ORIGINAL ARTICLE

Food Hygiene and Storage Practices towards the Understanding of Food Microbe among Universiti Malaysia Sabah (UMS) Students

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ABSTRACT

Introduction: Lack of microbial knowledge among university students may expose them to food poisoning and disregard food safety concerns, especially food hygiene and storage practices. This research aimed to assess undergraduate students' understanding of biological (microbial) food hazards and evaluate current food handling practices. **Methods:** The study involved 372 respondents consisting of UMS students, including Labuan and Sandakan campus branches. The respondents of this study consisted of students of different genders, ages, ethnicities, fields of study, years of study, faculties, and early studies. Respondents answered all 19 questions of the complete questionnaire, including demographics, personal hygiene practices, food storage practices, and microbial knowledge. **Results:** On average, the parts of personal hygiene, food storage practices, and microbial knowledge had values of (3.66 ± 0.414), (3.70 ± 0.363) and (3.52 ± 0.607), respectively. All variables showed a relationship categorised as moderate. The relationship between personal hygiene practices and knowledge was (r = 0.319), food storage practices and microbial knowledge were (r = 0.410), while personal hygiene practices and food storage practices were (r = 0.425). **Conclusion:** UMS students maintain a moderate level of knowledge on personal hygiene and food handling and have a level of knowledge on biological hazards (microbes) that affect food safety.
Malaysian Journal of Medicine and Health Sciences (2022) 18(SUPP15): 178-183. doi:10.47836/mjmhs18.s15.24

Keywords: Food hygiene, Food storage, Food Microbe, Food Safety

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INTRODUCTION

Food is a basic human necessity, but it can also serve as a vehicle for disease transmission if it is contaminated with hazardous microbes such as bacteria, viruses, parasites, or toxins. Food polluted with bacteria and chemicals can lead to outbreaks of congenital diseases (1). Children are the group most at risk for diarrhoea, with 220 million children suffering from diarrhoea, and 96 000 of them die each year (2). Diarrhoea is usually caused by eating raw or undercooked meat, eggs, and dairy products contaminated by norovirus, Campylobacter, Salmonella, and E.Coli. When certain microbes that cause disease infect food, food-borne infections can occur, which are called food poisoning. Contaminated foods will differ in appearance, smell, and taste compared to foods that are safe to eat, such as Listeria monocytogenes that can breed in refrigerators and ready-to-eat foods (3)

Young & Waddell (4) state that studies have shown an increase in foodborne illness can be attributed to improper food safety practices at home. The home environment stores various pathogens that can cause foodborne disease, for example, bacteria, viruses, and fungi (5). Not only that, but home kitchens that are constantly used for food preparation alone have even led to an increased risk of food contamination which can lead to foodborne illness (6). Previous studies have shown that errors in food handling, preparation and storage of food are a cause of foodborne illness (7). Evidence has also supported that, in most cases, properly cooked or processed foods can eliminate the risk of foodborne illness (8).

Therefore, this study proposes to assess the knowledge of the biological hazards (microbes) of Universiti Malaysia Sabah (UMS) food students. The study was conducted among educated people in developing countries such as Malaysia and university students to discover the knowledge gap about food safety. The knowledge of these students was assessed in terms of food handling practices specific to the level of personal hygiene and food storage practices that affect the knowledge of food.

MATERIALS AND METHODS

Study design

A study design is an overall plan that relates a conceptual study problem to a relevant and feasible empirical study. Empirical studies were conducted to answer the research questions. The study design is an overall strategic choice that leads to an approach to answering the study problem. Descriptive research has been used in this study where it can describe the characteristics of a group of people. For this study, the target respondents were UMS students from year one to year four from each faculty. Questionnaire form A contained an assessment of students ' knowledge of hand washing practices, food handling, and food storage while containing demographic information of the respondents.

This study determines food safety practices among Universiti Malaysia Sabah (UMS) students. According to the official website of UMS, ten faculties are operating in UMSatAll these faculties are located at the main UMS Kota Kinabalu, the Sandakan branch campus, and the Labuan branch campus. The following is a list of faculties available at UMS:

The sample population for this study was UMS undergraduate students. Referring to data and statistics from the official website of UMS, the number of UMS undergraduate students is 14 489 people. Based on the table by Cohen et al. (10) below, the table suggests a minimum number of respondents of 370 people, which is enough to represent the population of 1 489 people in UMS. Therefore, the number of respondents was rounded to 400 people. 40 respondents were recruited from each of the 10 faculties (Table I). To compare students 'knowledge from health-related courses such as medical students and students from non-health-related classes such as engineering, arts and heritage, and others.

This study was approved by Research Ethics Committee, Universiti Malaysia Sabah ethics committee (UMS/FSMP6.9/100-6/1/95).

Instrumentation

This descriptive study is used in a questionnaire form, in which instruments adapted and adopted to obtain results. Some of these instruments include a questionnaire that has been modified from a study by Gong et al., (11); More et al., (12), and Osaile et al., (13). The questionnaire is divided into two parts; the first will assess the respondents' personal information. The second section is evaluated at a moderate level of supervision. This section is measured using a five-scale Likert. The purpose of the personal information in the second section is to eliminate assessing the respondent's assumptions.

The instrumentation of this questionnaire was to assess UMS students' knowledge about food's biological hazards under a moderate level of supervision. Under this instrument's efficiency, there are three things to be measured: hand washing, food handling, and food storage practices. This instrument's efficiency was tested to determine the relationship to microbial knowledge among students.

Table I: List of UMS Faculties

No.	Faculty	Campus
1.	Faculty of Science and Natural Resources (FSSA)	Kota Kinabalu
2.	Faculty of Psychology and Education (FPP)	Kota Kinabalu
3.	Faculty of Humanities, Art and Heritage (FKSW)	Kota Kinabalu
4.	Faculty of Business, Economics and Accountancy (FPEP)	Kota Kinabalu
5.	Faculty of Food Science and Nutrition (FSMP)	Kota Kinabalu
6.	Faculty of Engineering (FKJ)	Kota Kinabalu
7.	Faculty of Computing and Informatics (FKI)	Kota Kinabalu
8.	Faculty of Medicine and Health Science (FPSK)	Kota Kinabalu
9.	Faculty of Sustainable Agriculture (FPL)	Sandakan
10.	Labuan Faculty of International Finance (FKAL)	Labuan

Source: UMS official website

Data analysis

Data analysis will use two common methods that use descriptive descriptions, for example,e age, gender, ethnicity, level of early education, and so on. The second method is the quantitative method, which is more of a statistical description interpreted than calculations using the Statistical Package for Social Science (SPSS). The main results to be obtained from the questionnaire e then analysed through mean, frequency, standard deviation, dependence and intercorrelation. The results were interpreted using a combination of SurveyMonkey and SPSS software; from here, the relationship between the two variables can be seen more clearly. The code for the results of the questionnaire will also be simpler.

The code is a response to a questionnaire represented by a number. The code is also the respondent's answer to each question, allowing the researcher to measure characteristics or find patterns between two variables. The study took several days after the last questionnaire was conducted to complete all, including coding, cleaning and preparation of data files. Two to four weeks were born to write a report documenting the questionnaire procedure and answering the survey questions.

RESULTS

Participant

A total of 372 respondents participated and answered the questionnaire distributed to all faculties at UMS. Sixty-six respondents from the first year of study answered the questionnaire, covering 17.7% of the total respondents. The second-year research recorded only 42 respondents involved, which is only 11.3%. Respondents from the second year of study are also the

lowest number compared to other years of study. For year three, 31.7% of 372 respondents were involved, equivalent to 118. While students from the fourth year, there were 146 respondents representing 39.2% of the total. Respondents from year four studies also recorded the highest number of respondents.

Based on the table II, the profiles of the respondents who answered the questionnaire took into account aspects of gender, age, the field of study, year of study, faculty, early education, ethnicity, and the main sources of food safety information. All these demographic aspects were analysed first before starting the next analysis related to the objectives of this study. This table shows a summary of the descriptive analysis. Of the 372 respondents involved, the total number of male respondents is 141 people (37.9%), which indicates a low number compared to the number of females, 231 people (62.1%). Of these respondents, respondents who belong to the age group of 18 to 23 years old are 320 people, who recorded the highest number of 86%. While only 52 respondents or 14% of the age group of 24 to 28 years.

Table II: Social-demography of UMS Student (N=372)

	Students (n=372)	Percent (%)
Gander		
Male	141	37.9
Female	231	62.1
Age		
18 – 23 years	320	86.0
24 – 28 years	52	14.0
Field of Study		
Related to the field of health	95	25.5
Non-related to the field of health	277	74.5
Years of Study		
Year 1	66	17.7
Year 2	42	11.3
Year 3	118	31.7
Year 4	146	39.2
Faculty		
FSSA	55	14.8
FPP	36	9.7
FKSW	25	6.7
FPEP	41	11.0
FKJ	45	12.1
FKI	28	7.5
FSMP	47	12.6
FPSK	31	8.3
FPL	30	8.1
FKAL	34	9.1
Early Studies		
STPM	111	29.8
Diploma	62	16.7
Matriculation	118	31.7
Foundation	81	21.8
Ethnic		
Malay	85	22.8
Chinese	49	13.2
Indian	7	1.9
Bumiputera Sabah	198	53.2
Bumiputera Sarawak	28	7.5
Others	5	1.3
Key Sources of Food Safety Information		
University studies	72	19.4
Family and friends	104	28.0
Personal doctor	7	1.9
Mass media	62	16.7
Internet	124	33.3
Others	3	0.8

Analysis of student food hygiene

Table III is a report on the frequency and percentage of the level of personal hygiene practices of UMS students. Descriptive statistics based on Likerthe t scale five showed only the first four questions exceeded the mean value of 4.00. The other two questions showed mean results of 4.00 and below and gave mean values of 3.44 and 3.70. The highest mean value is 4.53, referring to question number three: "I think washing hands before handling cooked food can reduce the risk of food poisoning. The question that got the lowest mean value was question five, "I use paper towels to dry my hands after washing my hands", with a mean value of 3.44.

Table III: Analysis of Student Hygiene

Variables	Min	Standard deviation
1. Knowledge of food safety is important to me.	4.49	0.629
2. Knowledge of food safety will benefit my personal life.	4.47	0.686
3. Raw foods and cooked foods must be stored separately.	4.49	0.698
4. Knowing the temperature of the refrigerator and freezer to reduce food safety risks is important.	4.09	0.812
5. Frozen meat will be thawed in a basin under running water.	3.83	0.952
6. In a power outage, meat, poultry, and seafood stored in the freezer will be discarded.	2.75	0.951
7. -18°c is the recommended temperature for a freezer.	3.35	0.848
8. 4°c is the recommended temperature for the refrigerator.	3.45	0.902

In addition, the majority of respondents, of which more than 300 respondents, agreed with the first four questions, which also had a mean value of more than 4.0, namely "I believe good personal hygiene can prevent foodborne illness", "I think washing hands before handling raw food can reduce the risk of food poisoning", "I think washing hands before handling cooked food can reduce the risk of food poisoning," and "I believe covering the head and gloves can reduce the risk of food poisoning." These results are in line with the findings from Buccheri et al. (14). Their findings found that over 90% of respondents believe wearing protective clothing and gloves is crucial in ensuring food safety.

In addition, two questions from this personal hygiene practice variable have a mean value above 3.0, namely questions five and six, with values of 3.44 and 3.70, respectively. In question five, 51.9% of respondents agreed to practice using paper towels to dry hands after washing hands. Question eight related to washing hands with the help of soap and rinsing with warm water and then wiping dry recorded 231 respondents, 62.1% of the total who agreed with the practice. These results align with a previous study in which about 81% of respondents knew the correct way to wash hands: wetting hands, using soap and warm water, and then

drying hands by wiping with paper towels until dry (15). Consumers must always wash their hands at every stage, i.e., before touching food, after touching dirty or contaminated items, and after using the bathroom (16). Training and education can be

Effective tools to increase food safety knowledge and awareness of personal hygiene can improve food safety practices (17). This is because high knowledge does not necessarily lead to positive changes in food handling habits (18).

Analysis of student food storage

The descriptive statistics for the five-scale assessment showed that half of the questions in this section recorded a mean value above 4.0 and the other half below the value of 4.0, where one of them was below the value of 3.0, which is 2.75. The first question, "knowledge of food safety is important to me", and the third question ", raw food and cooked food must be stored separately", had the highest mean value of 4.49 with standard deviation values of 0.629 and 0.698, respectively. The second question, "knowledge of food safety will benefit my personal life", recorded a mean value of 4.47 and a standard deviation of 0.686. "Knowing the temperature of the refrigerator and freezer to reduce the risk of food safety is important" is the last question which recorded a mean value above 4.0, which is 4.09, with a standard deviation value of 0.812. Although the four questions registered a mean value above 4.0, the standard deviation value for the questions was categorised in the moderate category, and one with a standard deviation value of 0.812 was included in the good category.

In addition, 299 respondents (80.4%) disagreed with the statement "in the event of a power outage, meat, poultry, and seafood stored in the freezer will be discarded." These records show many students still have poor food safety knowledge and proper food storage methods. Not only that, a large number of students who are not yet sensitive and know about the correct temperature for freezers and refrigerators which as many as 246 respondents (66.1%) do not and less agree that -18 ° C is the recommended temperature for refrigerators frozen. At the same time, 214 respondents (57.5%) also did not and less agreed about 4 ° C being the recommended temperature for refrigerators (Table IV).

According to Newell et al. (19), most food handlers are unaware of the importance of temperature control requirements in controlling microbial growth in food. If this is not considered, microbial hazards will occur, leading to foodborne diseases.

In a study by (20), about 83% of respondents were unsure about food defrosting. Foods that are frozen and thawed repeatedly will increase the number of microorganisms in the food that can invite danger. Based on the table above, 32.2% of the respondents

Table IV: Analysis of student food storage

Instruments	Min	Standard deviation
1. Campylobacer bacteria are closely related to raw chicken or undercooked chicken.	3.37	0.768
2. To prevent salmonella poisoning, food should be fully heated.	4.05	0.738
3. Raw beef or pork is more likely to be contaminated with Escherichia coli (E. coli).	3.56	0.940
4. Botulism is a disease that is closely related to canned food.	3.52	0.747
5. Most disease -causing bacteria can grow in the temperature range between 5 ° C to 60 ° C.	3.59	0.884

did not know about proper food defrosting. Although the number of respondents who practised the question "frozen meat will be thawed in a basin under running water" was higher at 252 people (67.8%), there are still several higher education students who do not practice proper food thawing.

Giritlioglu et al. (21) found that 29.3% of their respondents did not know that raw and cooked food must be kept separate. Storing raw and cooked foods together is a major cause of food poisoning (22). However, in the study conducted on UMS students, only 40 respondents did not know, while the rest practised the separation of raw food and cooked food.

DISCUSSION

The frequencies, percentages, mean values, and standard deviation values for microbial knowledge variables among students are recorded in the table above. Based on the table above, all the items or questions stated have good standard deviation values. Four of the five questions had a mean value approaching 4.0, and one question with a mean value of 4.05. The second question, "to prevent salmonella poisoning, food should be fully heated," recorded a mean value of 4.05 and a standard deviation of 0.738. The question with the lowest mean value was the first question, "Campylobacter bacteria are closely related to raw chicken or undercooked chicken", with a mean value of 3.37 and a standard deviation value of 0.768. Although the value of oil is low, still in the category of mean value and good standard deviation value. The question that recorded the highest standard deviation value was questioned three: "raw beef or pork is more likely to be contaminated with Escherichia coli (E. coli)" with 0.940 and a mean value of 3.56.

Through the analysis of the table above, three questions record the highest number of respondents who do not and disagree among the five questions in the microbial knowledge variable, the first question with several respondents 240 people (64.4%), the fourth question with 222 respondents, which is 59.7 %, and the last or fifth question with a total of 199 respondents (60.7%). These results show that the number of UMS students with microbial knowledge is still low.

More than half of the respondents were unsure about Campylobacter bacteria being closely related to raw or undercooked chicken (64.4%). In the study conducted by Asiegbu et al. (2016), nearly 70% of the study respondents had never heard of Salmonella, E. coli, monocytogenes, and Campylobacter jejuni. This is likely due to the respondents' difficulty identifying a specific name for each food pathogen. Osaili et al. (23) also found that less than 10% of respondents in a study conducted in Jordan had heard of Listeria monocytogenes, Staphylococcus aureus, Bacillus cereus, Escherichia coli, Clostridium perfringes, Campylobacter jejuni, Shigella and only 40% of its respondents had heard of Salmonella. Therefore, there is a tendency for consumers to be unable to differentiate or identify each type of food-borne pathogen. Salmonella and followed by E. coli were the most known foodborne pathogens by the respondents in this study. Similar findings were also recorded by Courtney, Majowicz, & Dubin (24), who showed that most respondents involving university students could identify the medium of transmission of Salmonella compared to other pathogens. Awareness of these two pathogens may be due to outbreaks of Salmonella and E. coli which have been the cause of foodborne illnesses that are often reported on television screens, radio, and newspapers (25).

There are still differences in the knowledge about food hygiene between the educated respondents in this study. Students may not specialise in food hygiene because this is not their field of study. However, the awareness of food hygiene among these students is influenced by the knowledge, attitudes, and practices during childhood. As Mullan (26) points out, childhood is a critical time for understanding, forming attitudes and applying good techniques related to food hygiene. This could be attributed to the fact that most students with different faculty and backgrounds still varied despite a similar level of education.

Using the results of current studies, tailoring such interventions can help better understand food microbes and improve positive behaviours toward food hygiene. We recommend that educational materials on food hygiene should be available in every faculty, cafeteria and dormitory. Media and social networks should be consistent and active in increasing public and student awareness of food hygiene.

CONCLUSION

The study conducted and based on the data obtained shows that the overall knowledge and practice of UMS students on food safety and microbial hazards, particularly, is at a moderate level. From these findings, proper procedures for personal hygiene and food storage practices among UMS students are still unsatisfactory. There is still a knowledge gap about food safety between students from health-related studies and non-health-related studies. The data obtained also show that the relationship of the three variables in this study is at a moderate level and then gives a picture and indication that personal hygiene practices and food storage practices, as well as microbial knowledge among UMS students, are not in a satisfactory level. This may be due to students still lacking exposure to personal hygiene practices and food storage practices which are factors for optimal food safety. The information gathered in this study indicates the more effective approaches that need to be taken and implemented to enhance proper food safety culture further and practices especially focusing on students from non-health-related studies or not from science streams. Effective food safety education programs need to focus more on information related to food temperature control, proper food preparation and storage practices, good ways to avoid cross-contamination of food, appropriate cleaning procedures, knowing the agents of foodborne diseases, and other contributing factors.

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