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Lack of Food Safety and Hygienic Practices among Street Vendors in Dhaka, Bangladesh: Implications for Consumers' Health

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Abstract: Food safety is a persistent global health challenge. Improper handling of foods increases the chances of food contamination, which may endanger the consumers' health. The knowledge gap and improper hygienic practices of food handlers are the key factors for the transmission of foodborne diseases. This study aimed to investigate the level of food safety knowledge, attitudes, and practices among street food vendors in Dhaka City, Bangladesh. In this cross-sectional study, a randomly selected 350 street vendors from seven locations in Dhaka City were enrolled. Data were collected by trained interviewers using a questionnaire. Only 36.5% of the respondents had primary, and 48% had secondary education. The majority of the vendors who handled food in front of observers showed good handwashing practice. However, very few vendors showed positive attitudes for washing hands before handling raw or cooked food (3.7%), practicing good personal hygiene (1.2%), and other food safety attitudes (less than 1%). This study showed a significant correlation between the education level of the participants, work experience, and qualification of the head chef with knowledge about hand washing, wearing gloves, and food-borne illnesses. The study demonstrated that formal education played a significant role in vendors' knowledge and practice of health safety measures of food handlers in preventing foodborne illness.

Keywords: street food; consumers; knowledge; attitudes; practice; foodborne illness; personal hygiene; Bangladesh

1. Introduction

"Street-food vending" means ready-to-eat foods and beverages that are prepared and sold by mobile or stationary vendors, most commonly on streets and in different public places. Street food is considered as an essential part of the society, especially in developing countries [1–3]. Millions of people in developing countries have chosen street food vending as their source of livelihood as it requires only a small start-up capital. On the other hand, for most of low and middle-income consumers, street foods serve as a cheap and easily accessible option outside the home [4]. In addition, street foods are gaining popularity due to rapid urbanization, lifestyle changes and people's consumption behaviors. Consumers prefer these ready-to-eat foods over homemade ones, as street foods are convenient [5–7].

In 2019, food safety was reported as one of the top ten threats among all health challenges. It is estimated that in the Third World countries annually about 2 million people die due to food- borne diseases and about one-third of the total world population is estimated to be infected with intestinal

parasites per year, the majority of which are reported from the middle and low-income countries [5,8]. Different studies from the United Kingdom and the United States suggest that 20–40% of gastrointestinal diseases are associated with the contaminated food consumption [9]. In Europe, approximately 22% of all foodborne illnesses from foods served in restaurants, whereas in the US and in England the problem is around 45% and 54%, respectably [7,9]. Besides this, it has also been reported that every year 1 in every 1500 catering operations in England and Wales give rise to cases due to foodborne illnesses [9]. Research conducted in several countries indicated that the most of the reported foodborne illness outbreaks originate from the types of food service establishments [8]. Therefore, food handlers have an important role in controlling these incidences. However, the control measures involve a good level of food safety knowledge and a positive attitude towards hygiene practice during food handling and storage [10]. High level of food safety knowledge and its implementation is considered essential components for safe food production in the food service establishment [11]. Moreover, as per cognitive-consistency theory, knowledge can be explained as what a person knows, how he feels and implements them. Attitude is the association of a person's thought, feelings, and behavior towards a phenomenon [12].

Due to s significant number of food borne disease incidences, the safety of street food is a major concern for both developing and developed countries. In a study of the microbial quality of street vended foods in Dhaka, Bangladesh, a high microbial load was found in the collected samples. Most of the identified organisms were multidrug-resistant isolates, including *Staphylococcus* spp., *E. coli*, *Vibrio* spp., and *Salmonella* spp. [13–15]. Moreover, studies also suggested to focus on in-depth knowledge in food safety, food borne illnesses, good manufacturing practices among the food handlers to improve the public health management in Bangladesh [14].

Lack of food handling knowledge and expertise of the food vendors are associated with foodborne illnesses. Identified risk factors include poor personal hygiene and sanitation, cross-contamination, inadequate cooking, inadequate storage improper reheating, contaminated equipment, contaminated water, and raw foods collection/purchase from unsafe sources [7,9,16–19]. In some cases, street vendors do not follow minimum hygiene practices, posing a high risk to the consumers' health [20]. To fill out the gap of information on food handing knowledge, attitudes, and practices of food handlers, this in-depth study aimed to investigate the level of food safety knowledge, attitudes, and practices among the street food vendors in Dhaka City, Bangladesh.

2. Materials and Methods

This cross-sectional study was conducted among a randomly selected sample of 350 street vendors in seven locations, namely Rampura, Banashree, Khilgaon, Siddeswari, Dhanmondi, Khilkhet and Basundhara of Dhaka City, Bangladesh. The study was conducted from February to September 2019. Verbal consent was taken from the adult participants (aged > 18 years) and assent from the children along with consent from their parents. In addition, vendors' permission for observing the food handling practice was collected verbally. Participants who did not provide consent, and vendors who have experience of less than 2 months were excluded from the study. Within each establishment, the survey took the form of a face-to-face interview by trained data collectors after taking informed consent. The interview was done by three data collectors who had a minimum education of a bachelor's degree. The data collectors were trained on the questionnaire, and how to build rapport with respondents.

Primarily, the questionnaire was developed through literature review and then feedbacks were obtained from relevant experts and researchers in the field. The questionnaire was pretested in a sample of 15 people from the same locality of the study. The questionnaire contained 41 questions, which included: demographics, food storage, food handling practice, personal hygiene/cleaning practice, food preparation, and knowledge of foodborne illnesses.

2.1 Statistical Analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences, Version 28.0 (SPSS, Inc., Chicago, IL, USA). Data on knowledge were classified into several sections

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– (1) Importance of hand washing before and after different activities; (2) Importance of wearing hand gloves during different activities; (3) Knowledge of food-borne diseases; and (4) Type of health problems that can affect food safety. For each correct answer, the respondent scored one point and for an incorrect answer, the respondent received a zero point. The scores were computed and the relation between the knowledge scores were compared with educational level of the participants, qualification of the head chef, work experience, and type of the vending facility. Descriptive statistics were assessed for data distribution. The mean knowledge scores were compared by using one-way ANOVA. A post-hoc test (Tukey's HSD) was computed for multiple comparisons and to identify which of independent groups are significantly associated with the knowledge categories such as practice of hand washing, wearing gloves, food-borne diseases, and type of health problems. A Pearson's correlation was computed between the variables. Findings with a *p*-value of ≤ 0.05 were considered statistically significant.

3. Results

3.1 Demographic Characteristics

The socioeconomic and vending information (Table 1) of the participants show that majority of them were in the age range of 25-29 years (38.5%) and 30-34 years (41.2%). Regarding the educational level, 36.5% had completed primary and about 48% had completed secondary education. About 13% participants had less than 1 year working experience; 50% had 1 to 5 years and 37% had 6 to 10 years working experience. However, majority (84.9%) of them never received any food safety training or course work.

Table 1. Socioeconomic and street vending background information of the study population.

Socioeconomic Information	**N (%)**
Age (n=330)	
<18 years	3 (0.9)
19-24 years	50 (15.2)
25-29 years	127 (38.5)
30-34 years	136 (41.2)
35-39 years	13 (3.9)
No answer	1 (0.3)
Gender (n=330)	
Male	324 (98.2)
Female	6 (1.8)
Education level (n=323)	
No formal education	35 (10.6)
Primary	120 (36.5)
Secondary	157 (47.7)
Arabic Education (Madrasa)	17 (5.2)
Vending information	
Responsibility in food vending (n=330)	
Chef	168 (50.9)
Washing utensils	24 (7.3)
Cutter	77 (23.3)
Server	27 (8.2)
Others	34 (10.3)
Main occupation (n=318)	
Yes	230 (72.3)
No	88 (27.7)
Work experience (n=330)	
<1 year	42 (12.7)

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1-5 years	166 (50.3)
6-10 years	122 (37.0)
Participation in food safety training/course (n=324)	
Yes	49 (15.1)
No	275 (84.9)
Jobs done by family members (n=330)	
Supervision	46 (13.9)
Cash holding	62 (18.8)
Purchases	135 (40.9)
Cooking	2 (0.6)
Serving	69 (20.9)
Cleaning	13 (3.9)
Nobody is involved	3 (0.9)
Average no. of customers in a week (n=329)	
21-99	43 (13.1)
100-199	165 (50.2)
200-299	52 (15.8)
300-399	57 (17.3)
400-499	12 (3.6)
No. of people associated with food handling (n=297)	
1-2	100 (33.7)
2-3	125 (42.1)
3-4	57 (19.2)
>4	15 (5.0)
Qualification of head chefs achieved through training (n=321)	
Certified chef	56 (17.2)
Diploma or degree	8 (2.4)
Trained in restaurant	25 (7.7)
None	236 (72.6)
Type of vending facility (n=328)	
Fixed stall	150 (15.2)
Mobile vending unit	169 (51.5)
Restaurant	7 (2.1)
Canteen	2 (0.6)

3.2 Food Safety Knowledge

More than fifty per cent of the respondents correctly mentioned that their hands should be washed after touching money and knew that gloves should be worn before touching ready-to-eat foods (Table 2). However, only a few mentioned the importance of washing hands after handling garbage (1.2%), raw foods (4.6%) and cleaning tables (8.2%). Less than one-third of the participants (32%) mentioned to continue their work even after they have abrasion or cuts on their hands. Ninety per cent or more of the participants had a good knowledge regarding the source of water that is used for cooking, cleaning and drinking.

Table 2. Food safety knowledge of the respondents.

Variables	**N (%)**
It is important to wash hands	
(a) After touching money	173 (52.7)
(b) After handling raw materials	15 (4.6)
(c) After cleaning tables	27 (8.2)
(d) After eating food	109 (33.2)

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(e) After handling the garbage	4 (1.2)
It is important to wear gloves	
(a) During touching ready to eat food products	177 (53.8)
(b) During handling raw materials	4 (1.2)
(c) During cleaning tables	5 (1.5)
(d) During preparing foods	27 (8.2)
(e) During handling the garbage	136 (41.3)
(f) During continuous food handling	6 (1.8)
Sources of water used by food vendors for cooking should be (n=328)	
Tap water	163 (49.6)
Tanker/surface water (rivers, reservoirs and lakes etc.)	1 (0.4)
Filtered water	164 (50.0)
Sources of water used by food vendors for cleaning should be (n=330)	
Tap water	300 (90.9)
Tanker/surface water (rivers, reservoirs and lakes etc.)	24 (7.3)
Filtered water	6 (1.8)
Sources of water used by food vendors for drinking should be (n=329)	
Tap water	7 (2.1)
Filtered water	322 (97.9)
Required action of food handlers if they have abrasions or cuts on their hands (n=322)	
Continue working	103 (32.0)
Leave from work	121 (37.6)
Do not handling foods	91 (28.3)
Handling foods with gloves	7 (2.2)

3.3 Knowledge about Food-Borne Diseases

About 90% of the participants claimed to have experience of foodborne illnesses and had knowledge about the sign and symptoms of these diseases. But about 77%, 13.2% and 5.6% of the respondents identified abdominal pain, diarrhea, and nausea respectively as the most common symptoms of foodborne illnesses (Table 3). About 55% participants preferred to work throughout their illness period if they are sick. About 15.5%, 23.9% and 0.9% of the respondents knew that diarrhea, coughing and vomiting would affect food safety, respectively.

Table 3. Food-borne disease knowledge of the participants.

Variables	**N (%)**
Experience with food borne diseases (n = 328)	
Yes	291 (88.7)
No	37 (11.3)
Knowing about the sign and symptoms (n = 327)	
Yes	292 (89.0)
No	37 (11.0)
Sign and symptoms of food borne diseases (n = 319)	
(a) Abdominal pain	245 (76.8)
(b) Nausea	18 (5.6)
(c) Headache	7 (2.2)
(d) Difficulty in swallowing	4 (1.3)
(e) Diarrhea (watery)	42 (13.2)
(f) Blurred vision	3 (0.9)

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Food borne diseases can lead to (n = 312)	
(a) Respiratory failure	71 (33.5)
(b) Kidney failure	93 (43.9)
(c) Death	48 (22.6)
Work-related activities during illness (n = 330)	
(a) Stopped working on food handling immediately	149 (45.2)
(b) Worked throughout the sickness period	60 (18.2)
(c) Worked initially but stopped until symptoms disappeared	121 (36.7)
Opinion about food handler's health problems can affect food safety (n = 319)	
Yes	199 (62.5)
No	119 (37.5)
Health problems that can affect food safety (n = 213)	
(a) Abdominal pain	34 (16.0)
(b) Nausea	61 (28.6)
(c) Headache	9 (4.2)
(d) Hypertension	2 (0.9)
(e) Difficulty in swallowing	13 (6.1)
(f) Diarrhea (watery)	33 (15.5)
(g) Hypoglycemia	4 (1.9)
(h) Blurred vision	3 (1.4)
(i) Coughing	51 (23.9)
(j) Vomiting	2 (0.9)
(k) Sneezing	1 (0.5)

3.4 On-Site Observation of Food Handling Practices

Table 4 shows that around 90% of the interviewed street vendors practiced hand washing or were using gloves during food handling. But majority of them (around 77%) were using gloves only during handling the ready-to-eat food products. About 78% of them were using gloves during handling raw foods, garbage or during the food preparation processes. Regarding the cleaning process, more than one-third of the respondents were referring to the option "wipe them off on a tea towel/dish cloth". For cleaning cutting board and used knives, around 18% mentioned to use detergents with hot water, and a large percentage of them mentioned to rinse them under cold water only. Around 68% of the participants were reusing the spoons for the customers with occasional cleaning. About 90% of the vendors were using filtered water for drinking purposes, but only 50% used filtered water for cooking purposes. About 85% of them were using tap water for cleaning purposes.

Table 4. Observed food handling practice of the participants.

Variables	**N (%)**
Wash hands (n = 328)	
Yes	291 (88.7)
No	37 (11.3)
Wear gloves during food handling (n = 329)	
Yes	292 (89.0)
No	37 (11.0)
Wear gloves (n = 319)	
(a) During touching ready to eat food products	245 (76.8)
(b) During handling raw materials	18 (5.6)
(c) During cleaning tables	7 (2.2)
(d) During preparing foods	4 (1.3)
(e) During cleaning utensils	42 (13.2)

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(f) During handling the garbage	3 (0.9)
Cleaning process of cutting board after cutting raw foods (n = 312)	
(a) Wipe them on a tea towel/dish cloth	71 (33.5)
(b) Rinse it under cold water	93 (43.9)
(c) Wash it with detergent and hot water	48 (22.6)
Approaches to ensure that cutting board used to cut raw foods are not subsequently used on foods that won't be cooked (n = 330)	
(a) Rinse it under cold water	149 (45.2)
(b) Wash it with detergent and hot water	60 (18.2)
(c) Wash it with detergent and hot water and mild bleach 8%	121 (36.7)
Approaches to ensure that knives used to cut raw foods are not subsequently used on foods that won't be cooked (n = 213)	
(a) Two knives system	34 (16.0)
(b) Wipe it on a tea towel / dish cloth	61 (28.6)
(c) Wash after each use	9 (4.2)
(d) Other	18 (0.5)
Dirty/used knife was cleaned (n = 328)	
(a) Rinse it under cold water	237 (72.3)
(b) Wash it with detergent and hot water	63 (19.2)
(c) Wash it with detergent and hot water and mild bleach	10 (3.1)
(d) Dishwasher or its equivalent	18 (5.5)
Clean your worktops by (n = 295)	
(a) Detergent	207 (70.1)
(b) Washing up liquid	69 (23.4)
(c) Sanitizer	19 (6.5)
Clean your hands after handling raw foods by (n = 325)	
(a) Wipe them on a tea towel/dish cloth/j-cloth	120 (36.9)
(b) Wash them with ordinary soap and hot/warm water	111 (34.2)
(c) Wash them with antibacterial soap and hot/warm water	37 (11.4)
(d) Do nothing	42 (12.9)
(e) Other	15 (4.6)
Frequency of refreezing food after defrosting (n = 328)	
(a) Once	137 (41.7)
(b) Twice	30 (9.2)
(c) Many times	7 (2.2)
(d) Never	154 (46.9)
Duration of Food storage (n = 327)	
(a) No storage at all	161 (49.2)
(b) Half day to 1 weak	161 (49.2)
(c) More than 1 weak	5 (1.6)
Spoons used in serving food to customers (n = 290)	
(a) Used all day without washing	8 (3.3)
(b) Washed occasionally and reused	199 (68.1)
(c) Disposable spoon	83 (28.6)
Main sources of water used by you for cooking (n = 328)	
Tap water	161 (49.1)
Tanker/surface water (rivers, reservoirs and lakes etc.)	1 (0.3)
Filtered water	166 (50.6)
Main sources of water used by you for cleaning (n = 329)	
Tap water	279 (84.8)
Tanker/surface water (rivers, reservoirs and lakes etc.)	44 (13.4)
Filtered water	6 (1.8)

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Main sources of water used by you for drinking (n = 326)	
Tap water	26 (8.1)
Tanker/surface water (rivers, reservoirs and lakes etc.)	4 (1.3)
Filtered water	296 (90.6)
Approaches taken by the food handlers if they have abrasions or cuts on their hands (n = 325)	
(a) Continue working	13 (4.0)
(b) Take leave from work	98 (29.9)
(c) Do not handling foods	106 (32.3)
(d) Handling foods with gloves	111 (33.8)

3.5 Food Safety Attitudes

More than 90% of the subject population showed positive response to obtain more food safety knowledge (Table 5). However, very few people showed any positive attitudes for washing hands before handling raw or cooked food (3.7%), practicing good personal hygiene (1.2%), and other food safety attitudes (less than 1%).

Table 5. Food safety attitudes of the respondents.

Variables	**N (%)**
Attitudes towards ensuring food safety/ prevent food borne disease (n = 326)	
(a) Obtain more food safety knowledge	301 (92.3)
(b) Washing hands before handling raw or cooked foods	12 (3.7)
(c) Use different clean clothes to mop dining tables and food utensils	2 (0.6)
(d) Attend training regarding food hygiene/safety	3 (0.9)
(e) Attend training regarding sanitation	1 (0.3)
(f) Practicing good personal hygiene	4 (1.2)
(g) Keeping raw and cooked foods separately	1 (0.3)
(h) Washing hands before work	2 (0.6)

3.6 Factors Associated with Knowledge Scores

Bivariate correlation analysis (Table 6) shows that education level of the participants, work experience, and qualification of the head chef had statistically significant relationship with knowledge about hand washing, wearing gloves, and food-borne illnesses, except that work experience with knowledge about food-borne illnesses was not statistically significant.

Table 6. Bivariate correlation between variables of interest.

				Knowledge about		
	Education Level	**Work Experience**	**Head chef's Qualification**	**Hand Washing**	**Wearing Gloves**	**Foodborne Illnesses**
Education level		$r = 0.177$ $p = 0.001$	$r = -0.297$ $p < 0.001$	$r = 0.223$ $p < 0.001$	$r = 0.117$ $p = 0.034$	$r = 0.212$ $p < 0.001$
Work experience			$r = -0.291$ $p < 0.001$	$r = 0.279$ $p < 0.001$	$r = 0.220$ $p < 0.001$	$r = -0.90$ $p = 0.105$
Head chef's qualification				$r = -0.436$ $p < 0.001$	$r = -0.406$ $p < 0.001$	$r = -0.189$ $p < 0.001$
Hand washing					$r = 0.861$ $p < 0.001$	$r = 0.449$ $p < 0.001$
Wearing gloves						$r = 0.491$ $p < 0.001$

4. Discussion

To our knowledge this is the first report on food safety and hygienic practices of street vendors from Bangladesh. In our study, we observed that the head chef's education level, work experience, and qualification had a statistically significant relationship with the knowledge regarding hand washing, wearing gloves, and food-borne illnesses. We also identified areas of knowledge gap, lack of healthy practices, and lack of attitudes for practicing safe personal hygiene that prevent foodborne illnesses.

Formal education played a significant role in vendor's knowledge and practice of health safety measures of food handlers in preventing foodborne illness. Street vendors' knowledge, attitude and practice (KAP) plays an important role in food safety [21]. Earlier study has found a strong positive correlation between attitude and practice ($r = 0.839$, $p < 0.01$) and between knowledge and practice ($r = 0.835$, $p < 0.01$) [22]. Akabanda et al showed a strong link between positive attitude, behavior and education of food handlers in maintaining safe food handling practice [21].

Our present study demonstrated limited practice of washing utensils, other food preparation stuffs, and attitude towards personal hygiene practices among the food vendors in Dhaka city, Bangladesh. These findings are consistent with previous studies where lack of cleanliness of street food preparations may be the sources of contamination of infectious agents [23].

Personal hygiene is the single most important factor in preventing contaminating food. Most of the studies found a lack of hygiene practices in food handlers and consumers or mishandling of the foods during the preparation, storage, and vending [5,16]. Our study also showed only very few handlers (1.2%) practiced good personal hygiene and they had very limited knowledge of washing hands after handling garbage. These practices of the food handlers may contribute to the transmission of infection to the consumers. Our study also demonstrated a knowledge gap among the participants regarding illnesses like upper respiratory infection (having symptoms of sneezing, coughing, etc.), diarrhea and vomiting which can contaminate food. An earlier study in three European countries showed that the average knowledge score for Portuguese, Serbian and Greek food handlers were 72.6%, 71.3%, and 69.1% respectably [24]. Studies from different countries with lower knowledge scores have been reported as well. For example, a study performed in a catering company which was responsible for manufacturing and distributing foods to the canteens of schools, kindergartens and nursing establishments in Portugal had a knowledge score of 56.5% [25]. Another study of Nigerian food handlers showed that only 50% had good knowledge level regarding food hygiene [8]. However, due to the variations in questions, sampling, geography, analysis methods etc. data of the present study cannot be directly compared with other studies.

Contrary to our report, Akabanda and co-workers (2017) [21] found that the food handlers had adequate knowledge about hygienic practices like hand washing, using gloves as well as cleaning utensils properly by using detergents in a developing country (Ghana). However, the sources of data collection of the Ghanaian population and those in our study were different. For example, in the study in Ghana Akabanda et al. [21] collected data on food handlers from different institutions that included schools, hospitals, universities, health centers etc. Whereas, we selected local street vendors as our study participants. Our study corroborates the finding of Nizame and his co-workers who also demonstrated poor hygiene practices among street food vendors [26].

About 30 million people annually suffer from foodborne disease in Bangladesh [27]. There is a scarcity of proper sanitary facilities in the vending sites in Dhaka City, Bangladesh. Due to the lack of proper sanitation and hygiene practices, foodborne diseases are prevalent in Bangladesh [16] (Noor, 2016). Thus, it is necessary to promote food safety practices in the production and consumption of street vended foods, especially in developing countries where levels of hygiene standards are questionable [28].

4.1 Limitation

The present study had a few limitations. As this is a cross-sectional study, we collected data after informing the study population about the purpose of our study, which might have resulted in reporting bias. Self-reporting of the vendors might be overestimated in their hygiene practices.

Although there are studies that showed the role of toilet and hand washing facilities in street vending sites, we have not collected any data on these factors. In addition, the sample populations cannot represent the entire country population. However, in this cross-sectional study, data were collected from seven areas of the Dhaka City, which strengthens the validity of the data. In this study we could not establish a cause-and-effect relationship because we had not collected samples from the study sites for the identification of pathogens. Further studies are needed to determine the correlation between isolated pathogens from street food samples and illnesses of the consumers.

To improve the safety of street foods in Bangladesh and other low-income countries, adequate toilet facilities with sufficient water supply as well as proper hand washing facilities should be implemented and enforced.

5. Conclusions

The current study demonstrated knowledge gaps in food safety, poor hygienic practice in food preparation and negative attitudes regarding food safety among street-food vendors. Effective food safety training, motivation and continuous monitoring can ensure strict food hygiene practice and reduce the risks of food hazards. Findings from this study will be helpful for the policymakers to take initiatives for the implementation of good hygiene practices of the street vendors. Future interventional studies should be initiated on enhancing the knowledge and attitude of the food handlers and making them aware for providing safe food to the consumers.

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