Handling Practices and Microbiological Status of Food Service Establishments within Morogoro Municipality, Tanzania

***Kussaga, J.B. and D.P. Nziku**

Department of Food Science and Agroprocessing, School of Engineering and Technology, Sokoine University of Agriculture, P.O. Box.3006, Morogoro. Tanzania

*Corresponding author e-mail: *kussaga@sua.ac.tz; kussaga15@yahoo.com;*
Mob: +255 232 603511-4

Abstract

The study assessed handling practices and microbiological status of ready-to-eat food (stiff porridge and rice), contact surfaces, and personnel hands in 20 food service establishments and 10 street vendors within Morogoro municipality. It used face-to-face interviews and microbiological sampling of food, contact surfaces and personnel hands in the selected food businesses. The samples were then analysed for Total Viable Counts (TVC), Staphylococcus aureus and Escherichia coli. The findings of the study revealed that that personnel had low education level with limited training on food hygiene. Hygienic practices that are essential for food handling and preparation such as hairnets, gloves, protective clothing and potable water were not consistently observed. Street vendors operated in informal settings with unroofed makeshift huts, in contrast to restaurants and cafeterias which operated in relatively proper-designed facilities. Although preparation methods of ugali and rice involved cooking, both foods had high microbiological contamination level than the specified standards in raw materials. The contamination levels in foods reflected the levels on tables, plates and personnel hands; which ranged from 4.4-5.6 Log CFU/cm^2 for TVC, 4.7-6.4 Log CFU/cm^2 for S. aureus, and 3.6-5.5 Log CFU/cm^2 for E. coli. This further indicates inadequate handling practices, faecal contaminated water or poor hand washing procedures. Therefore, personal hygiene training and control by legal authorities are needed to ensure quality and safety of ready-to-serve foods.

Keywords: food establishments, microbiological quality, hygienic practices, street.

Introduction

Majority of people across the world eat outside their homes; this has brought an insurmountable challenge to ensure quality and safety of the food supply (Moloi *et al.,* 2021). The major places where people get meals outside their homes, especially during the day are restaurants, cafeteria and street foods. In Tanzania, street food accounts for more than 70% of the total calorie intake for the urban low and middle-income groups (Kinabo, 2004). Despite the importance of street foods, they are potential routes of exposure to various food safety risks (Imathiu, 2017). Food, particularly ready-to-serve, can be contaminated through dirty hands and clothing. Food- and water-borne diseases are the leading causes of deaths, affecting 1.8 million people annually in the developing countries (Sylvia *et al.,* 2015). About 70% of diarrheal related diseases are due to consumption of contaminated foods (WHO, 2018). Moreover, food handlers contribute to 10-20% of foodborne disease outbreaks (Abdalla *et al.,* 2009).

Despite the effort by the Tanzanian government to control and assure food safety, food and water borne diseases are reported especially during outbreaks (food safety crises). However, what is reported is a tip of an iceberg as majority goes unreported. As a consequence, proper control and monitoring of the FSEs are most likely done during the emergencies like outbreak of diseases such as cholera and COVID-19. This illustrates that FSBs are not routinely regulated. Outbreaks of cholera in Dar es Salaam (2015-2018), which killed 542 people with 33,421 hospitalisations (WHO, 2018), echoes on this situation.

As compared to sauce/garnish which can be reheated, rice and ugali are not. This creates favorable conditions for microbiological growth and contamination as such foods are prepared in advance before being served. This situation is exacerbated by the nature of food service businesses in Tanzania. Majority of food businesses are small-scale operated by people with limited knowledge in food hygiene and often in non-hygienically designed facilities. Although some studies have assessed hygienic practices in street foods in cities like Dar es Salaam and Dodoma, little has been done on quality of ready-to-serve foods (e.g. rice and ugali) in food business in Morogoro. Therefore, this study aimed at assessing handling practices, personal hygiene, and microbiological status of ready-to-serve food (i.e. ugali and rice) and contact surfaces (tables and plates) of FSEs within Morogoro municipality. The information obtained from this study will assist the FSEs, street vendors, government, food control authorities, and other stakeholders to develop measures to reduce microbiological contamination and foodborne diseases in the country.

Materials and Methods

Assessment of food handling practices in the FSEs

A questionnaire with both open-ended and closed-ended questions was used to assess food handling practices by operators in cafeteria, restaurant and street food within Morogoro Municipality, Tanzania. The questionnaire comprised of questions on demographic characteristics of the respondents (6), source of water (6), food handling practices (9), and food contamination and food-related illnesses (6). Face-to-face interviews involved one personnel (owner or food handler) from each food business (10 restaurants, 10 cafeterias, and 10 street food vendors). The number of FBs were restricted to 30 due to budgetary and time constraints but also the study aimed to establish the current status. Taking into account that the establishments and street vendors operate in the same context and characteristics, even if several units are involved no significant variation would be established. Therefore, the type of food service establishments and street vendors were purposefully selected, whereas the individual operators were randomly selected.

Microbiological status of ready-to-eat foods, personnel hands and food contact surfaces

Samples for microbiological analysis were randomly collected in the afternoon (1.00 – 2.00 p.m) from ready-to-serve stiff porridge (commonly known as Ugali) and rice, hands of the FSE staff, and food contact surfaces (Tables and Plates) in three different FSEs (i.e., one restaurant, one cafeteria, and one food vendor). Hands of personnel comes into direct contact with food, if not properly washed could be a source of contamination. The samples were taken from 1-2 p.m because it was the normal lunch-time in Tanzania. Although some restaurants could prepare some meals well-in advance, this study did not enquire about the time of preparation of the meals. About 200 g samples of ugali or rice were collected, stored, and transported in a cool box containing sterile ice packs. A sterile metallic template was used to delineate 25 cm^2 on the tables, plates, and hands of the food serving personnel. Then peptone water pre-moistened cotton swabs were used to swab the delimited areas. After swabbing, the swabs were put back into their respective tubes, which were stored and transported at $\leq$ 4°C in a sterile cool box to the laboratory. A sterile swab was used for every single sampling. A total of 15 samples (i. e. ugali, rice, tables, plates, and personnel hands) were collected for microbiological assessment from three establishments (i. e. cafeteria, restaurant and street vendor). This cross sectional study collected samples once from each food service establishment and street vendor.

For each food sample (n=6), a 25 g analytical sample was taken and mixed with 225 ml of peptone water to prepare 10^{-1} dilution. Then the mixture was stomached for one minute in a stomacher blender (Seward STOMACHER R 3500 Lab System), whereas for cotton swab samples, they were vortex-mixed for 10 seconds. Then from each sample, five serial dilutions were made by taking 1 ml of 10^{-1} into 9 ml of peptone water to prepare 10^{-2} dilution, then 1 ml from 10^{-2} into 9 ml of peptone water to make

10^{-3} dilution, the same procedure was repeated to make other serial dilutions (10^{-4} – 10^{-5}) (ISO, 2003). Classical cultural ISO methods were used to analyse S. aureus (De Buyser et al., 2003), *E. coli* (ISO, 2004), and TVC (ISO 4833-1, 2003). From each dilution 1 ml was taken in triplicate and plated on Plate Count Agar (PCA, for TVC) and Violet Red Bile Agar (VRBA for *E. coli*), whereas 0.1 ml was inoculated on Baird Parker Agar (BPA, for *S. aureus*). After inoculation, the Petri dishes were incubated at 29°C - 31°C for 72 hours for TVC, and 36°C – 38°C for *S. aureus* and 43°C - 45°C for *E. coli* for 24 hours. Presumptive colonies were counted using the colony counter (Galenkamp, England) and expressed as colony-forming unit per 25 gram (CFU/g) of the sample.

Data analysis and interpretation

The data collected were coded and analysed by Microsoft Word Excel (2010). Descriptive statistics involved means and percentages. The microbiological results were compared against the East African food standards (EAS 128:2011, EAS 44: 2011) and scientific literature.

Results and Discussion

Characteristics of the food service establishments influencing microbiological quality of food

Majority of food service establishments and street food vendors had very low level of education, ranging from primary (7/10 street vendors) to secondary (6/10 restaurant, 9/10 cafeteria) level. Low level of education and inadequate food hygiene training indicate that poor handling is inevitable and consumers are most likely exposed to food safety hazards. Previous studies linked lower levels of education to poor hygienic practices among the food handlers (Kitagwa *et al.,* 2006). Street food vendors had capacity to serve <50 plates per day (5/10) and 50-99 plates per day (5/10, Table 1). Cafeteria could serve >500 plates per day and restaurants served 50-99 plates per day. Cafeteria served more plates because it is

Table 1.Characteristics of the food service establishments

Characteristic	Street vendors N=10	Restaurants N=10	Cafeterias N=10
Sex of respondent			
Male	5	8	4
Female	5	2	6
Age of respondents (years)			
18-20	3	4	3
21-30	4	5	3
31-40	3	1	4
Marital status			
Single	4	6	3
Married	4	3	6
Divorced	2	1	1
Education level			
Primary	7	4	1
Secondary	3	6	9
Size of the FSE (number of plates served per day; number of employees)			
Micro-scale (less than 50 plates, <5 employees)	5	0	0
Small (50-99 plates, 6-10 employees)	5	6	0
Medium (100-500 plates, 11-50 employees)	0	4	5
Large (>500 plates, >50 employees)	0	0	5

located in public institutions like Universities. Although most cafeteria could have all essential facilities, as indicated above employ people of limited education. With several customers to serve at a go, it indicates that a big volume of food is being prepared well in advance. There is also a likelihood that some hygienic principles may not be followed during preparation and serving of food. Personnel could focus more on serving as many customers as possible rather than observing hygiene. This situation may expose customers to microbiological contamination. Several food borne disease outbreaks are linked to mass catering.

Handling practices in the food service establishments and street foods

Although the majority of FSE (10/10 cafeteria, 8/10 restaurants) and street food vendors (6/10) used public tap water, a few (4/10 of street vendors and 2/10 of restaurants) used water (often not treated) from other alternative sources like well, river, and rain. However, tap water is supposed be of drinking quality, most often tap water is dirt and not treated. Unfortunately, the majority of FSEs did treat for washing utensils (8/10) and personnel hands (7/10, Table 2), which increase vulnerability to contamination. Besides, the majority of street vendors (6/10) did not change water for dishwashing. If dirty water is not frequently changed, may serve as a growth medium of pathogenic micro-organisms. Another study observed that shortage of water compelled street vendors to reuse water for cleaning utensils and dishes (Chukuezi, 2010). If not properly washed, hands are potential routes of cross-contamination to micro-organisms including pathogens (WHO-FAO(UN), 2009).

The majority of workers put on hairnets (cafeteria 8/10; restaurants 6/10) and gloves (cafeteria 8/10, restaurant 7/10) to prevent contamination. On contrary, most of the street vendors did not put on protective hair nets (6/10) and none of the employees used hand gloves (0/10). If food handlers are not using hairnets there is likelihood that hairs and dandruff could fall and contaminate foods. Besides, the same person who is serving food could be also receiving money. Some food products may be served by using bare hands. Such inadequate practices like touching ready to eat foods could result into cross-contamination (Lues *et al.,* 2006; Oluwafemi *et al.,* 2013).

Although food handlers in cafeterias (10/10) and restaurant (8/10) put on clean clothes, a significant number of street vendors (6/10) did not. Failure to put on clean clothes poses a considerable risk of cross-contamination of food with safety hazards. Dirty clothing is a source of microbiological contamination in the FSEs as may come into direct contact with food or hands which subsequently touch foods. Moreover, 8/10 of street vendors and 4/10 of handlers in the restaurants, and 2/10 in the cafeteria did not remove jewelry during food preparation. A study in Dodoma, Tanzania, reported that 13% of 200 food vendors visited put on aprons (Juma *et al.,* 2018). Apart from the risk of detachment from the personnel's body, jewelry is a good source of microbiological contamination as it may trap microorganisms and other physical contaminants. It is recommended that food handlers remove their watches, rings, and jewelry before handling/processing food (WHO-FAO(UN), 2009).

Moreover, majority of street vendors (6/10) did not use detergents and disinfectants for hand washing (Table 2). Majority of street vendors lacked hand washing facilities as they did operate in informal settings. A similar study in Dodoma, Tanzania, reported that only 25% of 200 food vendors assessed, washed hands with soap before preparation and serving of food (Juma *et al.,* 2018). Effective use of hand sanitizing agents and disinfectants in cleaning operations significantly reduce the risk of microbiological contamination and foodborne diseases (Parker, 2007).

The majority of respondents for the cafeteria (10/10), restaurants (9/10), and street vendors (7/10) were aware of the effects of food contamination (Table 2). Similarly, the majority of respondents for the cafeterias (8/10) and restaurants (8/10), and street vendors (6/10) attended food hygiene training. Restaurants and cafeterias did operate in a more formal system as opposed to street vendors operating in a less controlled and monitored environment. Moreover, while majority (8/10) of cafeteria and

Table 2: Handling practices in the food service establishments

	Street vendor N=10	Restaurant N=10	Cafeteria N=10
Do you use tap water to prepare food?			
Yes	6	8	10
No	4	2	0
Do you boil water for washing equipment and utensils?			
Yes	2	7	9
No	8	3	1
Do you supply boiled water for customers' hand washing?			
Yes	3	8	8
No	7	2	2
Do you treat tap water before using it to prepare food?			
Yes	2	6	7
No	8	4	3
Do you have tap water at the kitchen?			
Yes	5	8	9
No	5	2	1
Do you change water for washing plates and utensils?			
Yes	4	7	9
No	6	3	1
Do you wear hairnet during preparation and serving food?			
Yes	3	6	8
No	7	4	2
Do you wear special gloves during food preparation?			
Yes	0	2	3
No	10	8	7
Do you wear apron when preparing food?			
Yes	4	8	10
No	6	2	0
Do you remove jewellery when dealing with food?			
Yes	2	4	8
No	8	6	2
Do you wash hands before handling the food?			
Yes	4	8	9
No	6	2	1
Do you use any chemical disinfectant in cleaning and sanitation processes?			
Yes	7	9	10
No	3	1	0

Table 2: Handling practices in the food service establishments (Continue)

	Street vendor N=10	Restaurant N=10	Cafeteria N=10
Do you clean the table by using hot water and soap?			
Yes	1	3	6
No	9	7	4
Do you clean cutting boards before and after use?			
Yes	7	9	9
No	3	1	1
Do you use detergents (e.g., soap) in cleaning processes?			
Yes	9	10	10
No	1	0	0
Do you think that contamination of food can lead to food poisoning?			
Yes	7	9	10
No	3	1	0
Did you receive any training on food hygiene?			
Yes	6	8	8
No	4	2	2
Did you go for medical check-up when you were employed?			
Yes	5	8	8
No	5	2	2
Do you go for medical check-up after every six months?			
Yes	1	4	6
No	9	6	4

restaurants had workers gone through medical examinations, about half of street vendors did not (Table 2). According to Tanzania food legislation, all workers in FSE shall be examined before being employed and after every six months. Lack of health examination of personnel in FSE could be a route cause of various communicable diseases like typhoid, diarrhea and tuberculosis. Although street vendors are very scattered and difficulty to monitor (Lues e*t al.,* 2006) deliberate effort is needed to ensure their compliance with national food hygiene regulations.

Microbiological status of food, food contact surfaces and hands of personnel of the food service establishments

Total viable counts were recovered in food (ranging from 5-5.4 log CFU/g), which reveals poor general hygiene of the food businesses (Table 3). A study in Nigeria reported high levels ($2.4 \times 10^{-4} – 2.0 \times 10^{-6}$ CFU/g) of aerobic bacteria in hot foods (Oluwafemi *et al.,* 2013). Although *E. coli* were below the detection limit (<1 log CFU/g) in ready-to-serve foods from cafeterias, were excessively recovered from restaurants (4.8 CFU/ g) and street vendors (3.9 CFU/g, Table 3) beyond the set limits in the raw materials. Since, stiff porridge and rice are not risk products and were normally cooked, then higher contamination in these ready-to-serve products indicated possible cross-contamination from personnel hands, utensils, and/or water. Moreover, even if ugali and rice have been prepared in advance, they are rarely reheated. Yet operators (i.e. both food service establishment and street vendors) were people with low education and knowledge of proper food handling (Table 1), creating more possibilities to contamination. Previous studies in Uganda

(Muyanja *et al.,* 2011) and Cameroon (Edima, 2014) observed that street vendors handled food in very inadequate environment which could cause cross-contamination. Presence of *E.coli* in stiff porridge and rice indicated poor faecal hygiene (Kimani *et al.,* 2018). This illustrates that personnel did not properly wash their hands after visiting the toilet or water used for washing operations was not treated.

Staphylococcus aureus (5.2-5.4 log CFU/g) and TVC (5.0-5.4 log CFU/g) recovered in foods from all FSEs were beyond the legal limits in raw materials (Table 3). High levels of *S. aureus* were also observed on personal hands and food contact surfaces (Table 3), which indicated inadequate personal hygiene. A previous study on ready-to-eat meat samples (n=96), 32%, 11%, and 7% were beyond the Namibian legal limits for TVC, *E. coli*, and *S. aureus*, respectively (Shiningeni *et al.,* 2019). When food handlers wipe their noses, sneeze over food or scratch their skins and touch food with bare hands, the transfer of microorganisms, particularly, *S. aureus* to food is inevitable (Rodger *et al.,* 2015). Besides, high TVC indicates unsatisfactory general hygiene and handling of food in the FSEs (Mulugeta & Bayeh, 2012). As observed in the previous sections, low training on food hygiene and use of inappropriately designed facilities could increase the risks of contamination.

Moreover, high counts of *E. coli* were observed on working tables (3.9-5.5 Log CFU/cm²), chopping boards (5.2-5.5 Log CFU/cm²), plates (3.6-5.2 Log CFU/cm²) and hands of the personnel (< 1-4.8 Log CFU/cm², Table 3). Since *E. coli* are regarded as indicators of faecal hygiene, these findings indicate that there is inadequate faecal hygiene. Personnel did not wash properly their hands after visiting the toilets. This reflects the situation narrated above as majority of FSE, especially street vendors did not have hand washing facilities. The high *E. coli* contamination levels observed in ready-

Table 3: Microbiological status of ready-to-eat stiff porridge and rice, food contact surfaces and hands of the personnel in the FSEs

Item/ parameters analysed	FSE (Log CFU/g for food or Log CFU/cm² for contact surfaces)			
	Restaurants	**Cafeterias**	**Street vendors**	**EAS 128:2011 & EAS 44: 2011**
Food				
E. coli	4.3	0.0	3.9	<1 log CFU/g
S. aureus	5.2	5.2	5.4	<1 log CFU/g
TVC	5.2	5.0	5.4	5 log CFU/g
Plates				
E. coli	5.2	3.6	5.2	**
S. aureus	5.6	5.2	4.7	**
TVC	4.2	4.7	4.6	**
Tables				
E. coli	4.4*	3.9	5.5	**
S. aureus	4.9	4.8	5.8	**
TVC	4.7	5.1	5.6	**
Hands of the personnel				
E. coli	4.8	4.5	<1	**
S. aureus	5.1	5.8	6.4	**
TVC	5.2	5.1	5.5	**

** Values in bold are beyond the recommended levels specified in the raw materials*

*** Similar to products handled within the FSE (no specified standards)*

to-serve foods could be linked to inadequate hand washing practices after visiting the toilets or using water that has been contaminated. Inadequate personal hygiene (failure to wash hands after visiting the toilets), use of non-potable water and cleaning and disinfection of food contact surfaces are potential causes of microbiological contamination (Edima, 2014; Mulugeta & Bayeh, 2012).

Likewise, *S. aureus* were observed on tables (4.9-5.8 Log CFU/cm²), plates (4.7-5.6 Log CFU/cm²) and hands of the personnel (5.1-6.4 Log CFU/cm², Table 3) beyond the legal limit on the raw materials. Since *S.aureus* are regarded as indicators of personal hygiene, high recovery on personal hands indicated that people did not properly wash their hands or observed hygienic principles like not picking from the nose, scratching skin or sneezing or touching food contact surfaces with their bare hands. Previous studies have also linked recovery of *S.aureus* on food contact surfaces (tables, containers) with inadequate personal hygiene (Kussaga *et al.,* 2014; Moloi *et al.,* 2021).

Furthermore, TVC were recovered from working tables (4.7-5.6 Log CFU/cm²), plates (4.2-4.7 Log CFU/cm²), and hands of the personnel (5.1-5.5 Log CFU/cm², Table 3). TVC are regarded as indicators of general hygiene, thus high TVC on personal hands and contact surfaces indicated inadequate general cleanliness of the FSEs. Likewise, a previous study in Malaysia observed high microbiological contamination in food contact surfaces (Zulfakar *et al.,* 2018). Poor personal hygiene like failure to properly wash hands after visiting the toilet or touching dirty materials is the potential cause of microbiological contamination in food (Moloi *et al.,* 2021). Although cafeterias used tap water, the treatment of tap water from the public supply could be done on an occasional basis. Yet, there was no boiling or filtration of water (water for dishwashing) to eliminate any possible microbiological hazards. Although some establishments had resources and facilities to boil water, it is not practiced. For the street vendors, some of them operate in makeshift huts without essential facilities to boil or safely store water.

Conclussions

Although FSEs play a critical role in offering affordable food options to the majority of the urban population, they are also potential sources of microbiological contamination and food-borne diseases. Stiff porridge and rice are not among the risk products with microbiological contamination. Microbiological contamination beyond the set limits reflect the inadequacy of hygienic practices in such food businesses. In general, FSEs are owned and operated by people with limited knowledge of proper food handling. The use of non-potable water and infrequent change of dish- and hand-washing water create further opportunities for cross-contamination. Apart from training of personnel in the FSEs, monitoring by food control authorities including health officers at municipal levels is highly recommended. Enforcement of food hygiene related laws and regulations will improve hygienic practices and safety and quality of ready-to-eat foods from FSEs. Given the current state of affairs in the world, proper hygiene is of utmost importance to prevent food borne diseases but also to control the spread of COVID-19. The killer disease could be transmitted in FSE through various routes; aerial, person-to-person, and surface contact transmissions if proper containment measures are not observed. Although transfer of COVID-19 through food has not been established, proper control is critical to prevent any potential route. Therefore, training of personnel, monitoring and change the way the FSE operate to reduce contamination and spread of COVID-19 are highly recommended.

References

Abdalla, M.A., Suliman, S.E., & Bakhiet, A.O. (2009). Food safety knowledge and practices of street foodvendors in Atbara City (Naher Elneel State Sudan). *African Journal of Biotechnology,* 8(24).

Chukuezi, C.O. (2010). Food Safety and Hyienic Practices of Street Food Vendors in Owerri, Nigeria. Studies in Sociology of Science, 1(1).

De Buyser, M.L., Lombard, B., Schulten, S.M., In't Veld, P.H., Scotter, S.L., Rollier, P., & Lahellec, C. (2003). Validation of EN ISO

standard methods 6888 Part 1 and Part 2: 1999 - Enumeration of coagulase-positive staphylococci in foods. *International Journal of Food Microbiology,* 83(2). https://doi.org/10.1016/S0168-1605(02)00371-9

Edima, H. (2014). Dairy Farm Breeding Practices and Milk Production in the Sudano Guinean and Sudano Sahelian Zones of Cameroon. *Journal of Scientific Research and Reports,* 3(12). https://doi.org/10.9734/jsrr/2014/9800

Imathiu, S. (2017). Street vended foods: Potential for improving food and nutrition security or a risk factor for foodborne diseases in developing countries? Current Research in Nutrition and Food Science, 5(2). https://doi.org/10.12944/CRNFSJ.5.2.02

ISO. (2003). ISO 6887-4:2003 Microbiology of food and animal feeding stuffs Preparation of test samples, initial suspension and decimal dilutions for microbiological examination. International Standard, 2003.

ISO. (2004). ISO 21528-2: 2004 Microbiology of food and animal feeding stuffs Horizontal methods for the detection and enumeration of Enterobacteriaceae Part 2: Colony-count method. Natural Language Engineering, 10(3–4).

ISO 4833-1. (2003). Microbiology of the food chain — Horizontal method for the enumeration of microorganisms — Part 1: Colony count at 30°C by the pour plate technique. Geneva, Switzerland: International Organization for Standardization.

Juma, M.S., Mfinanga, F.A., & Mnyone, G.I. (2018). Compliance of Food Vendors To Food Vending Regulations in Tanzania - a Case of Dodoma Municipality. *International Journal of Research in Social Sciences,* 8(5).

Kinabo, J. (2004). Impact of globalization on food consumption, health and nutrition in urban areas: a case study of Dar es Salaam, United Republic of Tanzania. FAO Food and Nutrition Paper, 83.

Kitagwa, W.G.I., Bekker, J.L., & Onyango, R.O. (2006). The influence of knowledge, attitudes and practices of food handlers on food kiosk hygiene. Eldoret, Kenya. Environment and Health International, 8(2).

Kimani, E.W., Kariuki, J.G., & Irungu, R.W. (2018). Food Hygiene and Safety Practices among Street Food Handlers in Juja Sub-County, Kiambu County, Kenya. *The International Journal of Humanities and Social Studies,* 6(11).

Kussaga, J.B., Luning, P.A., Tiisekwa, B.P.M., & Jacxsens, L. (2014). Challenges in performance of food safety management systems: A case of fish processing companies in Tanzania. *Journal of Food Protection,* 77(4). https://doi.org/10.4315/0362-028X.JFP-13-254

Lues, J.F.R., Rasephei, M.R., Venter, P., & Theron, M.M. (2006). Assessing food safety and associated food handling practices in street food vending. *International Journal of Environmental Health Research,* 16(5). https://doi.org/10.1080/09603120600869141

Moloi, M., Lenetha, G.G., & Malebo, N.J. (2021). Microbial levels on street foods and food preparation surfaces in mangaung metropolitan municipality. Health SA Gesondheid, 26. https://doi.org/10.4102/hsag.v26i0.1407

Mulugeta, K., & Bayeh, A. (2012). The sanitary conditions of food service establishments and food safety knowledge and practices of food handlers in bahir dar town. *Ethiopian Journal of Health Sciences,* 22(1).

Muyanja, C., Nayiga, L., Brenda, N., & Nasinyama, G. (2011). Practices, knowledge and risk factors of street food vendors in Uganda. Food Control, 22(10). https://doi.org/10.1016/j.foodcont.2011.01.016

Oluwafemi, F., Akisanya, E., Odeniyi, K., Salami, W., & Sharomi, T. (2013). Microbiological Quality of Street-Vended Foods and Ready-To-Eat Vegetables in Some Nigeria Cities. In www.ajbrui.net *Afr. J. Biomed. Res* (Vol. 16).

Parker, A. (2007). Effective Cleaning and Sanitizing Procedures. In Good Aquacultural Practices Manual.

Shiningeni, D., Chimwamurombe, P., Shilangale, R., & Misihairabgwi, J. (2019). Prevalence of pathogenic bacteria in street

vended ready-to-eat meats in Windhoek, Namibia. Meat Science, 148. https://doi.org/10.1016/j.meatsci.2018.05.014

Sylvia, A.B., RoseAnn, M., John, B.K., Baluka, S.A., Miller, R., & Kaneene, J.B. (2015). No Title. African Journal of Food Science, 9(1). https://doi.org/10.5897/ajfs2014.1170

WHO-FAO(UN). (2009). Codex Alimentarius: Food Hygiene Basic Texts 4th edition. In Food Standards Programme, Codex Alimentarius Commission.

WHO. (2018). Disease Outbreak News: Cholera – United Republic of Tanzania. In WHO.

Zulfakar, S.S., Abd-Hamid, N.H., & Sahani, M. (2018). Microbiological Assessment of Food Contact Surfaces in Residential College Cafeterias at a Local University in Malaysia. *Jurnal Sains Kesihatan Malaysia,* 16(02). https://doi.org/10.17576/jskm-2018-1602-05