ISSN 2449-8947 MicroMedicine *Original Article*

DOI: http://dx.doi.org/10.5281/zenodo.3813342

Microbiological safety assessment of food handlers in Wudil Local Government Area of Kano State, Nigeria

Gloria C. Ifiora[1], Chidimma R. Chukwunwejim[1], Chika P. Ejikeugwu[2]*, Roselyn N. Egbuna[1], Francis C. Ifiora[3], Isaiah C. Abonyi[4], Peter M. Eze[4], Auwalu H. Arzai[5], Muhammad D. Mukhtar[5]

[1] Department of Pharmaceutical Microbiology and Biotechnology, Nnamdi Azikiwe University, Awka, Nigeria

[2] Department of Applied Microbiology, Ebonyi State University, Abakiliki, Nigeria

[3] College of Pharmacy, Igbinedion University, Okada, Nigeria

[4] Department of Environmental Health Science, Nnamdi Azikiwe University, Awka, Nigeria

[5] Department of Microbiology, Bayero University, Kano, Nigeria

* Correspondence: Phone: +2347081775676; E-mail: chika.ejikeugwu@ebsu.edu.ng

Received: 22 February 2020; **Revised submission:** 15 April 2020; **Accepted:** 06 May 2020

http://www.journals.tmkarpinski.com/index.php/mmed

ABSTRACT: This study was conducted to investigate the bacteriological safety levels of food handlers in Wudil Local Government Area (LGA) of Kano State, Nigeria. A total of 200 hand-swab samples were collected from different male [100 (50%)] and female [100 (50%)] food handlers/peddlers in the study area. From these samples, 200 non-duplicate bacterial isolates consisting of strains of *Salmonella typhi* [60 (30%)], *Salmonella choleraesuis* [52 (26%)], *Proteus mirabilis* [10 (5%)], *Morganella morganii* [10 (5%)], *Pseudomonas aeruginosa* [10 (5%)], *Escherichia coli* [18 (9%)] and *Staphylococcus aureus* [40 (20%)] were isolated. A significant proportion (33.3%) of the food handlers sampled was children within the age range of 8-12 years. In addition, only 33.5% of the food handlers had basic level of primary education and a majority (96.5%) of the food handlers displayed poor levels of personal hygiene, especially with regards to safe food handling. *S. typhi*, *S. cholaeresius* and *S. aureus* were found to be the common bacterial species that colonized the hands of food handlers/peddlers in Wudil LGA, Kano State. This highlights a lack of food safety and the resulting risk of spreading foodborne diseases in the area. In addition, low literacy levels and lack of safe food handling practices contribute to the prevalence of these pathogens among the food handlers. It is important for food handlers to obtain training on safe food practices, undergo periodic health checks and practice proper hand hygiene.

Keywords: Foodborne diseases; Food handlers; *Salmonella*; Wudil; Kano State; Nigeria.

1. INTRODUCTION

Globally, foodborne diseases are a growing public health problem resulting into morbidity and mortality in the general population, particularly in susceptible groups, such as infants, young children, elderly, and the immunocompromised [1]. About 600 million people (which is almost 1 in 10 people in the world) fall ill after eating contaminated food resulting in 420 000 deaths every year and the loss of 33 million healthy life

years (DALYs). Children under the age of five carry 40% of the foodborne disease burden, with 125 000 deaths every year [2].

Bacteria are common agents of foodborne illnesses, and are implicated in foodborne diseases in 60% of hospitalization-related cases. [3]. The Enterobacteriaceae, a family of Gram-negative, non-spore-forming bacteria includes a number of important foodborne pathogens such as *Salmonella* spp., *Yersinia enterocolitica*, pathogenic *Escherichia coli* (including *E. coli* O157:H7), *Shigella* spp. and *Cronobacter* spp. Other members of the family, e.g. *Klebsiella* spp., *Serratia* spp. and *Citrobacter* spp., are regarded as opportunistic pathogens especially in clinical settings [4]. Transmission of enteropathogenic bacteria and also, intestinal parasites is possible directly or indirectly through objects contaminated with feces. These include food, water, nails, and fingers, indicating the importance of feco-oral human-to-human transmission [5].

Unhygienic food handlers working in food-serving establishments could be potential sources of infections of many intestinal helminths, protozoa, and enteropathogenic bacteria [6]. Food handlers who harbor and excrete intestinal parasites and enteropathogenic bacteria may contaminate foods from their feces via their fingers, then to food, and finally to healthy individuals [7].

Poor hygiene and unsafe food handling practices by food handlers or peddlers have been reported in several parts of Nigeria [8-10]. Many of the food peddlers are itinerant in nature, moving their food-laden carts, wheel-barrows or specially built bicycles to serve their customers from one place to the next. Others operate in small stalls and shops. Such street foods are sold at fairly low prices which attract most of their customers. A majority of these food peddlers are often more interested in making money than in matters of health, quality and hygiene [11].

This present study evaluates the bacteriological safety levels of food handlers in Wudil Local Government Area (LGA) of Kano State, Nigeria.

2. MATERIALS AND METHODS

2.1. Study area and population

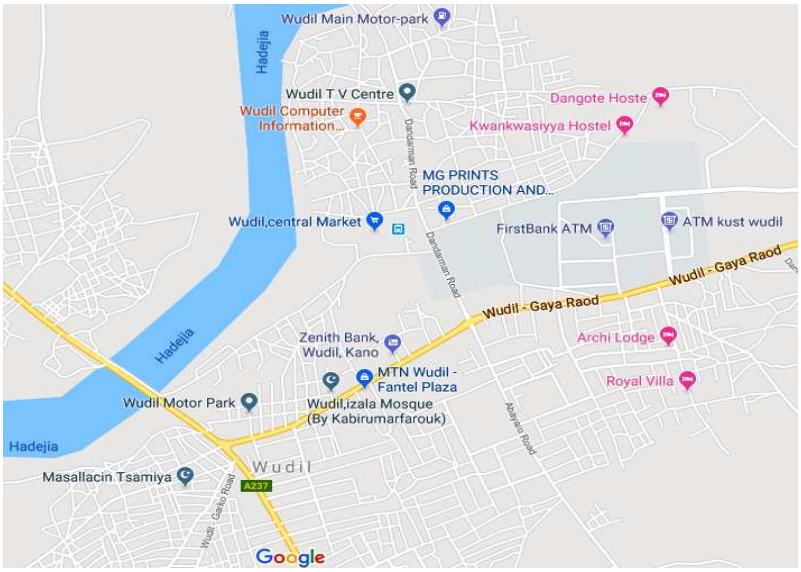

Figure 1. Map showing parts of Wudil LGA, Kano State, Nigeria (© Google Maps [12]).

The study area is the environs of Wudil LGA, Kano state, Nigeria. It has an area of 362 km^2 and a population of 188,639 according to the Nigerian 2006 population and housing census [13]. The study

population comprised of food handlers operating restaurants, as well as road side or street food peddlers. Inclusion criteria included participants that are ≥ 8 years, healthy or apparently healthy food handlers. Participant ≤ 8 years and apparently unhealthy food handlers were excluded from the study.

2.2. Collection of samples and demographic data of participants

A total of 200 hand-swab samples were randomly collected over a three (3) months period (January-April, 2010) from consenting food handlers spread across Wudil LGA. Palms of the food handlers were swabbed using sterile cotton wool moistened with sterile normal saline solution. The samples collected were held in coolers with ice packs and transported to the laboratory within 6-10 h of collection for analysis. Also, consent forms and pre-tested structured questionnaires were used to obtain information regarding the demographics, literacy and hygiene status of the participants.

2.3. Isolation and identification of microorganisms

Bacterial isolation and identification was carried out using standard microbiological methods [14]. The samples were inoculated into respective test tubes containing 5 ml of freshly sterile peptone water (Oxoid, UK) and incubated at 35°C for 24 h. Bacterial growth was indicated by the turbidity of the broth culture. The broth cultures were aseptically streaked onto MacConkey, mannitol salt and cetrimide selective agar (Oxoid, UK) plates and incubated at 35°C for 24 h. To obtain pure cultures, suspected colonies of *Staphylococcus* spp., *Pseudomonas* spp., and isolates belonging to the Enterobacteriaceae were subcultured onto freshly prepared mannitol salt, cetrimide and MacConkey agar plates respectively. For confirmation, Gram staining and conventional biochemical tests including sugar fermentation, indole, citrate and malonate utilization, oxidase and catalase tests were carried out.

2.4. Ethical clearance

Ethical clearance was obtained from the Kano State Hospital Management Board with number; SPS/08/SCI/00009.

3. RESULTS

3.1. Isolation and identification of microorganisms

A total of 200 hand-swab samples collected from the food handlers were analyzed. From these samples, 200 non-duplicate bacterial species comprising *Salmonella typhi* [60 (30%)], *Salmonella choleraesuis* [52 (26%)], *Proteus mirabilis* [10 (5%)], *Morganella morganii* [10 (5%)], *Pseudomonas aeruginosa* [10 (5%)], *Escherichia coli* [18 (9%)] and *Staphylococcus aureus* [40 (20%)] were isolated. *S. typhi*, *S. choleraesuis* and *S. aureus* represent the most prevalent bacterial species associated with the hands of food handlers in Wudil LGA (Table 1).

Figure 2 shows the gender, age, literacy and hygiene status of the participants. Equal number of male [100 (50%)] and female [100 (50%)] food handlers were sampled. Significant portion (33.3%) of the sample population was children within the age range of 8-12 years. Also, only 33.5% of the total participants had basic level of primary education, and majority (96.5%) of the food handlers exhibited low levels of personal hygiene, especially with regards to safe food handling.

Table 1. Bacterial strains isolated from hand-swab samples of food handlers in Wudil LGA.

Organisms	Total [n (%)]
S. typhi	60 (30%)
S. choleraesuis	52 (26%)
P. mirabilis	10 (5%)
M. morganii	10 (5%)
P. aeruginosa	10 (5%)
E. coli	18 (9%)
S. aureus	40 (20%)
Total	200 (100%)

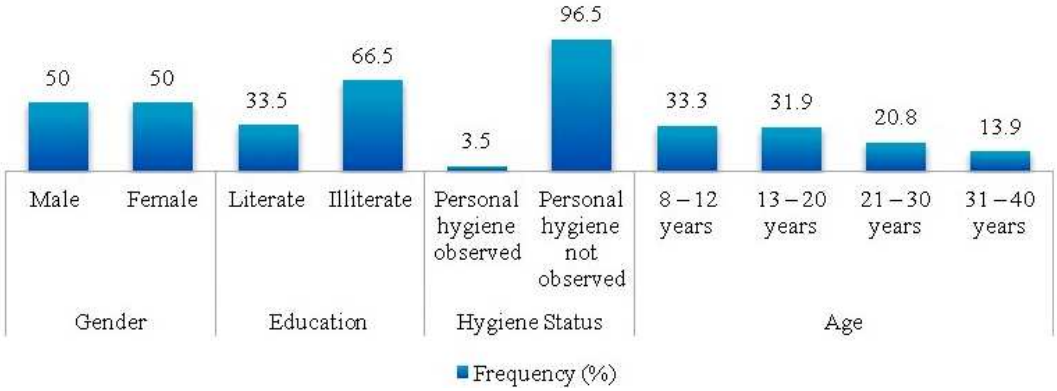

Figure 2. Demographics, literacy and hygiene statuses of food handlers in Wudil LGA.

4. DISCUSSION

Of all the bacterial species isolated, *S. typhi* (30%), *S. choleraesuis* (26%) and *S. aureus* (20%) exhibited the highest percentage occurrence. Also, a prevalence rate of 9% was recorded for *E. coli*. *Salmonella* persists as a major cause of food poisoning and its incidence is on the rise. It is reasonable to assume that all products contaminated with *Salmonella* at the point of consumption have the potential to cause human disease [15]. Major outbreaks involving *E. coli* and *Salmonella* have highlighted problems with food safety and increased public anxiety that modern farming systems, food processing and marketing may not provide adequate safeguards for public health [16].

It is important to note that the prevalence of foodborne diseases is very much dependent on the levels of personal hygiene and literacy of food handlers. A report by Mohan et al. [17] showed that 0.47% of the food handlers studied harbored *S. typhi* and this was attributed to their poor personal hygiene. In our study, a significantly poor level of hygiene, as well as poor knowledge and practice of food hygiene amongst the food handlers was observed. It was noted that only 3.5% of the study participants displayed some levels of personal hygiene.

Andargie et al. [6] in their study suggested that the reason for infection among the food handlers surveyed was due to their illiteracy or low education level. In our study, only 33.5% of participants indicated that they had received some form of primary or secondary education. It can therefore imply that high level of food hygiene among food handlers is directly proportional to high literacy level.

It was also observed in our study that a majority of the food handlers were children and teenagers within the age group of 8-20 years. It is dissatisfying to observe that children are involved in food peddling

business in Wudil LGA and they accounted for about 33% of the study population. It was hence not surprising to observe that these individuals, who are mostly uneducated, do not observe proper personal hygiene and safe food handling practices.

Wudil LGA of Kano State comprises rural communities that reflect high level of poor sanitation typical of most rural communities in other parts of Nigeria. Nkere et al. [8] revealed that rural communities in Nsukka, Nigeria have a high level of poor sanitation, lack of good water supply, limited toilet facilities and resultant open defecation. Food handlers from these environments may end up using unwashed and contaminated hands to carry out their business and consequently become a vehicle of foodborne diseases.

The presence of bacteria belonging to the family *Enterobacteriaceae* such as *Salmonella* and *Escherichia* species in the hands of the food handlers are serious indications of poor level of personal hygiene. Poor hygienic practice might have been compounded by the fact that most food handlers were individuals from the lower socio-economic class with low level of education.

Cases of poor food hygiene in some urban cities in Nigeria have also been reported. Poor hand hygiene, as well as poor knowledge and practice of food hygiene amongst food handlers in Lagos, Nigeria, was reported by Smith et al. [9]. Their findings revealed that personal hygiene (hand washing) was neglected by majority of the food handlers in Lagos, Nigeria [9]. Also, in Abuja, the capital city of Nigeria, it was reported that personal hygiene, especially with regards to hand washing, was neglected by majority of food handlers operating *bukas* and restaurants [10].

The findings of this study indicate that health authorities in both rural and urban areas need to adopt and enforce effective sanitary control measures and good food management policies to minimize the transmission of foodborne pathogens. Governments, as well as the private sector, can make a major contribution to curbing the spread of foodborne diseases by providing adequate public toilet facilities, organizing continuous food safety enlightenment programs and ensuring regular medical checks for food-handling personnel. Food vendors and handlers should ensure they carry out their operations in a safe and clean environment. Also, policies should be put in place to prevent school age children from commercial food vending.

5. CONCLUSION

The findings of this study show that food handlers who do not observe proper hygiene during handling of food are potential vehicles for foodborne diseases. *S. typhi*, *S. cholaeresius* and *S. aureus* were found to be the common bacterial species colonizing the hands of food handlers/peddlers in Wudil LGA, Kano State, Nigeria. Other factors like poor literacy level and lack of safe food handling practices are contributory to the prevalence of these pathogens among food handlers in the study area. It is important food handlers receive training on safe food practices, undergo periodic health examinations and practice proper hand hygiene.

Authors Contributions: AHA and MDM conceptualized and supervised the study; GCI, FCI, CRC and PME were involved in data collection and analyses; PME, CRC, RNE, ICA, and CPE wrote and revised the manuscript. All authors read and approved the final manuscript.

Conflict of Interest: The authors declare that there is no conflict of interest regarding the publication of this article.

Acknowledgements: The authors would like to thank all the food vendors/handlers who participated in the study.

Funding: No funding was obtained for this study.

REFERENCES

1. Nyenje ME, Ndip RN. The challenges of foodborne pathogens and antimicrobial chemotherapy: A global perspective. Afr J Microbiol Res. 2013; 7(14): 1158-1172.
2. WHO. Food safety. World Health Organization, Geneva. https://www.who.int/news-room/fact-sheets/detail/food-safety. 2019.
3. Mead PS, Slutsker L, Dietz V, McCaig LF, Bresee JS, Shapiro C, et al. Food-related illness and death inthe United States. Emerg Infect Dis. 1999; 5: 607-625.
4. Baylis C, Uyttendaele M, Joosten H, Davies A. Enterobacteriaceae and their significance to the food industry. ILSI Europe Report Series. 2011: 1-48.
5. Zaglool DA, Khodari YA, Othman RA, Farooq MU. Prevalence of intestinal parasites and bacteria among food handlers in a tertiary care hospital. Niger Med J. 2011; 52(4): 266-270.
6. Andargie G, Kassu A, Moges F, Tiruneh M, Huruy K. Prevalence of bacteria and intestinal parasites among food-handlers in Gondar town, northwest Ethiopia. J Health Popul Nutr. 2008; 26(4): 451-455.
7. Schlundt J, Toyofuku H, Jansen I, Herbst SA. Emerging food-borne zoonoses. Rev Sci Tech. 2004; 23: 513-533.
8. Nkere CK, Ibe NI, Iroegbu CU. Bacteriological quality of foods and water sold by vendors and in restaurants in Nsukka, Enugu State, Nigeria: a comparative study of three microbiological methods. J Health Popul Nutr. 2011; 29(6): 560-566.
9. Smith SI, Agomo CO, Bamidele M, Opere BO, Aboaba OO. Survey of food handlers in bukas (a type of local restaurant) in Lagos, Nigeria about typhoid fever. 2010; 2(8): 951-956.
10. Ifeadike CO, Ironkwe OC, Adogu PO, Nnebue CC. Assessment of the food hygiene practices of food handlers in the Federal Capital Territory of Nigeria. Trop J Med Res. 2014; 17: 10-15.
11. Ezirigwe J. Much ado about food safety regulation in Nigeria. J Sustain Develop Law Policy. 2018; 9(1): 109-132.
12. Google Maps. https://www.google.com/maps/@11.8022931,8.8394038,15z [Date accessed: April 09, 2020].
13. National Population Commission. Federal Republic of Nigeria 2006 Population and Housing Census. Priority Table Volume IV. Population distribution by age & sex (State & Local Government Area). National Population Commission, Abuja, Nigeria 2010.
14. Cheesbrough, M. District laboratory practice in tropical countries. 2nd edn, part 2. Cambridge University Press. 2000: 62-70.
15. Mølbak K, Olsen JE, Wegener HC. *Salmonella* infections. In: Foodborne infections and intoxications. Elsevier Inc. 2006.
16. FAO. Assuring food safety and quality: Guidelines for strengthening national food control systems. Food and Agriculture Organization of the United Nations (FAO) food and nutrition paper. 2003: 254-4725.
17. Mohan U, Mohan V, Raj KA. Study of carrier state of *S. Typhi*, intestinal parasites & personal hygiene amongst food handlers in Amritsar City. Indian J Commun Med. 2006; 31: 60-61.