaurant food be controlled within the study area?

Aim and Objectives of the Study

The aim of this study is to assess the susceptibility of restaurant foods to contamination in Obio/Akpor LGA. In order to achieve this aim, the following specific objectives are pursued to:

1. Examine personal characteristics of the residents of Obio/Akpor Local Government Area.
2. Ascertain the factors behind contaminated restaurant food in Obio/Akpor LGA.
3. Identify the practices of the restaurant operators in the study area.
4. Find out the state and quality of food served at the restaurant in the study area.

The Study Area

Geographical Location and Extent

Obio/Akpor Local Government Area of Rivers State is an urban settlement with its headquarters at Rumuodomanya. It is one of the twenty- three local government areas in Rivers State, (Niger Delta). The area is one of the major locations of the oil and gas sector of the economy and the hub of commerce and industry of Nigeria It is the chief oil-refining city in Nigeria, Oil and gas are Nigeria's most important commodities and the main foreign exchange earner (Poronakie, 2015).Geographically the area is located within the tropical region between latitudes 4°45'N and 4°60'N of the equator and longitudes 6°50'E and 8°00'E of the Greenwich Meridian. Its total landmass is approximately 260 sq km occupied by 554,735 people (NPC, 2017). Hence it has a high population density of 2,134 persons per Km^2. The area is bounded in the north by Ikwerre LGA and Etche Local Government Areas, in the south by Oyigbo and Eleme Local Government Areas and in the west by Emohua Local Government Area, respectively. (See figure 1 & 2 below)

Figure 1: Rivers State showing the Study Area
Source: Rivers State Ministry of Land and Housing

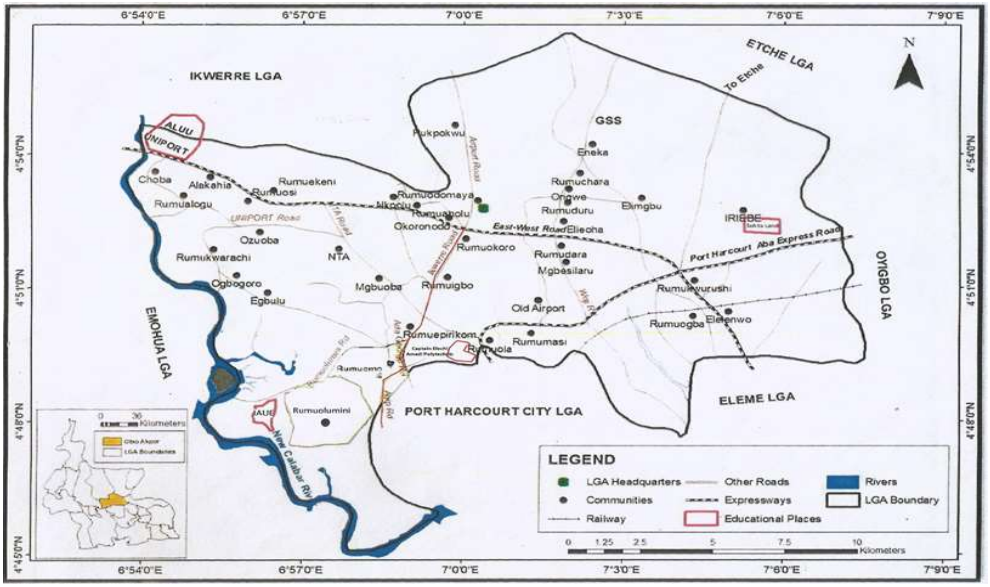

Figure 2: Locational Base of Study Area

Source: Rivers State Ministry of Land and Housing

Geology and Relief

The relief of Obio/Akpor is generally a lowland area with average elevationbetween 20 and 30 metres above sea level (Oyegun and Akpoghomeh, 2009). Its geology comprises basically of alluvial sedimentary basin and basement complex assemblages at its fringe areas linking Port Harcourt City and Degema LGA's

The area is characterized by a semi- hot equatorial climate and relative humidity (Tamuno, (2008). It is typified by a uniformity of high temperature throughout the year, intense rainfall which occurs virtually every month of the year, seasonally variable and energetic in down pour with increasing continentality. This often graduates to thunderstorm on its onset and cessation with variation in duration and amount between 2,000mm – 4,000mm in July through September (Ede, 1995). This high incidence of rainfall in the presence of low relief produced flooding in the area, particularly along the Ntaworba creek linking undulating areas of Rumuola, Rumueme, Rumuolumeni and Rumuodomanya. This is determined by its proximity to the coast and elevation with respect to two air masses (responsible for seasonal variation of wet and dry) that operated interchangeably in the area. While the wet season spans over nine months (March to November) with a double rainfall maxima in the months of July and September, the dry season coincides with the harmattan period which lasts from December – February (Oyegun and Arokoyu, 2003).

The soil of the Niger Delta which encompasses Obio/Akpor LGA of Rivers State (Nigeria), could be described as very scanty, heavily leached and Acidic with relative low fertility (Poronakie, 2015, Bell-Gam, 1990). These acidic soils are also known to be ferralitic because of the presence of alumina and iron oxides contained in them (Bell-Gam, 1990).The vegetation of the study area is basically located on three major ecological zones namely, low-land rainforest, freshwater – swamp forest and mangrove forest indicating parts of the Delta of River Niger which is one of the world's largest wetland covering 70,000km (NDDC, 2006).The vegetation of the study area is basically located on three major ecological zones namely, low-land rainforest, freshwater – swamp forest and mangrove forest indicating parts of the Delta of River Niger which is one of the world's largest wetland covering 70,000km (NDDC, 2006).

II. LITERATURE REVIEW

Historically, humans secure food through two methods: hunting and gathering, and Agriculture. Today, the majority of the food energy required by the ever increasing population of the world is supplied by food industry. Food is essential for ecosystem functioning and its high nutrient environment is capable of Sustaining many microbial lives (Ogbumgbada, 2018). The inhabitation of some microorganisms can bring about positive transformation of the food into a high value product, while others cancompletely render it useless. Our "foods whether freshly harvested or manufactured start its existence as an integral part of the natural ecosystem; and inevitably, with time,"are possessed by microorganisms. Most of these microbiological organisms when ingested by man are pathogenic in nature (Aguelera and Stanley, 1999).

Onwuka (2005) opined that most cases of food poisoning may require non antibiotic treatment, but increased fluid intake, and salt based fluids. The common practice is quite contrary, as people either ignore the condition until it becomes worst off and they simply rush to the nearby medicine shop and get

few tablets/capsule of antibiotics to treat the symptoms. This practice of not completing a course for each antibiotic or random use account for future ineffectiveness due to resistant strain developed (Nicki *et al,* 2010).

The resistance could be traced to high degree of abuse of the drug, through self-medication. Nicki *et al* (2010) affirm that microorganisms are accelerated by inappropriate use of antimicrobials. Food contamination can be prevented at a personal level by its careful handling, good self hygiene practices, cooking foods to the appropriate temperature,separate raw from cooked food, refrigerating perishable food promptly, and defrosting properly (Ajala,2006). Hand washing with water and soap several times, especially after usage of toilets, before and after meal preparations is a very important aspect of Personal hygiene (Fewtrell, Kaufmann, Kay, Enanoria, Haller, and Colford Jr., 2005). Moreover, it has been demonstrated that hand washing with water and soap before and after eating also reduces the prevalence of gastro intestinal and diarrheal diseases (Lopez-Quintero, Freeman, and Neumark, 2009).

Lucas and Gilles (2003) defined food safety as the absence of adverse health effect following consumption of' food. Food could be processed to eliminate or at least reduce risk of contamination. The methods enumerated by Achalu (2003) include thermal method, freezing, chemical preservation, dehydration, use of microorganism and microbial polymers. Sunday (2001) confirmed that, the manner of handling food has a profound effect on its quality in terms of the extent to which it is germ free or its potential to initiate diseases. Poorly handled food may be a source of food poisoning to the consumers. This danger emphasizes the need for hygiene which concerns not only those involved in the preparation but also those involved in the distribution, production, storage, transportation, display, sale, cooking and serving of food.

Food hygiene involves the prevention of food contamination and spoilage in Food production, food handling, during distribution and marketing, as well as in preparation, and finally serving of food (Achalu, 2003). Moronkola and Okanlawon, 2003) expressed that; food hygiene is concerned with how treatment of food affects the health of the consumer. That, the high standard of hygiene minimizes food spoilage and helps to ensure that, when food is eaten it is wholesome and free from pathogenic bacteria as possible.

However, one obstacle to food safety in Nigeria is the unsanitary conditions of the outlets including poor water supply, poor personal hygiene and exposure of food to contamination. This makes a case for improvement on the general hygiene situation of restaurants in Nigeria (Akpaudo, 2016).

Health education of both the public and food vendors on the dangers of improper food handling will foster awareness and reduce one's desire for just any food on the street. WHO (2009) stressed that the education of food vendors is of paramount importance. It noted that vendors are often poorly educated and untrained in food safety. That, they work under unsanitary conditions with little or no infrastructural support. Following reports of researches that most food related illnesses could be prevented by the use of proper food handling. Education and training of caterers and food vendors may offer the most cost effective way to reduce the incidence of food borne illnesses.

Wardlaw and Kessel (2002) emphasized that consuming adequate protein, the gamut of vitamins (especially vitamin E and B) amid zinc, helps to maximize the health of immune system. Deficiency of these nutrients lead to recurrent sickness and poor wound healing process. Food could taste nice actually, but may not be enjoyed when eating. Quite a lot of Variables could be linked to this, such as the location of eating, the materials and technique used in serving, among others.

A lot of restaurant and fast food dealers struggle to make a living out of fast food business. They employ all manners of strategies, including unhealthy techniques to attract patronage. They equally spice up their food with varying forms of flavour enhancer and colouring agents to disguise the true nature of the food and to achieve similar taste and colour of natural food materials (Wardlaw & Kessel, 2002). Some of these artificial stuffs could in themselves be factors for illnesses or diseases. It is also understood that most fast foods restaurant are basically of carbohydrate and fat classes of food. Even the so called protein class of food like meat, fish among others is often insignificant and sometimes completely useless because a lot of them cannot be properly chewed and digested.

III. MATERIALS AND METHODS

For the purpose of this study, social survey and quasi experimental research design were employed. This involved fields cross examination of the targeted respondents through well-structured questionnaire and oral interviews using the Likert – type four – point rating scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) in analyzing responses from the respondents to effectively capture the participants views on the subject matter as well as field observation. The population of this study comprised literate adult inhabitants of Obio/Akpor local government area which has 88 communities with a population of approximately 268,516 (NPC, 1991).

However, we projected the population of 1991 to 2017 using 2.83% growth rate (NPC 2003). Hence, the projected population of the study area for 2017 is approximately 554,735. However, to get the exact sample size for this study, we applied the use of purposive sampling techniques by randomly selecting 26 communities, which also amounts to 30% of the total communities of the study area. The total population for 26 communities randomly selected and projected from 1991 to 2017 is **236,633** as shown in Table 1.

Also, a total of 30 food samples were collected from the selected sample sites and microbial analysis of the food samples conducted using standard laboratory and recommended procedure for the isolation, characterization and identification of microorganisms. Bacterial Isolates were characterized based on colonial, cultural, morphological, microscopic examination and biochemical characterization.

Table 1: Sampling Size for each of the Communities Projected From 1991 to 2017 Using 2.83% Growth Rate and Applying Purposive Sampling Technique

SN	COMMUNITY	NPC 1991	2017 PROJECTED POPULATION	SAMPLE SIZE
1	CHOBA TOWN	10,986	22,696	15
2	RUMUALOGU	1,528	3,156	15
3	ALAKAHIA	1,914	3,954	15
4	RUMUOWHA 11 ENEKA	857	1,770	15
5	ELIMGBU	2,886	5,962	15
6	ELIOZU OROIGWE	1,231	2,543	15
7	RUMUODOMAYA	4,548	9,395	15
8	RUMUOGBA	3,093	6,389	15
9	OGBOGORO	9,360	19,336	15
10	RUMUIGBO	8,619	17,805	15
11	BORI CAMP	10,168	21,006	15
12	RUMUOMASI	13,210	27,290	15
13	RUMUOBIAKANI	8,451	17,458	15
14	RUMUODARA	4,910	10,143	15
15	ELIOWHANI RUMUODARA	411	849	15
16	RUMUOKWURUSI	4,937	10,199	15
17	ELELENWO	3,275	6,765	15
18	RUMUIBEKWE	2,006	4,144	15
19	RUMUOGBA	5,614	11,597	15
20	WOJI	6,635	13,709	15
21	RUMUOKWUTA	7,990	16,506	15
22	MGBUAKARA	286	590	15
23	AZUMINI	379	782	15
24	IWOFE	613	1,266	15
25	AGIP ESTATE RUMUEME	456	942	15
26	RUMUOLA	4,327	8,939	15
	TOTAL	118,690	245,191	400

Source: Researchers' field Work (2018)

Based on the projected population, we applied the Taro Yamane (1967) formula to obtain the sample size of 400 for the study area.

TARO YAMANE (1967): $n = \frac{N}{1+N(e)^2}$ Where n = sample size, 1 = constant, N = Total population, e^2 = level of significance $(0.05)^2$

$$n = \frac{254191}{1+254191(0.05)^2} = \frac{254191}{1+254191(0.05)^2} = \frac{254191}{254192x0.0025} = \frac{254191}{612.98}$$

= 399.9 Approximately = 400

400 copies of questionnaire were randomly distributed to literate adults at the 26 communities selected for the study. However, using purposive sampling technique (15) copies of questionnaire were distributed at each of the selected communities. The entire administered questionnaires were returned intact because we employed the services of research assistants to administer the questionnaire. Hence, we have 400 as the sample size for the study area. The Likert – type four – point rating scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) was used in analyzing responses from the respondents. The results of the analysis were presented using appropriate tables, figures and maps. Also descriptive and simple statistical analysis i.e. pie chart, frequency and Simple percentages were used to test the veracity of the research questions.

From the above, both primary and secondary data were used. While the primary data deal with information elicited from the respondents during the field survey, secondary data cover previous studies and government publications e.g population data of the study area etc. (see Table 1 above). Specifically the study covers five randomly selected locations taken from the sampling frame, these are:

1. Rumuomasi market axis to Artillery junction
2. Rumuokoro market to Oil-mill market / Elelenwo
3. Iriebe-Okro market- School-to-Land to Eagle Estate junction
4. Rumuolumeni covering Ignatius Ajuru University of Education (IAUE)
5. Choba / University of Port Harcourt (UNIPORT) to Mgbuoba Location junction

In each sampled location, popular restaurants and food samples of rice and stew, beans, moi-moi, egusi soup, garri, boiled yam and fish/meat pepper soup were randomly selected and taken to laboratory tests at the University of Port Harcourt. The researcher also distributed questionnaires where necessary to capture the respondents' perception of the credibility of restaurants foods from contamination, there were mostly those who patronized restaurant foods, restaurant operators and officials from ministries of Health and Environment.

IV. RESULTS AND INTERPRETATIONS

Respondents' Socio-economic Characteristics

The Table 2 below shows the outcome of the respondents' socio-economic characteristics which were obtained from the 400 questionnaires used for the analysis. The characteristics are: Sex, Age, Educational Level, Occupation, Marital Status and Income Level.

Table 2: Respondents' Socio-economic Characteristics

Variable	Characteristics	Frequency	Percentage (%)
Sex	Male	312	78
	Female	88	22
	Total	400	100%
Age of respondents	18– 27 years.	176	44
	28 - 37 years	144	36
	38– 47years	40	10
	48– 57 years	24	6
	58 and above	16	4
	Total	400	100%
Educational level	Noformal Education	-	-
	Primary Education	104	26
	Secondary Education	256	64
	Tertiary Education	40	10
	Total	400	100%
Occupation	Unemployed	20	5
	Self- ernployed	280	70
	civil servant	68	17
	Students	32	8
	Total	400	100%
Marital status	Married	72	18
	Single	302	75
	Separated	8	2
	Divorced	20	5
	Total	400	100%
Income Level (₦) Monthly	Below ₦10,000.00	192	48
	₦10,000.00 - ₦ 20,000.00	68	17
	₦ 21,000.00 – ₦40,000.00	52	13
	₦ 41,000.00 – ₦60,000.00	48	12
	₦ 61,000.00 & above	40	10
	Total	400	100%

Source: Researchers' Field Work (2018)

Table 2 above, presents the sex of the respondents. Male respondents were the majority of the respondents being 312 (78%). The remaining 88 (22%) came from the female respondents. This implies that the males who are always out for work and other business eat restaurant food while away from their homes.

The age of respondents were presented in Table 2 above. Greater percentage 176 (44%) of respondents was obtained from the age bracket of 18-27 years. This was followed by those within 28-37 years with 144(36%). Those within the age bracket of 38-47 were 40 which formed (10%) and 24 (6%) was recorded for the age bracket 48-57, while those at age range of 58 and above was 16, which formed (4%) of the respondents.

Enquiry on educational level of the respondents revealed that majority of the respondents (256) had secondary school education and this represent 64%. Those who had primary education ranked next being 104 (26%) while those with tertiary education were 40 (10%). None belonged to non-formal education group. This implies that those at secondary level of education patronize restaurant food more than other levels as this class of respondents tend to be more of the singles, unemployed or self-employed among them.

On occupation as presented in Table 2 above, the self-employed formed the greater percentage of respondents being (70%) 280. Civil servants ranked next with 68 (17%), students were 32 (8%) while 20 (5%) were unemployed. This implies that majority of the respondents engaged in time consuming businesses or activities, hence they often preferred restaurant foods to meet targets.

Table 2 above revealed that 302 (75%) of the respondents are single, 72 (18%) are married couples, 20 (5%)are divorced while the remaining 8 (2%)are separated. The implication of this scenario is that majority of the respondents 330 (82%) patronized restaurant foods because they are single, separated or divorced which make them not to have time for private cooking, particularly the workers and business men/self-employed among them.

Income status of respondents was presented in Table 2 above. Greaterpercentage 192 (48%) of respondents was obtained from the income level of below ₦10,000.00. This was followed by those within ₦10,000.00 - ₦20, 000.00 with 68(17%). Those within the range of ₦21,000.00 – 40,000.00were 52 which formed (13%) and 48(12%) was recorded for income level of ₦41,000 –₦60,000, while those at income level range of ₦61,000 and above was 40, which formed (10%) of the respondents.

Table 3: Respondent's Opinion on chances of contamination of Restaurant Food in the Study Area

S/N	Questionnaire Items	Strongly Agree	Agree	Disagree	Strongly Disagree	% of Agreement
1	Food exposure could facilitate easy access to microorganisms that cause diseases	152 (38%)	248 (62%)	0 (0%)	0 (0%)	(100%)
2	Most restaurant foods are served with hands that are not properly washed	260 (65%)	120 (30%)	16 (4%)	4 (1%)	(95%)
3	Inadequate washing of cutleries could lead to the transfer of infection	204 (51%)	144 (36%)	32 (8%)	20 (5%)	(87%)
4	Foods served by children and teenagers are more prone to contamination	256 (64%)	56 (14%)	52 (13%)	36 (9%)	(78%)
5	Some restaurants serve food that is about to spoil	208 (52%)	116 (29%)	60 (15%)	16 (4%)	(81%)
	TOTAL	(72%)		(28%)		(100%)

Source: Researchers' Field Work (2018)

Opinion on Chances ofContamination of Restaurant Food

The chances of restaurant food contamination are presented in Table 3 above.

Respondents unanimously agreed that exposure of food creates access for microorganism (100%). Findings about

serving most restaurant food with hands that are not properly washed showed that a very great number of the respondents strongly agreed to this common practice (95%). Most of the respondents, (87%) agreed that inadequate washing of cutleries could lead to transfer of infection. In terms of restaurant food served by children and teenagers as having the tendency for contamination, the greater number of response came from those who agreed (78%). The result of findings onserving food about to spoil showed that majority response came from those who indicated agree with (78%).

Generally, on chances of restaurant food contamination, majority of the respondents attest to the fact that most of the activities of restaurant operators result to unsafe and unhygienic handling of both food materials and restaurant equipment, which ultimately predispose restaurant food to contamination.

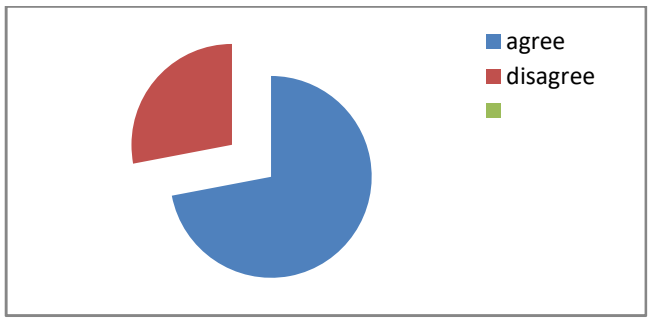

Figure 5: Respondents' opinion on Restaurants food contamination in the study area

Source: Researchers' Field Work (2018).

Laboratory Test/Analysis

Table 4: Total Bacterial Counts in Food Samples

Samples	Sample Location	Total Bacterial Count (TBC)	Total Pathogenic Bacterial Count (TPBC)
Rice and Stew	Rumuomasi market-Artillery	0.17 x 10^8	0.15 x 10^8
	Rumuokoro – Oil Mill Market	0.34x10^8	0.12 x 10^8
	Iriebe-Okro Market/School to Land	2.5x 10^8	1.28 x 10^8
	Rumuolumeni/IAUE Road	2.5x 10^8	0.25 x 10^8
	Choba/Uniport Road	l.0 x 10^8	l.0 x 10^8
Beans	Rumuomasi market-Artillery	0.17 x 10^8	0. 15x 10^8
	Rumuokoro – Oil Mill Market	0.34 x 10^8	0.02 x 10^8
	Iriebe-Okro Market/School to Land	2.01 x 10^8	1.28 x 10^8
	Rumuolumeni/IAUE Road	I.58 x I0^8	0.25x10^8
	Choba/Uniport Road	1.02x10^8	0.8 x l0^8
Moi-Moi	Rumuomasi market-Artillery -	0.48 x 10^8	0.31 x 10^s
	Rumuokoro – Oil Mill Market	1.68 x 10^8	-
	Iriebe-Okro Market/School to Land	0.23 x 10^8	0.11 x 10^8
	Rumuolumeni/IAUE Road	1.04 x 10^8	1.0 x 1 0^8
	Choba/Uniport Road	0.92 x10^8	0.I9 x 10^8
Egusi soup	Rumuomasi market-Artillery	0.25 x 10^8	0.03 x10^8
	Rumuokoro – Oil Mill Market	0.92 x 10^8	0.09 x 10^8
	Iriebe-Okro Market/School to Land	0.17 x 10^8	0.04 x 10^8
	Rumuolumeni/IAUE Road	1.08x 10^8	0.18 x 10^8
	Choba/Uniport Road	0.14 x 10^8	0.04 x 10^8
Boiled Yam	Rumuomasi market-Artillery	0.40 x 10^8	0.19x 10^8
	Rumuokoro – Oil Mill Market	0.04x 10^8	0.01 x 10^8
	Iriebe-Okro Market/School to Land	0.43 x10^8	0.27 x 10^8
	Rumuolumeni/IAUE Road	0.58 x 10^8	0.22x 10^8
	Choba/Uniport Road	0.14x10^8	0.1 x 10^8
Fish pepper soup	Rumuomasi market-Artillery	0.35 x10^8	-
	Rumuokoro – Oil Mill Market	1.2 x 10^8	0.49 x 10^8
	Iriebe-Okro Market/School to Land	0.17 x 10^8	0.09 x I0^8
	Rumuolumeni/IAUE Road	1.58 x 10^8	0.8 x 10^8
	Choba/Uniport Road	0.14 X 10^8	0.9 x 10^8

Source: Researchers' Field Work (2018)

Total Bacterial count in food samples

Table 4 presents the result of total bacterial count in food samples from the study locations.

In the test conducted on the food samples, it was generally observed that a very-high microbial count came from rice and stew samples from different locations. The highest count of 2.50 x 10 cfu/g was found in samples from Iriebe-okro market as well as Rumuolumeni/IAUE Road. A mean count of I .0 x 10^8cfu/g was found in Choba/Uniport Road samples and 0.34 x 10^8cfu/g in samples from Rumuokoro-Oil mill. The lowest count in rice and stew samples was 0.17 x 10^8cfu/g which was from Rumuomasi market-Artillery. The result of total

pathogenic bacterial count showed that the highest mean count was obtained in Iriebe-Okro market samples with a value of 1.28 x I0^{8}cfu g. In samples from Choba/Uniport Road, it was observed that all the bacterial isolates were pathogenic, potential health hazard bacteria with a count of 1.0 x 10^{8}cfu/g, same as total bacterial counts.

Table 4 also shows the results of total bacterial counts in beans samples, both total and pathogenic counts. For total bacterial count, the result showed that the beans sample from Iriebe-okro market had a high count of 2.01 x 10^{8}cfu/g. Also, 1.58 x 10^{8}cfu/g pathogenic count was recorded from the sample collected from Rumuolumeni/IAUE Road. The samples from Choba/Uniport Road reflected a high count 1.02 x10^{8}cfu/g. The beans samples from Rumuokoro-Oil mill market were moderately contaminated, with a bacterial count of 0.34 x 10^{8}cfu/g. Rumuomasi-Artillery samples showed the least count in the group being 0.17 x 10^{8}ctu/g, When considering pathogenic bacteria counts, the samples from Iriebe-okro market still ranked the highest with a value of1.28 x 10^{8}cfu/g followed by Choba/Uniport Road samples which had 0.8 x 10^{8}cfu/g. Rumuolumei/IAUE road samples recorded 0.25 x 10^{8}cfu/g for pathogenic bacteria count, and Rumuomasi-Atillery had 0.15 x 10^{8}cfu/g. The least count of 0.02 x 10^{8}cfu/g was recorded from Rumuokoro-Oil mill market samples.

The result of total bacterial counts and total pathogenic counts in moi-moi samples of study locations were both demonstrated in table 4. High microbial counts were obtained from Rumuokoro-Oil Mill market, with a mean count of 6.8 x 10^{8}cfu/g. 1.04 x l0cfu/g was obtained as bacterial counts in samples from Rumuolumeni/IAUE Road. Choba/Uniport Road sample had a count of 0.92 x 10^{8}cfu/g, while Rumuomasi Market-Artillery had a mean count of 0.48 x 10^{8}cfu/g. The lowest count was recorded from samples obtained from Iriebe-Okro Market which was 0.23 x 10^{8}cfu/g. The Table shows that highest total pathogenic bacteria count came from samples collected from Rumuolumeni/IAUE Road which was 0.73 x 10^{8}cfu/g. Samples from Rumuomasi Market-Artillery had a count of 031 x 10^{8}cfu/g; Choba/Uniport Road, 0.19 x 10^{8}cfu/g and Iriebe-Okro market had 0. 11 x10^{8}cfu/g. Moi-moi samples from Rumuokoro-Oil mill market were free of pathogenic bacterial contamination.

Table 4 further presented the total bacterial and total pathogenic bacterial counts as observed in Egusi soup samples from the study locations as well. Egusi soup from Rumuolumeni/IAUE Road had the highest bacterial count of 1.08xl0^{8}cfu/g. Rumuokoro-Oil mill market ranked next with a count of 0.92 x 10^{8}cfu/g. The bacterial counts of 0.25 x I0^{8}cfu/g and 0.17 x 108cfu/g were recorded for Rumuomasi-Artillery and Iriebe-okro market, respectively. The least bacterial counts were from the samples of Choba/Uniport Road which were 0.14 x 10^{8}cfu/g. For the total pathogenic bacteria count, it was observed that the highest-count of 0. 1 8 x 10^{8}cfu/g was obtained from Rumuolumeni/IAUE Road sample followed by a count of 0.09 x 10^{8}cFu/g from Rumuokoro-Oil mill market. Egusi samples from Choba/Uniport Road and Iriebe-okro market both had the pathogenic count of 0.4 x 10^{8}cfu/g each, while Rumuomasi-Artillery sample recorded 0.03 x 10^{8}cfu/g being the least count.

Table 4 also presented the result of total bacterial count in boiled yam samples. Boiled yam samples were generally observed to be least contaminated of all the samples investigated. The different mean counts were: 0.40 x 10^{8}cfu/g from Rumuomasi market-Artillery and 0.43 x 10^{8}cfu/g from Iriebe-okro; and the highest count of 0.57 x l0^{8}cfu/g was from Rumuolumeni/IAUE road samples. The least was found in Rumuokoro-oil mill market sample as 0.04 x l0cfu/g. Pathogenic bacterial counts were 0.27 x l0cfu/g, being the highest from the sample obtained from Iriebe-okro market, 0.22. x 10 cfu/g counts from Rumuolumeni/IAUE road; Rumuomasi-Artillery had 0.19x10^{8}cfu/g while Choba/Uniport Road had 0.1 x 105cfu/g. The least counts came from Rumuokoro-Oil mill market (0.01 x 10^{8}cfu/g).

Table 4 further reported the bacterial counts in fish pepper soup samples. The highest bacterial mean count was 1.58 x I0^{8}cfu/ml which were collected from Rumuolumeni/IAUE Road samples. This was followed by Rumuokoro-oil mill market samples which had a mean count of 1.20 x I0^{8}cfu/ml. Samples from Rumuomasi market – Artillery had a mean count of 0.35 x 10^{8}cfu/ml. Choba/Uniport Road and Iriebe-okro market samples had a mean of 0.14 x 10^{8}cfu/ml each respectively.

In considering total pathogenic bacteria count, Rumuokoro/Oil mill market sample presented the highest mean Count of 0.49 x 10^{8}cfu/g. Samples from Rumuolumeni/IUE Road had a count of 0.18 x 10^{8}cfu/g. Iriebe-Okro Market and Choba/Uniport Road each had 0.09 x l0cfu/g mean count. Rumuomasi market to Artillery samples was free from pathogenic bacterial contamination. Thus the result is significant demonstrating bacterial contamination of the food samples. (See table 4)

Table 5: Microbial count of Aetiologic Sample Agents of Health problems in Food

Samples	Sample location	Total Salmonella and Shigella Count	Total Escherichia coli count	Total vibrio cholera count
Rice and Stew	Rumuomasi market-Artillery	0.3x 10^8	0.3 x 10^8	0
	Rumuokoro – Oil Mill Market	0.3x10^8	0.12x10^8	0
	Iriebe-Okro Market/School to Land	0.11xI0^8	0.5xI0^8	0.9 x 10^8
	Rumuolumeni/IAUE Road	0 x 10^8	0.16 x 10^8	0.38x 10^8
	Choba/Uniport Road	0.2xl0^8	1.3 x l0^8	0

Beans	Rumuomasi market-Artillery	0.2 x10^8	0.1 x 10^8	0
	Rumuokoro – Oil Mill Market	0.3 x 10^8	0	0
	Iriebe-Okro Market/School to Land	0.11 x 10^8	0.8 x 10^8	0.6 x 10^8
	Rumuolumeni/IAUE Road	0.01 x 10^8	0.11 x 10^8	0.28 x 10^8
	Choba/Uniport Road	0.2x 10^8	0.2x 10^8	0.12 x 10^8
MoiMoi	Rumuomasi market-Artillery	0.13 x 10^8	0.8 x 10^8	0.8x 10^8
	Rumuokoro – Oil Mill Market	0	-	0
	Iriebe-Okro Market/School to Land	0.2 xl0^8	0.4x 10^8	0.2x 10^8
	Rumuolumeni/IAUE Road	0.3xl0^8	0.15 xl0^8	0.33 x 10^8
	Choba/Uniport Road	0.9x 10^8	0	0.8.x 10^8
Egusi soup	Rumuomasi market-Artillery	0.13 x 10^8	0	0.1 x 10^8
	Rumuokoro – Oil Mill Market	0.51x 10^8	0.05 x 10^8	0.16 x 10^8
	Iriebe-Okro Market/School to Land	0.3x 10^8	0.1 6 x 10^8	0.16 x 10^8
	Rumuolumeni/IAUE Road	0.8x 10^8	0.3 x 10^8	0 .25 x 10^8
	Choba/Uniport Road	0.2.x 10^8	0.13 x 10^8	0.4 x 10^8
Boiled Yam	Rumuomasi market-Artillery	0.4x 10^8	0.1 x 10^8	-
	Rumuokoro – Oil Mill Market	0	0	0
	Iriebe-Okro Market/School to Land	0.3x10^8	0.1x10^8	-
	Rumuolumeni/IAUE Road	0.6x10^8	0.3 x 10^8	0.1 x 10^8
	Choba/Uniport Road	-	-	0.7x 10
Fish pepper soup	Rumuomasi market-Artillery	0	0	0
	Rumuokoro – Oil Mill Market	0.49 x 10^8	0.49 x 10^8	0.18 x 10^8
	Iriebe-Okro Market/School to Land	0.1x 10^8	0.09x 10^8	0
	Rumuolumeni/IAUE Road	0.1 x 10^8	0.1 8 x 10^8	0.32x 10^8
	Choba/Uniport Road	0.1 x 10^8	0.09x 10^8	0.3 x 10^8

Source: Researchers' Field Work (2018)

Microbial Count of Aetiologic Agents of Health Problems in Food Samples

Table 5 presents the microbial count of agents that cause serious gastro-intestinal problems. It should be noted that *shigella*and *salmonella* are lumped together because a single agar *(Shigella*and *Salmonella Agar)* is used for the test. In rice and stew samples of various study locations, Iriebeo-kro market samples were the most contaminated with *Vibrio cholerae*0.9 x 10^8cfu/g, *E. coli* having a count of 0.5 x 10^8cfu/g and its *Salmonella* and *Shigella*counts were 0.11 x 10^8cfu/g. Rumuomasi-Artillery and Rumuokoro-Oil mill market had *Salmonella* and *Shigella* counts of 0.3 x10^8cfu/g each. Both samples had zero counts for *Vibrio cholerae,* and same applied to samples from Choba/Uniport Road. *E. coli* counts For Rumuomasi-Artillery and Choba/Uniport Road samples were 0.3 x 10^8cfu/g. Samples from Rumuolumeni/IAUE Road had 0.16 x 10^8cfu/g for E. *coli,* 0.38 x I0^8cfu/g for *vibrio cholera* and none for *Salmonella* and *Shegella.*

Beans samples also demonstrated the presence of microbial agent causing health problems. The samples from Rumuokoro-Oil mill market had the value of 0.3 x 10^8cfu/g for *Salmonella* and *Shigella,* zero for *E.coli* and zero for *Vibrio cholera.* The samples From Rumuomasi-Artillery had counts of 0.2 x 10^8cfu/g *for Salmonella* and *Shigella,* 0.1 x 10^8cfu/g for E coli and zero for *Vibrio cholerae. Iriebe*-okro market samples had a *Salmonella* and *Shigella* counts of 0.11. x 10^8cfu/g, 0.8 x I0^8cfu/g for E. coli which was the highest. *Vibrio cholera* counts of 0.6 x 10^8cfu/g were recorded. Rumuolumeni/IAUE Road mean counts for the three agents were 0.01 x 10^8cfu/g, 0.11 x 10^8cfu/g and 0.28 x l0^8cfu/g for *Salmonella* and *Shigella, E. coil* and *Vibrio cholera* respectively. Choba/Uniport Road samples reflected a mean count of 0.2 x 10^8cfu/g for both *Sahnonella* and *Shigella, E. coil* while a count of 0.12 x 10^8cfu/g was recorded for *Vibrio cholerae.*

In moi-moi samples analyzed, the samples from Choba/Uniport Road had highest *Salmonella* and *Shigella* counts of 0.9 x 10^8cfu/g, *Vibrio choleras* counts of 0.8 x 10^8cFu/g but completely free from *E. coli.* Rumuomasi-Artillery samples recorded highest counts *of E. Coli*in the group as 0.8 x 10^8cfu/g was the count of *Vibrio cholera* and 0.13 x 10^8cfu/g for *Salmonella* and *Shigella.* Samples from Iriebeo-kro market had 0.2 x 10^8cfu/g for *Salmonella* and *Shigella,* 0.4 x 10^8cfu/g *for E.coli*and 0.2 x 10^8cfu/g for *Vibrio cholera* Rumuolumeni/IAUE sample had the count of 0.3x 10^8cfu/g for *Salmonella* and *Shigella,* 0.15 x 10^8cfu/g for *E.coli* and 0.33 x 10^8cfu/g for *Vibrio cholera.* The moi-moi samples from Rumuokoro-Oil mill market were completely free of all the agents that can cause serious health problems.

The result of microbial agents of health problems in Egusi soup samples was presented as well. The samples from Rumuolumeni/IAUE Road had salmonella shigella counts of 0.8 x 10^8cfu/g each; total E.coli counts of 0.3 x 10^8cfu/g and vibro cholera counts of 0.25 x 10^8cfu/g each. Rumuokoro-Oil mill market egusi soup samples recorded 0.5 x 10^8cfgu for *Salmonella* and *Shigella.* 0.05 x 10^8cfu/g for E.coli and 0.16 x

10^8cfu/g for vibro*cholera.* Choba/Uniport Road samples had s*almonella* and *Shigella* counts of 0.2 x10^8cfu/g. E.coli counts of 0.13 x 10^8cfu/g and *Vibro cholerae,* 0.4 x 10^8cfu/g which was highest. Rumuomasi-Artillery samples had *Salmonella* and *Shigella* counts of 0.13 x 10^8c fu/g, *E.coli,* recorded zero count, while *Vibrio cholera* was 0.1 x 10^8cfu/g.

Table 5 also presents the microbial agents of health problem in boiled yam samples. The samples from Rumuolumeni/IAUE road had *Salmonella* and *Shigella* count which were 0.6 x 10^8cfu/g ,*E. coli* count 0.3 x 10^8cfu/e and *Vibrio choleras* count 0.1 x 10^8cfu/g. samples from Rumuomasi-Artillery and Iriebeokro market had mean counts of 0.4 x10^8cfu/g and 0.3 x 10^8cfu/g, respectively for *Salmonella* and *Shigella,* 0.1 x10^8cfu/g for *Vibrio cholera* and nil count for E *coli.* The samples from Choba/Uniport Road had the highest counts of 0.7 x 10^8cfu/g for *Vibrio cholera* while other agents were not present. The samples from Rumuokoro-Oil mill market were free from contamination of potential epidemic agents

In fish pepper soup, the most contaminated were samples from Rumuokoro-Oil mill market with a mean count of 0.49 x10^8cfu/ml *for Salmonella* and *Shigella,* 0.8 x 10^8cfu/ml for *E. coli,* and 0.1 8 x 10^8cfu/ml for *Vibrio cholera* count. Rumuolumeni/IAUE Road samples had 0. 1 x 10^8cfu/ml *for Salmonella* and *Shigella,* 0.13 x I0^8cfu/ml for E. coli and 0.32 x 10^8cfu/ml for *Vibrio cholerae,* which was the highest count recorded for *Vibrio cholerae,* Choba/Uniport Road had *Salmonella* and *Shigella* counts of 0. 1 x 10^8cfu/ml and same Count for *E. coli,* while *Vibrio cholera* count was 0.3 x 10^8cfu/ml. Iriebe-okro market had *Salmonella* and *Shigella* counts of 0.1 x 10^8cfu/ml but no count for E coli and *Vibrio cholera.* Rumuomasi-Artillery sample was completely free of all the infecting agents.

Table 6: Total Mycological Count in Food Samples

Samples	Sample location	Cell count
Rice and Stew	Rumuomasi market-Artillery	0.16 x 10^8
	Rumuokoro – Oil Mill Market	0.03 x l0^8
	Iriebe-Okro Market/School to Land	0.03 x 10^8
	Rumuolumeni/IAUE Road	2.02 x 10^8
	Choba/Uniport Road	0.51 x 10^8
Beans	Rumuomasi market-Artillery	0.02 x 10^8
	Rumuokoro – Oil Mill Market	0.03 x 10^8
	Iriebe-Okro Market/School to Land	0.21 x 10^8
	Rumuolumeni/IAUE Road	0.04 x 10^8
	Choba/Uniport Road	04 x 10^8
Moi-Moi	Rumuomasi market-Artillery	0.l0 x 10^8
	Rumuokoro – Oil Mill Market	0.20 x 10^8
	Iriebe-Okro Market/School to Land	0.47 x 10^8
	Rumuolumeni/IAUE Road	0.46 x 10^8
	Choba/Uniport Road	0.50 x 10^8
Egusi soup	Rumuomasi market-Artillery	0.31 x 10^8
	Rumuokoro – Oil Mill Market	0.10 x 10^8
	Iriebe-Okro Market/School to Land	0.04 x 10^8
	Rumuolumeni/IAUE Road	0.l0 x 10^8
	Choba/Uniport Road	0.12 x 10^8
Boiled yam	Rumuomasi market-Artillery	0.33 x 10^8
	Rumuokoro – Oil Mill Market	0.03.x 10^8
	Iriebe-Okro Market/School to Land	0.07 x 10^8
	Rumuolumeni/IAUE Road	0.11 x 10^8
	Choba/Uniport Road	0.14 x 10^8
Fish pepper soup	Rumuomasi market-Artillery	0.07 x 10^8
	Rumuokoro – Oil Mill Market	1.09 x 10^8
	Iriebe-Okro Market/School to Land	0.31 x 10^8
	Rumuolumeni/IAUE Road	0.04 x 10^8
	Choba/Uniport Road	0.11 x 10^8

Source: Researchers' Field Work (2018)

Total Mycological Count in Food Samples

Table 6 shows the mycological count in food samples of the study locations. When considering Rice and stew, the samples from Rumuolumeni/IAUE Road showed such a heavy growth of mycological mean count of 2.02 x10^8cfu/g. Choba/Uniport had 0.5 x 10^8cfu/g. Rumuomasi-Artillery, 0.16 x 10^8cfu/g; and count of 0.03 x 10^8cfu/g each was obtained for Rumuokoro-Oil mill market and Iriebe-okro market samples, respectively.

In beans samples, the highest count came from Choba/Uniport samples which had 0.4 x 10^8cfu/g. This was followed by 0.21 x I0^8cfu/g from Iriebe-okro market samples. Rumuolumeni/IAUE Road and Rumuokoro-Oil mill market had mycological counts of 0.04 x 10^8cfu/g and 0.03 x 10^8cfu/g respectively. The least counts came from Rumuomasi-Artillery samples which were 0.02 x 10^8cfu/g.

Table 6 also reflects the mycological counts in moi-moi samples. The highest count recorded was 0.50 x 10^8cfu/g from Choba/Uniport sample. Iriebe-okro market had a count of 0.47 x 10^8cfu/g, Rumuolumeni/IAUE Road 0.46 x 10^8cfu/g, Rumuokoro-Oil mill market, 0.20 x 10^8cfu/g and Rumuomasi market-Artillery (0.10 x 10^8cfu/g) was the least contaminated.

In considering Egusi soup samples, observation showed that the highest mycological counts from egusi soup samples came from Rumuomasi-Artillery, which was 0.31 x 10^8cfu/g. Choba/Uniport samples had 0.12 x10^8cfu/g. Rumuokoro-Oil mill market and Rumuolumeni/IAUE Road samples had counts of0.10 x 10^8cfu/g each while samples from Iriebe-okro market showed counts of 0.4 x 10^8cfu/g which was the least contaminated in the group.

For boiled yam samples, counts with the highest value of 0.33 x 10^8cfu/g were obtained from Rumuomasi-Artillery, Choba/Uniport and Rumuolumeni/IAUE Road had counts of 0.14 x 10^8cfu/g and 0.11 x 10^8cfu/g, respectively. Sample from Iriebe-okro market had 0.07 x 10^8 cfu/g. The least count came from Rumuokoro-Oil mill market samples as 0.03 x 10^8cfu/g.

Fish pepper soup was considered also in relation to contamination with fungal group. The samples from Rumuokoro-Oil mill market had the highest counts of 1.09 x 10^8cfu/ml, followed by Iriebe-okro market samples with count of 0.31 x 10^8cfu/ml. Choba/Uniport samples had 0.11 x 10^8cfu/ml. Rumuomasi-Artillery, 0.07 x 10^8cfu/ml and Rumuolumeni/IAUE Road samples, 0.04 x 10^8cfu/ml. (See Table 6 above)

Table 7 : Morphological Appearance/Biochemical Characteristics of Bacterial Isolates (Bacterial Identification)

		Chemical Test								Sugars Fermentation													
S/N	Cell Shape	Gram Stain	Catalase	Maltose	Heam	Urease	Indole	Vp	\	Citrate	Spore	10% Bile	6.5 NaCl	MR	Starch	Galacotose	Glucose	Lactose	Mannitol	Malaclose	Sucrose	Xyl	Probable O Probable Organisms
1	Cocci	+	+	-	+	-	-	-	-	+	-	-	+	-	-	AO	AO	OO	AO	AO	AO	OO	Micrococcus Virans
2	Rod	-	+	+	-	-	+	-	-	-	-	+	+	+	+	AG	AG	AG	AG	AG	AG	AO	E. Coli
3	Rod, Branched	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	AO	AO	AO	AO	AO	AO	Actinomyces sp
4	Cocci	+	-	-	+	-	-	-	-	-	-	-	+	+	+	-	AG	AO	AG	AG	AG	AG	Streptococcus pneumoniae
5	Cocci	+	+	-	-	-	-	-		-	-	-	+	+	+	-	AG	AO	AG	AG	AG	AO	Streptococcus epidermidis
6	Cocci	+	-	-	-	-	-	-	-	+	-	-	+	-	+	AO	AO	AO	AO	AO	AO	AO	Aerococcus viridans
7	Rod	+	-	-	-	-	-	-	-	-	-	+	-	+	+	AG	AO	AO	-	AG	AO	AG	Lactobacillus acidophilis
8	Rod	+	-	-	-	+	+	-	-	+	-	-	+	-	+	AG	-	-	AO	AG	AG	AO	Lactobacillus silivarius
9	Rod	-	-	+	-	-	-	-	-	-	-	+	+	+	-	-	AO	AO	AG	-	AO	-	Salmonella Choleraesins
10	Rod	-	+	+	-	+	-	-	-	+	-	+	+	+	-	-	AO	-	-	-	AO	AO	Proteus Mirabilis
11	Rod	-	+	+			-	-	-	-	-	-	+	+	+	-	AO	-	AG	AO	-	-	Samonella typhi
12	Rod	-	+	+	-	-	-	-	-	+	-	+	+	+	-	-	AO	-	AO	AO	AO	-	Yersinia pseudo tuberculosis
13	Rod	-	-	+	-	-	-	+	-	-	-	+	+	+	-	AO	AO	-	-	AO	-	-	Shigella dysenteriae
14	Rod	+	+	+	+	+	-	+	-	+	+	+	+	+	+	AO	AG	AO	-	AG	AG	-	Bacillus cerens
15	Rod	+	+	+	-	+	-	+	-	+	+	+	+	+	+	AG	AG	AG	AG	AG	AG	AG	Bacillus subtilis
16	Curved Rod	-	-	+	+	-	-	+	+	+	+	+	+	+	+	AO	AO	AO	AO	AO	AO	AO	Vibrio sp
17	Cocci	+	+	-	-	+	-	+	-	+	-	+	+	+	-	-	AO	AO	AG	AO	AO	-	Staphylococcus aureus
18	Rod	+	+	+	-	-	+	-	+	+	+	+	-	+	+	AO	AG	AO	AO	AO	AO	AO	Bacillus polymza
19	Rod	+	+	+	-	-	-	-	-	-	+	+	+	+	+	AO	AG	AG	-	AO	AG	-	clostridium septicum

Source: Researcher's Field Work (2018)

Bacterial Identification

Table 7 shows the identification of 19 different bacterial isolates, morphological appearance and biochemical characterization. Some of them are of serious health implication such as *Vibrio sp, Salmonella typhi* and *Staphylococcus aureus*. Table 4.2.4 further shows their cell shapes in which some are cocci, others are rod-shaped and a few are branched. The results of reactions of microorganisms are also indicated as well as their ability to absorb dye proving gram positive or negative. Different degrees of sugar fermentation by the organisms were also shown. Some

fermented sugar to produce Acid and Gas (AG) or Acid with No gas (AO), while others produced neither gas nor acid (-)

Table 8 : Taxonomy Features of Filamentous Fungi from Food Samples

Colony colour	Types of somata	Nature hyphae	Special vegetative structure	Asexual spore	Special reproductive structure	Coridial head	Vesicle shape	Probable organism
White becoming dard with age	Filamentous	Co-enocytic	Stolons/rhizoid	Ovoid sporagio spores	Tall, growth sporangiosphre	-	-	*Rhizopus stolonifer*
Cotton white	Filamentous	Septate	-	Unicellular conidial (cylindrical)	Phialides	-	-	*Vertia Lilum sp.*
Dark or black	Filamentous	Septate	Foot cell	Globoseconidia	Smothered conidioiphores	Globose	Globose	*Aspergillus stereos*
very dark mycelium	Filamentous	Septate	-	Aleuryospores phialespores	Erect condiogenoics	-	-	*Humilia sp*
White	Filamentous	Septate	-	Unicellular conidia in chains	Condiogenoics	-	-	*Monilia sp*
very dark mycelium	Filamentous	Septate		Sporos pores	Clusters conidiophores	-	-	*Helminthosporium velutinum*
Blush green	Filamentous	Septate	Broomlike	Globose conidia	Dense brush like	-	-	*Penicullus*
Powdery brown	Filamentous	Septate	-	Acroopetal chains conidia micro conidia	Short conidiosphres	-	-	*Clasdiosporium sp*
Creamy yell	Filamentous	Septate	Foot cell	Micro conidia	Differentiatd condiophores	-	Spinelike projection	*Microsporium sp*
Basal dark	Filamentous	Septate	Broomlike	Globose conidia	Smooth erect condiophores	Globose	Globose	*Aspergillus niger*
Bluish green	Filamentous	Septate	Broomlike	Saboglobose	Branched condisphores	-	-	*Penicullus expansium*

Source: Researcher's Field Work (2018)

Taxonomic Features of Fungi

Table 8 shows the taxonomic features of fungal species isolated from the food samples. All the isolates were filamentous in nature; all except one had hyphae. Their vegetative structures vary — some were broom like, two were of foot cell one had stolon/rhizoid structure while others showed no definite structure. Two of the organisms had globoseconizoids heads and vesical shapes. The asexual spores were of varieties except three that had globosecandial spores. The mycological species are made of varieties of colours; white, dark, powdery brown, creamy jell and bluish green as indicated in Table 8.

Table 9 : Taxonomic Features of Yeast Isolates from Food Samples

Colony shape	Type of somate	Nature of Ph	Pseudo mycedium	Asexual Reproductive spores	Growth on NaCl	Glucose	Lactose	Maltose	Sucrose	Refinose	Galactose	Glu	Lac	Mal	Gal	Suc	Raginose	Probable organism
Moist milky colony	Large unicellular globose cell	-	Rudimentary	Budding cell	5%+	+	-	+	+	+	+	+	-	+	+	+	+	Saccharomyces cerevisiae
Creamy whitish colony	Pseudo hyphae	Septate	Develop	Plasto-conidia	10% +	+	-	+	+	+	+	+	-	+	-	+	+	Conidida tropicalis
Most milky colony	Single globose cell	-	Pseudo mycelium rudimentary	Budding	5%+	+	-	-	-	-	-	+	-	-	+	+	-	Saccharomyces sp

Source: Researcher's Field Work (2018)

Taxonomic Features of Yeast

Table 9 shows the taxonomic features of yeast isolates from the food samples. Three different forms were isolated. 'Their colony colour was commonly moist milky except *Canidatropicalis* which had creamy whitish colour; and also had septate hyphae while the other two were non-septate. *Canidatropicalis* had plasto-conidia asexual spores while others had biding cells. Their growth ability in sodium ranged between 5% and 10%. Their capabilities to ferment and utilize sugars are also shown in Table 9.

Table 10: Occurrence of Bacterial Isolates in the Food Samples

Sample Code	Aerococcus viridians	lactobbacillus acidophilus	S.choleriasius	Proteus mirabian	Staphylococcu s s epidemidis	Actinomyees sp	Micrococcus virans	L. salivarius	Streptococcus pneumoniae	C. septicum	B. polymyza	Staph. Aureus	Vibrio sp	B. subtilis	Bacillus cerus	Shigella dysentriae	Salmonella typhi	Yersinia	Inseudo	E.coli
MMPP					+	+	+													
UAAR			+	-		+				+	-	+	+			+	+	+		+
AERP	+		+		+	+						-	+				-			+
MMPR	+	+	+		+	+										+				+
IJMM	+				+	+									+					
AERC						+	+				-	+	+							+
AERR	+	+						+					+	+		+	-			+
SSR			+			+	+		+	+							-			+
IJMP									+	+	-		+							+
IJMC	+				+											-				
AERM											-		+				-			+
UAAC	+					+						+	+			-	-	&		
MMPC	+												+			-	-	+		+
SSM	+			+					-		+	+	+	+						
UAAM		+	+	+									+		-			+		+
SSC	+								-		-		+	+			-			
SSP							+						+		-	-	-			+
UAAP	+			+	+	+	+	+				-								
MMPM			+	+			+		-							-		+		
IMPB				+							-									+
UAAB	+																			+
AERB	+											-				-		+		
MMPB				+					-	-							-	+		
SSB																-				+
IMPMT		+																		+
WAAMT						+			-	-	-						-	+		
AERMT	+											+								
MPMT		+		+																
SSMT																-				+

Source: Researcher Field Work (2018)

Occurrence of Bacterial Isolates in the Sample

Table 10 presents the rate at which different bacterial species occur in the different samples tested. Some food samples had a wide range of different bacterial isolates, example moi-moi from Rumuomasi market – Artillery having ten (10) different bacteria. The least number of bacterial species encountered in a sample was two *(2)* found in boiled yam Rumuokoro – Oil mill market.

The Table also shows that the most occurring bacterial isolate was *vibrio sp* with 60% occurrence. This was immediately followed by *E. Coli* with 53% occurrence. *Bacillus viridians* had 45% prevalence frequency while *Actinoniyces* and *Shigella* dyscentiae had 36% each. These organisms indicated very recent contamination of the food samples as revealed by this analysis. (See Table 10).

Table 11 : Frequency of Mycological Species

Sample code	Rihzopus stolenifer	Verticillium sp	Aspergullus ferreus	Humicola sp	Mornia sp	Helminthospo ium velutinum	Penicillium notatum	Clostosporium sp	Microsporium sp	Asperglus niger	Penicillium expansium	Sacharomyces cerevisiae	Candida tropicalis	Saccharomyces sp
UAAR	-	-	-	-					-		-			-
UAAB		+			+		+		+					
UAAC				-										
UAAP		+				+						-	-	-
UAAMT	+			-		+			+		-	+		
UAAM	+				+		+		+					+
IJMB	+		+	-										+
IJMR								+	+					
IJMC	+						+							
IJMMT					-					-	-			
IJMP		-	-									+	+	
IJMM		-	-	-				+						
AERB												+	+	
AERR											-	-	+	
AERMT														+
AERC	+			-										
AERP	+	+												
AERM	+													
SSB			-											-
SSR		-			-									
SSC				-				-			-			
SSMT	+								-			-		
SSP		-				-	+		-					-
SSM				-	-	-						-		-
MMPR			-											
MMPC		-										-		
MMPP		-					+			-				+
MMPB		-				-								
MMPM		+							-			-		
MMPMT		-									-			-

Source: Researcher's Field Work (2018)

Frequency of Mycological Species

The frequency at which the mycological species were found in the different food samples is shown in **Table 11.** The least occurring mycological species was *Penicilliumexpanshim*with the incidence rate of 7. The most occurring species was *Saccharomyces sp* with the incident frequency of 42. From standard these figures are high as they are not expected to be found in cooked food (See Table 11).

Table 12: Identified Microorganisms from Restaurant Food Causing Health Problems in the Study Area

Microorganisms	Health problems
Aerococciis viridians	Common cold (flu)
Actinomyces sp Actinomytic	lump (on the jaw)
Bacillus cereus	Cellulose fermentation
Bacillus polymyza Anaemia	(blood lysing)
Bacillus subtilis	Cellulose fermentation
Clostridium perferingens	Locked jaw
Clostridium septicum	Neuroseptic toxins chronic wound infections
E. coli	Diarrhea (stained with blood)
Lacto bacilhisacidophillis	Itching and carries formation
Lacto bacilhissilivarius	Normal flora of the moth
Micrococcus virans	Dental plaque
Proteus mirabilis	Stomach cramps
Salmonella choleriaesius	Pseudo cholera (partial rice water stool)
Salmonella typhi	Typhoid fever
Shigelladysentrae	Travelers dysentery
Staphylococcus aureus	Boils, carbuncles, rashes, cancer, shock and stroke.
Staphylococcus epidermidis	Non pathogenic
Streptococcus pneumonia	Pneumonia
Yersinia poseudotuberculosis	Partial tuberculosis

Source: Researchers' Field Work (2018)

IV. DISCUSSION OF FINDINGS

The research objectives were achieved based on the results from respondents, which were quite revealing. The conditions, practices and factors that make restaurant food susceptible to contamination have been exposed by the respondents. They mentioned exposure of food 100%, inadequate washing of cutleries 87%, improperly washed hands 95%, services of underage persons 75% and preparation of food with food material that is about to spoil account for 81%. It is very apt that younger people are not sensitive to rules of hygiene. They drop food on the ground and pick them back, or simply wipe them with their bare hands or dirty clothes, thereby creating more pathogenic contamination. Food Exposure gives easy access for microorganisms present in the air to come in contact and contaminate the food. Similarly unhygienic water sources and dirty environment predispose foods to infestation of pathogens thus leading to infections (diseases). This is traced to the unhygienic handling of the serving equipment such as the cooking utensils, plates, cutleries, hand towels among others. The food dealers often have to wash the utensils between customers and in most cases use particular water repeatedly. Also, storage facilities such as freezers viz-a-viz inadequate power supply makes food preservation very un-thorough, thereby giving room to the use of partially decaying food ingredients for cooking. The techniques of handling food are found to be associated with food contamination. Allowing food to come in contact with body, clothing's and body secretions can lead to outbreak of serious illness such as *Staphylococcai* illness (Jacob. 1989). Mudambi and H. Rajagupal (2007) affirm that insect (flies) chemicals as well as bio-aerosols which may result in various levels of contamination and gastrointestinal problems get easy access to food when they are exposed. These are some of the avenues opened to favour access of infecting organisms.

V. CONCLUSION

Health is our precious possession and prerequisite for happiness, and long life and productivity, yet more often than not people take their health for granted until it is lost. The major determinants of health discovered here include environment, behavior, genetics and health care delivery services. However, behavior otherwise lifestyle is the most paramount as it relates to restaurant services in the society.

This study investigated the susceptibility of restaurant foods contamination in Obio/Akpor Local Government Area of Rivers State, Nigeria**.** It evaluated the chances for contamination of restaurant foods which yielded a significant result. It was generally agreed that factors such as eating with improperly washed hands, sharing of cutleries and equipment, unsafe handling, exposure and underage restaurant service personnel predispose to contamination of restaurants food. The study has ultimately revealed that poor handling techniques were responsible for the conditions that make quick service restaurant foods susceptible to contamination by pathogenic microorganisms. It therefore implies that a lot of attention should be paid to proper handling rules and techniques which will eliminate or significantly reduce the degree of contamination of restaurant foods.

This requires continuous food hygiene training and application of ethics for both the food handlers and the general public. The use of water from contaminated sources for food preparation is quite unsafe, and should be avoided. Also, Personal decisions should be taken in ensuring that engagement of underage persons is completely avoided. All restaurant operators and their employees should be made to

undergo at least minimum standard training on catering and be issued with authorized license. Also, food service employees should be properly trained on hygiene education and made to wear clean and appropriate apparels while handling foods.

VI. RECOMMENDATIONS

Based on the results obtained and conclusions reached, the following policy recommendations are considered as being quite appropriate

i. All restaurant food should be adequately covered with modern preservation techniques.
ii. Regular inspection of restaurant food materials should be done before and after cooking by officials from ministries of Health, Environment, National Agency for Food and Drug Administration and Control (NAFDAC) and Standard Organization of Nigeria (SON) etc.
iii. Only License restaurant food operators with proven qualities of personnel and public hygiene be allowed to serve in Nigeria
iv. Conferences, Seminars, and Workshops should be organized regularly for restaurant operators in the study area.

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