



# Assessment of Food Hygiene Knowledge, Attitudes and Practices of Fish Handlers in Kaduna State, Nigeria

HAFSAT ALI GREMA<sup>\*1,2</sup>, JACOB KWAGA<sup>1</sup>, MOHAMMED BELLO<sup>1</sup>, HASSAN UMARU ONIMISI<sup>3</sup>

<sup>\*1</sup>Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University Zaria, Samaru Campus, Nigeria; <sup>2</sup>Department of Veterinary Medicine University of Maiduguri, Maiduguri, Nigeria; <sup>3</sup>National Agricultural Extension and Research Liaison Services, Ahmadu Bello University Zaria, Samaru Campus, Nigeria.

**Abstract** | Fish farming is among agricultural activities that are used to fight food and nutritional security in Nigeria. But, the aim of the Nigerian government is not only to make its citizen food and nutritional secure, but to provide a safe food for its populace as well. The mere isolation and characterization of potential food borne illness pathogens does not provide sufficient information for public health policy development. Hence, a cross-sectional study was conducted to assess the knowledge, attitudes and practices of fish handlers in Kaduna State, Nigeria. A structured face-to-face questionnaire was designed and administered to 37 street fish vendors between May-August, 2017. Results indicated that respondents had good level of knowledge and attitudes and poor practices toward food hygiene measures. Almost all of the food workers were aware of the role of hand washing before and after handling of fish as well as wearing protective clothing during work while majority lack knowledge about microbial hazards transmitted through fish in the (67–78%) study area. A significant positive correlation was observed between knowledge and attitude ( $r_s = 0.60$ ,  $P = 0.00$ ), level of education ( $r_s = 0.5$ ,  $P = 0.000$ ) and but negative correlation with years of business experience ( $r_s = -0.3$ ,  $P = 0.03$ ). A significance between knowledge and practices ( $r_s = 0.2$ ,  $P = 0.23$ ) revealed that increased knowledge of food safety does not always result in positive change in fish handling behaviors.

**Keywords** | Fish handlers, Food safety knowledge, Attitude and practices, Street vendors, Kaduna state, Nigeria

**Editor** | Kuldeep Dhama, Indian Veterinary Research Institute, Uttar Pradesh, India.

**Received** | January 29, 2018; **Accepted** | July 08, 2018; **Published** | December 29, 2018

**\*Correspondence** | Hafsat Ali Grema, Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University Zaria, Samaru Campus, Nigeria; **Email:** gremahafsa@yahoo.com

**Citation** | Grema HA, Kwaga JKP, Bello M, Onimisi HU (2019). Assessment of food hygiene knowledge, attitudes and practices of fish handlers in kaduna state, nigeria. *Adv. Anim. Vet. Sci.* 7(3): 131-137.

**DOI** | <http://dx.doi.org/10.17582/journal.aavs/2019/7.3.131.137>

**ISSN (Online)** | 2307-8316; **ISSN (Print)** | 2309-3331

**Copyright** © 2019 Grema et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

There is increased interest of Nigerian government to strengthen the agricultural sector and develop the food value chains due to its significance to food and nutrition security (Veliu et al., 2009; Alagoa et al., 2011; Ilu et al., 2016). This has stimulated the increase importance of animal sourced food as part of a national concern for socio-economic development (NORAD-FAO, 2013). To make food affordable and accessible to the growing human population and urban dwellers, street food vending is promoted in several countries including Nigeria due to its benefits. Street processed food such as fish which could be a better alternative to expensive animal product and a convenient and often nutritious ready-to-food also serves as

an easy source of income to particularly women (Ekanem, 1998). Studies conducted in other parts of Nigeria have shown street food vendors rely wholly in this business because of the customers' preference to buy street processed food; being cheaper and affordable to buy than to cook (Draper, 1996; Dipeolu et al., 2007).

Fish is a common delicacy in African food and contributes in provision of nutritional requirement for essential proteins, minerals and other micronutrients (FAO, 1992; Belton and Thilsted, 2014). It is responsible for more than 40% of the animal protein intake of the Nigerian populace (Anetekhai, 2013). There is high dependence on fish as a source of animal protein especially in low income households who purchase processed fish by the road side as part

of family meal (Akinyele, 1998). With the increase demand for food and nutrition security in most developing countries particularly the rural communities by promoting fish production, it is essential to incorporate safe production along the chain to fight against preventable diseases. Street fish vendors in Nigeria provide the services of selling both raw and processed fish in an unregulated and haphazard manner. The less attention of the government on activities of small business owners particularly those in agricultural chains have promoted hazards such as operating in poor local infrastructure, poor food hygiene practices and lack of sanitation (Omemu and Aderoju, 2008). Most street food business owners in Africa aren't licensed, formally trained in food hygiene and sanitation and conduct business activities under unsanitary conditions (Muinde and Kuri, 2005). Several studies that assessed the microbial quality of different street foods in African countries including Nigeria showed street vended food as unfit for human consumption due to isolation of common microbes responsible for food borne illnesses (Kwaga and Adesiyun, 1984; Tafida et al., 2013; Suleiman et al., 2013; Ndahi et al., 2013; Tamba et al., 2016; Akabanda et al., 2017). However, these studies mostly limited themselves to the isolation and characterization of the microbes, but did not assess the risk factors such as knowledge, attitude and practices of the vendors that might predispose to the presence of these agents on food products.

WHO (1989) has reiterated the significance of food handling personnel in ensuring food safety throughout the food production chain especially regarding animal products. Poor handling and inefficient hygienic measures by vendors promote food contamination by pathogens which could survive and multiply significantly to cause disease to consumers. The organization has set food safety standards measures like personnel protection equipment and training along entire production chains including practices related to food production, preparation, processing, labeling, hygiene, additives, residues, as well as policies on food biotechnology (FAO/WHO, 2006). However, most African countries do not comply with these rules and allow street vendors to proliferate and self regulate their business activities which pose great risk to public particularly when they have poor knowledge and practices. This study aims to determine the current status on the food safety knowledge and practices of street fish vendors in Kaduna and the information from this study might be useful for national and state health officers in the development of policies towards regulating safe street fish handling, preparation and vending within the State.

## MATERIALS AND METHODS

### PARTICIPATING FISH HANDLERS

The study was conducted in Kaduna; a state located at

the Northern part of Nigeria. A cross sectional study was employed from March to August 2017 using semi-structured questionnaire administered to fish processors based on their willingness to participate in the study. In order to ensure consent and participation, discussions were held prior to fieldwork to introduce the research objectives and benefits of the study and to seek for cooperation and mobilization of colleagues. All questionnaires were administered via face-to-face interview to ensure the accuracy of the responses. Respondents were interviewed in early hours of the day before business engagement to give adequate time to answer written queries and avoid distraction from business.

### PARTICIPATING BUSINESSES AND QUESTIONNAIRE DELIVERY

For the analyses of fish handlers' knowledge about general food safety principles and their opinion according to food safety requirements, a questionnaire was designed for handlers of fish in restaurants, roadside street vendors and the hawkers. The basic criterion for selection was processing of fish for public consumption. For this purpose only restaurant with fish on their menus and those that sell fish in whatever processed forms were selected.

### QUESTIONNAIRE STRUCTURE

A questionnaire was developed to target fish processors in the fish production chain. Each questionnaire consisted of three parts. First part of the questionnaire consisted demographic questions on age, gender, education level, years of experience and food safety related training. Second part was designed into three sections to explore the knowledge and attitude of the fish handlers regarding roles of microbes in disease transmission, risk of fish contamination and fish borne illnesses, temperature control and fish storage methods. The final part assessed the personal hygiene practices of the fish handlers. A simple rating scale of three answers was used in each section to avoid confusion due to low level of education among fish handlers and ease of back-to-back translation into local language.

### FOOD SAFETY KNOWLEDGE, ATTITUDE AND PRACTICES

The drafted questionnaire was designed based on formats adopted by several published questionnaires (Omemu and Aderoju, 2008; Ansari-lari et al., 2010; Eltholth et al., 2014) and rearranged to suit target objectives of this research. The questionnaire included 14 questions each with three possible answers. To lessen response bias, optional answers were true and false and "I don't know" included. The knowledge score range between 0 to 30 and score below 15 in the food safety knowledge questionnaire was regarded as poor knowledge.

Fish handlers were asked 12 statements on food hygiene attitude to indicate their level of agreement using a three-point likert scale (3 = agree, 2 = disagree and 1 = no idea). Score ranges between 0 and 30 and scores less than 15 were considered negative attitude to food safety and hygiene measures.

The final section consisted of a list of 14 practical questions that would indicate fish handlers' practices toward food borne disease prevention. A three-point rating scale (1 = never, 2 = sometimes and 3 = always) was used for respondents to rate the level of each practice. The score range was between 0 and 30 and score less than 15 were considered poor practices

**PILOT TEST**

The reliability of food safety knowledge, attitudes and practices questionnaire was determined by pilot study on 10 fish handlers from the processing units. Various questions were modified to improve clarity and ease of translation. Afterwards, questionnaires were submitted to Linguistic Department of Ahmadu Bello University Zaria for back-to-back translation.

**RESULTS**

**DEMOGRAPHIC AND OPERATIONAL CHARACTERISTICS OF FISH PROCESSORS**

Table 1 shows the demographic characteristics of fish processors interviewed in the study area. A total of 37 fish processing outlets were visited within the study area and about 73% owned the business while 27% were employees at the fish processing outlets. Six (16.2%) were operating fry shops, 5.4% operated restaurants, 29 (78.4%) were mobile and fixed street vendors. Type of fish handled by processors included locally farmed fishes (40.5%), imported fish species (51.4%) and wild caught fishes (8.1%). Women accounted for about 51.4% of the fish processors in the study area while men accounted for 48.6%. Respondents with no formal education were 27%, those who attained primary education were 13.5%, and those with secondary school education were 48.6% whilst 10.8% had tertiary qualification. About 32.4% of the respondents were between 21-30 years whereas 35.1% were between the ages of 31-40 years and 32.4% were above 41 years of age. Formal food safety training was acquired by only 1 fish processor while 97.3% had no formal training on safety and hygienic processing of food. Traders with 6-10 years business experience were 18 (48.6%) while 10 (27%) traders had 11-20 years of business experience.

**FOOD SAFETY KNOWLEDGE, ATTITUDE AND PRACTICES OF FISH PROCESSORS INTERVIEWED**

Table 2 presents food safety knowledge of fish processors

in the study area, 64.9% of respondents had good knowledge of fish safety. All respondents had excellent knowledge on use of hand gloves (100%) and hand washing (100%) as well as proper cleaning of utensils. In addition, 35.1% and 73% answered positively to abstinence from eating in business premises and covering wound surfaces, respectively. Similarly, questions on likelihood of disease conditions transmitted through fish contamination such as cholera 28 (75.4%), diarrhoeal related diseases 17 (45.9%) and typhoid 18 (48.6%) were answered correctly except for role of fish as vehicle for transmission of pathogens causing abortion (8.1%).

**Table 1: Demographic and operational characteristics of Fish processors in Kaduna and Zaria metropolises (n=37)**

| Variables                       | Description         | No. of respondents (%) |
|---------------------------------|---------------------|------------------------|
| Gender                          | Men                 | 18 (48.6)              |
|                                 | Women               | 19 (51.4)              |
| Educational level               | No formal education | 10 (27.0)              |
|                                 | Primary             | 5 (13.5)               |
|                                 | Secondary           | 18 (48.6)              |
|                                 | Tertiary            | 4 (10.8)               |
| Formal food safety training     | Yes                 | 1 (2.7)                |
|                                 | No                  | 36 (97.3)              |
| Age (years)                     | ≤20                 | 0                      |
|                                 | 21-30               | 12 (32.4)              |
|                                 | 31-40               | 13 (35.1)              |
|                                 | 41≥                 | 12 (32.4)              |
| Years of business experience    | ≤5                  | 7 (18.9)               |
|                                 | 6-10                | 18 (48.6)              |
|                                 | 11-15               | 12 (32.4)              |
|                                 | 16-20               | 0                      |
| Role of respondents             | Owner               | 27 (73.0)              |
|                                 | Worker              | 10 (27.0)              |
| Type of fish processing outlets | Fry shops           | 6 (16.2)               |
|                                 | Restaurants         | 2 (5.4)                |
|                                 | Street vendors      | 29 (78.4)              |

Most of the fish processors had a positive attitude to food safety and hygiene measures. Almost all participants (62.2-100%) agreed with various statements targeted at scoring food safety attitudes. Small percentages disagreed (27-40.5%) on use of protective clothing or use of storage temperature in reduction of food borne disease risks. Some did not have any idea (2.7-8.1%) on the statements for use of protective clothing and temperature control in food borne diseases (Table 2).

**Table 2:** Summary of questions and responses for assessment of fish processors' food safety knowledge (n=37).

| Statements   | No. of Respondents (%) |           |              |
|--|------------------------|-----------|--------------|
|  | True                   | False     | I don't know |
| Washing hands before work reduces the risk of fish contamination                               | 37 (100)               | 0         | 0            |
| Using gloves during work reduces the risk of food contamination                                | 3 (100)                | 0         | 0            |
| Using apron during work reduces the risk of food contamination                                 | 23 (62.2)              | 13 (35.1) | 1 (2.7)      |
| Hair covering during work reduces the risk of food contamination                               | 29 (8.2)               | 7 (18.9)  | 0            |
| Proper cleaning and handling of contact surfaces reduces the risk of food contamination        | 37 (100)               | 0         | 0            |
| Eating and drinking in the work place increases the risk of food contamination                 | 13 (35.1)              | 24 (64.9) | 0            |
| If you have diarrhea, it is necessary to stay away from handling fish for consumption/business | 27(72.9)               | 10 (27)   | 0            |
| If you have skin wound on hands, it is necessary to cover it when handling fish                | 27 (72.9)              | 6 (16.2)  | 4 (10.8)     |
| Typhoid can be transmitted by food   | 18 (48.6)              | 12 (32.4) | 7 (18.9)     |
| Dysentery can be transmitted by food   | 17 (45.9)              | 15 (40.5) | 5 (13.5)     |
| Diarrhea can be transmitted by food  | 34 (91.9)              | 2 (5.4)   | 1 (2.7)      |
| Cholera can be transmitted by food   | 28 (75.7)              | 4 (10.8)  | 5 (13.5)     |
| Abortion in pregnant women may be induced by food borne disease                                | 3 (8.1)                | 19 (51.4) | 15 (40.5)    |
| The refrigerator is the safest fish storage facility   | 37 (100)               | 0         | 0            |

**Table 3:** Food safety attitude statements and responses of fish processors in the study area (n=37)

| Statements  | No. of Respondents (%) |           |         |
|---|------------------------|-----------|---------|
|   | Agree                  | Disagree  | No idea |
| Using gloves is important in reducing risk of food contamination                        | 37 (100)               | 0         | 0       |
| Using apron is important in reducing risk of food contamination                         | 27 (73.0)              | 8 (21.6)  | 2 (5.4) |
| Using face masks is important in reducing risk of food contamination                    | 20 (54.1)              | 15 (40.5) | 2 (5.4) |
| Using caps is important in reducing risk of food contamination                          | 24 (64.9)              | 10 (27.0) | 3 (8.1) |
| Food handlers who have abrasions or cuts on hands should not touch foods without gloves | 37 (100)               | 0         | 0       |
| Raw and cooked foods should be stored separately to reduce risk of food contamination   | 37 (100)               | 0         | 0       |
| Food hygiene training for workers is important for reducing risk of food contamination  | 37 (100)               | 0         | 0       |
| Sick people should not be involved in food handling and preparation                     | 35 (94.6)              | 1 (2.7)   | 1 (2.7) |
| Fish kept at room temperature can be contaminated                                       | 23 (62.2)              | 13 (35.1) | 1 (2.7) |
| Fish stored at room temperature when consumed can cause disease                         | 23 (62.2)              | 12 (32.4) | 2 (5.4) |

**Table 4:** Fish processors' practices toward food-borne disease prevention (n = 37)

| Statements  | No. of Respondents (%) |           |           |
|---|------------------------|-----------|-----------|
|   | Never                  | Sometimes | Always    |
| Do you use gloves during work?                                      | 34 (91.9)              | 2 (5.4)   | 1 (2.7)   |
| Do you wash your hands before using gloves?                         | 35 (94.5)              | 1 (2.7)   | 1 (2.7)   |
| Do you wear apron during work?                                      | 17 (45.9)              | 9 (24.3)  | 11 (29.7) |
| Do you use face mask during work?                                   | 37 (100)               | 0         | 0         |
| Do you cover hair during work?                                      | 19 (51.4)              | 12 (32.4) | 6 (16.2)  |
| Do you clean contact surfaces before you start business?            | 0                      | 1 (2.7)   | 36 (97.3) |
| Do you clean contact surfaces after the end of the days/business?   | 22 (59.4)              | 2 (5.4)   | 13 (35.1) |
| Do you wash your hands before you handle raw fish?                  | 0                      | 3 (8.1)   | 34 (91.9) |
| Do you wash your hands after you handle raw fish?                   | 0                      | 1 (2.7)   | 36 (97.3) |
| Do you wash your hands after you finish work at the end of the day? | 0                      | 0         | 37 (100)  |
| Do you eat or drink in your business place?                         | 0                      | 9 (24.3)  | 28 (75.7) |

|  |           |           |           |
|--|-----------|-----------|-----------|
| How often do you consume fish from your business?                      | 4 (10.8)  | 15 (40.5) | 18 (48.6) |
| Do you store left over fish at room temperature for sale the next day? | 12 (32.4) | 9 (24.3)  | 16 (43.2) |
| Do you further process left over fish for sale the next day?           | 21 (56.8) | 6 (16.2)  | 10 (27.0) |

All participants (100%) agreed to the statements that indicated use of gloves and covering surface wounds as important means of reducing risk of food contamination. Similarly, respondent also agreed on separation of raw food from cooked food as a risk mitigation strategy in reducing contamination (Table 3). On the other hand, respondents disagree on statements that showed keeping fish at room temperature can result to contamination (62.2%) and subsequent diseases (62.2%).

Majority of fish processors had good food safety practices (86.5%) such as use of gloves (91.9%), use of apron (45.9%) and caps (51.4%) during fish handling, cleaning contact surfaces before (97.3%) and after (35.1%) business, hand washing before (91.9%) and after (97.3%) handling raw fish and hand washing at the end of business (100%). However, majority (75.7%) did eat food at business place; keep left over fish (43.2%) for resale the next day, and some did not reheat the fish (27%) before selling it (Table 4).

A positive correlation recorded between knowledge and attitude ( $r_s = 0.6$ ,  $P < 0.01$ ) and knowledge and practices ( $r_s = 0.2$ ,  $P = 0.23$ ) as well as attitudes and practices ( $r_s = 0.17$ ,  $P = 0.315$ ). There was also significant association between knowledge and level of education ( $r_s = 0.5$ ,  $P = 0.000$ ), as well as attitude and level of education ( $r_s = 0.6$ ,  $P = 0.000$ ) but negative correlation between practices with years of business experience ( $r_s = -0.03$ ,  $P = 0.830$ ).

## DISCUSSIONS

There are limited research conducted in relation to assessment of food safety knowledge, practices, and attitudes of food handlers in food businesses; which indicates a safety problem that need to be addressed. The most critical component of any food value chain is the processors involved in final product preparation, processing and packaging for onward sale to consumers (Raspor, 2007). A concerning fact is that, most food industries particularly in developing countries do not understand the concept of good food safety and hygiene practices of handling and preparation of food (Delia, 2015). The isolation and characterization of pathogens responsible for food borne illnesses alone could not provide data required for policy development on risk factors such as improper food handling practices. A study in USA reported poor food handling practices contributing to over 97% of food borne illnesses in food processing units and homes (Howes et al., 1996). Therefore, understanding of the prevailing food safety knowledge, attitude and practices of food handlers in provision of safe

and nutritional food is crucial for effective achievement of nutritional security (WHO, 2000). A number of the fish handlers in this study had no formal training on food hygiene measures; which could be a setback for safe delivery of fish. This is because several studies have indicated that food safety training which increases food safety knowledge does not always result in a positive change in food handling behavior (Howes et al., 1996). The disparity of which could occurs because most of the existing formal certificated training is designed using the KAP model which assumes that attitude and practice are dependent on knowledge. This implies that the mere provision of information will lead directly to a change in attitude and consequently a change in behavior but this model is criticized as flawed in its assumption that knowledge is the main precursor to behavioural change (Ehiri et al., 1997).

In Nigeria, there are no food safety codes directly applying to practices of street food vendors or undergo food hygiene training and certification before conducting food processing business (Nurudeen et al., 2014). Ninety-one percent of the vendors had never taken any formal food hygiene training; however, 48.6% of the respondent had at least secondary school certificates. Personal hygiene practices such as cleaning contact surfaces before and after business, washing hands before and after handling raw fish and cleaning contact surfaces at the end of the day were practices frequently conducted by few processors in this study. However, reasons for not practicing the listed hygiene measures might be related to reasons reported by WHO in which the organization stated reasons like aesthetics and/or for development of customer confidence but not strictly for food safety (WHO, 1996). Lack of use of hand gloves when handling fish by processors in this study posed increased risk for food borne disease because the hands of food handlers were reported to be the most important vehicle for transfer of pathogens from body surfaces or other environmental sites onto food (WHO, 1989). Epidemiological studies demonstrated fecal and human micro flora on fish and body surfaces of fish handlers and other environmental surfaces (Grema et al., 2015a, b).

From this study, it is shown that most of the street fish vendors had a good knowledge on food hygiene practices such as hand washing after some activities; however, knowledge on hygienic fish handling could not be translated into practices. A study indicated the importance of food safety knowledge of food handlers reporting that good knowledge mostly translates into positive behaviour and practices leading to safe food production and handling

(Howes et al., 1996). Rennie (1995) similarly speculated that formal food safety training certification of food handlers can influence practice; however, the dependence of knowledge from mere apprenticeship cannot lead to direct change in attitudes and practices as presented in this study. This study did not conform to the model of assessment of knowledge, attitude and practices of food handlers as conclusively reported as flawed in its assumption that basic informal knowledge is the main precursor to behavioral change such as practice (Ehiri et al., 1997). Attributable factors that may promote poor practices in this case may be assumed to be due to poor infrastructural development like portable water and toilet facilities readily available at vending points as reported in other parts of Nigeria (Idowu and Rowland, 2006; Omemu and Aderoju, 2008). Absence of basic sanitary facilities at various public places and vending sites is a common finding in Nigeria and developing countries (Van-Kampen et al., 1998; Muinde and Kuri, 2005).

Majority of the vendors surveyed in this study agreed that it's necessary to stay away from conducting business when sick or to cover topical wounds during fish handling. However, it appeared that they did not abstain from businesses when sick or cover topical wounds as food hygiene necessities. Although several studies have shown that sick individual are at risk of transmitting pathogens and contamination of food, most vendors prefer to continue fish handling and trade for economic reasons with less concern to public health requirement (Rane, 2011; Alimi, 2016). This finding is similar to findings of (Omemu and Aderoju, 2008) that vendors did not abstain from food handling or vending when afflicted with infectious diseases. They probably had perception of controlling the risk of contamination and disease spread due to belief of high knowledge and experience in food handling.

In conclusion, the results of this study have shown that in spite good knowledge and attitudes of fish vendors, their practices toward food hygiene are very poor. Almost all the fish handlers had never had a formal food safety training program; hence vendor training is necessary for behavioral changes to occur (Tolulope et al., 2014). Food safety issues such as role of food in disease transmission vehicle as well as standards of personal hygiene and practices in handling street food may minimize level of poor practices among fish handlers. The Nigerian Government should emphasize not only on achieving food and nutrition security of its populace but deliverance of safe food to avoid outbreaks. This could be achieved by regulation of vendor activities as well as provision of available basic infrastructures in public places.

## ACKNOWLEDGEMENTS

This work is supported by the fund provided by tertiary ed-

ucation trust fund (TET Fund) from University of Maiduguri, Nigeria.

## CONFLICT OF INTEREST

All authors declare no conflict of interest.

## AUTHORS CONTRIBUTION

**Hafsat Ali Grema, Jacob Kwaga, Mohammed Bello and Hassan Umaru Onimisi:** Responsible for the conceptualization of the study, drafting of proposal for fund and possible implementation. Statistical tool to be employed was collectively agreed upon.

**Jacob Kwaga and Mohammed Bello:** Responsible for the information regarding study areas and sampling points.

**Hassan Umaru Onimisi:** Characterised the fish value chain components in the study area and the hygiene practices commonly employed by the handlers.

## REFERENCES

- Akabanda F, Hlortsi EH, Owusu-Kwarteng J (2017). Food safety knowledge, attitudes and practices of institutional food-handlers in Ghana. BMC, Public Health. 17: 40. <https://doi.org/10.1186/s12889-016-3986-9>
- Akinyele IO (1998). Street foods and their contribution to the food security and nutritional status of Nigerians, West Afr. J. Food Nutr. 6–20.
- Alagoa Y, Ovueziric E, Udah A, Arinze O (2011). A Report on Aquaculture Value Chain Analysis in the Niger Delta, A Partnership Initiative in the Niger Delta (PIND). Pp. 5–45.
- Alimi BA (2016). Risk factors in street food practices in developing countries: A review, Food Science and Human Wellness. 5(3):141–149. <https://doi.org/10.1016/j.fshw.2016.05.001>
- Anetekhai MA (2013). Catfish Aquaculture Industry Assessment in Nigeria: In (Eds) Mohamed Seisay and Simplicie Nouala), Inter-African Bureau for Animal Resources, African Union Pp 1-29.
- Ansari-Lari M, Soodbacksh S, Lakzadeh L (2010). Knowledge, attitudes and practices of workers on food hygienic practises in meat processing plants in Fars, Iran. Food Control. 21(3): 260–263.
- Belton B, Thilsted SH (2014). Fisheries in transition: Food and nutrition security implications for the global South. Global Food Sec. 3(1): 59–66 <https://doi.org/10.1016/j.gfs.2013.10.001>
- Delia G (2015). Food Safety in Low and Middle Income Countries. Int. J. Environ. Res. Public Health. 12(9): 10490–10507. <https://doi.org/10.3390/ijerph120910490>
- Dipeolu AO, Akinbode SO, Okuneye PA (2007). Income generating potentials of street food vending businesses in Ogun State, Nigeria. Int. J. 2 (1): 180–189
- Draper A (1996). Street foods in developing countries: The potential for micronutrient fortification. London School Hyg. Trop. Med.
- Ehiri JE, Morris GP, McEwen, J (1997). Evaluation of a food

- hygiene training Course in Scotland. *Food Control*. 8:137-147. [https://doi.org/10.1016/S0956-7135\(97\)00005-4](https://doi.org/10.1016/S0956-7135(97)00005-4)
- Ekanem EO (1998). The street food trade in Africa: safety and socio-environmental issues, *Food Cont.* 9 (4): 211-215.
  - Eltholth M, Fornace K, Häsler B, Rushton J (2014). Rapid Integrated Assessment of Nutrition and Health Risks Associated with Tilapia Value Chains in Egypt, For the International Livestock Research Institute. Pp. 1-60
  - FAO (1992). Fermented fish in Africa: A study on processing, marketing and consumption, Food and Agriculture Organization of the United Nations Rome, 1992, FAO. Fisheries Technical Paper 329, <http://www.fao.org/docrep/t0685e/T0685E00.htm#Contents>
  - FAO/WHO (2006). FAO/WHO guidance to governments on the application of HACCP in small and/or less-developed food businesses. Retrieved on March 7, 2015 from [www.fao.org](http://www.fao.org)
  - Grema HA, Geidam YA, Gadzama GB, Ameh JA, Suleiman A (2015a). Multi-drug Resistant Bacteria isolated from fish and fish handlers in Maiduguri, Nigeria. *IJAVA*. 7 (3): 49-54.
  - Grema HA, Geidam YA, Gadzama GB, Ameh JA, Suleiman A (2015b). Methicillin Resistant *Staphylococcus aureus* and Methicillin Resistant Coagulase Negative Staphylococci isolated from fish and fish handlers in Maiduguri, Nigeria. *AJFST*. 9 (7): 76-81.
  - Howes M, McEwen S, Griffiths M, Haris L (1996). Food handler certification by home study: measuring changes in knowledge and behavior. *Dairy Food Environ. Sant.* 3: 208-214.
  - Idowu OA, Rowland SA (2006). Oral fecal parasites and personal hygiene of food handlers in Abeokuta, Nigeria. *Afr. Health Sci.* 6(3):160-4.
  - Ilu IY, Frank A, Annatte I (2016). Review of the Livestock/ Meat and Milk Value Chains and Policy Influencing them in Nigeria (Olanrewaju B. Smith, Abdou Salla, Berhanu Bedane, Eds), Published by the Food and Agriculture Organization of the United Nations and the Economic Community of West African States. Pp. 56-89.
  - Kwaga JKP, Adesiyun AA (1984). Antibigrams of *Staphylococcus aureus* Isolates from Some Ready-To-Eat Products. *J. Food Prot.* 11(3):836-901. <https://doi.org/10.4315/0362-028X-47.11.865>
  - Muinde OK, Kuri E (2005). Hygienic and sanitary practices of vendors of street foods in Nairobi, Kenya. *AJFAND*. 5(1):1-14.
  - Ndahi MD, Kwaga JKP, Bello M, Kabir J, Umoh VJ, Yakubu SE, Nok AJ (2013). Prevalence and Antimicrobial Susceptibility of *Listeria monocytogenes* and Methicillin Resistant *Staphylococcus aureus* strains from Raw Meat and Meat Products in Zaria, Nigeria. *Lett Appl. Microb.* <https://doi.org/10.1111/lam.12183>
  - NORAD-FAO (2013). A value-chain analysis of international fish trade and food security with an impact assessment of the small-scale sector: Summary Article January 2013, IIFET 2012 Tanzania Proceedings.
  - Nurudeen AA, Lawal AO, Ajayi SA (2014). A survey of hygiene and sanitary practices of street food vendors in the Central State of Northern Nigeria. *J. Pub. Health Epi.* 6(5):174-181
  - Omemu AM, Aderoju ST (2008). Food safety knowledge and practices of street food vendors in the city of Abeokuta, Nigeria. *Food Control*. 19(4): 396-402. <https://doi.org/10.1016/j.foodcont.2007.04.021>
  - Rane S (2011). Street Vended Food in Developing World: Hazard Analyses. *Indian J. Microb.* 51(1): 100-106. <https://doi.org/10.1007/s12088-011-0154-x>
  - Raspor P (2007). Total food chain safety: How good practices can contribute?. *Trends Food Sci. Technol.* <https://doi.org/10.1016/j.tifs.2007.08.009>
  - Rennie DM (1995). Health education models and food hygiene education. *J. R. Soc. Health.* 75-79. <https://doi.org/10.1177/146642409511500203>
  - Suleiman AB, Umoh VJ, Kwaga JKP, Shaibu SJ (2013). Enterotoxigenicity and Antibiotic Resistance of *Staphylococcus aureus*. Isolated from Sub-clinical Bovine Mastitis Milk in Plateau State, Nigeria. *Res. J. Microb.* 8: 101-107. <https://doi.org/10.3923/jm.2013.101.107>
  - Tafida SY, Kabir J, Kwaga JKP, Bello M, Umoh VJ, Yakubu SE, Nok AJ, Hendriksen RS (2013). Occurrence of *Salmonella* in retail beef and related meat products in Zaria, Nigeria. *Food Control*. 32(1):119-124. <https://doi.org/10.1016/j.foodcont.2012.11.005>
  - Tamba Z, Bello M, Raji MA (2016). Occurrence and Antibigram of *Salmonella* spp. in Raw and Fermented milk in Zaria and Environs. *Bangladesh J. Vet. Med.* 14 (1): 103-107. <https://doi.org/10.3329/bjvm.v14i1.28850>
  - Tolulope OA, Hassan ZI, Bello DA, Tagurum YO, Miner CA, Zoakah AI, Ogbonna C (2014). Training: A vital tool for improving the knowledge and practice of food safety and hygiene among food handlers in boarding secondary schools in Plateau state. *J. Med. Trop.* 16:2:87-92 <https://doi.org/10.4103/2276-7096.139061>
  - Van-Kampen J, Gross R, Schultink W, Usfar A (1998). The microbiological quality of street foods in Jakarta as compared to home-prepared foods and foods from tourist hotels. *Int. J. Food Sci. Nutr.* 49:17-26. <https://doi.org/10.3109/09637489809086400>
  - Velu A, Gessese N, Ragasa C, Okali C (2009). Gender Analysis of Aquaculture Value Chain in Northeast Vietnam and Nigeria, Washington D.C., World Bank Agriculture and Rural Development Discussion Paper. Pp. 44
  - Webber M, Austin JE (2011). Using value chain approaches in Agribusiness and Agriculture in Sub-Saharan Africa, A Methodological Guide: Tools That Make Value Chains Work, Prepared for the World Bank.
  - WHO (1989). Health surveillance and management procedures for food handling personnel. WHO technical report series, 785. Geneva. 52pp.
  - WHO (1996). Essential safety requirements for street vended foods. Food Safety Unit, Division of Food and Nutrition. WHO/FNU/FOS/96.7.
  - World Health Organization (WHO) (2000). Food borne disease: A focus for health education. Geneva: World Health Organization, Retrieved January 16, 2016 from [http://www.who.int/foodbornedisease/WHO\\_Global\\_Strategy.htm/en/](http://www.who.int/foodbornedisease/WHO_Global_Strategy.htm/en/)