Spatial Assessment of Polluted Hawked Food in Uyo Municipality, Akwa Ibom State, Nigeria

Akpaudo Unyime[1] and Collins H. Wizor (PhD)[1*]

[1]Department of Geography and Environmental Management,
University of Port Harcourt,
P.M.B 5323, Port Harcourt, Nigeria.
Corresponding Author: *Email: collins.wizor@uniport.edu.ng, wizorcollins@yahoo.com

Abstract
This study spatially assessed polluted hawked food in Uyo Municipality, Akwa Ibom State, Nigeria. The study aimed at exploring the possible health implications that could be associated with polluted hawked food in Uyo municipality. A total of 410 respondents were used and chosen from five different locations on the major roads in the municipality. These included Aka Etinan Road, Itam Junction market, Mbiabong Motor Park, Urua Akpan Andem market and the State Secretariat. A total of 150 food samples were used for laboratory investigation, which included "moi-moi", cakes, rice and stew, beans, fried meat and meat pepper soup collected from the dealers. The result of the investigations shows that there are special conditions about hawked food that precipitate their contamination and that, hawked foods are quite below standard in quality to guarantee good health. The two-way Analysis of Variance was significant (F=28.19 and 72.28) respectively. The laboratory results showed that there was a total of 19 bacteria including those of health concern such as Salmonella spp., Escherichia coli and Vibrio spp; and 14 fungi including Aspergillus niger that causes non-enteric problems in the food samples. Health problems that can result from eating contaminated hawked food include pneumonia, typhoid fever, anaemia, among others. It was suggested that law enforcement, hygiene education and frequent inspection be undertaken by the government; while the general public should avoid hawked food or carefully choose a hawker.

Keywords: *Assessment; Polluted; Hawked; Food; Uyo Municipal; Nigeria*

1. INTRODUCTION

Food can be considered as a means of collection of chemicals taken into an organism for growth, energy release and maintenance of life processes. This includes water, minerals, vitamins, carbohydrates, fat and oil, proteins. (Jenkins 2000). Aguelera and Stanley (1999) defined food as any substances either composed of carbohydrates, water, fats, and proteins, eaten or drank by any animal including humans for nutrition or pleasures. In addition to nutrients, food conveys emotional satisfaction and hormonal stimuli that contribute to health. Food also contains photo chemicals that give it taste, aroma, colour and characteristics. Some photo chemicals are believed to play a role in disease prevention (Kicklighter, 2003).

Food is a true 'ecosystem' and their high nutrient environments are capable of sustaining many microbial lives. These microorganisms can bring about a very positive transformation of the food into a high-value product, while others can completely render the food useless. Our food whether freshly harvested or manufactured starts its existence in contact with the natural ecosystem and

thus, inevitably possessed by microorganism from these sources. There is growing evidence that gastro-intestinal pathogens are also important in airborne transmission of disease and not just respiratory pathogens primarily believed (Mohapatra, 2008). Parasitic infection can be acquired through unwashed fingers, insects, circulation of banknotes and windy conditions when in contact with food. A study carried out in Abeokuta, Nigeria revealed that the commonest source of parasitic infection is the contamination of food with its egg and cysts, and that, hawked foods are especially the source of transmission to consumers of such items (Idowu, 2009).

The outstanding predisposing factor for food contamination is that of excessive handling. Onwuka (2005) clearly explained that, in practical food processing, a larger proportion of foodborne bacteria are destroyed at a temperature below the boiling point of water. Besides, spores forming organisms are destroyed at temperature up to 121o C or above. However, if such foods, which have been rendered safe through adequate cooking, is packed in contaminated wraps or containers, the chances of infection still exist. The more the number of food handlers the higher the risk of infection of enterotoxins. Skin lesions and nasal secretions are the media through which the infecting organisms are transmitted to others (Duyff, 2007).

Food contamination can be prevented ultimately at a personal level by those who handle food carefully, keep clean, cook it to safe internal temperature, separate raw from cooked food, chill perishable food promptly, and defrost properly (Ajala,2006). Among the major public health problems that particularly need attention are hunger, high-risk lifestyle and diet. Providing information on the quality of food service, sanitation and safety can salvage a good number of individuals from being victims to contaminated hawked food (Duyff, 2007,). It could be believed that easy accessibility to food could provoke the habit of eating out of gullibility and not due to hunger. The already filled stomach has no more space for excess incoming food. The longer it takes the food to reach the stomach, the higher the risk of infection due to the growth of infectious organisms in the gullet. Studies have shown that organism particularly microorganisms grow more rapidly in an alkaline environment (Onwuka, 2005). Therefore, the acidic stomach fluid acts against the growth of microorganisms. Achalu (2005) listed some factors, which influence consumers' behaviour to include the cost of the product and availability. These factors apply so well to hawked food as they are fairly cheaper and accessed with little or no stress. The author considered motives as being another major determinant of consumers' behaviour in the market place. Explaining, his opinion that, motives are the impulses or feelings that causes one to act in a specific way, which could be physical or psychological. The physical motives had to do with the buying of a product to satisfy a need, while psychological tilt to the aspect of purchasing a particular product to be accepted by a peer group.

Winarao and Allain (2008), gave an elaborate report on food hawing activities and stated that a hawker is considered as merchandise that moves and sells his product from place to place. In most places, a hawker sells items or food that is native to the area. For this study, the definition of a hawker is strictly limited to street food vendors. It is observed that urban population growth has stimulated a rise in the number of street food vendors in many cities throughout the world. Migration from rural areas has created a daily need among many workers to eat food outside their homes. Greater numbers of people in contemporary times are exposed to hawked food and at times are tempted to patronize the hawked food vendors. Both processed and unprocessed foods are hawked freely in many cities of the global south which calls for concern, particularly this period that several countries of the world are battling with the rampaging coronavirus. However, this study is interested in the prepared hawked foods that are eaten as they are presented. The aim of the study, therefore, is to explore the possible health implications that could be associated with

polluted hawked food using Uyo municipality, as a study area. Among the hawked foods that this study investigated are meat pepper soup, rice and stew, beans, moi-moi, cakes, and fried meat.

2. MATERIALS AND METHODS

The study was carried out in Uyo Metropolis, Akwa Ibom State, Nigeria (Fig. 1). Akwa Ibom State lies between latitudes $4^0$33' and $5^0$33' north; and longitudes $7^0$35 and $8^0$25' East. The study area falls within the tropical zone with dominant vegetation of green foliage of trees, shrubs and oil palm trees, which hold the highest density of the cash crops in the world including rubber, cocoa and rice. Uyo is located in the tropical monsoon climate with rainfall having a bimodal peak in June and September/October. The weather is hot and humid for most of the year, the wet season, on the other hand, starts early around March. The meteorological conditions of the area are greatly influenced by tropical maritime air mass. The dry season is thus short, not more than three months from December when rain-bearing winds are sometimes replaced by the harmattan wind. The study is designed to include four of the major roads in the municipality (Fig. 2). These are State Secretariat (Abak road), Aka Etinan Road, an offshoot of Aka roads, Itam Junction Market along Ikot Ekpene Road, Mbiabong Motor Park representing Oron Road axis, and the number one market in the municipality - Urua Akpan Andem Market. The wind speed in Uyo is not constant, wind speed is lower than 2.5m/s and rarely exceeds 2.8m/s. winds speed were observed to be lower at night compared to values recorded during daytime hours. The highest wind speeds in the area are recorded at the outset of the raining season – late March to early April. The temperature in the study area is also characterized by little variation in mean air temperature. The average temperature in Akwa Ibom State ranges from 23^0C to 31^0C. Temperature is lower in the raining moth than in the dry months. The soils are derived from sand deposits and shales, sandy parent materials which are highly weathered and are dominated by low activity day (Udo and Sobulo, 1981). The area generally has undulating topography which breaks at river and stream valleys.

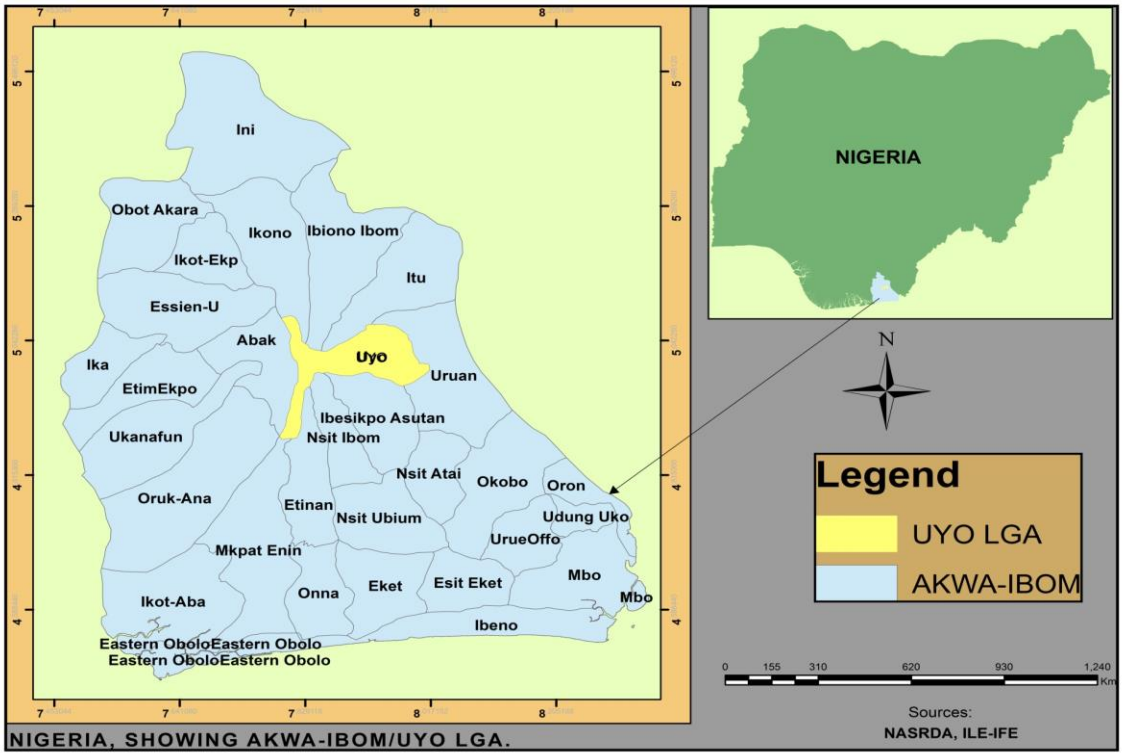

Fig. 1: Nigeria showing Akwa Ibom/Uyo LGA

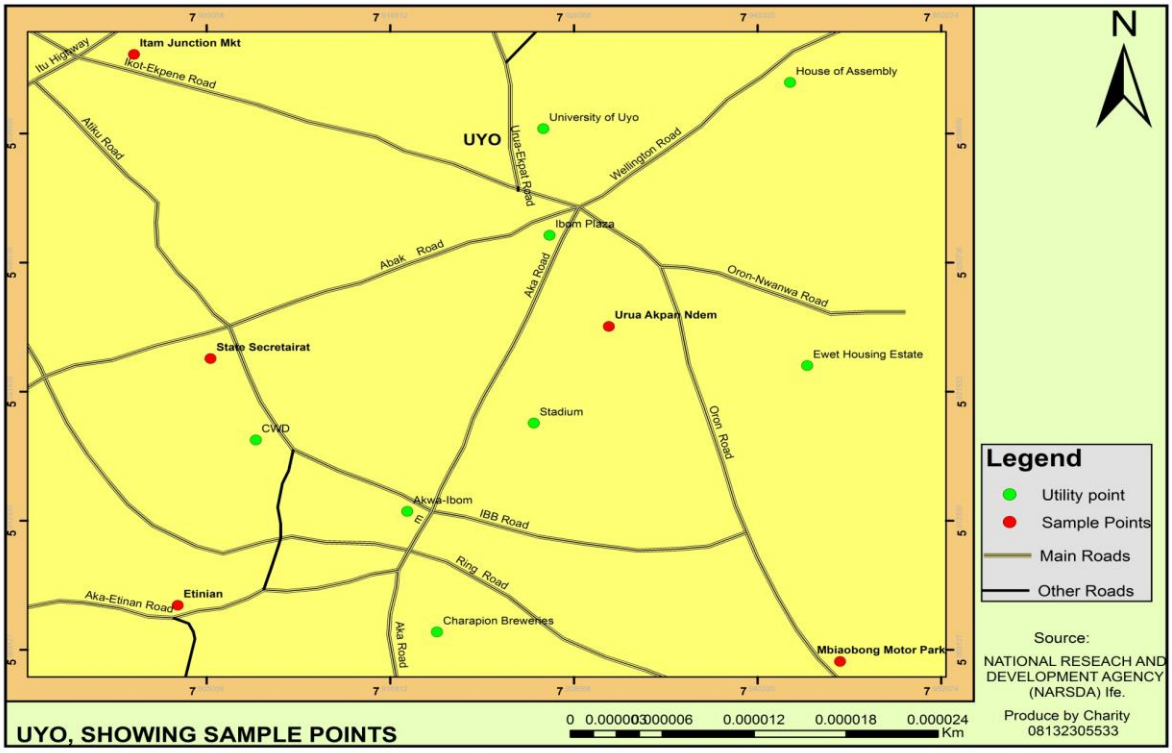

Fig. 2: Uyo LGA Showing Sample Points

The study focused on the four locations only and the proposed respondents chosen to respond to the questionnaire items were adult of both sexes and minimum of 17 years of age. The food items considered for this study were moi-moi, rice and stew, beans, cakes, meat pepper soup and fried meat. Convenient sampling technique was adopted in this study. The method paved the way to make use of available subjects until the required number is gotten (Udontre, 2004). Using this procedure judiciously, thirty food samples were collected from each of the five locations, making one hundred and fifty samples. Simple random sampling technique was later employed to choose at least eighty-two respondents per location, totaling four hundred and ten in all. The study locations were purposively selected to ensure representation of all the major roads, and areas with enough population to allow for random sampling procedure.

The main tool of data collection for the study was a questionnaire developed in two sections, A and B. Section A paid attention to demographic details of the respondents; while section B presented questions in Likert format in form of strongly agree (4), agree (3), disagree (2), and strongly disagree (1). Different food samples (moi-moi, rice and stew, beans, fried meat, cakes, and meat pepper soup) were collected at five times which amounts to a total of 150 samples, using sterile polyethene bags and plastic bowels directly from the hands of the hawkers. They were immediately transported to Microbiology Laboratory, University of Uyo Teaching Hospital, for analysis within 5hours of collection. The samples were collected and analyzed in batches of 4 to complete the laboratory analysis of the food samples. The laboratory analyses were carried out to detect the bacteria and fungi present in each food items.

3. RESULTS AND DISCUSSIONS

3.1 Demographic Details of Respondents

Table 1 presents the demographic details of the study respondents. On age issue, the greater percentage (4 5%) of respondents was obtained from the age bracket of 17-23 years. This was followed by those within 24-30 years with 35%. Those at the range of 31-37 formed 10%, and 8% was recorded for the age bracket 38-44, while those at the age range of 45 and above years formed 2% of the respondents. Enquiry on the educational level of the respondents revealed that minority of the respondents (61%) had secondary school education. Those who had primary education ranked next being (31%) while those with tertiary education were 8%. None belonged to the non-formal education group. Information was sought regarding the marital status of the respondents. 76% were unmarried and was the largest group. The married were 17%, 6% were divorced and 1% were widowed. Investigation on sex showed that male respondents were 77% while female was 23%. On religion, overwhelming majority of 98% were Christians and 2% were identified with other forms of religion. None of the respondents is Moslem or traditional worshipper. Being a heterogeneous community and a commercial centre, it was necessary to find out the locality of each respondent. Those with urban orientation and upbringing were the majority of the respondents being (83%). The remaining 17% came from rural area. On occupation, the self-employed formed a greater percentage of respondents (68%). Civil servants ranked next with 17%, students were 10% while 5% were unemployed.

Table 1. Demographic Characteristics of the Respondents

Variables	**Frequency**	**Percentage (%)**
Age of respondents		
17 -23 years	185	45

24 – 30 years	144	35
31 – 37	41	10
38 – 44	33	8
45 and above	8	2
Total	**410**	**100**
Educational level		
Primary	126	31
Secondary	250	61
Tertiary	34	8
Non-formal	-	-
Total	**410**	**100**
Marital status		
Unmarried	310	76
Married	70	17
Widowed	5	1
Divorced	25	6
Total	**410**	**100**
Sex		
Male	35	77
Female	95	23
Total	**410**	**100**
Religion		
Christianity	402	98
Muslim	-	-
Traditional	-	-
Others	8	2
Total	**410**	**100**
Locality		
Urban	340	83
Rural	70	17
Total	**410**	**100**
Occupation		
Unemployed	20	5
Self employed	280	68
Civil servant	70	17
Students	40	10
Total	**410**	**100**

3.2 Perception of Chances for Contamination of Hawked Food

The chances for hawked food contamination are presented in Table 2. Responding to the conditions of exposure of food as creating access for micro-organism, majority of the respondents (62%) agreed while 38% strongly agree. No respondent disagreed to this fact. Findings of eating most hawked food with unwashed hands showed that a very great number of the respondents strongly agreed to this common practice (65%); a good number (30%) agreed; while just a few answered negatively to the item with 4% disagree and 1% strongly disagree. Most of the respondents (51%)

strongly agreed that sharing of' cutleries could lead to the transfer of infection while 36% agreed. A reasonable number (8%) indicated that they disagreed and 4% strongly disagreed with the notion.

In terms of food hawked by children as tending contamination, the greater number of responses came from those who strongly agreed (64%), those who agreed were 19%. Some respondents though few still saw nothing wrong in children hawking food, as 13% disagreed and 4% strongly disagreed to the assertion. The result of findings on hawking about to spoil food showed that majority response came from those who indicated 'strongly agree' with (52%) and 30.2% indicated 'agree'. A few numbers (15%) of respondents 'disagreed' and 3% 'strongly disagreed' to the assertion. Generally, the result shows that the responses reflected in respect of' chances for hawked food contamination shows that, the respondents attest to the fact that there are special conditions that make hawked food prone to contamination.

Table 2 further presents the different opinions of hawked food consumers about the quality of hawked foods. On the issue of standard, the great majority of' the respondents testified that the quality of' hawked food is not of a good standard with 44% 'strongly agreed', 46% 'agreed'. 6% disagreed as they responded that there is nothing wrong about the standard of hawked food and 4% 'strongly disagreed' to the ill-opinion, raised about the standard of hawked food. Responding to the question which examined how enjoyable eating hawked food could be, about 86.1% of the respondents affirmed that hawked food is not quite enjoyable. The remaining respondents had a contrary view as 7.6% 'disagreed' and 6.3% 'strongly disagreed' to the questionnaire item. Answering question relating to the appearance of hawked food, the respondents who 'strongly agreed' and those that 'agreed' that they do not appreciate the appearance of hawked food formed the greater majority with 28% and 45.6% respectively. Some respondents claimed to be satisfied with the appearance of hawked foods as 20% 'disagreed' and 6.3% 'strongly disagreed'.

The impression of the respondents about the price prescribed for a certain quantity of' hawked food shows dissatisfaction. About 85.1% of the respondents opined that they did not consider the quantity of some hawked foods as suitable for the prize sold while the, remaining 14.8%, on the contrary, justified the cost for the quantity of food. In respect of the taste of hawked food, those who answered that most hawked foods do not taste fresh and nice were 'Strongly Agree' (47%) and 'Agree' (43%). A few numbers of the respondents had nothing against the taste of hawked foods with 6% 'Disagree' and 4% 'Strongly Disagree'. Generally, the result shows that even though people eat hawked food, they do not consider its quality as satisfactory or meeting health standard.

Table 2: Opinion on chances for contamination and quality of Hawked Food

S/N	Questionnaire Items	Strongly Agree	Agree	Disagree	Strongly Disagree
1	Exposing food could facilitate easy access to microorganisms that cause diseases	157 (38.3)	253 (61.7)	0 (0.0)	0 (0.0)
2	Most hawked foods are eaten with unwashed hands	267 (65.1)	123 (30.0)	16 (3.9)	4 (1.0)
3	Sharing or inadequate washing of cutleries transfer infection	211 (51.5)	149 (36.3)	34 (8.3)	16 (3.9)

4	Foods hawked by children are more prone to contamination	263 (64.1)	78 (19.0)	54 (13.2)	15 (3.7)
5	Some dealers hawked out foods that are about to spoil	215 (52.4)	124 (30.2)	60 (14.6)	11 (2.7)
6	Hawked foods may not be of good standard.	179 (43.7)	187 (45.6)	25 (6.1)	19 (4.6)
7	Hawked foods are not always enjoyable	208 (50.7)	145 (35.4)	31 (7.6)	26 (6.3)
8	The appearance of hawked foods is not always highly appreciated	115 (28.0)	187 (45.6)	82 (20.0)	26 (6.3)
9	The quantity of some hawked foods does not worth the cost	125 (30.5)	224 (54.6)	3 (0.7)	58 (14.1)
10	Most hawked foods do not actually taste fresh or nice	191 (46.6)	175 (42.7)	26 (0.3)	18 (4.4)

Percentage (%) in brackets

3.3 Spatial Variation of Total Bacterial Count in Food Samples

Table 3 presents the result of the total bacterial count in food samples from the study locations. In meat pepper soup samples, the highest bacterial mean count was 1.58 x l08cfu/ml which was collected from Aka Etinan Road samples. This was followed by Itam Junction market samples which had a mean count of 1.20 x I08cfu/ml. Samples from Mbiabong Motor Park had a mean count of 0.35 x 108cfu/ml. State Secretariat and Urua Akpan Andem market samples had a mean count of 0.14 x 108cfu/ml each respectively.

In considering total pathogenic bacteria count, Itam Junction market sample presented the highest mean Count of 0.49 x 108cfu/g. Samples from Aka Etinan Road had a count of 0.18 x 108cfu/g. Urua Akpan Andern and State Secretariat each had 0.09 x l0cfu/g mean count. Mbiabong Motor Park samples were free from pathogenic bacterial contamination. Thus, the result is significant demonstrating bacterial contamination of the food samples.

The Table also shows the results of total bacterial counts in rice and stew samples. It was generally observed that a very high microbial counts came from rice and stew samples from different locations. The highest count of 2.50 x 108cfu/g was found in samples from the Urua Akpan Andem market as well as Aka Etinan Road. A mean count of 1 .0 x 108cfu/g was found in State Secretariat samples and 0.34 x 108cfu/g in samples from Itani Junction market. The lowest count in rice and stew samples was 0.17 x l08cfu/g which was from Mbiabong Motor Park. The result of total pathogenic bacteria count showed that the highest mean count was obtained in Urua Akpan Andem market samples with a value of 1.28 x I08cfu/g. In samples from State Secretariat, it was observed that all the bacterial isolates were pathogenic, potential health hazard bacteria with a count of 1.0 x 108cfu/g, the same as total bacterial counts.

The result of bacterial counts of both total and pathogenic in moi moi samples of study locations was demonstrated in Table 3. High microbial counts were obtained from Itam Junction market, with a mean count of 6.8 x 108cfu/g. 1.04 x 10cfu/g was obtained as bacterial counts in samples from Aka Etinan Road. The State Secretariat sample had a count of 0.92 x 108cfu/g, while Mbiabong Motor Park had a mean count of 0.48 x 108cfu/g. The lowest count was recorded from samples obtained from Urua Akpan Andern market which was 0.23 x 108cfu/g. The Table shows that the highest total pathogenic bacteria count came from samples collected from Aka Etinan Road which was 0.73 x 108cfu/g. Samples from Mbiabong Motor Park had a count of 0.31 x

l08cfu/g; Slate Secretariat, 0.I9 x 108 cfu/g and Urua Akpan Andem market had 0. 11 x 108cfu/g. Moi moi samples from Itam Junction market were free of pathogenic bacterial contamination.

Table 3 further presented the total bacterial and total pathogenic bacteria count observed in cake samples. Cake samples were generally observed to be the least contaminated of all the samples investigated. The different mean counts were: 0.40 x l08cfu/g from Mbiabong Motor Park and 0.43 x 108cfu/g from Urua Akpan Andem market; and the highest count of 0.57 x 108cfu/g was from Aka Etinan road samples. The least was found in Itam Junction market sample as 0.04 x l0cfu/g. Pathogenic bacteria counts were 0.27 x 10cfu/g, is the highest from the sample obtained from Urua Akpan Andem market, 0.22. x 108cfu/g counts from Aka Etinan road; Mbiabong Motor Park had 0.19 x 108cfu/g while State Secretariat had 0.1 x l08cfu/g. The least counts came from Itam Junction market (0.01 x 108cfu/g).

Total bacterial count in fried meat samples from the study locations were presented as well. The meat from Aka Etinan Road had the highest bacterial count of 1.08x l08cfu/g. Itam Junction market ranked next with a count of 0.92 x l08cfu/g. The bacterial counts of 0.25 x l08cfu/g and 0.17 x I08cfii/g were recorded for Mbiabong Motor Park and Urua Akpan Andern market, respectively. The least bacterial counts were from the samples of State Secretariat which were 0.14 x 108cfu/g. For the total pathogenic bacteria count, it was observed that the highest count of 0. 1 8 x 108cfu/g was obtained from Etinan Road sample followed by a count of 0.09 x 108cfu/g from Itam Junction market. The meat samples from State Secretariat and Urua Akpan Andem market both had the pathogenic count of 0.4 x 108cfu/g each, while Mbiabong Motor Park sample recorded 0.03 x 108cfu/g being the least count.

The bacterial counts in beans samples were also presented in Table 3. For total bacterial count, the result showed that the beans sample from Urua Akpan Andem market had a high count of 2.01 x 108cfu/g. Also, 1.58 x 108cfu/g pathogenic count was recorded from the sample collected from Aka Etinan Road. The samples from State Secretariat also reflected a high count of 1.02 x108cfu/g. The beans samples from Itam Junction market were moderately contaminated, with a bacterial count of 0.34 x l08cfu/g. The Mbiabong Motor Park samples showed the least count in the group being 0.17 x 108ctu/g. When considering pathogenic bacteria counts, the samples from Urua Akpan Andem still ranked the highest with a value of 1.28 x l08cfu/g followed by State Secretariat samples which had 0.8 x 108cfu/g. Aka Etinan samples recorded 0.25 x 108cfu/g for pathogenic bacteria count, and Mbiabong Motor Park had 0.15 x 108cfu/g. The least count of 0.02 x 108cfu/g was recorded from ltam Junction market samples.

Table 3. Total Bacterial Count in Hawked Food Samples

Samples	Sample location	Total bacterial count (TBC)	Total pathogenic Bacterial count (TPBC)
Meat pepper soup			
	Mbiabong Motor Park	0.35×10^8	-
	Itam Junction Market	1.2×10^8	0.49×10^8
	Urua Akpan Andem Market	0.17×10^8	0.09×10^8
	Aka Etinan Road	1.58×10^8	0.18×10^8
	State secretariat	0.14×10^8	0.09×10^8
Rice and Stew			
	Mbiabong Motor Park	0.17×10^8	0.15×10^8
	Itam Junction Market	0.34×10^8	0.12×10^8

	Urua Akpan Andem Market	2.5 x 10^8	1.28 x 10^8
	Aka Etinan Road	2.5 x 10^8	0.25 x 10^8
	State secretariat	1.0 x 10^8	1.0 x 10^8
Moi Moi			
	Mbiabong Motor Park	0.48 x 10^8	0.31 x 10^8
	Itam Junction Market	1.68 x 10^8	-
	Urua Akpan Andem Market	0.23 x 10^8	0.11 x 10^8
	Aka Etinan Road	1.04 x 10^8	1.0 x 10^8
	State secretariat	0.92 x 10^8	0.19 x 10^8
Cake			
	Mbiabong Motor Park	0.40 x 10^8	0.19 x 10^8
	Itam Junction Market	0.04 x 10^8	0.01 x 10^8
	Urua Akpan Andem Market	0.43 x 10^8	0.27 x 10^8
	Aka Etinan Road	0.58 x 10^8	0.22 x 10^8
	State secretariat	0.14 x 10^8	0.1 x 10^8
Fried meat			
	Mbiabong Motor Park	0.25 x 10^8	0.03 x 10^8
	Itam Junction Market	0.92 x 10^8	0.09 x 10^8
	Urua Akpan Andem Market	0.17 x 10^8	0.04 x 10^8
	Aka Etinan Road	1.08 x 10^8	0.18 x 10^8
	State secretariat	0.14 x 10^8	0.04 x 10^8
Beans			
	Mbiabong Motor Park	0.17 x 10^8	0.15 x 10^8
	Itam Junction Market	0.34 x 10^8	0.02 x 10^8
	Urua Akpan Andem Market	2.01 x 10^8	1.28 x 10^8
	Aka Etinan Road	1.58 x 10^8	0.25 x 10^8
	State secretariat	1.02 x 10^8	0.8 x 10^8

3.4 Spatial variation of Microbial Count of Aetiologic Agents Health [Problems Food Samples]

Table 4 presents the microbial count of agents that cause serious gastrointestinal 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 meat pepper soup, the most contaminated were samples from Itam Junction market with a mean count of 0.49 x108cfu/ml for *Salmonella* and *Shigella*, 0.8 x 108cfu/ml for *E. coli*, and 0.18 x 108cfu/ml for *Vibrio cholera* count. Aka Etinan Road samples had 0. 1 x 108cfu/ml for *Salmonella* and *Shigella*, 0.13 x 108cfu/ml for E. coli and 0.32 x 108cfu/ml for *Vibrio cholera*, which was the highest count recorded for *Vibrio cholera*. State Secretariat had *Salmonella* and *Shigella* counts of 0. I x 108cfu/ml and same Count for *E. coli*, while *Vibrio cholera* count was 0.3 x 108cfu/ml. Urua Akpan Andem market had *Salmonella* and *Shigella* counts of 0.1 x 108cfu/ml but no count for E. coli and *Vibrio cholera* Mbiabong Motor Park sample was completely free of all the infecting agents. In rice and stew samples of various study locations, Urua Akpan Andem market samples were the most contaminated with *Vibrio cholera* 0.9 x 108cfu/g, *E. coli* having a count of 0.5 x 108cfu/g and its *Salmonellu* and *Shigella* counts were 0.11 x l08cfu/g. Motor Park and Itam

Junction market had *Salmonella* and *Shigella* counts of 0.3 x l08cfu/g each. Both samples had zero counts for *Vibrio cholera,* and the same applied to samples from State Secretariat. *E. coli* counts For Mbiaborng Motor Park and State Secretariat samples were 0.3 x 108cfu/g. Samples from Aka Etinan Road had 0.16 x 108cfu/g for *E. coli*, 0.38 x I08cfu/g for *Vibrio cholera* and none for *Salmouella* and *Shegella*. In moi moi samples analyzed, the samples from State Secretariat had the highest *Salmonella* and *Shigella* counts of 0.9 x 108cfu/g, *Vibrio cholera* counts of 0.8 x I 08cFu/g but completely free from *E. coli*. Mbiabong Motor Park samples recorded the highest counts of *E. Coil* in the group as 0.8 x 108cfu/g was the count of *Vibrio cholera* and 0.13 x 108cfu/g for *Salmonella* and *Shigella*. Samples from Urua Akpan Andem market had 0.2 x 108cfu/g for *Salmonella* and *Shigella*, 0.4 x 108cfu/g for *E.coli* and 0.2 x 108cfu/g for *Vibrio cholera* Aka Etinan sample had the count of 0.3 x 108 cfu/g for *Salmonella* and *Shigella*, 0.15 x 108 cfu/g for *E.coli* and 0.33 x 108cfu/g for *Vibrio cholera*. The moi moi samples from Itam Junction market were completely free of all the agents that can cause serious health problems. However, the microbial agents of health problem in cake samples from Aka Etinan road had *Salmonella* and *Shigella* count which were 0.6 x 108cfu/g, *E. coli* count 0.3 x 108cfu/g and *Vibrio cholera* count 0.1 x 108cfu/g. samples from Mbiabong Motor Park and Urua Akpan Andem market had mean counts of 0.4 x108cfu/g and 0.3 x108cfu/g, respectively for *Salmonella* and *Shigella*, 0.1 x108 cfu/g for *Vibrio cholera* and nil count for *E.coli*. The samples from State Secretariat had the highest counts of 0.7 x 108cfu/g for *Vibrio cholera* while other agents were not present. The samples from Itam Junction market were completely free from contamination of potential epidemic agents.

The result of microbial agents of health problems in fried meat samples was presented as well. The samples from Aka Etinan Road had *Salmonella* and *Shigella* counts of 0.8 x108cfu/g each; total E. coli counts of 0.3 x108cfu/g and *Vibrio cholera* counts of 0.25 x108cfu/g each. Itam Junction market meat samples recorded 0.51 x108cfu/g for *Salmonella* and *Shigella*, 0.05 x 108cfu/g for *E. coli* and 0.16 x108cfu/g for *Vibrio cholera*. State Secretariat samples had *Salmonella* and *Shigella* counts of 0.2 x108cfu/g. *E. coli* counts of 0.13 x 109cfu/g and *Vibrio cholera*, 0.4 x 109cfu/g which was highest. Mbiabong Motor Park samples had *Salmonella* and *Shigella* counts of 0.13 x 108c fu/g, *E. coli*, recorded zero counts, while *Vibrio cholera* was 0.1 x 108cfu/g.

Beans samples also demonstrated the presence of the microbial agent of health problems. The samples from Itam Junction market had the value of 0.3 x 109cfu/g for *Salmonella* and *Shigella*, zero for *E. coli* and zero for *Vibrio cholera*. The samples From Mbiabong Motor Park had counts of 0.2 x 109cfu/g for *Salmonella* and *Shigella*, 0.1 x 109cfu/g for E. coli and zero for *Vibrio cholera*. Urua Akpan Andem market samples had a *Salmonella* and *Shigella* counts of 0.11 x 109cfu/g, 0.8 x I09cfu/g for E. coli which was the highest. *Vibrio cholera* counts of 0.6 x 109cfu/g were recorded. Aka Etinan Road mean counts for the three agents were 0.01 x 109cfu/g, 0.11 x 109cfu/g and 0.28 x109cfu/g for *Salmonella* and *Shigella, E. coil* and *Vibrio cholera* respectively. The State Secretariat samples reflected a mean count of 0.2 x 109cfu/g for both *Salmonella* and *Shigella, E. coli* while a count of 0.12 x 109cfu/g was recorded for *Vibrio cholera*.

Table 4: Microbial count of Aetiologic Agents of Health Problems in Food Samples

Samples	Sample location	Total	Total Escherichia coli count	Total vibrio cholera count

		Salmonella and Shigella Count		
Meat pepper soup				
	Mbiabong Motor Park	0	0	0
	Itam Junction Market	0.49×10^8	0.49×10^8	0.18×10^8
	Urua Akpan Andem Market	0.1×10^8	0.09×10^8	0
	Aka Etinan Road	0.1×10^8	0.18×10^8	0.32×10^8
	State secretariat	0.1×10^8	0.09×10^8	0.3×10^8
Rice and Stew				
	Mbiabong Motor Park	0.3×10^8	0.15×10^8	0
	Itam Junction Market	0.3×10^8	0.12×10^8	0
	Urua Akpan Andem Market	0.11×10^8	1.28×10^8	0.9×10^8
	Aka Etinan Road	0×10^8	0.25×10^8	0.3×10^8
	State secretariat	0.2×10^8	1.0×10^8	0
Moi Moi				
	Mbiabong Motor Park	0.8×10^8	0.31×10^8	0.7×10^8
	Itam Junction Market	0	-	0
	Urua Akpan Andem Market	0.2×10^8	0.11×10^8	0.2×10^8
	Aka Etinan Road	1.3×10^8	1.0×10^8	0.33×10^8
	State secretariat	0.9×10^8	0.19×10^8	0.8×10^8
Cake				
	Mbiabong Motor Park	0.4×10^8	0.1×10^8	0.1×10^8
	Itam Junction Market	0	0	0
	Urua Akpan Andem Market	0.3×10^8	0.1×10^8	0.1×10^8
	Aka Etinan Road	0.6×10^8	0.1×10^8	0.1×10^8
	State secretariat	0×10^8	0.7×10^8	0.7×10^8
Fried meat				
	Mbiabong Motor Park	0.18×10^8	0.1×10^8	0.1×10^8
	Itam Junction Market	0.51×10^8	0.03×10^8	0.03×10^8
	Urua Akpan Andem Market	0.3×10^8	0.16×10^8	0.16×10^8
	Aka Etinan Road	1.8×10^8	0.25×10^8	0.25×10^8
	State secretariat	0.2×10^8	0.4×10^8	0.4×10^8
Beans				
	Mbiabong Motor Park	0.2×10^8	0	0
	Itam Junction Market	0.3×10^8	0	0
	Urua Akpan Andem Market	0.11×10^8	0.8×10^8	0.6×10^8
	Aka Etinan Road	0.01×10^8	0.11×10^8	0.28×10^8
	State secretariat	0.2×10^8	0.2×10^8	0.12×10^8

3.5 Spatial Variation of Total Mycological Count in Food Samples

Table 5 shows the mycological count in food samples in the study locations. When considering meat pepper soup, the samples from Itam Junction market had the highest counts of 1.09 x

108cfu/ml, followed by Urua Akpan Andem market samples with a count of 0.31 x 108cfu/ml. State Secretariat samples had 0.11 x 108cfu/ml. Mbiabong Motor Park, 0.07 x 108cfu/mI and Aka Etinan Road samples, 0.04 x l08cfu/ml. Rice and stew samples were considered also concerning contamination with fungal groups. Aka Etinan Road rice samples showed such a heavy growth of mycological mean, count of 2.02 x 108cfu/g State Secretariat had 0.5 x 108cfu/g, Mbiabong Motor Park, 0.16 x 108cfu/g; and a count of 0.03 x 108cfu/g each were obtained for Itam Junction market and Urua Akpan Andem market samples, respectively. Table 5 also reflects the mycological counts in moi moi samples. The highest count recorded was 0.50 x 108cfu/g from the State Secretariat sample. Urua Akpan Andem market had a count of 0.47 x 108cfu/g, Aka Etinan Road 0.46 x 108cfu/g, Itam Junction market, 0.20 x 108cfu/g and Mbiabong Motor Park (0.10 x 108cfu/g) was the least contaminated. For cake samples, counts with the highest value of 0.33 x 108cfu/g was obtained from Mbiabong Motor Park. State Secretariat and Aka Etinan Road had counts of 0.14 x l08cfu/g and 0.11 x l08cfu/g, respectively. Sample from Urua Akpan Andem market had 0.07 x 108cfu/g. The least count came from Itam Junction market samples as 0.03 x 108cfu/g. In considering fried meat samples, observation showed that the highest mycological counts came from meat samples From Mbiabong Motor Park, which was 0.31 x l0cfu/g. State Secretariat samples had 0.12 x10cfu/g Itam Junction market and Aka Etinan Road samples had counts of 0.10 x 10cfu/g each while samples from Urua Akpan Andem market showed counts of 0.4 x 10cfu/g which was the least contaminated in the group. In beans samples, the highest count came from State Secretariat samples which had 0.4 x 108cfu/g. this was followed by 0.21 x 108cfu/g from Urua Akpan Andem market samples. Aka Etinan Road and Itam Junction market had mycological counts of 0.04 x 108cfu/g and 0.03 x 108cfu/g respectively. The least counts came from Mbiabong Motor Park samples which were 0.02 x 108cfu/g.

Table 5. Total Mycological Count in Food Samples

Samples	Sample location	Cell count
Meat pepper soup		
	Mbiabong Motor Park	0.07×10^8
	Itam Junction Market	1.09×10^8
	Urua Akpan Andem Market	0.31×10^8
	Aka Etinan Road	0.04×10^8
	State secretariat	0.11×10^8
Rice and Stew		
	Mbiabong Motor Park	0.16×10^8
	Itam Junction Market	0.03×10^8
	Urua Akpan Andem Market	0.03×10^8
	Aka Etinan Road	2.02×10^8
	State secretariat	0.51×10^8
Moi Moi		
	Mbiabong Motor Park	0.10×10^8
	Itam Junction Market	0.20×10^8
	Urua Akpan Andem Market	0.47×10^8
	Aka Etinan Road	0.46×10^8
	State secretariat	$0.50x\ 10^8$
Cake		
	Mbiabong Motor Park	0.33×10^8

	Itam Junction Market	0.03×10^8
	Urua Akpan Andem Market	0.07×10^8
	Aka Etinan Road	0.11×10^8
	State secretariat	0.14×10^8
Fried meat		
	Mbiabong Motor Park	0.31×10^8
	Itam Junction Market	0.10×10^8
	Urua Akpan Andem Market	0.04×10^8
	Aka Etinan Road	0.10×10^8
	State secretariat	0.12×10^8
Beans		
	Mbiabong Motor Park	0.02×10^8
	Itam Junction Market	0.03×10^8
	Urua Akpan Andem Market	0.21×10^8
	Aka Etinan Road	0.04×10^8
	State secretariat	0.40×10^8

3.6 Spatial Variation of Taxonomic Features of Fungi

Table 6 shows the taxonomic features of fungal species isolated from the hawked food samples. All the isolates were filamentous; all except one had hyphae. Their vegetative structures vary as some were broomlike, two were of foot cell, one had stolon/rhizoid structure while others showed no definite structure. Two of the organisms had globose conizoids heads and vesical shapes. The asexual spores were of varieties except three that had globose candial spores. The mycological species are made of varieties of colours like white, dark, powdery brown, creamy jell and bluish green as indicated in Table 6.

Table 6. 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 dark with age	Filamentous	Co-enocytic	Stolons/ rhizoid	Ovoid sporagio spores	Tall, growth sporangiosphre	-	-	*Rhizopus stolonifer*
Cotton white	Filamentous	Septate	-	Unicellular conidial (cylindrical)	Phialides	-	-	*Vertialliu m sp.*
Dark or black	Filamentous	Septate	Foot cell	Globosecon idia	Smothered conidioiphores	Globose	Globose	*Aspergillus stereos*
Very	Filamentous	Septate	-	Aleuryospores	Erect conidiophore	-	-	*Humicola sp*

dark myceliu m				phialespore s				
White	Filamen tous	Septa te	-	Unicellular conidia in chains	Condiogeno ics hyphae	-	-	*Monilia sp*
Very dark myceliu m	Filamen tous	Septa te	-	Sporos pores	Clusters conidiophor es	-	-	*Helmintho sporium velutinum*
Blush green	Filamen tous	Septa te	Broomli ke	Globose conidia	Dense brush like	-	-	*Penicullus*
Powder y brown	Filamen tous	Septa te	-	Acropetal chains conidia micro conidia	Short conidiospho res	-	-	*Clasdiosp orium sp*
Creamy yell	Filamen tous	Septa te	Foot cell	Micro conidia	Differentiat d condiophor es	-	Spineli ke projecti on	*Microspor ium sp*
Basal dark	Filamen tous	Septa te	Broomli ke	Globose conidia	Smooth erect condiophor es	Globo se	Globos e	*Aspergillu s niger*
Bluish green	Filamen tous	Septa te	Broomli ke	Saboglobos e	Branched condisphore s	-	-	*Penicilliu m expansium*

4. DISCUSSION OF FINDINGS

The respondents accept that certain conditions make hawked food susceptible to contamination; such conditions include exposure of food, underage dealer, unwashed hands and sharing of equipment. It is very clear that underage hawkers are not sensitive to rules of hygiene, they drop foods on the ground and pick them back, or just wipe with dirty clothes, thereby contaminating them. Where proper handwashing facility with soap and water is lacking before handling food to eat, the hand contaminates the food with the organisms it harbours. Exposing food give easy access for microorganisms present in the air to come in contact with and contaminate the food.

Ajala (2006) agreed that eating food outside home increases the chances of food-borne diseases. Food handling technique is found to be associated with food contamination; that is, allowing food to come in contact with body, clothing and secretions can lead to an outbreak of serious illness such as *Staphylococcal* illness (Jacob, 1989). Mudambi and Rajagupal (2007) confirm that exposing food provides easy access for insect (flies) and chemical as well as bioaerosol contamination which may result in various gastrointestinal problems.

The laboratory analysis revealed that food samples from Mbiabong Motor Park were the least contaminated. The reason could be traced to population density which is not as congested as the

markets. The park is located at a distance from the centre of the city and with better sanitary outlook. Overcrowding increases pollution of air which eventually rests on food. The reason for least contamination of cake and fried meat samples observed may be attributed to the low water content which reduces the microbial population. On the other hand, rice and stew and beans samples which had the highest water content were most contaminated as they provide favourable conditions for microbial growth (Mohapatra, 2008).

Close observation of the result has given the impression that the procedure involved in serving a particular food contributes to the level of contamination. Rice and stew samples were the most heavily contaminated and this could be traced to the serving equipment. Very often, the dealers have to wash the utensils between customers. The washing facility is quite inadequate for a wheel barrel food transaction, in addition to an extreme economic container of water. Thus, there are lots of avenues opened to favour access to infecting organisms.

The microbial densities encountered in the food samples, do not agree with food standard, therefore the food samples were considered as substandard. It is worthy of' note that, not all bacterial isolates were pathogenic. Hence the analysis paid attention to the bacterial density of pathogenic importance. The results also showed high microbial densities of serious health problems. Only two of the samples were free from contamination with pathogenic bacteria. This could be that the dealers were following food hygiene principles while preparing the food.

A high incidence of enteric bacteria was also observed in many hawked food samples. These bacteria are *Salmonella, Shigella, E. coli* and *Vibrio sp.* Statistically, 72% of the samples were contaminated with at least one of these bacteria of serious health implication. This implies that the food samples had a tendency to cause epidemic health conditions. This result is confirmed by Holt *et al.* (2007) who disclosed that laboratory analysis of samples of certain hawked foods had shown high levels of total coliform and in some cases, the presence of pathogenic bacteria such as *Salmonella sp, Staphylococcus aureus, Clostridium, Perferingen* and *Vibrio cholera.*

Mycological counts also presented high densities. The highest count was observed in rice samples from Aka Etinan Road and the lowest count was found on samples from Mbiabong Motor Park. It must be mentioned that the pathogenic influence does not depend on a high density of mycological load but the virulence of the organisms, bacteria and fungi, isolated from the food samples. Mycological isolate such as *Asperrgillus* should not be found in food as they are capable of producing spores which are chemical and heat resistant (Nester *et al*, 1995). *Aspergillus niger* produces aflo- and afla-toxins and cause such symptoms as sneezing, coughing and restlessness which are not enteric (Garigan and McCanee, 1990). The filamentous fungi are sometimes called amylalotic fungi, because of their ability to produce amylase enzymes which convert carbohydrates to simple sugars. The spores of these fungi are virulent and, in the body, they are aetiologic agents of aspergillosis. Non-filamentous fungi were also found in food samples. Some yeast isolates identified were the aetiologic agents of some important diseases. Wild *Saccharomyces* is the aetiologic agent of sacchamycetosis an infection of red blood cells by wild yeasts. Candia topicalis infection mimic candidacies both in women and children These organisms found in food could be as a result of handling which favours droplet contamination from the mouth.

Lactobacillus silivarius is a normal flora in the human mouth thus contamination may have resulted from talking and tasting during food preparation as well as through sharing of cutleries. Its presence in the large sample indicates careless handling of food after cooking. *Vibrio* is the aetiologic agent of cholera and an indicator for recent contamination. *Saccharomyces* is heat-

labile, destroyed by the small application of heat. Its presence in food is a confirmation of human contamination after cooking (Nester et al, 1995).

It is a known fact that hawked foods are made cheap enough for everybody to afford, including children who may have just N10 to N20. The cheap food cannot certainly contain enough food nutrients needed by the body for good health, even though it may satisfy hunger. Onwuka (2005) has rightly observed that selection, preparation and serving of nutritious meals prepared from suitable and locally available foodstuffs are essential in ensuring good health. Supporting, Obionu (2001) confessed that minerals needed by the body in correct proportion is derived from natural and local foodstuffs. Wardlaw & Kessel (2002) also clarified that when a child has filled his stomach with snacks; the appetite for foods that are beneficial for healthy living will be diminished and this contributes to malnutrition.

The majority of food hawking dealers belong to the low-income group who just struggle to make a living out of this method and to make ends meet. They certainly employ all forms of unhealthy techniques to promote their product just to secure the patronage of their customers. They use varying forms of' flavour enhancer and colouring agents to achieve similar taste and colour of natural materials, (Wardlaw & Kessel, 2002). Some of these artificial pieces of stuff could in themselves be factors for illnesses or diseases. It is also clear that most hawked food is of carbohydrate and fat classes of food (being fried).

What seems to be of protein class (e.g. meat) most often appearing to be very insignificant and sometimes completely useless since most cannot be properly chewed to be digested. Wardlaw and Kessel (2002) emphasized that consuming adequate protein, the gamut of vitamins (especially vitamin E and l3) arid zinc helps to maximize the health of the immune system. Deficiency of these nutrients leads to recurrent sickness and poor wound healing.

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. The comfort and dignity lacking in consumption of hawked food seem to have an effect on the psychological health of an individual. Some hawked food vendors do exploit their customer through camouflaging with the attachment of very low price for their products with the desire to enforce the purchase of the food because of low price, and not actually because the quantity is reasonable. As such, the negative impression of the respondents on majority note about the quantity of hawked food cannot be argued.

Most hawkers do not maintain a specific route or location, and as such blessed with different customers daily. When a customer is disappointed by the taste of a certain product, that cannot affect their patronage as they can change to another area for their hawking the next day. Even when one has to throw away a product purchased; the vendor has already collected his money. Very often too, customers just try to consume the tasteless food for the sake of the money paid. These factors can make a food hawker not to pay particular attention to ensuring quality food.

This study extended to include testing microbial sensitivity to antibiotics on the bacterial isolates, to identify the possible antibiotics that may effectively be used to treat conditions of food poisoning. From the analysis, it was observed that *Vibrio. sp* and *Clostridium septicum* show no meaningful response to any of the tested antibiotics. A broad-spectrum antibiotic, Ampiclox that is widely used, proved useless on 12 out of 19 isolates. Resistant to common antibiotics implies that a more specialized one would be needed to treat some infections caused by the isolates.

The resistance could be traced to a high degree of abuse of the drug, through self-medication. Nicki *et al* (2010) affirms that microorganisms are accelerated by inappropriate use of antimicrobials. Onwuka (2005) opined that most cases of food poisoning may require no antibiotic

treatment, but the increased fluid intake, and salt-based fluids. The common practice is quite contrary, as people either ignore the condition until it becomes worst or simply rush to the nearby medicine shop and get few tablets/capsules 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 preventive measures against food contamination include but not limited to embrace laws, proper storage, avoidance, health education and disposable equipment. Making a personal effort and decision against hawked food means reducing exposure to microorganisms that could cause diseases. Health education of both the public and hawked food vendors on the dangers of improper food handling will foster awareness and reduce one's desire for just any food on the street. Formulating laws by the government on the operation of hawked food is considered to be one of the methods that could safeguard the consumers. Tinker (1987) assured that regulations can make hawked food safer. Once policymakers have taken their stand, there are immeasurable small ways to make life easier for both the vendors and inspectors while ensuring that the food is safer for consumers. He recommended fair licensing for eligible hawkers, and that inspection of hawking activities be carried out regularly. WHO (2009) stressed that the education of the vendors is very important. He noted that vendors are often poorly educated and untrained in food safety; 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 hawked food vendors may offer the most cost-effective way to reduce the incidence of foodborne illnesses. Disposable serving equipment ensures usage by a single customer and is discarded. Some hawked food vendors are not financially strong to opt for better equipment. The use of some polythene materials poses problems of littering and chemical contamination. Some equipment though disposable could be contaminated by handling, especially by hawkers with communicable diseases such as typhoid fever or cholera (FAO, 2009). The responsibility for food safety rests with many different people. In the developed world, there is a a great deal of emphasis placed on the responsibility of government to regulate safe production of food right through the point of purchase to consumption. Environmental Health Officers (EHOs) are one group representing the government in enforcing such regulations. EHOs focus on the structural, operational and personal hygiene aspects of food premises, in addition to the taking of food samples for analysis. Thereafter, the responsibility rests with the consumer, influenced hopefully by public hygiene practice on the storage preparation and cooking of food (Lucas and Gills, 2003). Hygiene education is an important preventive mechanism against contamination of hawked food. Hygiene education allows people to become better informed or aware of the influences affecting their health. This combined with some other components of health promotion, enable people to make possible behavioural changes. This gives people the opportunity to protect both their health and other peoples' health.

5. CONCLUSION AND RECOMMENDATIONS

The study has revealed the spatial conditions of hawked food in Uyo Municipality and has shown that hawked foods are susceptible to contamination by microorganisms which are all associated with handling techniques. This implies that attention should be paid to proper handling rules which will significantly reduce the degree of contamination of hawked food. This, in turn, requires food hygiene education for the hawkers and the general public, Economical use of water in food preparation is quite unsafe and should be avoided, Knowing that most food hawkers are under aged and untrained on food hygiene education, personal decision should be taken to avoid hawked

food as much as possible and at least be very selective of hawkers to patronize. Government bodies should undertake educational drives to give food hygiene message freely and elaborately; and regulations for food vendors should be realistic, attainable and properly enforced. Safety controls should be attractive and better implemented.

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