

## Assessment of Knowledge, Attitudes and Practices (KAP) Among Food Handlers at Residential Colleges and Canteen Regarding Food Safety

(Penilaian Pengetahuan, Sikap serta Amalan Pengendali Makanan di Kolej Kediaman dan Kantin Terhadap Keselamatan Makanan)

SIOW OI NEE & NORRAKIAH ABDULLAH SANI\*

### ABSTRACT

*The main purpose of this study was to evaluate the level of knowledge, attitudes and practices among food handlers at residential colleges and canteen in the main campus of Universiti Kebangsaan Malaysia regarding the aspect of food hygiene and safety. Sixty five food handlers from two residential colleges' cafeterias and one Faculty of Science and Technology's canteen were involved in the study. The data were collected from the food handlers through the methods of questionnaire and analyzed using the SPSS version 12.0. In general, the respondents' knowledge was moderate with mean point of 57.8%. However, they have good knowledge on personal hygiene and definition of foodborne diseases with mean point of 93.85% and 73.85%, respectively. On the contrary, their knowledge on food storage and preparation temperatures was poor with only 28%. Respondents showed positive attitudes towards two categories of questions in the aspect of food safety and hygiene (76.9%); foodborne prevention and control (70.8%). Majority of the respondents have an average practices in all parts of the questions. Analysis tests showed significant difference ( $p < 0.05$ ) between the relationship of respondents' knowledge with their working experiences ( $p = 0.008$ ), attitudes with training attended ( $p = 0.006$ ) and practices with gender ( $p = 0.032$ ). There was significant difference for knowledge based on cafeteria ( $p = 0.000$ ). In conclusion, amongst the three levels, respondents showed only good attitudes in food handling and all the cafeterias in this survey need to increase the hygiene level of their food handlers' hand and environment of the premises.*

*Keywords: Attitudes; food handlers; food safety; knowledge; practices*

### ABSTRAK

*Tujuan utama kajian ini dijalankan adalah untuk menilai tahap pengetahuan, sikap dan amalan pengendali makanan di kafeteria kolej kediaman dan kantin di Universiti Kebangsaan Malaysia terhadap aspek kebersihan dan keselamatan makanan. Seramai 65 orang pengendali makanan dari dua kolej kediaman dan satu kantin Fakulti Sains dan Teknologi terlibat dalam kajian soal-selidik ini. Data yang diperolehi dianalisis dengan menggunakan perisian SPSS versi 12.0. Secara umumnya, tahap pengetahuan responden adalah sederhana dengan min mata betul 57.8%. Responden menunjukkan sikap positif bagi kedua-dua kategori soal-soal iaitu keselamatan dan kebersihan makanan (76.9%); pencegahan dan kawalan penyakit bawaan makanan (70.8%). Majoriti responden mempunyai amalan pengendalian makanan yang sederhana untuk kesemua kategori soal-soal. Ujian analisis menunjukkan perbezaan yang signifikan ( $p < 0.05$ ) iaitu terdapat perkaitan di antara pengetahuan dengan tempoh pengalaman kerja, sikap dengan kehadiran kursus dan amalan dengan jantina. Terdapat perbezaan signifikan terhadap pengetahuan mengikut kafeteria yang berlainan ( $p = 0.000$ ). Secara keseluruhannya, daripada ketiga-tiga tahap tersebut, responden kajian hanya menunjukkan sikap yang baik dalam pengendalian makanan dan kafeteria dalam kajian ini perlu meningkatkan lagi tahap kebersihan tangan pengendali makanan dan persekitaran premis mereka.*

*Kata kunci: Amalan; keselamatan makanan; pengendali makanan; pengetahuan; sikap*

### INTRODUCTION

Food is a product that is rich in nutrients required by microorganisms and may be exposed to contamination with the major sources from water, air, dust, equipment, sewage, insects, rodents and employees. Due to the changes in food production, handling and preparation techniques as well as eating habits, the fact remains that food is the source for microorganisms that can cause illness. The US Centers for Disease Control and Prevention (USDHHS-CDC 1996) revealed that the outbreaks of foodborne diseases

which resulted from foods of animal origin had caused approximately 76 million illness, 325,000 hospitalizations and 5000 deaths each year. Data obtained from UK and USA, suggest that 20–40% of such illness is associated with the consumption of contaminated food where catering establishments are the most frequently cited sources of sporadic and outbreak foodborne infection (Harrison et al. 2001; Griffith 2000; Tarsitani et al. 1998). According to Bryan (1988) and Mederios et al. (2001), the common food handling mistakes besides serving contaminated

raw food also include inadequate cooking, heating, or reheating of foods consumption of food from unsafe sources, cooling food inappropriately and allowing too much of a time lapse.

It is important to have an understanding of the interaction on prevailing food safety beliefs, knowledge and practices of food handlers in order to minimize foodborne outbreaks (WHO 2000). Mortlock et al. (1999) stated that there was general agreement revealed from several authors as good levels of knowledge towards food safety among food handlers and the effective practices of such knowledge in food handling were imperative in ensuring the safe production of food in any catering operations. Recently, many studies pinpoint the need for training and education of food handlers in public hygiene measures due to their lack of knowledge on microbiological food hazards, temperature ranges of refrigerators, cross contamination and personal hygiene (Bas et al. 2004; Nel et al. 2004). Education on food safety should be given to all staff in food processing businesses so as to bring behavioral changes besides adoption of positive attitudes (Coleman & Roberts 2005; Powell et al. 1997). But in some previous studies no differences were detected between the staff who attended an educational course with those who did not (Angelillo et al. 2001; Askarian et al. 2004). This statement was supported by several studies (Howes et al. 1996; Powell et al. 1997) and indicate that although training may increase the knowledge of food safety, this does not always produce a positive change in food handling attitudes. Meanwhile, Ehiri and Morris (1996) pointed out that knowledge alone is not sufficient to promote positive attitudes and safe behaviors among food handlers. Therefore, alternative educational strategies, such as those based on motivational health education and promotion models are required (Angelillo et al. 2001; Askarian et al. 2004; Clayton et al. 2002).

Besides knowledge, attitude is also an important factor that ensures a reduction trend of foodborne diseases. Howes et al. (1996) indicates the correlation of positive behaviour, attitudes and continued education of food handlers towards the maintenance of safe food handling practices. On the other hand, Bas et al. (2004) in their study found that the attitude scores of the food handlers toward foodborne diseases prevention and control was poor ( $44.2 \pm 13.2$ ) as well as safety practice scores were very low ( $48.4 \pm 8.8$ ). According to Howes et al. (1996), a study in the USA showed that approximately 97.0% of foodborne outbreaks were due to improper food handling practices in food service fields. Previous reports indicate that besides poor hand and surface hygiene, lack in personal hygiene amongst food handlers was also one of the most commonly reported practices that gave rise to foodborne illness (Collins 2001). This shows that if food handlers take serious note on the cleanliness of their hand, body and clothing, this will help in preventing incidence of cross-contamination from occurring (Sneed et al. 2004).

Food safety in Malaysia is governed by the Food Safety and Quality Division, The Ministry of Health Malaysia under the 1983 Food Act and 1985 Food Regulation. The microbiological guidelines for ready-to-eat food has been approved by the Food Regulation 1985 Technical Advisors Committee on 28 October 2005 as a guideline to enforce microbiological standard for ready-to-eat food since the Food Hygiene Regulations has not been gazetted yet (MOH 2006b). The actions that need to be taken by the regulatory body if there are cases where the guidelines were not fulfilled are premise inspection, counseling and training of related food premise operators. Food poisoning cases are on the rise; the incidence rate of 31.1 cases per 100,000 populations in 1997 which is a two-fold increase from the previous year (MOH 1997). Overall, unhygienic food handling practices and the inadequacy of a safe water supply, as well as poor environmental sanitation were some causes of foodborne illness outbreaks in Malaysia. In 2006, about 3,625 from 81,686 inspected food premises had been closed when recognized as unhygienic according to the regulations in Part II of Food Act 1983 (MOH 2006a).

Very few studies have been conducted to explore the food safety knowledge and practices of food handlers among college or university in developed countries (Morrone & Rathburn 2003). Hence this paper presents data on a survey that assessed the knowledge, attitudes and practices (KAP) of food handlers at two residential colleges' cafeteria and a canteen of learning faculty in the campus of Universiti Kebangsaan Malaysia regarding food safety and hygiene.

## MATERIALS AND METHODS

### RESEARCH POPULATION AND DATA COLLECTION

The survey to evaluate the food safety knowledge, practices and attitudes of food handlers within the campus of Universiti Kebangsaan Malaysia was carried out from January to March 2009. The cafeterias involved were two residential colleges, namely Burhannudin Helmi College and Ungku Omar College as well as the canteen of the Faculty of Science and Technology. A total of 65 food handlers were recruited for this survey. To guarantee anonymity of responses and easy identification of questionnaires by respondents, identity numbers were randomly assigned to each questionnaire. Each questionnaire took approximately 15 min to complete. In this study, the questionnaire were left to the respondents and collected on the following day due to their hectic schedule.

### QUESTIONNAIRE DESIGN

A self-administered questionnaire for this study was prepared based on the previous research conducted by Nurul Huda (2008). The modified questionnaires included four parts. The first part has been designed to obtain information about the demographic characteristics of

the respondents. Second part consisted of 15 questions covering aspects of knowledge about food hygiene (equipment and personal hygiene) and food safety (food poisoning, food pathogen, risky foods, cross-contamination and temperature control). Respondents were asked to choose from among three options – yes, no or don't know to reduce the response bias. The score range was between 0 and 15 which were converted to 100 points. The score below 50% of food safety knowledge questionnaire is defined as poor knowledge. Part three and four included 20 questions each related to food handlers' attitudes and practices toward food safety handling (control and prevention of foodborne diseases). Food handlers were asked to indicate their level of agreement to the statements using a five-point rating scale for part three (strongly disagree=1, disagree=2, uncertain=3, agree=4 and strongly agree=5) and part four (never=1, rarely=2, sometime=3, often=4 and always=5). The score ranges were between 0 to 40 for part three and 0 to 60 for part four. Both were then converted to 100 points.

#### PRE TEST

The reliability of the food safety questionnaire designed was determined by pre-study on 30 food handlers. These

respondents were not included in the final survey. By using *Cronbach Alfa* test, the reliability coefficient test was 0.70 (Santos 1999). As a result of the item analysis, several test questions were modified to improve clarity.

#### DATA ANALYSIS

The SPSS 12.0 statistical package was used for all analyses. Mean responses and percentages of responses in each category were calculated and presented in tabular form. Independent sample *t*-test and ANOVA (confidence interval 95%) were used to compare selected test parameters such as sex, ages, education levels, working experiences and attendance of training courses.

### RESULTS AND DISCUSSION

#### DEMOGRAPHICS OF RESPONDENTS

Table 1 demonstrates the socio-economic and demographic data of respondents. Out of the 65 respondents involved in this research, 75.4% were men, 24.6% were women; majority (53.8%) were Malay, others were Indonesian (44.6%) and Indian (1.5%); 83.1% of the participants were 20 to 40 years old, and the rate of those who were

TABLE 1. Descriptive characteristic of the consumers

Characteristic	Demographic characteristics	Number (%)
Age group	<20	2 (3.1)
	21-30	38 (58.5)
	31-40	16 (24.6)
	41-50	7 (10.8)
	>50	2 (3.1)
Gender	Male	49 (75.4)
	Female	16 (24.6)
Race	Malay	35 (53.8)
	Indian	1 (1.5)
	Others	29 (44.6)
Education level	No formal education	3 (4.6)
	Primary school	12 (18.5)
	Secondary school	43 (66.2)
	Others	7 (10.8)
Responsibility	Chef	24 (36.9)
	Dishwasher	6 (9.2)
	Cutter	6 (9.2)
	Server	13 (20.0)
	Others	16 (24.6)
Working experience	< 1 year	7 (10.8)
	1-5 years	33 (50.8)
	6-10 years	12 (18.5)
	11-20 years	7 (10.8)
	> 20 years	1 (1.5)
Training courses	Yes	18 (27.7)
	No	47 (72.3)
<i>Typhim Vi</i> injection	Yes	40 (61.5)
	No	25 (38.5)

below 20 and above 50 years old were 3.1%, respectively. About 61.5% accepted injection of *Thypim Vi* before being hired. Education level of more than half of the respondents (66.2%) were high school compared with primary school (18.5%) and without formal educational (4.6%). 10.8% of the respondents had less than one year of working experience, 50.8% have been in this sector for about five years, 29.3% for six to 20 years and 1.5% with more than 20 years of experiences. When the employers respond to the survey have been evaluated according to their job distribution, it has been found that 36.9% of them were chefs and assistant cooks who were related to food preparation and cooking, 20.0% of them were staff responsible for service, 9.2% were dishwashers appointed for other works except cooking and 24.6% were cafeteria' entrepreneurs and cashiers. Only 27.7% of the participants had attended food training courses where 3.1% of them attended these courses more than 3 times. Majority of the employers (61.5%) stated that they had received injection of *Thypim Vi*.

SAFETY PERCEPTIONS

The findings were analysed with the respect to gender, age, working experience and training course attendance variables.

GENDER

Table 2 shows the different average mean points of respondents on the aspect of their knowledge, attitudes and practices. Female respondents received higher grades than male respondents for all the three aspects. When the result was examined by taking into consideration the three different aspects, it can be observed that both women and men got lower points than they were expected to (total 100 points); however, there was significant different in

average points of practice with respect to the gender variable ( $P < 0.05$ ).

AGE

The safety perceptions of the respondents have been evaluated in five different age groups in Table 3. The difference between the average points received from all three aspects and the age groups was statistically insignificant ( $p > 0.05$ ). All age group of respondents obtained lower points than they were expected to (total 100 points for each aspect). On the other hand, these points increased with age and the highest average recorded by the respondents who were at the age of 31-40 years old ( $94.6 \pm 5.9$ ) in the aspect of attitude while respondents with the age below 20 years showed lowest average mean points for the aspect of knowledge ( $43.3 \pm 23.6$ ). It is a fact that both knowledge and experience increase with age. This is clearly observed in the high average of points received by those 31 years old or above.

WORKING EXPERIENCE

The findings with respect to the working experience variable are in Table 4. The higher the educational status, the higher the level of hygiene perception was. Statistically, there was significant difference between the knowledge aspect and the duration of working experiences ( $p < 0.05$ ). It was observed that employees with working experience less than one year acquired the lowest knowledge score ( $41.0 \pm 17.8$ ) compared to those working more than 6 years ( $70.0 \pm 11.2$ ).

TRAINING COURSES

Table 5 represented the average mean points on the perception of safety with respect to the attendant of

TABLE 2. Mean Score on KAP based on gender (n=65)

Aspect	Male (n=49)	Female (n=16)	Sig
Knowledge	<sup>a</sup> 63.3 ± <sup>b</sup> 17.3	63.8 ± 21.2	0.448
Attitude	90.4 ± 9.5	91.9 ± 6.9	0.336
Practice	70.7 ± 11.1	88.3 ± 6.0	0.032*

\*P < 0.05 <sup>a</sup> Mean ± <sup>b</sup> Standard Deviation  
KAP (knowledge, attitudes and practices)

TABLE 3. Mean score on KAP based on age groups (n=65)

Aspect	<20 (n=2)	21-30 (n=38)	31-40 (n=16)	41-50 (n=7)	>50 (n=2)	Sig
Knowledge	<sup>a</sup> 43.3± <sup>b</sup> 23.6	61.4 ± 20.0	65.8 ± 16.3	71.4 ± 9.2	70.0 ± 4.7	0.448
Attitude	87.5 ± 10.6	88.5 ± 10.1	94.6 ± 5.9	93.7 ± 6.5	94.5 ± 3.5	0.230
Practice	87.5 ± 12.0	85.1 ± 10.5	88.8 ± 10.0	91.4 ± 8.2	93.5 ± 3.2	0.525

\*P < 0.05 <sup>a</sup> Mean ± <sup>b</sup> Standard Deviation  
KAP (knowledge, attitudes and practices)

TABLE 4. Mean score on KAP based on working experience (n=65)

Aspect	< 1 year (n=7)	1-5 years (n=33)	6-10 years (n=12)	11-20 years (n=7)	> 20 years (n=1)	Sig
Knowledge	<sup>a</sup> 41.0± <sup>b</sup> 17.8	63.2 ± 18.1	70.0 ± 11.2	66.7 ± 15.9	66.7	0.008*
Attitude	87.7±10.7	89.5 ± 9.7	93.7 ± 6.7	95.9 ± 4.0	94.0	0.373
Practice	83.6±10.6	86.9 ± 11.4	86.3 ± 7.8	91.9 ± 9.5	95.0	0.695

\*P < 0.05 <sup>a</sup>Mean ± <sup>b</sup> Standard Deviation  
KAP (knowledge, attitudes and practices)

TABLE 5. Mean score on KAP based on the attendance of training courses (n=65)

Aspect	Yes (n=18)	No (n=47)	Sig
Knowledge	<sup>a</sup> 71.9 ± <sup>b</sup> 13.6	60.1 ± 18.7	0.090
Attitude	94.6 ± 4.9	70.3 ± 9.7	0.006*
Practice	88.6 ± 8.6	86.5 ± 10.6	0.343

\*P < 0.05 <sup>a</sup> Mean ± <sup>b</sup> Standard Deviation  
KAP (knowledge, attitudes and practices)

respondents to training courses variable. Of the 65 respondents involved in this study, about 27.7% reported that they had followed training courses regarding food safety. It was observed that only attitude gave significant value less than 0.05 ( $p=0.006$ ). This indicated that there was an obvious difference between respondents who had attended courses (94.6±4.9) than those without any record of it (70.3±9.7) where respondents who had attended courses showed positive attitudes when handling foods.

#### KNOWLEDGE ON FOOD SAFETY

Overall, the knowledge level of food handlers at the two residential cafeterias and canteen of the Universiti Kebangsaan Malaysia was moderate, with a mean value of 57.8%. Based on Figure 1, respondents have good knowledge on personal hygiene where 93.9% answered correctly. However, some observational studies found that although the food handlers have good knowledge towards

food safety but they do not always put the knowledge into practice (Oteri & Ekanem 1989). Manning and Snider (1993) reported that 81% of their respondents are aware of the importance of hand washing, but only 2% observe washing their hands thoroughly. More than half of the respondents (73.9%) answered with the correct option which indicates that they realized food prepared without proper handling may contribute to the risk of food-borne illnesses. Questions about time and temperature control were correctly answered by most of the respondents (61.2%), but 30.0% of them did not give answer correctly while 8.0% did not know the answer. According to Anon. (2003), most cases of foodborne disease were due to improper handling of food, including the inappropriate use of temperature during food preparation and conservation, cross-contamination, poor personal hygiene and inadequate food utensils. In this survey, only 28.0% of the respondents managed to prove that they know the right temperature for storage of hot and cold ready to eat foods besides the

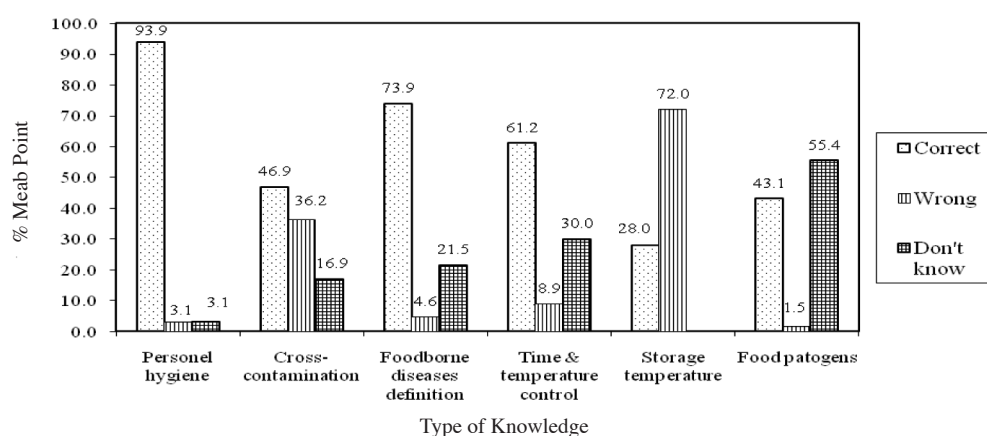


FIGURE 1. Knowledge level of food handlers based on six types of questions



temperature of refrigerators and freezers. This result is supported by Bas et al. (2004) that reports the knowledge of critical temperatures of these aspects were low amongst their studied food handlers. Walker et al. (2003) also reported that less than half of 444 respondents knew the correct temperature of holding hot foods. Majority of the respondents (55.4%) did not know the harm caused by *Staphylococcus aureus*.

#### ATTITUDES OF RESPONDENTS

Majority of the respondents reported positive attitudes when handling foods. 76.9% stated that, safe food handling was an important part of their job responsibilities. 72.3% stated that learning more about food hygiene was imperative for them. Most of them (52.3%) agreed to participate in any training courses (HACCP, GMP, GHP, etc.) if provided. Forty six staff agreed that use of caps, gloves and garments will reduce the risks of food contamination. Almost 55.4% of them agreed with the statement that food service staffs with abrasions and cuts on hands should avoid from unwrapping foods. Jiang and Doyle (1999) in their study mentioned that 94.5% of respondents also agreed with this statement. About 56.9% and 66.2% of respondents respectively, stated that not monitoring refrigerator and freezer temperatures and improper storage of foods might be harmful to health. However, in the previous study by Clayton et al. (2002), food handlers might be aware of the food safety attitudes they should have, but 63.0% of their respondents admitted that they seldom practice such positive attitudes. This proved that although most of the food handlers in this survey gave positive answers but they might not practice it when handling foods. Based on Toh dan Birchenough (2000), there were strong correlation between knowledge and food handling practices. Earlier studies on adults also indicated that food safety knowledge tends to increase with age and practice. Females showed higher scores than males and younger respondents need to be given additional food safety education (Albert 1995; Rimal et al. 2001). Hence, training, motivation and initiative should be provided to encourage food handlers practicing appropriate attitudes and procedures when working in food areas (Nurul Huda 2008).

#### PRACTICES IN HANDLING FOOD

When food handlers did not practice good personnel hygiene or proper handling, they can be the vector for growth of microorganisms through hands, cuts, mouths, skins and hairs (Bryan 1988). Table 6 presented the results obtained from the five types of related questions. Respondents in this study showed good practices when 75.4% of them wash hands after using the toilet. Only 60.0% washed their hands thoroughly with soap and hot water before handling foods. Many of the previous studies proved that it is crucial to practice self hygiene especially hand hygiene because hand is the major agent that transmit microorganisms and intestinal parasites to foods (Aarnisalo et al. 2006). Approximately 66.5% of the respondents produced good personnel hygiene practices. According to Bas et al. (2004), the staff employed in food and beverages services should have a clean, tidy and proper appearance, without any skin infections, good dental hygiene, have short finger nails and are not in the habit of biting nails, do not wear jewellery except wedding ring, wearing no make-up, work in clean shoes and uniform, and stick to good hygiene practices. Many of the studied respondents fulfilled some of these characteristics. About 66.2% of them gave good respond in the aspects of raw materials management and 52.3% always put the use of gloves into practice. Angelillo et al. (2001) and Askarian et al. (2004) stated that using of gloves is mainly influenced by employees' ages where younger workers seem to be more motivated in preventing risk practices compared with older workers. In the aspects of food safety, answers provided by the respondents indicated that level of their practices was average, in which the overall percentage was 59.3%. Data for the risk factors showed that majority of the cases were due to improper food handling practices (Clayton et al. 2002). A study in USA proposed that inappropriate food handling practices lead to 97.0% of foodborne diseases (Howes et al. 1996).

#### CONCLUSIONS

Food handlers' knowledge level in this study can be categorized as moderate with the mean score of 57.8%. Respondents showed positive attitudes in both categories of questions, i.e. food safety and hygiene (76.0%); prevention

TABLE 6. Percentage of respondents scores based on five categories of questions (n=65)

Category	Number of question	%				
		Never	Rarely	Sometimes	Often	Always
Personnel hygiene	5	6.8	3.7	6.8	16.3	66.5
Hand washing	4	1.5	2.1	4.6	25.0	68.5
Using of gloves	2	6.2	2.3	9.2	30.0	52.3
Food safety control	7	9.5	2.8	9.2	22.2	59.3
Raw materials management	2	6.2	2.3	3.1	25.4	66.2

and control of foodborne diseases (70.8%). Majority of the respondents exhibited average practices in handling of foods with 68.0% in hand washing; 66.5% in personnel hygiene; 66.2% in raw materials management; 59.3% in food safety control and 52.3% in gloves usage.

#### ACKNOWLEDGEMENT

Authors would like to acknowledge the funding assistance from UKM-GUP-KRIB-14/2008 for this project and statistical input from Dr. Nur Riza Mohd. Suradi of Statistics Programme, School of Mathematical Sciences, Faculty of Sciences and Technology, Universiti Kebangsaan Malaysia.

#### REFERENCES

- Aarnisalo, K., Tallavaara, K., Wirtanen, G., Maijala, R. & Raaska, L. 2006. The hygienic working practices of maintenance personnel and equipment hygiene in the Finnish food industry. *Journal of Food Control* 17: 1001-1011.
- Albert, J.A. 1995. Food safety knowledge and practices of consumers in the USA. *Journal Consumer Studies and Home Economics* 19: 119-134.
- Anon. 2003. Acute Gastroenteritis in Ireland, North and South – a Telephone Survey. Health Protection Surveillance Centre, 25-27 Middle Gardiner Street, Dublin 1, Ireland.
- Angelillo, I.F., Viggiani, M.A., Greco, R.M. & Rito, D. 2001. HACCP and food hygiene in hospital: Knowledge, attitudes and practices of food services staff in Calabria, Italy. *Infection Control Hospital Epidemiology* 22: 1-7.
- Askarian, M., Kabir, G., Aminbaig, M., Memish, Z. & Jafari, P. 2004. Knowledge, attitudes, and practices of food service staff regarding food hygiene in Shiraz, Iran. *Infection Control Hospital Epidemiology* 25: 16-20.
- Bas, M., Ersun, A.S. & Kivanc, G. 2004. The evaluation of food hygiene knowledge, attitudes and practices of food handlers in food businesses in Turkey. *Journal of Food Control* 17: 317-322.
- Bryan, F.L. 1988. Risks of practices, procedures and processes that lead to out-breaks of foodborne diseases. *Journal of Food Protection* 1: 663-673.
- Clayton, D.A., Griffith, D.J., Price, P. & Peters, A.C. 2002. Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research* 12: 25-39.
- Coleman, P. & Roberts, A. 2005. Food hygiene training in the UK: A time for change. *Journal of Food Service Technology* 5: 17-22.
- Collins, J.E. 2001. Impact of changing consumer lifestyles on the emergence/re-emergence of foodborne pathogens. *Emergence Infection Disease* 3: 1-13.
- Ehiri, J.E. & Morris, G.P. 1996. Hygiene training and education of food handlers: Does it work? *Ecology Food Nutrition* 35: 243-251.
- Griffith, J. 2000. Food safety in catering establishments. In *Safe Handling of Foods*, edited by Farber, J.M. & Todd, E.C.D. New York: Marcel Dekker.
- Harrison, W., Griffith, C.J., Tennant, D. & Peters, A.C. 2001. Incidence of *Salmonella* and *Campylobacter* in poultry and poultry packaging. *Letters in Applied Microbiology* 33: 1-5.
- Howes, M., McEwen, S., Griffiths, M. & Haris, L. 1996. Food handler certification by home study: measuring changes in knowledge and behaviour. *Dairy Food Environmental Sanitation* 3: 208-214.
- Jiang, X.P. & Doyle, M.P. 1999. Fate of *Escherichia coli* O157:H7 and *Salmonella enteritidis* on currency. *Journal of Food Protection* 62: 805-807.
- Manning, C.K. & Snider, O.S. 1993. Temporary public eating places: food safety knowledge, attitudes and practices. *Journal of Environmental Health* 56: 24-28.
- Mederios, L., Hillers, V., Kendall, P. & Mason, A. 2001. Evaluation of food safety education for consumers. *Journal of Nutrition Education and Behavior* 33: 27-34.
- Ministry of Health Malaysia. 1997. *Annual Report 1996 for the Family Health Information System*. Information and Documentation Unit, Ministry of Health Malaysia, Kuala Lumpur.
- Ministry of Health Malaysia. 2006a. *Annual Report 2006*. Public Health Department, Ministry of Health Malaysia, Putrajaya, MOH.
- Ministry of Health Malaysia. 2006b. KKM-163. Letter from the Director for the Food Safety and Quality Division, Ministry of Health Malaysia regarding Microbiological Guidelines for Ready-to-eat Food, Abd. Rahim b. Mohd., circulated list, January 2006.
- Morrone, M. & Rathburn, A. 2003. Health education and food safety behavior in the university setting. *Journal of Environment Health* 65: 9-15.
- Mortlock, M. P., Peters, A.C. & Griffith, C. 1999. Food hygiene and HACCP in the UK food industry, practices, perceptions and attitudes. *Journal of Food Protection* 62: 786-792.
- Nel, S., Lues, J.F.R., Buys, E.M. & Venter, P. 2004. The personal and general hygiene practices in the deboning room of a high throughput red meat abattoir. *Journal of Food Control* 15: 571-578.
- Nurul Huda, H. 2008. Tahap pengetahuan, sikap dan amalan kebersihan dan keselamatan makanan di kalangan pengendali makanan di hospital. MSc Thesis. Universiti Kebangsaan Malaysia.
- Oteri, T. & Ekanem, E.E. 1989. Food hygiene behavior among hospital food handlers. *Journal of Publish Health* 103: 153-159.
- Powell, S.C., Attwell, R.W. & Massey, S.J. 1997. The impact of training on knowledge and standards of food hygiene-a pilot study. *International Journal of Environmental Health Research* 7: 329-334.
- Rimal, A., Fletcher, S.M., McWatters, K.H., Misra, S.K. & Deodhar, S. 2001. Perception of food safety and changes in food consumption habits: a consumer analysis. *International Journal of Consumer Studies* 25: 43-52.
- Santos, J.R.A. 1999. Cronbach's Alpha: A tool for assessing the reliability scales. *Journal of Extension* 37(2). <http://www.joe.org/joe/1999april/tt3.php> [8 Mac 2008].
- Sneed, J., Strohbehn, C., Gilmore, S.A. & Mendonca, A. 2004. Microbiological Evaluation of foodservice contact surfaces in Iowa assisted-living facilities. *Journal of American Dietitians Associations* 104: 1722-1724.
- Tarsitani, G., Gadliardi, C. & Persiani, G. 1998. Microbial analysis of health risks in university cafeterias. *Igiene-Moderna* 110: 3-12
- Toh, P.S. & Birchenough, A. 2000. Food safety knowledge and attitudes: Culture and environment impact on hawkers in Malaysia. Knowledge and attitudes are key attributes of

- concern in hawker foodhandling practices and outbreak of food poisoning and their prevention. *Journal of Food Control* 11: 447-452.
- USDHHS–CDC (US Department of Health and Human Services–Centers for Disease Control and Prevention). 1996. Surveillance for foodborne-disease outbreaks: United States, 1988-1992. Centers for Disease Control and Prevention Surveillance Summary. *Morbidity and Mortality. Weekly Reports* 45: 5.
- Walker, E., Pritchard, C. & Forsythe, S. 2003. Food handlers hygiene knowledge in small food businesses. *Journal of Food Control* 14: 339-343.
- World Health Organisation (WHO) 2000. *Foodborne Disease: Focus on Health Education*. WHO, Geneva.
- School of Chemical Sciences and Food Technology  
Faculty of Science and Technology  
Universiti Kebangsaan Malaysia  
43600, UKM Bangi, Selangor D.E.  
Malaysia
- \*Corresponding author; e.mail: norra@ukm.my
- Received: 9 December 2009  
Accepted: 25 July 2010