



## ASSESSMENT OF POOR FOOD SAFETY PRACTICES AMONG FOOD VENDORS AND HOUSEHOLDS IN LAGOS STATE, AND HEALTH IMPLICATIONS

Florence N. Uchendu

Department of Public Health Science, Faculty of Health Sciences, National Open University of Nigeria.

E-mail: uchendu\_flo@yahoo.com; Tel: +2348037065874

### Abstract

Poor food safety practices are major causes of food contamination and nutrient losses resulting in foodborne diseases and malnutrition especially in developing countries. This paper identified poor food safety practices among food handlers, consequences and remedies. A cross-sectional direct observational study was carried out to collect qualitative data on food safety practices in six major markets (Oshodi, Idumota, Mushin, Ejigbo, Isolo and Ikotun) and streets in Lagos State among 410 market food stuff sellers and 70 street food/fruit vendors. A focus group discussion was also used to obtain information on food safety practices among 200 women in households in these areas. Common poor food safety practises were documented and discussed. Data was analysed using SPSS version 20 statistical software and descriptive statistics was used to describe and summary categorical variables and result was presented in tables as proportions and percentages. Thirty nine poor food safety practices were observed among market food stuff sellers 12 (30.8 %), street food/fruit vendors 18 (46.1 %) and households 8 (23.1 %). High poor food safety practices included exposure of food stuffs and cooked foods (14.3-100.0 %), cutting of meat and vegetables before washing (70.0-83.3 %), overcooking of vegetables (71.4 %), cutting of vegetables for a long time before use (57.1 %) and selling of fried and roasted foods with old used papers and poly nylons (85.7 %). There were some general high poor food safety and hygiene practices among food handlers in this study population with immediate implications of food contamination and nutrient losses and long term health consequences of foodborne diseases and hidden hunger. Policies involving food and nutrition education through public enlightenment campaigns and monitoring will help to address poor food safety practices in this study population.

**Keywords:** Food vendors, food safety, food contamination, nutrient loss, foodborne diseases

## INTRODUCTION

Food safety involves handling of farm, public and home foods in such a way that they are dirt-, dust-, germ- and microorganism-free, thus resulting in hygienic, adequate nutrient and edible foods. Consumption of unsafe food results in foodborne diseases also known as food borne illnesses or food poisoning. Globally, foodborne diseases are a growing public health problem (Talaei *et al.*, 2015). It has been estimated that 600 million (1 in 10) people fall ill after eating contaminated food and 420, 000 die annually, resulting in the loss of 33 million healthy life years (DALYs) (WHO, 2019a). Foodborne and waterborne diarrhoeal diseases kill an estimated 2 million people annually, including many children (Ajayi and Oluwoye, 2015). The Centre for Disease Control and Prevention (CDC) estimated that, one in six Americans (or 48 million people) gets sick, 128,000 are hospitalized and 3,000 die of foodborne diseases every year (NIH, 2014). Sub-Saharan Africa experienced the highest disease burden for enteric foodborne disease followed by South-East Asia and then Eastern Mediterranean sub-region (WHO, 2015a). In 2007, about 90,000 cases of food poisoning were recorded across 56 tertiary health institutions (Ikpefan, 2014). In Nigeria, about 200,000 deaths are recorded annually mostly due to food contamination and improper food processing, preservation and service provision (Ihenkuronye, 2012).

Unsafe food containing harmful bacteria, viruses, parasites or chemical substances, causes more than 200 diseases ranging from diarrhoea to cancers (WHO, 2019a). Common symptoms of foodborne diseases are nausea, vomiting, stomach cramps/pain, diarrhoea, dysentery and fever (CDC, 2018). Diarrhoea is the acute, most common symptom of foodborne illness, but other serious consequences include kidney and liver failure, brain and neural disorders, reactive arthritis, cancer and death (WHO, 2019b). Diarrhoeal diseases cause high morbidity (220 million) and mortality (96,

000) rates among children annually (WHO, 2019a). Out breaks of cholera have been reported in different states in Northern Nigeria with case fatality range of 0.7-6.2 (WHO, 2019c; UN Office for the Coordination of Humanitarian Affairs, 2018). Cholera is an acute diarrhoeal infection caused by ingestion of food or water contaminated with the bacterium, *Vibrio cholera* (Adagbada *et al.*, 2012). Vulnerable groups to unsafe foods include infants, young children, pregnant women, the elderly and those with an underlying illness which weakens the immune system such as diabetes, liver disease, kidney disease, organ transplants, HIV/AIDS, or those receiving chemotherapy or radiation treatment (Uchendu, 2012; WHO, 2015c; CDC, 2018). Unsafe food creates a vicious cycle of disease and malnutrition among the at-risk groups. Pre-school children (0-5 years) carry 40.0 % of the foodborne disease burden, with 125, 000 deaths annually (WHO, 2015b, WHO, 2019a).

There is an inter-relationship between poor food safety practices and food handling procedures. Poor food safety may arise during food harvesting, transportation, processing and storage. inappropriate application of pesticides to stored products such as beans and grains to prevent insect infestation, inappropriate application of chemicals to fruits such as bananas to ripen them or to vegetables such as carrots and cabbages to control insect infestation (Ajayi and Oluwoye, 2015). Similar unhygienic food handling practices have been reported in Ghana (Frempong, 2015). Food can transmit diseases from one person to the other and also serve as growth medium for bacteria thereby causing food poisoning (Owusu, 2013). Cases of food poisoning and deaths have been linked to low food safety knowledge, educational level and knowledge of food pathogens and poor hygienic condition among Nigerians and some food vendors (Pepple, 2017). Lack of access to clean drinking water was reported as an important risk factor for the outbreak of cholera (WHO, 2019c; Dan-Nwafor *et al.*,

2019). A large proportion of foodborne disease incidents are caused by foods improperly prepared or poorly handled at home, in food service establishments or markets. Not all food handlers and consumers understand the roles they must play, such as adopting basic hygienic practices when buying, selling and preparing food to protect their health and that of the wider community (WHO, 2019c). The main causes of foodborne diseases are foods contaminated with microorganisms such as parasites, bacteria, mould, fungi, viruses and other pathogens (WHO, 2012a). Even though street food is enjoying wide acceptability, microorganisms from the genus *Campylobacter*, *Clostridium*, *Salmonella*, *Escherichia*, *Listeria*, *Shigella*, *Yersinia*, *Vibrio*, *Staphylococcus* and *Norovirus* are pathogens commonly isolated from contaminated foods and are recognized as the cause of foodborne diseases (WHO, 2012b) and their contribution to morbidity and mortality rates in Nigeria is a major health concern (Omojokun, 2013). Food poisoning bacteria can come from people's bodies, sneezes, coughs, high risk foods, insects, rodents, pets (rats, mice, cockroaches and flies), toilets and dust particles in the air (Australia Department of Health, 2019). Wrapping of food with old used papers could be a source of contamination if the papers are not clean. Use of Polyethylene nylon is said to be environmentally unfriendly. However, it has been reported that they are now biodegradable because there is a new additive that can be put into HDPE plastic bags which makes the polyethylene molecules biodegrade (International Plastics, 2019). A national policy on food safety and its implementation strategy has also been approved in Nigeria with the support of Food and Agricultural Organisation (Ikpefan, 2014). However, the challenges of these policies are that of monitoring and compliance.

Poor food safety practices could result in loss of vital nutrients especially nutrients that are susceptible to leaching and oxidation under high temperature such as vitamins A and C

and some other minerals. Foods which are processed with good manufacturing practices from high-quality, freshly harvested, garden-fresh commodities have higher nutrient content than fresh market food stuffs which have been improperly handled during transportation and/or which have been stored for  $\geq$  few days (Joshi, 2003). Your strength, vigour, health and even the span of life depend on what you eat (Hamblin, 2014). It has been reported that 90.0 % of diseases known to man are at least influenced by cheap food stuff (Hamblin, 2014). Prolonged consumption of foods with low nutrients as a result of poor food handling will predispose the consumer to malnutrition especially, infants, U-5, pregnant and lactating mothers, the elderly and the sick. Two major types of malnutrition that can result from nutrient depletion include protein energy malnutrition (PEM) and micronutrient deficiencies (hidden hunger) such as vitamin A deficiency (VAD), iron deficiency anaemia (IDA), iodine deficiency disorder (IDD), zinc deficiency, and folate deficiency. Nigeria is one of the sub-Saharan African countries experiencing high levels of malnutrition in children, pregnant and lactating mothers (Uchendu and Atinmo, 2011).

Fruits and vegetables are good sources of vitamins and minerals such as vitamins A (beta-carotene) and C (ascorbic acid) with antioxidant properties (NIH, 2007; TCC, 2019). Deficiency of vitamin C results in scurvy (TCC, 2019). Epidemiological evidence links high intake of ascorbic acid and other antioxidant micronutrients to health promotion (Szeto *et al.*, 2002). Vitamin A plays an important role in vision, bone growth, cell division, cell differentiation and regulation of immune system (Wardlaw and Kessel, 2002). Deficiency of vitamin A results in night blindness especially among pre-school children, pregnant and lactating mothers (Bowley, 1998). Vitamin C degrades upon exposure to air and the degradation is accelerated by the presence of metal ions (copper, silver and iron), temperature and light. Vitamin A is oxidized easily by light (UV), air/oxygen, and acid media (Boyacioglu, 2009).

Many food additives used in food preparation to improve food taste, remove sand and probably kill germs include potash, table salt and sugar. Excess consumption of potash (potassium chloride) is poisonous for the human heart and nervous system (Nakate, 2019). Hypertension or raised blood pressure is a global public health problem (WHO, 2013). Stronger evidence shows that salt intake is related to the development of hypertension especially rise in blood pressure (World Action on Salt, 2019). Recent studies have linked diets high in added sugar in a population's food supply to the development of obesity and diabetes (Paddock, 2012, Nordqvist, 2013). The recommended daily sugar intake per person is 150 calories per day (37.5 grams or 9 teaspoons) for men and 100 calories per day (25 grams or 6 teaspoons) for women (American Heart Association (AHA), 2018)

Post-harvest processing or handling methods could reduce nutritional benefits of vegetables. A study on the effect of boiling (5-20 minutes) and sun drying on *Amaranthus cruentus* vegetable (bush greens, English spinach; African spinach) showed that vitamin C content was significantly ( $p < 0.05$ ) decreased and  $\beta$ -carotene level increased on boiling but was reduced in sundried vegetable. Boiling exceeding 5 minutes significantly ( $p < 0.05$ ) reduced  $\beta$ -carotene level. The mineral elements decreased upon boiling but sun drying had no significant effect on their levels (Ogbadoyi *et al.*, 2011). A similar result was obtained in another study where boiling and sun-drying reduced vitamin C content significantly ( $p < 0.05$ ) in Zobo (Roselle, red sorrel, Jamaican sorrel, Bonga, Isapa, Aukan and Sour-sour) (*Hibiscus sabdariffa*). Boiling method retained more of the vitamin compared to sun drying.  $\beta$ -carotene levels increased in the boiled vegetable leaves, while its content was reduced in sundried leaves. However, boiling beyond 5 minutes led to significant reduction of  $\beta$ -carotene levels in the vegetable. Mineral elements (Fe, Cu, Mg, Na and K) decreased significantly

( $p < 0.05$ ) with boiling in *Hibiscus sabdariffa* while sun drying had no significant effect on the mineral contents ((Apeyuan *et al.*, 2017, Musa and Ogbadoyi, 2012).

A study on the effect of soaking time (480 minutes), squeeze-washing and volume of water on the ascorbic acid content of three Nigerian green leafy vegetables (Bush apple leaf (*Heinsia crinata*), water leaf (*Talinum triangulare*), and bitter leaf (*Venonia amygdalina*)) reported that the vitamin C content of fresh bush apple leaf which was 73.42 mg/100 g of which 49.7–71.9% was lost; fresh water leaf had 337.30 mg/100 g of which 54.9–93.2% was lost and fresh bitter leaf had 121.00 mg/100 g of which 49.9–89.1% was lost during soaking. The pre-processing treatments increased the degree of amino acid loss in the three leafy vegetables and the higher the soaking time, the higher the amino acid loss (Samuel *et al.*, 2015).

Slicing and soaking in salt solution caused the highest degree of vitamin C loss of water leaf samples. Generally, the degree of loss in vitamin C was high in water leaf than the other two samples and it was least in bush apple leaf (Samuel *et al.*, 2015). Slicing, squeeze-washing and brine solution caused more ascorbic acid losses in green leafy vegetables than when they were soaked as whole leaves. Percentage loss in the ascorbic acid content of green leafy vegetables is directly proportional to the soaking time while increase in volume of soaking water had no clear cut correlation (Samuel *et al.*, 2015). It has also been reported that the antioxidant capacity of vegetables decrease rapidly and significantly after cutting, breaking or fragmentation (Szeto *et al.*, 2002). The five keys to safer food include keeping the food clean, separating raw foods from cooked foods, keeping food at safe temperatures, using safe water and raw materials/ingredients (WHO, 2006; WHO, 2012c).

Untreated water is drinking water that has not been chemically treated, filtered, or boiled to eliminate contaminants such as infectious

bacteria, viruses, parasites (such as *Giardia lamblia*), heavy metals, pesticides, fertilizers, human and animal wastes (Healthwise Staff, 2018). Use of untreated water is unsafe because it is heavily contaminated and is the source of waterborne diseases (Crawford, 2019). These contaminants can cause diarrhoea (cholera), stomach cramps, vomiting, pneumonia and can potentially contribute to cancer ((NTWC, 2017; Crawford, 2019; Holland bpw, 2019). Conditions that may necessitate treatment of water at the point of use to remove or inactivate microbial pathogens include water scarcity, equipment and treatment failure, emergencies and disasters and uncertainty of water quality when travelling (WHO, 2011). Boiling water at the temperature 100<sup>0</sup>C for at least one hour and filtering the water will remove all the microbial pathogens (WHO, 2011, Hollandbpw, 2017).

The outcome of this study apart from creating awareness, will aid proper food safety practices to increase antioxidant and other nutrient dietary intakes. There are few studies that have tried to document poor food safety practices in Nigeria with a view to provoking policy action. The aim of this paper therefore is to document and discuss poor food safety practices, their health implications and proffer solutions that would inform policy actions.

## MATERIALS AND METHODS

A cross-sectional direct observational study was carried out to collect qualitative data on food safety practices in six major markets at Oshodi, Idumota, Mushin, Ejigbo, Isolo and Ikotun, and streets in Lagos State. Five times random visits and observations were made to each of these randomly selected markets to observe food stuff handling practices among sellers and street food/fruit vendors. Food handling practices of market food stuff sellers (n=410) and street food/fruit vendors (n=70) were observed.

**Table 1: Highlight of observed poor food safety practices among market food stuff sellers**

S/n	Observed Safety and Hygiene Practices	Freq (%)	Freq (%)
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Focused group discussions were also used to elicit information from mothers (n=200) on their level of food safety practices and methods of cooking in their households during four community outreach programmes in Oshodi/Isolo, Mushin, Ejigbo and Lagos Island environs. Mothers were asked how they handled, purchased and cooked their foods; especially vegetables, meat/fish, beans, yam, and rice in their households. Poor food safety practises were extracted from the discussions.

## Data analysis

Data from the direct observational study and the focused group discussions and responses was collated, cleaned and entered into Excel sheet. From Excel, it was imported into SPSS for analysis. Data was analysed using SPSS version 20 statistical software. Descriptive statistics was used to describe and summary the pattern of all the categorical variables and result was presented in tables as proportions and percentages.

## RESULTS

Table 1 shows the 12 (30.8 %) poor food safety practices observed among market food stuff sellers in Lagos markets. All the meat sellers (100.0 %) observed displayed their meat in the open waiting for customers to come and buy.

Table 2 indicates the 18 (46.4 %) poor food safety practices among street/road food and fruit vendors, bukaterias and restaurants. Overcooking of vegetables (71.4 %) and leaving cut vegetables for a long time before use (57.1 %) were predominant.

Table 3 shows the 9 (23.1 %) poor food safety practices common in the households obtained from focused group discussions. Three quarter of the households reported cooking their vegetables for  $\geq 5$  minutes.

	<b>Animal protein (n=85)</b>	<b>Yes</b>	<b>No</b>	<b>Total</b>
1.	Meat was displayed in the open on tables amidst flies and dusts while waiting for customers to come and buy.	60 (100)	0 (0.0)	60 (100)
2.	Meat and fresh fishes were cut for customers in the market and they took them home to wash before cooking.	50 (83.3)	10 (16.7)	60 (100)
3.	Street meat vendors carried meat in open trays round the streets exposed to air, dust and other extraneous materials. Some meat sellers hung meat in their bare arms while moving around in some of the busy markets such as Idumota.	20 (80.0)	5 (20.0)	25 (100)
	<b>Food stuffs (n=60)</b>			
4.	Food stuffs sold were displayed in open basins and exposed to dust, sand and air.	60 (100)	0 (0.0)	60 (100)
	<b>Vegetables (n=60)</b>			
5.	Vegetables such as fluted pumpkin (Ugu) and okra were cut for customers in the market and they took them home to wash before cooking.	50 (83.3)	10 (16.7)	60 (100)
6.	Vegetables were cut, sun dried and transported to zones where there was scarcity of vegetables for commercial purposes.	5 (8.3)	55 (91.7)	60 (100)
7.	Vegetables especially Ugu (fluted pumpkin) were dipped in water and then displayed for sales.	55 (91.7)	5 (8.3)	60 (100)
	<b>Fresh pepper and tomatoes (n=30)</b>			
8.	Fresh pepper and tomatoes were 'washed' in dirty water and ground for customers in the market.	20 (66.7)	10 (33.3)	30 (100)
9.	Dirty water was discarded indiscriminately in the market especially fresh tomatoes and pepper sellers.	20 (66.7)	10 (33.3)	30 (100)
	<b>Vitamin A fortified foods (n=75)</b>			
10.	Granulated sugar was displayed in open basins thereby exposing them to dust and other extraneous dirt.	10 (33.3)	20 (66.7)	30 (100)
11.	Vitamin A fortified wheat flour were exposed or displayed under sun outside shops for customers to see and buy. At retail levels, flour was tied in black nylons in small kilogram measurements for sale. Some retailers open a bag (50 kg) and retail directly from it and retail sales might take them months to finish.	5 (33.3)	10 (66.7)	15 (100)
12.	Orange soft drinks and fruit juices were displayed under the sun for customers to buy by petty traders.	10 (33.3)	20 (66.7)	30 (100)

**Table 2: Highlight of observed poor food safety practices among street food /fruit vendors**

S/N	Poor food safety practices and hygiene among street food/fruit vendors (n=70) Food items	Freq	Freq	Total
		(%) Yes	(%) No	
1.	Raw and cooked foods were sold on top of water drainage and waste disposal sites amidst flies and dirt.	2 (2.9)	68 (97.1)	70 (100)
2.	Food was cooked with unclean water.	1 (1.4)	69 (98.6)	70 (100)
3.	Cooked food was exposed and uncovered while selling to customers.	10 (14.3)	60 (85.7)	70 (100)
4.	Bare hand was used to sell cooked food especially Agege bread, spaghetti and fried foods.	5 (7.1)	65 (92.9)	70 (100)
5.	Fried foods such as akara, yam, sweet potatoes, chicken and fishes were kept open for customers to come and buy.	65 (92.9)	5 (7.1)	70 (100)
6.	Fried & roasted foods were wrapped in old used papers, newspapers and black nylon.	60 (85.7)	10 (14.3)	70 (100)
7.	Cooked food was dished out and sold using black nylons.	30 (42.9)	40 (57.1)	70 (100)
8.	Food hawkers carry food in trays exposed to air and dust.	15 (21.4)	55 (78.6)	70 (100)
9.	Salt or sugar was used in cooking some foods such as yam, rice and corn.	7 (10.0)	63 (90.0)	70 (100)
<b>Animal protein</b>				
10.	Cooked eggs were soaked in water continuously while selling.	20 (28.6)	50 (71.4)	70 (100)
11.	Some fast food outlets undercooked their chicken leaving it with traces of blood inside.	2 (2.9)	68 (97.1)	70 (100)
<b>Vegetables</b>				
12.	Vegetables were cut & soaked in water for a long time before washing and cooking them.	10 (14.3)	60 (85.7)	70 (100)
	Vegetables were cut down & left for a long time before washing and cooking them.	40 (57.1)	30 (42.9)	70 (100)
13.	Extra vegetables were cut and sun dried as a means of preservation before use.	5 (7.1)	65 (92.9)	70 (100)
14.	Vegetables were over cooked (5-20 minutes).	50 (71.4)	20 (28.6)	70 (100)
15.	Salt was sprinkled on vegetables already cut and allowed to stand for a long time before washing.	5 (7.1)	65 (92.9)	70 (100)
16.	Water from cooked beans was drained.	6 (8.6)	64 (91.4)	70 (100)
<b>Fruits</b>				
17.	Fruit vendors cut fruits such as orange, pineapple, water melon and paw-paw without washing them. Knives and trays were only wiped with foams or towels.	65 (92.9)	5 (7.1)	70 (100)
18.	Some apple sellers sprinkled pure water on apples bought by customers in the name of washing and the customer started eating immediately without thorough washing.	10 (14.3)	60 (85.7)	70 (100)

**Table 3: Highlight of poor food safety practices in households**

S/N	Poor food safety practices and hygiene (n=200)	Freq	Freq	Total
		(%)	(%)	
		Yes	No	
1.	Cassava chips were dried outside thereby exposing the cassava chips to multi risk contamination by rats, dusts, dirt etc.	5 (2.5)	195 (97.5)	200 (100)
2.	Vegetables such as ugu, okra, waterleaf, Afang, were bought and cut in the market before washing at home.	140 (70.0)	60 (30.0)	200 (100)
3.	Vegetables were overcooked (5-30 minutes).	150 (75.0)	50 (25.0)	200 (100)
4.	Potash was used in cooking vegetables and soups such as ewedu soup.	35 (17.5)	165 (82.5)	200 (100)
5.	Sugar or salt was used to cook yam, beans, corn and rice.	20 (10.0)	180 (90.0)	200 (100)
6.	Salt was used in washing already cut vegetables and meats "to remove sand".	50 (25.0)	150 (75.0)	200 (100)
7.	Bought adulterated palm oil in the market.	5 (2.5)	195 (97.5)	200 (100)
8.	Bought dry black fish rubbed with unpleasant 'oil' in the market.	1 (0.5)	199 (99.5)	200 (100)
9.	Some customers buy spoiled and decaying food stuffs such as broken tomatoes, pepper, tatase, agbalumo or udala, garden egg that the stalk has removed and the head is open.	40 (20.0)	160 (80.0)	200 (100)

## DISCUSSION

The poor food safety practices observed in this study might serve as a mirror image of poor food safety practices in other parts of Lagos State. Some poor food safety practices were a general practice among market food stuff sellers, street food and fruit vendors as can be seen in all the Tables. For example, three quarter of the food handlers displayed and exposed their food stuffs such as, meat, fish, tomatoes (*Lycopersicon esculentum*), pepper (*Capsicum annum*; *Capsicum* spp.), vegetables, beans (*Phaseolus vulgaris*), rice, melon seeds (egusi) (*Cucumis melo*), garri (processed cassava), meat, cassava chips to dust, sand, flies and splashes of dirty water even though unintentionally. Some few meat sellers covered the tray half way with brown paper which is better. Food vendors especially those at roadside, streets and bus-

stops frying akara, yam, potatoes, chicken kept the fried foods open. Food stuffs should not be exposed to sand, flies, dust and dirt water. They can be covered with clean paper bags, put in transparent containers or coolers. Drying of cassava chips outside exposed them to multi risk contamination by rats, dusts and dirt. Rats (*Mastomys* spp., popularly known as the "multimammate rats") infest foods and cause lassa fever. There have been incidences of Lassa fever epidemic in Nigeria. Foods should be covered from flies and rodents. Dust, sand, flies, rodents and splashes of dirty water are agents of food contamination and poisoning (Australia Department of Health, 2019).

Another predominant poor food safety practice among all the study population ( $\geq 70.0$  %) was the cutting of green leafy vegetables, okra, meat and fish in the market before washing and soaking them in water

for a long time before washing. Vegetables and fruits undergo soaking and washing in salty water to remove farm sand and other extraneous materials resulting in nutrient losses. Vegetables are good sources of vitamin C (antioxidants) which is water-soluble. Antioxidants are needed in the body for optimal health promotion (Sceto *et al.*, 2002). Cutting of vegetables and soaking them for a long time before washing exposes the water-soluble vitamins to leaching. Loss of vitamin C in vegetables soaked for 480 minutes was in the range of 50.0 – 94.0 % (Samuel *et al.*, 2015). Vegetables were also sliced and left to stand for a long time before use (57.1 %) thereby exposing them to oxidation. In the household, some mothers used salty water (brine) to wash the vegetables and meat to remove sand. Slicing and brine solution caused more ascorbic acid losses in green leafy vegetables than when they were soaked as whole leaves. Percentage loss in the ascorbic acid content of green leafy vegetables was directly proportional to the soaking time (Samuel *et al.*, 2015). It was also reported that the antioxidant capacity of vegetables decreased rapidly and significantly after cutting, breaking or fragmentation (Szeto *et al.*, 2002). Food ingredients should be taken home and washed thoroughly with enough water for at least three times before cutting to remove sand, dust, germs, worms, insect larva and other extraneous materials that could cause food borne diseases.

Another high poor food safety practice observed was over-cooking of vegetables in households reported by mothers (75.0 %). Over-cooking reduces the nutritional benefits of vegetables. Boiling >5 minutes was found to significantly reduce vitamin C,  $\beta$ -carotene, and minerals (Fe, Cu, Mg, Na and K) contents of vegetables. However, boiling <5 minutes increased  $\beta$ -carotene levels (Ogbadoyi *et al.*, 2011, Musa and Ogbadoyi, 2012). Sun drying of vegetables also had a degrading effect on vitamin C and  $\beta$ -carotene levels in vegetables but had no significant effect on the mineral elements (Ogbadoyi *et al.*, 2011, Musa and Ogbadoyi,

2012). Appropriate methods should be used in cooking food in order to preserve the nutrients in the food. Vegetables should not be cooked for more than 2 minutes in order to retain their nutrients. Consumption of fresh green vegetables and fruits is recommended for every person for maintenance of good health especially the vulnerable groups such as pre-school children, pregnant, lactating mothers, persons living with HIV/AIDS, hypertensive and sickle cell patients. Habitual consumption of over cooked and sun dried vegetables will increase their vulnerability to malnutrition and disease degenerability status. Your strength, vigour, health and even the line span depend on what you eat (Hamblin, 2014). Vegetables should be eaten “green”. Fruits should be washed very well before eating, paying attention to the cleavages. Sugar and wheat flour has been fortified with vitamin A which is easily degraded by heat, light and air. Orange drinks and juices also contain vitamin C which is also reduced by sunlight. Exposing vitamin A fortified foods and other foods that contain vitamins to air and sunlight might lead to the degradation of the vitamins.

Some foods were cooked with potash (potassium-rich salt), sodium chloride (edible salt) or sugar for culinary reasons. For example, ewedu soup was reportedly cooked with potash to make it draw and improve its green colour (17.5%). Salt or sugar was used in cooking yam, white rice, beans and corn to increase their sweet taste (10.0 %). Vegetables and meat were washed with salt to remove sand (25.0 %). This practice increases the sodium and sugar contents of the food. Dietary salt and sugar has been associated with increased prevalence of cardiovascular diseases such as hypertension, diabetes and heart diseases (Paddock, 2012, Nordqvist, 2013, Nakate, 2019, World Action on Salt, 2019). The recommended daily intake of sugars from all dietary sources is 38g for men and 25 g for women (AHA, 2018). Nigerian daily diets are carbohydrates and sugar filled (fufu, akpu, lafu, amala, garri, plantain, rice, yam, corn meal, tuwo

masara, Pap, wheat flour and its products) processed (boiled, fried, baked, pounded, roasted) and consumed (swallowed, chewed or drank) in different forms daily and all are diet. Consequently, extra care should be taken to limit the sources of salt and sugar in our diets to minimize the risk of non-communicable diseases. Except in extreme cases, use of salt and sugar should be restricted. Farm produce, such as vegetables, are often supplied to retailers contaminated with sand and dust, especially during rainy season because they were allowed to creep on the ground in the farm. Consumers should be conscious of sand laden vegetables and wash them very well with plenty clean water for at least 3 times before use. Nothing cleans better than water.

Many customers ground their fresh tomatoes and pepper in the market washed with dirty water (66.7 %). This water was dirty because it has been used to wash for several customers. Also dirty water was discarded indiscriminately especially if there was no gutter or water drainage around. This made the environment unclean and breeds flies and bad odour. Few food vendors (2.9 %) sold cooked food on top of water drainage and near waste disposal sites while some sold their food uncovered (14.3 %). These are unwholesome practices that could lead to food contamination and poisoning. Food businesses should be carried out in a very clean environment by maintaining good personal and food hygiene, carrying out sanitation through proper and regular disposal of waste, no foul odour, to discourage flies, cockroaches, birds and rodent infestation. Flies, rodents and birds contaminate food by depositing their excreta and fluids on the food. Clean water should be used to wash any food before grinding. Customers should buy water to wash food stuff before grinding.

Some food canteens soaked boiled eggs in bucket of water for easy peeling of the shells and sold to customers from there. These eggs were at risk of contamination from 'germs' in the water and could result in outbreak of

salmonellosis. Cooked eggs should not be soaked in water before selling. Some fast food outlets (2.9 %) undercooked their chicken leaving it with traces of blood. This exposes the consumer to microbial infestation due to *E. coli*. Raw meat and chicken should be cooked very well to make it edible and digestible. Draining of water from cooked beans by some food vendors (8.6 %) wastes some water-soluble nutrients. Beans should be cooked until the water in the pot dries up.

Some food vendors sold food with their bare hands (7.1 %) to consumers especially foods like Agege bread, cooked spaghetti and fried foods (akara, potatoes, plantain and yam). Similar practice was witnessed among two street food vendors of fried foods in Kano town on repeated occasions of buying. If the hand is not clean, it could contaminate the food. To reduce food contamination, hands should be washed thoroughly before touching food. Preferably, spoons and forks should be used to sale food.

Fruit vendors cut the fruits such as orange (*Citrus sinensis*), pineapple (*Ananas comosus*), water melon (*Citrullus lanatus*) and paw-paw (*Carica papaya*) without washing them. Even the knives and trays were only wiped with foams or towels on a daily basis. This practice attracts flies all over the fruits thereby making them unwholesome. They could be sources of foodborne diseases. Fruits, knives and trays should be washed thoroughly with clean water before cutting. Sliced wrapped fruits should be put in transparent buckets with cover for customers to buy. Some customers (14.3 %) bought apples and started eating without proper washing. Sprinkling water on them is not enough. All fruits should be washed thoroughly before eating to avoid food poisoning.

Some customers bought broken and decaying food stuffs because they were cheaper than the good ones. Cheap spoilt, broken, tomatoes (*Solanum lycopersicum*), pepper (*Capsicum*), tatase, agbalumo or udala or

African Star Apple (*Chrysophyllum africanum* or *Chrysophyllum albidum*), garden egg (Aghara, *Solanum melongena*) that the stalk has removed and the head is open should be avoided or else washed very well before use. These are agents of microorganisms such as mould, yeast and bacteria. Your strength, vigour, health and even the span of life depend on what you eat (Hamblin, 2014). It was reported that 90.0 % of diseases known to man are at least influenced by cheap food stuff (Hamblin, 2014). Foods which are processed with good manufacturing practices from high-quality, freshly harvested, garden-fresh commodities have higher nutrient content than fresh market food stuffs which have been improperly handled during transportation and/or which have been stored for a few days or more (Joshi, 2003).

Many food vendors of fried foods (86.0 %) wrapped food for customers with old used papers, newspapers and polythene nylons. This is a common practice. Wrapping cooked foods with old used papers and newspapers might lead to food contamination depending on the source of the paper, how clean the paper is, where and how long it was packed before use. Very clean paper should be used in wrapping foods. Use of paper to wrap food is environmental friendly because paper is biodegradable than poly bags. However, it has been reported that poly bags are now biodegradable because there is a new additive that can be put into HDPE plastic bags which makes the polyethylene molecules biodegrade (International Plastics, 2019).

Food was cooked with black, unclean and untreated water from a malfunctioned borehole (1.4 %). The water was used to wash dishing plates and soaked the vegetables for a long time before cooking in a restaurant. Use of untreated water is unsafe because it is heavily contaminated and may result in outbreak of waterborne diseases such as diarrhoea (cholera), stomach cramps, vomiting, pneumonia and can potentially contribute to cancer ((NTWC, 2017;

Crawford, 2019; Holland bpw, 2019). Boiling the water at the temperature 100<sup>0</sup>C for at least one hour and filtering it before use will remove all the microbial pathogens (WHO, 2011; Holland bpw, 2019).

Adulterated palm oil was bought in the market (2.5 %). According to the confession of one of the suppliers of adulterated palm oil in Lagos markets, they adulterate palm oil with a substance called “metu” to increase the volume. Adulterated oil may have foul odour, form thick paste and three quarter of 350ml bottle of the oil was emptied into a cocoyam pot of soup without getting the desired redish colour. Dry black fish rubbed with a substance that looked like oil was bought from the market (0.5 %). It was reported that on washing the fish in warm water, the water became light yellowish and thick. When the dry fish was used to cook stew, it gave the stew a foul odour. The stew was thrown away. Similar incidence of purchasing adulterated palm oil from Mararaba market in Abuja has just been reported in the social media. The researcher recently bought an adulterated yellow garri from Friday market in Abuja. The garri looked very good but on being stored for 1 week, started breeding blackish and reddish (young ones) maggots but still retained its yellowish colour, dryness and fresh garri aroma. Adulteration of any food makes the food unsafe, unwholesome and might result in food poisoning. It also wastes resources. Consumers should buy food stuff from credible sellers and be wary of any black fish rubbed ‘oil’.

The major reasons why food should be made safe for consumption are to minimize nutrient lost, contamination and supply of nutrients to the body as a source of nourishment. Appropriate food safety standards ensure safety of foods and protection of consumers from food poisoning. Awareness campaign is important because poor food safety has been linked to low food safety knowledge, educational level and knowledge of food pathogens and poor hygienic condition among food vendors

(Pepple, 2017). Also, not all food handlers and consumers understand their roles in food safety (WHO, 2019c). The five keys to safer food recommended by WHO which are keep clean, separate raw and cooked, cook thoroughly, keep food at safe temperatures and use safe water and raw materials should be adopted in homes, restaurants, bukaterias, local markets and by street food and fruit vendors.

## CONCLUSION

There were some general high poor food safety and hygiene practices among food handlers in this study population. The immediate implications are food contamination and nutrient losses while the long term consequences are foodborne diseases and hidden hunger. Policies involving food and nutrition education through public enlightenment campaigns and monitoring will help to address poor food safety practices in this study population.

## ETHICAL ISSUES

Ethical issues (including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, etc) have been observed by the author.

## CONFLICT OF INTEREST

The author declares that she has no conflict of interest.

## AUTHOR'S CONTRIBUTION

The author carried out the research, read and approved the manuscript.

## REFERENCES

**Adagbada A. O., Adesida S. A., Nwaokorie F. O., Niemogha M. and Coker A. O. (2012).** Cholera Epidemiology in Nigeria: an overview. The Pan African Medical Journal 2012; 12:59. ISSN 1937-8688.

**Ajayi O. A. and Oluwoye J. O. (2015).** Sustainable vended foods and food safety: a conceptual framework. International Journal of Food Safety, Nutrition and Public Health; Vol. 5. No 3-4: 195-216.

**Alaska Native Tribal Health consortium (NTWC) (2017).** Risks of drinking untreated water. <http://tribalwater.org/drinking-untreated-water/>. Accessed 21/6/19

**AHA (2018).** Sugar 101. American Heart Association Report. <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/sugar/sugar-101>. Accessed 20/6/2019

**Apeyuan K. D., Nwankiti A. O., Oluma O. A. H. and Ekefan E. J. (2017).** Effect of Different Sowing Dates on Disease Initiation and Development of Roselle (*Hibiscus sabdariffa* L.) Leaf Spot Disease Caused by *Coniella musaiensis* Var. *hibisci* in Makurdi, Central Nigeria. DOI: 10.4236/gep.2017.511007.

**Australia Department of Health (2019).** 9 Protecting food from contamination. <https://www.health.gov.au/internet/publications/publishing.nsf/Content/ohp-enhealth-manual-atsi-cnt-1~ohp-enhealth-manual-atsi-cnt-1-ch3~ohp-enhealth-manual-atsi-cnt-1-ch3.9>. Accessed 19/6/2019.

**Bowley A. (1998).** Paving way for maize fortification in Zambia. Nutriview 98/3. Basel, Switzerland: Vitamin Division, F. Hoffman-La Roche Limited. Pp.4.

**Boyacioglu, D. D. (2009).** Effect of food processing on nutrients: vitamin and mineral losses. Module 10. <http://www.atlas.cc.itu.edu.tr/rboysci/10%20effect-df-processing.pdf>. Accessed 5/3/2010

**Centers for Disease Control and Prevention (CDC), (2018).** Foodborne Illnesses and Germs. <https://www.cdc.gov/foodsafety/foodborne-germs.html>. Accessed 18/6/19

- Crawford C. (2019).** Three Reasons Why Drinking Untreated Water is Unsafe. <https://www.lifehack.org/448605/three-reasons-why-drinking-untreated-water-is-unsafe>. Accessed 21/6/19
- Dan-Nwafor C. C., Ogbonna U., Onyiah P., Gidado S., Adebobola B., Nguku P. (2019).** A cholera outbreak in a rural north central Nigerian community: an unmatched case control Study. *BMC Public Health* (2019) 19:112. <https://doi.org/10.1186/s12889-018-6299-3>
- Frempong A. A. (2015).** Handling and storage practices of food commodities retailers at open market in Ghana. *Journal of Harmoniz. Res. Appl. Sci.*, 3 (1): 10-20.
- Hamblin J. (2014).** Strength and Vigor Depend on What You Eat. <http://www.theatlantic.com/health/archive/2014/04/1922-strength-and-vigor-depend-on-what-you-eat/284604/>. Accessed April 3, 2015.
- Holland Board of Public Works (Bpw) (2019).** What You Should Know About contaminants that may be present in untreated water. <https://www.hollandbpw.com/waterqualityreport15/untreated.html>. Accessed 21/6/19
- Ihenkurye A. (2012).** 200,000 people die of food poison annually in Nigeria. *Premium Times*. <https://www.premiumtimesng.com/news/96700-200000-people-die-of-food-poison-annually-in-nigeria-prof-ihenkurye.html>. Accessed 8/6/19
- Ikpefan, F. (2014).** FAO provides \$495m for national food safety policy. <http://thenationonlineng.net/new/fao-provides-495m-national-food-safety-policy/>-. Accessed May 3, 2015.
- International Plastics (2019).** Recyclable Green Plastic Bags. <https://www.interplas.com/packaging-earth-friendly-recyclable-plastic-bags>. Accessed
- Joshi, S. 2003.** Processing methods and their effects on nutrient concentrations. *Nutrition and Dietetics*. Tata McGraw-Hill Publishing Company Limited. 2nd ed. Pp. 520-525.
- Musa A. and Ogbadoyi, E.O. (2012).** Effect of Processing Methods on Some Micronutrients, Antinutrients and Toxic Substances in Hibiscus Sabdariffa. *Asian Journal of Biochemistry*, 7: 63-79. DOI: 10.3923/ajb.2012.63.79.
- Nakate S. (2019).** What is Potash? <https://sciencestruck.com/what-is-potash>. Accessed 20/6/19.
- NIH, (2007).** Dietary Supplement Fact Sheet: Vitamin A and Carotenoids. National Institute of Health Report. <http://ods.od.nih.gov/factsheets/vitamin.asp>. P.1-11.
- NIH, (2014).** Understanding Foodborne Diseases. National Institute of Health Report. <http://www.niaid.nih.gov/topics/foodborne/pages/default.aspx>. Accessed April 3, 2015.
- Nordqvist J. (2013).** High Sugar consumption Linked To Type 2 Diabetes. <https://www.medicalnewstoday.com/articles/257108.php>. Accessed 20/6/2019
- Ogbadoyi, E. O., Musa A., Oladiran J. A., Matthew I.S. Ezenwa M. I. S., and Akanya F. H. (2011).** Effect of processing methods on some nutrients, antinutrients and toxic substances in *amaranthus cruentus*. *International Journal of Applied Biology and Pharmaceutical Technology* Volume: 2: Issue-2:487-502.
- Omojokun J. (2013).** Regulation and Enforcement of Legislation on Food Safety in Nigeria, Chapter 10. <http://dx.doi.org/10.5772/54423>. Accessed April 3, 2015.
- Owusu F. (2013).** Nigeria: Food safety, security as real transformation tools. *Food and Beverages, Life*. <http://dailyindependentnig.com/2013/>

- 10/nigeria-food-safety-security-as-real-transformation-tools/. Accessed March 3, 2015.
- Paddock, C. (2012).** How Added Sugar In Diet Leads To Obesity, Diabetes - New Clues About Fructose. <https://www.medicalnewstoday.com/articles/242259.php>. Accessed 20/6/2019
- Pepple N. (2017).** Environment and Food Poisoning: Food Safety Knowledge and Practice among Food Vendors in Garki, Abuja – Nigeria. *Journal Health Educ. Res Dev.* 2017, 5:2 DOI: 10.4172/2380-5439.1000217
- Samuel A. Akande S. A., Azeke A. E., Adedokun A. O., Israel D. U. (2015).** Effect of Soaking Time and Volume of Water on the Ascorbic Acid Content of Three Nigerian Green Leafy Vegetables. *Food Science and Quality Management* Vol.44: 23-27.
- Szeto Y. T., Tomlinson B. and Benzie I. F. F. (2002).** Total antioxidant and ascorbic acid content of fresh fruits and vegetables: implications for dietary planning and food preservation. *British Journal of Nutrition* (2002), 87: 55–59. DOI: 10.1079/BJN2001483.
- Talaei M., Holakouie-Naieni K., Foroushani A. R. and Asl H.M. (2015).** Knowledge, attitude and practice of people about foodborne outbreak in Isfahan city, Iran. *Journal of Food Safety and Hygiene*; Vol. 1 No. 2 July 2015.
- The Chemical Company (TCC), (2019).** Ascorbic Acid. <https://thechemco.com/chemical/ascorbic-acid/>. Accessed 19/6/19.
- Uchendu F. N. and Atinmo T. (2011).** The Silent and Neglected Crisis of Malnutrition: Scientific Evidence for taking Decisive Action. *Global Journal of Health Sci.*, Vol.3: 193-202.
- UN Office for the Coordination of Humanitarian Affairs (2018).** Nigeria – North-East Flash Update No. 5 – Cholera Outbreak, 21 September 2018. <https://reliefweb.int/report/nigeria/nigeria-north-east-flash-update-no-5-cholera-outbreak-21-september-2018>. Accessed 8/6/19
- Wardlaw, G. and Kessel, M. (2002).** The Fat Soluble Vitamins. In: *Perspectives In Nutrition* (5<sup>th</sup> ed.). Pp.328-333. McGraw Hill, New York, NY10020.
- WHO (2006).** Keys to Safer Food Manual. World Health Organisation Report. [https://www.who.int/foodsafety/publications/consumer/manual\\_keys.pdf](https://www.who.int/foodsafety/publications/consumer/manual_keys.pdf). Accessed 16/6/19.
- WHO (2011).** Boil water. World Health Organisation Report (WHO/FWC/WSH/15.02).
- WHO (2012a).** General information related to foodborne disease. World Health Organisation Report. [http://www.who.int/topics/foodborne\\_diseases/en/](http://www.who.int/topics/foodborne_diseases/en/). Accessed April 4, 2015.
- WHO, (2012b).** Foodborne disease surveillance. World Health Organisation Report. [http://www.who.int/topics/foodborne\\_diseases/en/](http://www.who.int/topics/foodborne_diseases/en/). Accessed April 3, 2015
- WHO, (2012c).** Prevention of foodborne disease: the five keys to safer food. World Health Organisation Report [http://www.who.int/topics/food\\_safety/flyer\\_keys\\_en.pdf?ua=1](http://www.who.int/topics/food_safety/flyer_keys_en.pdf?ua=1). Accessed April 3, 2015
- WHO, (2013).** Global brief on hypertension, 2013. Silent killer, global public health crisis. World Health Organisation Report (WHO/DCO/WHD/2013.WHO).
- WHO, (2015a).** WHO estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015. World Health Organisation Report. Accessed 17/6/19
- WHO, (2015b).** World Health day 2015. Food Safety. Campaign Tool Kit. World Health Organisation Report.

- <http://www.who.int/campaigns/world-health-day/2015/event/en/>. Accessed April 6, 2015.
- WHO, (2015c).** From farm to plate, make food safe. World Health Organisation Report.  
<http://foodsafety.einnews.com/article/258492691/qdqFhTwFkAtCGBjo>. Accessed April 6, 2015.
- WHO, (2019a).** Food Safety. World Health Organisation Report.  
<https://www.who.int/news-room/fact-sheets/detail/food-safety>. Accessed 16/6/19
- WHO, (2019b).** Foodborne diseases. World Health Organisation Report.  
[https://www.who.int/foodsafety/areas\\_work/foodborne-diseases/en/](https://www.who.int/foodsafety/areas_work/foodborne-diseases/en/). Accessed 18/6/19.
- WHO, (2019c).** Cholera – Nigeria. World Health Organisation Report.  
<https://www.who.int/csr/don/12-july-2017-cholera-nigeria/en/>. Accessed 8/6/19
- World Action on Salt (2019).** Blood Pressure.  
<http://www.worldactiononsalt.com>. Accessed 20/6/19.