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Food safety assessment of food handlers in the canteens of Khon Kaen University

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Abstract

The objective of this study was to assess the safety knowledge (K), attitudes (A), and hygienic practices (P) of canteen food handlers who were preparing foods daily. This research was conducted at Khon Kaen University. The study was divided into four parts: 1) demographic characteristics, 2) food safety knowledge, 3) food safety attitudes and 4) hygienic practice of food handlers. Part 1 to part 3 were accomplished by food handlers throughout the suvery questionnaires. The personal hygiene and handling practices (part 4) of food handlers were observed by the researchers. Ninety food handlers participated in this research. Most of the food handlers were female (75%) whose age ranging between 36-55 (65%). Seventy-five percent of food handlers had experiences of attending the hygienic practices training. The result showed that 55.37% and 68.50% of food handlers were revealed on average levels of knowledge and personal hygiene and handling practices, respectively. Moreover, the good attitude was 77.29%. The correct scores on KAP with gender, age, education and attending hygienic training of food handlers were not significantly different ($p>0.05$). However, total correct scores on K with A (r_s= 0.424, p=0.00) and A with P (r_s = 0.207, p=0.05) were significantly different. This study concluded that it is necessary to improve the knowledge of food handlers, because they were not aware of 1) the risk of foodborne pathogens, 2) critical temperature for storing of foods, and 3) the possibility of cross contamination. Effective ongoing training programs for the food handlers must be provided to improve their knowledge and practice. The food handlers must also be encouraged to implement the good hygiene practices to reduce the outbreak of foodborne illness.

Keywords: Food safety assessment, Knowledge, Attitudes, Practices, Food handlers

1. Introduction

Food is essential but it can also be a source of foodborne illness or poison to humans throughout consumption of unhygienic foods. The contamination of foods can occur at any point during food processing. When these activities are done manually, contamination primarily occurs due to mishandling by the food handlers. Every year, approximately 600 million people suffer from foodborne illnesses and 420,000 people die after eating contaminated foods. This results in mortality of approximately 33 million people annually (DALYs) [1].

The South East Asia region has the second highest death rate related with the consumption of unsafe foods [2]. There are more than 120,000 foodborne illness cases reported each year by Thai ministry of health. The consumption of microbes contaminated drinking water and foods, poor personal hygiene of food handlers and consumers, lack of food storage infrastructure, high ambient temperature of the region throughout the year and inadequate food standard regulations were the major reasons for the extensive prevalence of foodborne diseases [3 & 4]. Knowledge, attitude and practices (KAP) of the food handlers are the three main factors which can help to reduce the outbreak of foodborne illnesses [5]. Effective food safety trainings from the supporting organization as well as adequate resources will strengthen food handling practices and workplace safety practices. Apart from enough knowledge and stringent enforcements, the right attitude of food handlers can also reduce outbreak of

foodborne illness. Earlier researches proved that successful safety training improved the hygienic practices of food handlers and decreased the occurrence of pathogens in foods [6 & 7].

Food hygiene should be a basic requirement in university campus based food services because meals are consumed daily by the students and most of the implicated food poisoning occurs within the premises of schools and academic institutions [8]. It was therefore thought desirable to undertake such a study in the campus of Khon Kaen University (KKU), where prepared food is retailed through several canteens located in various facilities scattered around a large campus. Moreover, there have not been such studies on the safety KAP of food handlers in university campuses around Thailand. Each faculty in KKU has its own canteen and many food handlers prepare the food for a large number of students, staff and external consumers. Because of the large numbers of people eating at the cafeterias, the knowledge, attitudes and hygienic practices of food handlers must be assessed and observed. The aim of this study was to evaluate the level of safety KAP of food handlers who were working in the different canteens of Khon Kaen University as a typical illustration of a university campus.

2. Materials and Methods

This study was conducted in 18 canteens in Khon Kaen University, Thailand. A total of 90 food handlers who were working in those canteens participated in this research. The facts relating to demographic characteristics, food safety knowledge and attitudes of the food handlers were collected by distributing the survey questionnaires. The observation checklists of personal hygiene and handling practices of the food handlers were performed by the researcher. The questionnaires, initially developed in English, were translated into Thai language, and vetted by five expert individuals with considerable experience in food safety performance assessments. The research was conducting during lunch time, between 12 noon and 3 PM.

2.1 Questionnaires design and data collection

The food safety questionnaires used in this study were based on the guideline and regulations of the Ministry of Health (MOH) and also modified from previous studies [9-13]. The research undertaken is divided into four parts; (1) demographic characteristics of food handlers, (2) food safety knowledge questions, (3) food safety attitudes questions, and (4) observation of personal hygiene and handling practices of food handlers.

The questionnaire consisted of 18 questions on food safety knowledge, 16 questions on food safety attitudes and 20 questions on observation checklists of personal hygiene and handling practices. The questionnaire surveys included three choice of answers (Yes, No, and Do not know). If the food handlers responded with the right answer, they received a score of one point. When the food handlers answered incorrectly or did not know the answer, they got zero point.

The observation checklist on personal hygiene and handling practices of food handler consisted of 20 questions. These observation checklists were filled out according to right or wrong food handling and hygienic practices of the food handlers. Here again, a right practice for handling food and right hygienic practices scored 1 point, whereas a wrong practice get zero point. According to their total scores of corrected KAP, it was divided into three levels such as good (correct scores ≥70%), average (correct scores = 50-69%) and poor (correct scores ≤49%).

2.2 Statistical analysis

The data were analyzed by using SPSS software, version 20. The demographic characteristics of food handlers and their scores on the questionnaires were summarized by using Microsoft excel, 2007 and descriptive statistics (frequencies, mean±SD). Depending on their total correct scores of KAP, Spearman's rho was used to find their Bivariate correlation. Independent sample t test and analysis of variance (ANOVA) were used to establish the relationship between demographic characteristics of food handlers and the correct scores for KAP.

3. Results

3.1 Demographic characteristics of food handlers

A total of 90 food handlers participated in this research consisting of twenty-one (23%) males and sixty-nine (76%) females. The ages of the food handlers ranged between 16 and 69 years, and the dominant age group was 36-55 years (i.e. 65% of food handlers). Fifty-seven (63%) of food handlers had finished their high school or higher education qualifications. Among the food handlers, sixty-eight (75%) persons had experience relating to food safety training. The demographic characteristics of food handlers are shown in Table 1.

Table 1 Demographic characteristics of food handlers (N=90)

Characteristics	Category	[a]n (%)
Gender	Male	21 (23.3)
	Female	69 (76.7)
Age	16-35	22 (24.4)
	36-55	59 (65.6)
	56-75	9 (10.0)
Education	Elementary	19 (21.1)
	Secondary	14 (15.6)
	High school or higher	57 (63.3)
Hygienic training	Yes	68 (75.6)
	No	22 (24.4)

[a]n (%), number of food handlers (a percentage of food handlers)

3.2 Food safety knowledge of food handlers

The results on food safety knowledge of food handlers are shown in Table 2. The knowledge on the hygienic practices revealed that ninety (100%) and eighty-three (92%) food handlers agreed that washing hands, and using gloves and masks, could help to reduce the risk of food contamination. Sixty-two participants (68%) chose the incorrect answer that proper cleaning and sanitization of utensils increase the risk of food contamination. Thirty-eight (42%) food handlers reported that the habit of eating or drinking in food service establishments can subject the foods for sale to a higher risk of contamination. Thirty-six (40%) food handlers agreed that food prepared in advance, stored in a hygienic environment and at low temperatures can make food safe and suitable for consumption. Out of the respondents, thirty-nine (43%) agreed that the risk of food-borne outbreak is not the same between different ages and health status of the persons. The respondents gave the wrong answer on foodborne illness questions such as typhoid fever (74%) and abortion (83%) which can happen from consuming unhygienic foods. But seventy-five (83%) persons knew that AIDS cannot be transmitted by foods. Based on the responses to food-borne pathogens, 62% acknowledged that *Salmonella* is food-borne pathogen, but they did not know that *S. aureus* (64%) was a pathogenic microorganism. Forty-eight (53%) food handlers did not know that *Clostridium botulinum*- a bacteria which can be present in swollen cans that can cause serious damage to human health (botulinum). For the questions relating to temperature control of food, only forty (44%) and thirty-five (38%) food handlers answered correctly that the safe temperature for storing perishable foods was less than 5ºC and that the temperature of hot, ready-to-eat foods should not be below 65ºC respectively. Forty (44%) respondents were aware that microorganisms can present in the skin, nose and mouth of healthy adults. Almost all the food handlers (92%) agreed that contaminated foods show some changes in color, odor and taste. Eighty-one (90%) handlers had good knowledge that a person who was suffering from an infectious disease must be away from the workplace. The food handler in KKU had an average percentage of correct scores being 55.37±15.98 (%) relating to knowledge for processing and preparing safe foods. No statistical difference ($p \leq 0.05$) was found between the correct scores of food safety knowledge with gender ($p = 0.95$), age ($p=0.12$), education ($p = 0.059$) and hygienic training ($p=0.71$).

Table 2 Food safety knowledge of food handlers (N=90)

No	Food safety knowledge	[a]n (%)	
		Correct	Wrong
K1	Washing hands before work/after go to toilet reduce the risk of food contamination	90 (100.0)	0 (0.0)
K2	Using gloves and masks while handling foods reduces the risk of food contamination	83 (92.2)	7 (7.8)
K3	Proper cleaning and sanitization of utensils increase the risk of food contamination	28 (31.1)	62 (68.9)
K4	Eating and drinking in the work place increase the risk of food contamination	38 (42.2)	52 (57.8)
K5	Food prepared in advance reduces the risk of food contamination	36 (40.0)	54 (60.0)
K6	Children, healthy adults, pregnant women and older individuals are at equal risk of food poisoning	39 (43.3)	51 (56.7)
K7	Typhoid fever can be transmitted by food	23 (25.6)	67 (74.4)
K8	AIDS can be transmitted by food	75 (83.3)	15 (16.7)
K9	Abortion in pregnant women can be induced by foodborne disease	15 (16.7)	75 (83.3)
K10	*Salmonella* (Bacteria can cause diarrhea) is among foodborne pathogens	56 (62.2)	34 (37.8)
K11	*Staphylococcus aureus* (Bacteria transfer to food by a person) is among the foodborne pathogens	32 (35.6)	58 (64.4)
K12	Swollen cans may contain the microorganisms, *Clostridium botulinum*, which cause botulinum	42 (46.7)	48 (53.3)
K13	Microbes are on the skin, in the nose and mouth of healthy handlers	40 (44.4)	50 (55.6)
K14	Cross contamination is when microorganisms from a contaminated food are transferred by the food handler's hands or kitchen utensils to another food	61 (67.8)	29 (32.2)
K15	The correct temperature for storing perishable foods is < 5ºC	40 (44.4)	50 (55.6)
K16	Hot, ready to eat food should be kept at a temperature >65 ºC	35 (38.9)	55 (61.1)
K17	Contaminated foods always have some change in color, odor, or taste	83 (92.2)	7 (7.8)
K18	During infectious diseases of the skin, it is necessary to take leave from work	81 (90.0)	9 (10.0)
	Average percentage of correct scores relating to knowledge	[b]55.37±15.98	

[a]n (%), number of food handlers (percentage of food handlers)
[b]a percentage (mean±SD)

3.3 Food safety attitudes

Attitude of food handlers is another important factor that can reduce the outbreak of foodborne illness and it can also inculcate safe food handling practices. The results are shown in Table 3. Over 90% of the food handlers had the good personal hygiene attitudes such as the use of masks, gloves and caps as a way of preventing and reducing the risk of food contamination. The risk of touching the foods with cuts or abrasion on hands without using gloves was known to Eighty-eight (97%) respondents. Eighty-one (90%) respondents agreed that the health status of food handlers must be checked before handling the foods. Eighty-six (95%) participants were in favor of hand washing before handling products for human consumption. Eighty (88%) respondents agreed that cooking utensils should be well disinfected and sterilized before using, in order to deter pathogens contaminations. Also, seventy-three (81%) food handlers suggested that properly prepared foods promoted foods for safe consumption. The safe storage conditions of food such as temperature and moisture were only known by seventy (77%) of food handlers. Fifty-four (60%) respondents agreed that defrosted foods can be refrozen. Only eighteen (20%) food handlers agreed that raw meat should be kept in the bottom shelf of a refrigerator inside a sealed container in order to prevent the liquid dripping into the other foods. Forty-two (46%) food handlers agreed that refrigerated chicken should be thawed in cold water before cooking. The practice that egg must be washed after buying from the market was agreed by sixty (66%) food handlers. Eighty-two (91%) of food handlers were aware that dish towers can cause cross contamination of foods. Eighty-seven (96%) food handlers gave correct answers on the possibility of cross contamination, so the raw and cooked foods should be kept separately. An average percentage of 77.29±11.49 showed that the food handlers generally possessed right attitudes for preparing and handling of foods. The correct scores of food safety attitudes and gender ($p=0.32$), age ($p=0.17$), education ($p=0.91$) and hygienic training ($p=0.59$) were not significantly different.

Table 3 Food safety attitudes of food handlers (N=90)

No	Food safety attitudes	[a]n (%)	
		Correct	Wrong
A1	Well cooked foods are free of contamination	73 (81.1)	17 (18.9)
A2	Closed containers of cleaning products such as liquid soap, detergent must not stored together with food products	38 (42.2)	52 (57.8)
A3	It is necessary to check the temperature of a refrigerator or freezer periodically to reduce the risk of food contamination	70 (77.8)	20 (22.2)
A4	The best way to thaw a chicken is in a bowl of cold water	42 (46.7)	48 (53.3)
A5	Wearing mask is an important practice to reduce the risk of food contamination	83 (92.2)	7 (7.8)
A6	Wearing gloves is an important practice to reduce the risk of food contamination	84 (93.3)	6 (6.7)
A7	Wearing cap is an important practice to reduce the risk of food contamination	87 (96.7)	3 (3.3)
A8	Proper hand hygiene can prevent food-borne diseases	86 (95.6)	4 (4.4)
A9	Food handlers who have abrasions or cuts on their hands should not touch foods without gloves	88 (97.8)	2 (2.2)
A10	Raw and cooked foods should be stored separately to reduce the risk of food contamination	87 (96.7)	3 (3.3)
A11	Dish towels can be a source of food contamination	82 (91.1)	8 (8.9)
A12	The ideal place to store raw meat in the refrigerator is on the bottom shelf	18 (20.0)	72 (80.0)
A13	Defrosted foods can be refrozen	54 (60.0)	36 (40.0)
A14	Knives and cutting boards should be properly sanitized to prevent cross contamination	80 (88.9)	10 (11.1)
A15	The health status of workers should be evaluated before employment	81 (90.0)	9 (10.0)
A16	Eggs must be washed after bought from market	60 (66.7)	30 (3.3)
	Average percentage of correct scores relating to attitude	[b]77.29 ± 11.49	

[a]n (%), number of food handlers (percentage of food handlers)
[b]a percentage (mean±SD)

3.4 Food safety practices of food handlers

This part of the experiment was done by using the observation checklist during food preparation and serving of the food handlers. The results are shown in Table 4. In the checklists of facilities, sixty-five (72%) vending stalls were maintained in clean condition, eighty-seven (96%) stalls had potable water on their sites and seventy-seven (85%) stalls had hand washing facilities at their work stations. Only twenty-eight (31%) stalls were protected from the sun and animals. The remaining sixty-two (68%) stalls were protected from the sun, but insects and animals (flies, ants, cockroaches, mice and pets) could be observed around the stalls. Out of the stalls, fifty-seven (63%) had waste water and food disposal facilities available on site. For personal hygiene, eighty-seven (96%) and fifty-seven (63%) food handlers used an apron and covered their hair when handling, preparing and serving food. With regard to hand hygiene, sixty-nine (76%) and seventy-seven (85%) food handlers served the foods with bare hands and received money at the same time after serving foods. Eighty-eight (97%) kept their nails clean and short. Thirty-eight (42%) food handlers wore jewellery during handling and preparing foods. Almost all food handlers showed a good practice of washing hands after visiting the toilet. Eighty percent of food handlers separately used the knives and cutting boards for raw and cooked foods. Most of the handlers (91%) did not smoke during handling and preparing foods. Eighty-seven (96%) respondents stored raw and cooked foods separately and sixty-eight (75%) did not pack the food in a sealed container. Food handlers used plastic bags, and paper meal boxes for packaging their foods. Sixty-two (68%) of food handlers kept previous cooked foods and stored these in the refrigerator or ice boxes. None of the food handlers (100%) covered their cooking utensils, eventhough kitchen utensils such as plates, spoon, bowls, glasses etc., should be covered with a clean cloth to prevent contamination by insects, dust and physical hazards.

Table 4 Food safety practices of food handlers (N=90)

No	Food safety practices	[a]n (%)	
		Right	Wrong
P1	Is the vending stall protected from the sun, animals or pests, flies etc?	28 (31.1)	62 (68.9)
P2	Is the vending stall maintained in a clean condition?	65 (72.2)	25 (27.8)
P3	Is there access to potable water at the site or close to the site?	87 (96.7)	3 (3.3)
P4	Are there adequate waste water or food disposal facilities available?	57 (63.3)	33 (36.7)
P5	Are there adequate hand washing facilities available?	77 (85.6)	13 (14.4)
P6	Does the food handler wash their hands in clean water each time before the handling, preparation and serving of food?	49 (54.4)	41 (45.6)
P7	Are the food handler's clothes clean and presentable?	85 (94.4)	5 (5.6)
P8	Does the food handler use an apron when handling, preparation and serving of food?	87 (96.7)	3 (3.3)
P9	Does the food handler handle food with bare hands?	69 (76.7)	21 (23.3)
P10	Does the food handler wash their hands each time after visiting toilet?	90 (100.0)	0 (0.0)
P11	Is the hair of the food handler covered when handling preparing and serving of food?	57 (63.3)	33 (36.7)
P12	Are the nails of the food handler clean and short?	88 (97.8)	2 (2.2)
P13	Does the food handler handle money while serving food?	13 (14.4)	77 (85.6)
P14	Does the food handler wear jewelers during the handling of food?	52 (57.8)	38 (42.2)
P15	Does the food handler use the same utensil knives and boards to prepare raw and cooked foods?	72 (80.0)	18 (20.0)
P16	Does the food handler smoke during handling food?	82 (91.1)	8 (8.9)
P17	Are raw, partially cooked and cooked food products kept separately?	87 (96.7)	3 (3.3)
P18	Is the food stored/displayed in a sealed container?	22 (24.4)	68 (75.6)
P19	Are previously cooked foods kept cool i.e, in an ice box or refrigerator?	62 (68.9)	28 (31.1)
P20	Are the utensils covered?	0 (0.0)	90 (100.0)
	Average percentage of correct scores relating to practice	[b]68.5±9.37	

[a]n (%), number of food handlers (percentage of food handlers)
[b]a percentage (mean±SD)

In generally, most of the food handlers (respondents) had food safety knowledge, but implementing this in their daily routine was challenging. Depending on the 20 checklists questions, the food handler got a score of 68.5±9.37% average level of practices in food handling and personal hygiene. The right practices of food handlers with the gender (p=0.57), age (p=0.35), education (p=0.94), and hygienic training (p=0.22) were not significantly different.

Table 5 Demographic characteristics on correct scores of knowledge, attitudes and practices

		Knowledge (Mean±SD)	Attitudes (Mean±SD)	Practices (Mean±SD)
Gender	Male	55.55±12.04	79.46±11.37	69.52±10.94
	Female	55.31±17.08	76.63±12.52	68.18±8.91
Age	16-35	52.02±16.75	77.27±10.66	69.77±8.92
	36-55	55.17±15.40	76.27±12.10	68.64±9.04
	56-75	64.81±15.95	84.02±7.06	64.44±12.36
Education	Elementary	48.83±13.80	76.31±13.10	68.94±8.09
	Secondary	61.90±18.85	77.67±7.23	67.85±11.88
	High school or higher	55.94±15.38	77.52±11.92	68.50±9.25
Hygienic training	Yes	55.71±17.03	77.66±11.64	69.19±9.08
	No	54.29±12.47	76.13±11.18	66.36±10.13

3.5 Levels of food safety knowledge, attitudes and practices of food handlers

Figure 1 shows that the levels of safety knowledge, attitudes and practices of food handlers depend on their total correct scores. From the results, thirty-two (35%) food handlers possessed poor level of safety knowledge because they did not know about the food borne pathogens, food borne diseases and critical temperature for storing

foods. Sixty-two (69%) food handlers answered attitude questions correctly. Only 1% of food handler had a poor attitude level. Fifty-three (59%) food handlers were good in food handling and hygienic practices. The results show that most of the food handlers had a satisfactory level on food safety attitudes and hygienic practices. But, the level of safety knowledge still needed substantial improvement. The Spearman's rho correlations of the correct scores KAP are shown in Table 6. The results show a significant correlation of correct scores between safety knowledge and attitudes ($p \leq 0.05$) as well as attitudes and practices ($p \leq 0.05$).

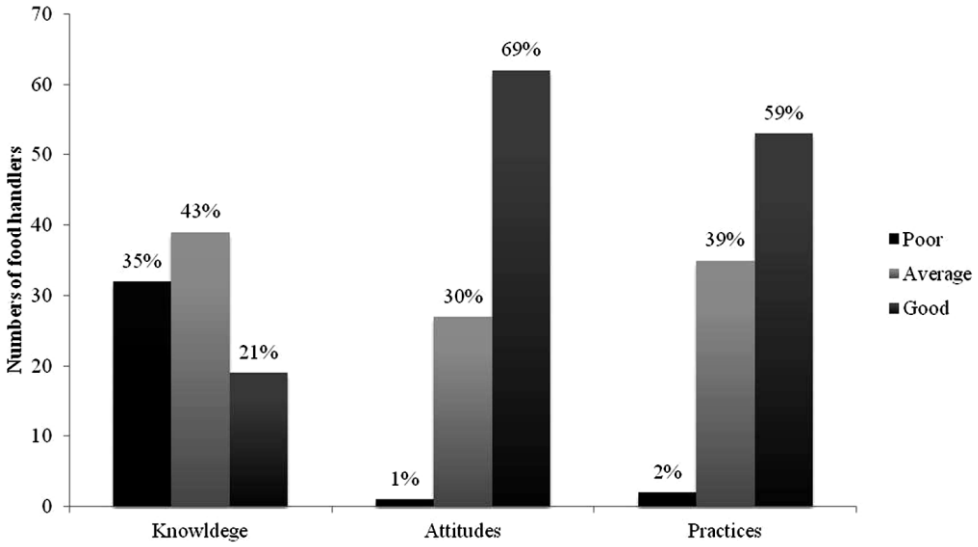

Figure 1 Levels of food safety knowledge, attitudes and practices of food handlers

Table 6 Spearman's rho correlations of the correct answers of food handlers

	Spearman's rho	Sig.
Knowledge-Attitudes	0.424**	0.000
Knowledge-Practices	0.121	0.255
Attitudes-Practices	0.207*	0.050

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

4. Discussion

The objective of this research was to assess the safety knowledge, attitudes and hygienic practices of food handlers in the campus cafeteria of KKU. The majority of the food handlers who participated in this research were females between 16 and 55 years old. The results are quite similar to other studies conducted in Nigeria, Brazil and Vietnam [11-12, 14]. The highest percentage of food handlers had finished their high school or higher qualifications. Moreover, 75% of food handlers had experienced of attending some form of hygienic practice training. The food handlers improved their food safety knowledge, hygienic awareness and the hygienic practices after attending such training [13 & 15].

The food handlers were aware that hygienic practices such as wearing gloves, masks, caps and apron can reduce the risk of food contamination (K2, A5, A6, A7, and P8). In the survey on actual practices, it was also observed that most of the food handlers did not use the gloves and masks during handling foods. Moreover, thirty-three (36%) food handlers did not cover their hair (P11). This research showed that the food handlers from KKU possessed knowledge and attitudes relating to hygienic practices, but this knowledge did not manifest into real practices. The same observation was also noted in the case of food handlers from the University Kebangsaan Malaysia [8]. But, one research from Thailand showed that the majority of food handlers had poor level of knowledge on food hygiene practices [16]. The response to the survey questions relating to hand hygiene of food handlers was found to be satisfactory (K1, A8, A9, and P10). Although the food handlers demonstrated a satisfactory level of knowledge and attitude on the hand washing, the practices were not consistent with knowledge (P6) [8]. Hand hygiene of the food handlers was an importance factor to reduce or prevent the occurrence of foodborne illness [12, 17-18] which also reduced the risk of cross contamination [19]. The CDC in 2010 recommended that food handlers must wash their hands with soap and hot running water at each stage of food

production, especially before handling ready to eat foods, after eating, after touching contaminated materials and after going to the washroom [20]. Adequate cleaning facilities were observed in almost all the food stalls (P3, P4 and P5). The results on observation checklists showed that 85% food handlers handled money without using the gloves and 42% food handlers wore jewellery. Hand hygiene of food handlers is also a critical factor to prevent contamination. This finding is the same as earlier studies which noted that food handlers handled food with bare hands and also handled money while serving the food [12-13, 17-18]. The food handlers did not know the name of common foodborne pathogens such as *Salmonella*, *Staphylococcus aureus*, and *Clostridium botulinum* which caused the highest outbreak of foodborne illness (K10, K11, and K12). The workers of meat processing plants from Iran [9] and food handlers from the schools of Brazil [12] were also found to lack knowledge on foodborne pathogens which can cause serious illness. These pathogens could contaminate different kind of food products during handling and after processing. They can be spread by cross-contamination from raw to cooked food, and post contamination of ready to eat food by infected person. The fact that personal hygiene of food handlers plays important roles in reducing microbial contamination have already been proved in several studies [8-9, 21-23]. For the attitudes questions in the questionnaire related to contamination, more than 80% of food handlers answered correctly (A1, A10, A11, and A14). However, more than 50% of food handlers were unsure about the risk of food contamination in knowledge questions (K3 and K4). Proper hand washing, adequate cleaning and good sanitation procedures should be given to food handlers through proper hygiene training. Such training is absolutely necessary to reduce the risk of cross-contamination [24]. Animals, flies, insects, or pets were found in 68% of vending stalls. There was a lack of waste disposal facilities as evidenced by the finding of insects, flies and pets around the stalls [13].

More than half of the food handlers did not know the right answers on correct storage temperature for hot, ready to eat foods and perishable foods (K15, and K16). The foods could not be kept in the temperature danger zone (4.4-60ºC) for more than two hours because foodborne pathogens could grow easily in this range of temperatures [25]. Insufficient knowledge on temperature control was also found in food handlers from Ghana and food handlers from the University of Kebangsaan Malaysia [8, 26-27]. As a result of foodborne illness, the food handlers gave the wrong answer to typhoid fever (K7) and abortion in pregnant women questions (K9). Typhoid fever can be induced by eating contaminated food, especially infection from *Salmonella* spp. [28]. And foods contaminated with *Listeria monocytogenes* can cause abortion in pregnant women [29]. Importantly, 83% of food handlers knew that AIDS could not be transmitted by foods. The results in this study were consistent with other researches where the public had the education on HIV/AIDS [11 & 26]. Sixty percentage of respondents agreed that defrosted foods can be refrozen. The food handlers from Malaysia showed that most of the handlers were not sure about the refreezing defrosted foods. They thought that repeated thawing and refreezing can increase the number of microorganisms in the foods and believed that it can cause food hazard [30].

Table 5 shows the correct answers of KAP with the demographic characteristics of food handlers. The correct scores of food safety knowledge, attitudes and practices of food handlers were not significantly different with respect to gender, age, education and hygienic training ($p>0.05$). The correlations of the correct scores between food safety knowledge and attitudes ($r_s=0.424$, $p=0.00$) as well as attitudes and practice ($r_s=0.207$, $p=0.05$) were significantly. Earlier studies also found that there were relationships between knowledge and attitudes of food handlers [11 & 16]. One study also claimed that the positive attitude is necessary for the transformation of knowledge into appropriate practices by food handlers [31]. The food handlers who had experience of attending hygienic training answered more correctly on food safety knowledge and attitudes, than untrained food handlers [10 & 13]. Ansari-Lari [9] reported that the knowledge of food handlers had not transformed into actual hygiene practices and behavior. From this study, the food handler possessed average level of safety knowledge and handling practices (50-69%), and good level on attitudes (≥70%). The food handlers should have safety training for reminding and motivating them to prepare the safe foods. The training should include clearly description of food contamination from various processing of foods, critical temperature for keeping cold, hot or ready to eat foods, risk of foodborne pathogens, awareness of good personal hygiene and handling practices, adequate sanitation of foods, utensils and environment [11].

5. Conclusion

Although the food handlers had attended hygienic training, their knowledge was not sufficient to provide safe foods. Most of the food handlers did not know about food contamination, critical temperatures for storage of foods, and risk or behaviors of food pathogens. Some handling practices of food handlers in the university canteens were also concerning, such as handling the money while serving food with bare hands. Therefore, the food handlers must have effective ongoing safety training, perhaps each semester. By giving regular training, the new or permanent food handlers will improve their knowledge and attitudes which will also motivate them to prepare safe foods for daily consumption.

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7. References

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