



## Evaluating food safety knowledge and practices of food handlers in university food courts (case study Nourahbint Abdulrahman university )

**Amal Nassir ALkuraieef**, Nutrition and Food Sciences Department/ Education College, Princess Nourahbint Abdulrahman University, [analkuraieef@pnu.edu.sa](mailto:analkuraieef@pnu.edu.sa)

**Omaima Ali Shiekheldien Elnor**, Economy, Hospitality & Hotel Administration Department / Community College, Princess Nourahbint Abdulrahman University, [dr.maima33@yahoo.com](mailto:dr.maima33@yahoo.com)

**Sanaa Saad El-Din Hamed Sobhy**, Hotels management, Hospitality & Hotel Administration Department / Community College, Princess Nourahbint Abdulrahman University, [SSSobhy@pnu.edu.sa](mailto:SSSobhy@pnu.edu.sa)

**Selma abdulrahman Hussein**, Industrial and Systems Engineering / College of Engineering, Princess Nourahbint Abdulrahman University, [sahussein@pnu.edu.sa](mailto:sahussein@pnu.edu.sa)

**Deema Mohamed Alskait**, Computer science and information Department / Community College ,Princess Nourahbint Abdulrahman University, [dmalsekait@pnu.edu.sa](mailto:dmalsekait@pnu.edu.sa)

**MahFahed Alotaibi**, Computer Science Department / community college, Princess Nourahbint Abdulrahman University, [mfahalotaibi@pnu.edu.sa](mailto:mfahalotaibi@pnu.edu.sa)

**Abstract-** This study focused on evaluating food safety knowledge and practices of food handlers in university food courts (case study Nourahbint Abdulrahman university (in order to reach results that benefits researchers and interested persons in this field in the future, and benefits and help decision makers taking appropriate action. The study concluded that the HACCP procedures are inadequate in hospitality and hotel industry establishment facilities, besides, it concluded that the new nutritional system has no importance in many large food establishments. The study adopted the descriptive analytical approach using SPSS program in the process of analysis and hypothesis testing. The study concluded that the level of statistical significance for all phrases is equal to (0.000), which confirms that the factors mentioned in the statements corresponding to the study questions are all statistically significant.

**Keywords:** Food safety; Food handler; Food courts; HACCP; Hazard; Critical control point.

### I. INTRODUCTION:

#### 1.1. Objectives and methodology:

The area in which this study was carried out is university food courts at Princess Nourahbint Abdulrahman University in the Kingdom of Saudi Arabia. It is an important girl university in the country. The study deals with the relationship between the quality of the new nutritional system and the success of hospitality and hospitality industry in the Kingdom of Saudi Arabia, due to the lack of effectiveness of traditional methods in reducing food poisoning, and in line with the new global trade system, and the requirement of some countries to apply Hazard Analysis Critical Control Points (HACCP) system for all products imported by these countries, and its desire to involve the private sector in the control process, as an integrated system on food safety by identifying the risks that threaten the safety. The study uses analytical descriptive methodology, and the survey of some specialists, in order to reach general results and guidelines that help in addressing the subject of the study and answer its questions, where the questionnaire is used to collect and analyze data, as well as observations and interviews to survey the opinions of experts and specialists.

#### 1.2. Previous studies

**1.2.1 (Junchao Lu, (2014)).** To guarantee the safety of chocolate ice cream production, the Hazard Analysis Critical Control Points (HACCP) system was applied to the production process. The biological, chemical, and physical hazards that may exist in every step of chocolate ice cream production were identified. In addition, the critical control points were selected and the critical limits, monitoring, corrective measures, records, and verifications were established. The critical control points, which include pasteurization and freezing, were identified. Implementing the HACCP system in food manufacturing can effectively ensure food safety and quality, expand the market, and improve the manufacturers' management level.

**1.2.2(El Tawila, Balkhyour and Batoubara(2010)).** This study was conducted to assess the technical specifications, and hygienic practices applied in Jeddah northern slaughterhouse, to evaluate microbial

contamination for all stages of slaughtering process, and to study the possibility of rehabilitation of the slaughterhouse for the application of HACCP system and to identify the points of weakness that prevent the application of the system in the slaughterhouse. The study was also planned to determine the ways of developing slaughterhouse through application of HACCP system after identifying the prerequisites for such system. The results concluded that Jeddah northern slaughterhouse in its status does not apply any quality or safety standards required for the production of good quality meat conform to Saudi and international specifications. Therefore, application of the Hazard Analysis Critical Control Point (HACCP) system after the completion of prerequisites and training of workers and staffs is highly recommended.

**1.2.3 (Hamad, Al-Juhaimi(2005)).** The microorganisms that contaminate tomato fruit samples before and after washing and those causing spoilage of the fruits stored at 5°C, 25°C and 40°C were studied. The microbial load of the unwashed fruit samples was about 104 cfu/cm<sup>2</sup>. Washing reduced the microbial load of the fruits from about 104 to about 102 cfu/cm<sup>2</sup>. Species of the microbial genera Bacillus, Pseudomonas, Micrococcus and Aspergillus were the dominant contaminants. Samples stored at 5°C were spoiled by the psychrotrophic bacterium *seudomonas fluorescens* and those stored at 25°C by the mesophilic organisms *Enterobacter aerogenes*, *Staphylococcus xylosus*, *Pseudomonas putida* and *Aspergillus fumigatus*. Samples stored at 40°C were spoiled by thermotolerant strains of the microbial species *Pectobacterium carotovorum*, *Enterobacter cloacae*, *Vibrio metschnikovii* and *Candida inconspicua*. Spoilage occurred when the microbial load exceeded 106 cfu/g.

**1.2.4 (Mohammed, Ahmed, (2005)).** HACCP is an effective tool to ensure the production of safe food, and implementation of HACCP system in hospitality sector is beneficial for many reasons such as good customer's relations, the mark of professionalism and legal protection, however there are ever increasing burdens to implement HACCP in many hospitality establishments in Egypt. This exploratory study aimed to achieve many objectives, the first objective was to assess the awareness of the HACCP concept in three different categories of hospitality establishments in Giza and Fayoum governorates in Egypt

### **1.3. General concepts:**

**1.3.1 HACCP**, which stands for Hazard Analysis and Critical Control Point, is defined as a "Food Safety Control System" in Taiwan's food hygiene legislative system (Department of Health, Executive Yuan, R.O.C., 2007). It stresses on through critical hazard control reducing or eliminating hazards to the lowest level during the processing steps, while establishing critical limits, monitoring procedures, corrective measures, records, and verifications. (Jeng HY, Fang JT, 2003).

**1.3.2 Hazard analysis:** It is the way in which information is collected on food-related risks appointee, its evaluation, and determining which of them should be addressed through the HACCP plan.

**1.3.3 HACCP Plan** It is a written document based on the HACCP rules by the created HACCP team It is registered based on the basic principles of HACCP and includes specific steps and means It is followed to control the sources of risk that threaten food safety during its production stages To achieve the purpose of the HACCP system.

#### **1.3.4 HACCP System**

It is an organized scientific method to enhance food safety by identifying potential hazards in an industry has assessed these risks both quantitatively and qualitatively to control their production line by points Critical control at which procedures and treatment are able to permanently eliminate or reduce the risk to the level that does not cause any harm to the consumer, that is, from the beginning of the initial production And take control and control measures to ensure the final consumption Its safety depends on the principle of prevention.

**1.3.5 Food safety** remains a top public health concern. Approximately 47.8 million foodborne-related illnesses occur annually in USA, costing healthcare economy over \$150 million (Scallan et al., 2011; Scharff, 2012) and causing consumer distrust in the food supply (Centers for Disease Control and Prevention, 2013; Laksanalamai et al., 2012). Consumption of food away from home has increased significantly (Medeiros and Salay, 2013) with one half of total food expenses in 2013 spent on food away from home in USA (US Department of Agriculture Economic Research Service, 2014).

**1.3.6** Majority of foodborne illnesses can be attributed to five risk factors: food from unsafe sources, inadequate cooking, improper holding temperatures, contaminated equipment, and poor personal hygiene (US Food and Drug Administration, 2000). Known foodborne disease outbreaks have been associated with foods served at commercial and noncommercial retail food stores and food service facilities including restaurants, clubs, assisted living facilities, nursing homes, child care centers, schools, and university food service. Most common reasons for foodborne illness are lack of food safety training for food handlers, purchasing from unapproved sources, time-temperature control, cross contamination, and lack of personal hygiene among food handlers (FAO, 2001; Saenz, 2001; Yatsco, 2000)

**1.3.7** Food safety culture has a positive relationship with food safety practices and, at the same time, is a mediator of the relationship between food handlers' knowledge and practices (De Boeck et al., 2017; Manning, 2018). While attitudes and knowledge about food safety are important, they aren't always connected with or applied to food safety practices (Lee et al., 2017; Zanin et al., 2017). Normative factors (e.g. subjective norms, descriptive norms) and food safety practices are positively associated (Clayton and Griffith, 2008; Hinsz and Nickell, 2015), but the relationship between normative factors and food safety culture is unclear.

**1.3.8** Mishandling of food plays a significant role in the occurrence of foodborne illness, which affects almost one in ten people globally who become ill every year from eating contaminated food, and 420,000 die as a result (World Health Organization, 2015).

**1.3.9** Food safety knowledge is important to prevent foodborne illness. Prevention of foodborne illnesses is one of the primary responsibilities of the foodservice industry. While Food safety practices is essential to assure food safety in retail foodservice operations and prevent the occurrence of foodborne illnesses, a health public problem (Cushman, Shanklin, & Niehoff, 2001). Females tend to have higher scores than males in food safety knowledge (Bruhn and Schutz, 1999; Byrd-Bredhenner et al., 2010; Rimal et al., 2001; Sanlier, 2009).

**1.3.10** Developed countries regularly launch national initiatives to educate food consumers and handlers. In developing countries, however, limited efforts are undertaken (Haapala, I., 2004). As indicated by an increasing number of foodborne illnesses in Saudi Arabia for example. The Ministry of Health in Saudi Arabia reported 255 incidences of food borne illnesses in the country in 2011 alone, causing 2066 people to fall ill (Ministry of Health Portal, Saudi Arabia 2019 and Ayaz, W.; 2018). The management of food control in the country is undertaken by the Saudi Food and Drug Authority (SFDA) and the execution of policies and procedures lies with the Saudi Arabia Standards Organization (SASO) spanning across various committees, agencies, and administrators (Food and Agricultural Organization, 2009). Recently, within Saudi Arabia the Department of Environmental Foods and Rural Affairs (DEFRA) standards of Good Manufacturing Practices (GMP) and Hazard Analysis Critical Control Points (HACCP) have been introduced, but the application of these standards has been slow (Al-Kandari, D.; 2009).

**1.3.11** Food handlers play a critical role in ensuring food safety, those who do not practice proper personal hygiene, including hand washing at the appropriate times and using appropriate methods, can contaminate food. The FDA Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurant, and Retail Food Store Facility Types (2009) identified risk practices and behaviors that contributed to foodborne illnesses: improper holding/time and temperature; poor personal hygiene; and contaminated equipment/prevention of contamination. Studies have found that food safety training is positively associated with self-reported changes in food safety practices (Clayton, Griffith, Price, & Peters, 2002; McElroy & Cutter, 2004), and improved attitudes (Wie & Strohbehn, 1997).

Poor handling practices are a major cause for several outbreaks reported (Tambekar, D.H., 2011). Previous studies have reported that food handler' practices, decision-making, attitudes, and perceived values are influenced by the food safety culture in an organization on multiple levels (De Boeck et al., 2017; Griffith et al., 2010a; Taylor, 2011; Yiannas, 2009).

The knowledge, attitudes and practices of food-handlers have been reported in studies from different countries around world (Martins RB., 2012 and Howes M., 1996). This is because a combination the three factors: knowledge, attitude and practice of food-handlers, play dominant role in food safety with regards to food service industry (Seaman P., 2010). In the hospitality industry, such as hotels and catering companies, evaluating food safety culture through a mixed method that includes quantitative surveys and interviews has encouraged continuous improvement in long-term case studies (Caccamo et al., 2018; Nouaimeh et al., 2018).

**1.3.12** Food courts are a common form of dining facilities in most colleges and universities – a platform of foodservice operations where various types of food choices are available – in order to satisfy the needs of a dynamic university community. The university populations comprised of students, faculty and staffs, and even off-campus consumer groups such as visitors and the local public, who apparently are diverse in their cultures, ages, education, and social development. University food courts are preferred by consumers who have diverse food preferences and daily nutritional needs, and seek for convenience and the promptness of service through on-campus foodservice (Kolodinsky et al., 2008). In this respect, university food courts strive to timely serve the consumers with different types of foods such as Deli foods (e.g. sandwich and salad), American foods (e.g. hamburger and pizza), Mexican foods (e.g. taco and burrito), Italian foods (e.g. pasta), Chinese foods (e.g. noodle and soup) and Japanese foods (e.g. sushi and roll) (Cushman et al., 2001; do Prado et al., 2015; Hsu and Huang, 1995; Lin and Sneed, 2005). University food courts present unique food safety concerns that shed light on the importance of appropriate food safety knowledge and practices among food handlers (Zandonadi et al., 2007).

**1.3.13 Critical control point:** It is the point or stage in the production line that is actually required to prevent or eliminate danger from food or pressure to the acceptable level.

**1.3.14 Critical limit** the value must be achieved at the critical control point for biological parameters that were chemical or physical level acceptable.

## II. RESEARCH MATERIALS AND METHODS

**2.1 Questionnaire Design:** The questionnaire on the self-completing form contained forty-two questions, which were divided into three parts. The first part included four questions on the demographic characteristics of each participant, such as age, gender, sexual status and work experience and covered seven questions on food safety Satisfaction. The second part involved the questions on the knowledge of the food handler, which was further subdivided into two parts. The first sub-section covered fourteen questions on food handler's practices, while the second sub-part on food handler's knowledge in two parts (A) about Safety, sanitation and cleaning included six questions, (B) contained six questions concerning the cross contamination.

### 2.2. Target Participants

Princess Nora University students and staff.

### 2.3. Data Collection

The questionnaire was distributed electronically. The questionnaire was distributed randomly. The response was 202 respondents.

### 2.4. Data Analysis

Cronbach alpha coefficient of internal consistency was used to estimate the reliability of the questionnaire. Alpha coefficient of the instrument was 0.968.

*Table (1): Cronbach's Alpha Analysis*

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.968	.963	38

source: results of statistical analysis

### 2.5 Statistical analysis

Statistical analyses were performed using the statistical package for the social sciences (SPSS). The average and the standard deviation were calculated. For the evaluation of food handlers' food safety knowledge and performance, the average and the standard deviation were calculated, and t-test was carried out for testing levels of significance.

The following table shows the extent of the beneficiaries' satisfaction with the food safety in the restaurant corner at Princess Nourah Bint Abdul Rahman University from the viewpoint of the respondents from the services provided.

*Table (2): The arithmetic means, the standard deviations, and the amount of satisfaction*

Clause	Mean	Std. Deviation	Satisfaction
I have confidence in the food safety control and monitoring procedures that exist in the corner of restaurants at Princess Nourah Bint Abdul Rahman University.	3.4653	1.25832	Satisfied
I feel satisfied with food restaurants of all kinds in the corner of restaurants at Princess Nourah Bint Abdul Rahman University.	3.5644	1.21693	Satisfied
I can classify food quality and safety just by looking at the outward appearance of the food.	3.9406	1.05398	Satisfied

The place where the service is provided suits me (comfortable, clean), and additional services are available such as a waiting area.	3.9802	1.10161	Completely satisfied
I can classify the restaurant just by looking at the working environment, such as (cleanliness of the kitchen, cleanliness of the workers, the quality of the storage space.	3.9307	1.19082	Completely satisfied
The concern of the restaurant's workers in implementing quality and safety requirements during meal preparation.	4.0693	1.07673	Completely satisfied
Satisfaction with the way restaurant workers deal with customers.	3.9307	1.11308	Completely satisfied

*Table (3): The computed value, the arithmetic means, the standard deviations, and the significance of the calculated value*

	Clause	Std.Deviation	Mean	Indication	Arrangement
<b>First: Food handler's practices</b>					
1	Touch or handle condiments (e.g. sauce bottle, dressing) with bare or gloved hands	.95554	3.7723	I don't know	24
2	Touch or handle bottled/cup beverage (e.g. water, juice, coffee) with bare or gloved hands	.99067	3.7921	I agree	23
3	Touch or handle personal belongings (e.g. purse, wallet, glasses, and cap) with bare or gloved hands	1.08266	3.8911	I totally agree	19
4	Touch or handle clothes (e.g. aprons) with bare or gloved hands	1.06486	3.9802	I totally agree	15
5	Touch or handle money (e.g. cash, credit card) with bare or gloved hands	1.02681	3.9802	I totally agree	16
6	Touch or handle electronic device (e.g. cellphone, laptop, ordering machine) with bare or gloved hands	.98748	4.0000	I totally agree	13
7	Touch or handle thermometer with bare or gloved hands	.98848	4.0891	I totally agree	9
8	Touch or handle paper (e.g. recipe, order receipt) with bare or gloved hands	.98128	3.8515	I don't know	21
9	Touch or handle paper (e.g. recipe, order receipt) with bare or gloved hands	1.04525	3.8911	I do not agree	18
10	Touch or handle cleaning items (e.g. dishcloth, broom) with bare or gloved hands	1.04148	3.9010	I totally agree	17
11	Touch or handling dirty dishes	1.15239	3.8416	I totally agree	22
12	Touch or handling garbage	1.17206	3.8614	I totally agree	20
13	Touch or blowing nose, sneezing, coughing, or touching eyes, nose or mouth	.99007	4.0693	I totally agree	10
14	Touch or handling raw meat, fish, or poultry	1.28005	3.7129	I totally agree	28
<b>Second : Food handler's knowledge</b>					
<b>A) Safety, sanitation and cleaning</b>					
1	Preparation utensils not cleaned/sanitized after use	1.28005	3.7129	I totally agree	29
2	Working tables clean and sanitized	1.28005	3.7129	I totally agree	30
3	The stove, steamer, grill, boiler, salamander,	.89385	4.2376	I totally agree	2
4	Knives utensils not cleaned/sanitized after use	.96610	4.1089	I totally agree	7
5	Cutting boards not cleaned/sanitized after use	1.23509	3.7426	I totally agree	26
6	handle cooking equipment (e.g. grilling facility) with bare or gloved hands	1.25973	3.6931	I totally agree	31
7	Surface disinfection after the previous cleaning	1.05678	3.7228	I don't know	27
8	All food covered, dated, and labeled	1.02441	4.1584	I totally agree	5
9	handle surface/table with bare or gloved hands	.85935	4.3267	I totally agree	1
10	Drying of surfaces/processing utensils into contact with food with a clean dishcloth or paper towels	.91402	4.0198	I totally agree	11
11	Cleaning production areas using cleaning agent after the previous removal of visible dirt.	.91960	3.9901	I totally agree	14

<b>B) Cross contamination</b>					
1	Food is covered	.91110	4.1881	I totally agree	3
2	Are separate chopping boards, knives and other equipment used for raw and cooked foods	.88921	4.1584	I totally agree	6
3	Are separate work surfaces provided and used for raw and cooked foods	.96814	4.0891	I totally agree	8
4	Frozen raw foods are thawed away from cooked/ready to eat foods	.93036	4.0099	I totally agree	12
5	The probe thermometer being disinfected	1.01610	3.7723	I do not agree	25
6	Surfaces used for cooked/ready to eat foods are sanitized before use	.82723	4.1485	I totally agree	4

Source: preparing researchers from the results of statistical analysis

Source: preparing researchers from the results of statistical analysis

The respondents had confidence in the procedures for monitoring and controlling food safety in the corner of restaurants at Princess NourahBint Abdul Rahman University and they are completely satisfied with the way restaurant workers deal with customers.

The following table shows the calculated value and the arithmetic means of the questionnaire statements and the standard deviations corresponding to each value, the significance of the calculated value, and the order of the expressions according to their attainment of the highest degree of consensus of the study individuals.

### III. RESULTS AND DISCUSSION

From the previous table:

3.1 The study sample estimates in the field of food handler's practices, I strongly agree with all the paragraphs, the arithmetic mean ranged between (4.09-3.71), with the exception of paragraph 1 and 9, I don't know, the arithmetic mean ranged between (3.89-3.77), and paragraph 2, I agree, the mean is (3.79).

3.2 The sample estimates on Food Handler's Knowledge; paragraph (A) Safety, sanitation and cleaning it was strongly agree with all the paragraphs, where the arithmetic mean ranged between (4.23-3.69), except for paragraph 7 I don't know, the arithmetic mean (3,72).

3.3 The sample estimates, in Food handler's knowledge; paragraph(B)Cross contamination, were strong agreement in all paragraphs, as the arithmetic averages of the response ranged between(4.18-4.00). With the exception of the fifth paragraph, the sample estimates were in it, I do not agree, the arithmetic mean was (3.77).

3.4 A basic data analysis:

One-Sample Test was used to analyze the study data and answer its questions.

*Table (4): Statistical analysis of the expressions of the first question:*

<b>One-Sample Test</b>			
	Clause	T	Sig. (2-tailed)
1	Touch or handle condiments (e.g. sauce bottle, dressing) with bare or gloved hands	56.109	.000
2	Touch or handle bottled/cup beverage (e.g. water, juice, coffee) with bare or gloved hands	54.403	.000
3	Touch or handle personal belongings (e.g. purse, wallet, glasses, and cap) with bare or gloved hands	51.080	.000
4	Touch or handle clothes (e.g. aprons) with bare or gloved hands	53.123	.000
5	Touch or handle money (e.g. cash, credit card) with bare or gloved hands	55.092	.000
6	Touch or handle electronic device (e.g. cellphone, laptop, ordering machine) with bare or gloved hands	57.571	.000
7	Touch or handle thermometer with bare or gloved hands	58.794	.000
8	Touch or handle paper (e.g. recipe, order receipt) with bare or gloved hands	55.784	.000
9	Touch or handle paper (e.g. recipe, order receipt) with bare or gloved hands	52.908	.000
10	Touch or handle cleaning items (e.g. dishcloth, broom) with bare or gloved hands	53.235	.000

11	Touch or handling dirty dishes	47.379	.000
12	Touch or handling garbage	46.824	.000
13	Touch or blowing nose, sneezing, coughing, or touching eyes,nose or mouth	58.416	.000
14	Touch or handling raw meat, fish, or poultry	41.225	.000

From the results of Table No. (4) that the level of statistical significance for all expressions is equal to (0.000), which confirms that the factors mentioned in the phrases corresponding to the first question are statistically significant

<i>Table (5): Statistical analysis of the expressions of the second question:</i>			
	Clause	T	Sig. (2-tailed)
<b>Second : Food handler's knowledge</b>			
<b>A) Safety, sanitation and cleaning</b>			
1	Preparation utensils not cleaned/sanitized after use	41.225	.000
2	Working tables clean and sanitized	41.225	.000
3	Shelves in the place clean and organized	67.380	.000
4	The stove, steamer, grill, boiler, salamander,	60.448	.000
5	fryer clean and tidy	43.067	.000
6	Knives utensils not cleaned/sanitized after use	41.666	.000
7	Cutting boards not cleaned/sanitized after use	50.068	.000
8	handle cooking equipment (e.g. grilling facility) with bare or gloved hands	57.694	.000
9	Surface disinfection after the previous cleaning	71.559	.000
10	All food covered, dated, and labeled	62.507	.000
11	Garbage can used for food waste covered,	61.668	.000
12	unless in use at that moment	65.332	.000
13	handle surface/table with bare or gloved hands	41.225	.000
14	Drying of surfaces/processing utensils into contact with food with a clean dishcloth or paper towels	67.380	.000
<b>B) Cross contamination</b>			
1	Food is covered	60.448	.000
2	Are separate chopping boards, knives and other equipment used for raw and cooked foods	66.466	.000
3	Are separate work surfaces provided and used for raw and cooked foods	60.030	.000
4	Frozen raw foods are thawed away from cooked/ready to eat foods	61.257	.000
5	The probe thermometer being disinfected	52.765	.000
6	Surfaces used for cooked/ready to eat foods are sanitized before use	71.276	.000

From the results of Table No. (5) that the level of statistical significance for all expressions is equal to (0.000), which confirms that the factors mentioned in the phrases corresponding to the second question are statistically significant.

#### IV. CONCLUSIONS

This study assessed the evaluating food safety knowledge and practices of food handlers in university food courts in Nourahbint Abdulrahman university, Saudi Arabia.

In generally, the institutional food-handlers have satisfactory knowledge in food safety but this does not translate into strict hygienic practices during processing and handling food products.

In summary, the findings of this study revealed poor food safety practices and hand sanitization behaviors among both consumers and employees at university food courts. Inherently, the observed characteristics of the pattern of food safety behaviors among consumers and employees were found to be different but the compliance rates of handsanitization practices when required were minimal in both

cases, raising the pressing need of developing effective risk communication strategies at university food courts.

Another important finding of this study was that consumers displayed different food safety behaviors during food consumption depending on gender, observed ethnicity, and party size. Considering these factors, the food safety authorities would be able to promote the most effective and efficient ways to deal with food safety education and practice strategies at university food courts.

#### REFERENCES

1. Anthony Suppiah, (2018), "Food safety implementation in hotels: challenges and benefits.
2. Al-Kandari, D.; Jukes, D.J. (2009) "A situation analysis of the food control systems in Arab Gulf Cooperation Council (GCC) countries". *Food Control* 2009, 20, 1112–1118.
3. Ayaz, W.; Priyadarshini, A.; Jaiswal, (2018) "A. Food Safety Knowledge and Practices among Saudi Mothers". *Foods*, 7, 193.
4. Bruhn, C.M. and Schutz, H.G. (1999), "Consumer food safety knowledge and practices", *Journal of Food Safety*, Vol. 19, pp. 73-87.
5. Byrd-Bredbenner, C., Abbot, J.M. and Quick, V. (2010), Food safety knowledge and beliefs of middle school children: implications for food safety educators", *Journal of Food Science Education*, Vol. 9 No. 1, pp. 19-30.
6. Caccamo, A., Taylor, J.Z., Daniel, D. and Bulatovic-Schumer, R. (2018), "Measuring and improving food safety culture in a five-star hotel: a case study", *Worldwide Hospitality and Tourism Themes*, Vol. 10 No. 3, pp. 345-357.
7. Centers for Disease Control and Prevention (2013), "Notes from the field: use of electronic messaging and the news media to increase case finding during a *Cyclospora* outbreak-Iowa, July 2013", *MMWR. Morbidity and Mortality Weekly Report*, Vol. 62 No. 30, pp. 613-614.
8. Clayton, D. A., and Griffith, C. J., Price, P., & Peters, A. C. (2002), Food handlers' beliefs and self-reported practices. *International Journal of Environmental Health Research*, 12(1), 25–39.
9. Clayton, D.A. and Griffith, C.J., (2008), "Efficacy of an extended theory of planned behaviour model for predicting caterers' hand hygiene practices", *International Journal of Environmental Health Research*, Vol. 18 No. 2, pp. 83-98.
10. Cushman, J.W., Shanklin, C.W. and Niehoff, D.B.P. (2001), "Hygiene practices of part-time student employees in a university foodservice operation", *The Journal of the National Association of College and University Food Services*, Vol. 23, pp. 37-44, available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.200.6147&rep=rep1&type=pdf#page=37>.
11. De Boeck, E., Mortier, A.V., Jacxsens, L., Dequidt, L. and Vlerick, P. (2017), "Towards an extended food safety culture model: studying the moderating role of burnout and job stress, the mediating role of food safety knowledge and motivation in the relation between food safety climate and food safety behavior", *Trends in Food Science & Technology*, Vol. 62, pp. 202-214, available at: [www.sciencedirect.com/journal/trends-in-food-science-and-technology/issues](http://www.sciencedirect.com/journal/trends-in-food-science-and-technology/issues)
12. Do Prado, D.B., Bettoni, A.P., Correa, V.A., de Abreu Filho, B.A., Garcia, L.B., Tognim, M.C.B. and Cardoso, C.L. (2015), "Practice of hand hygiene in a university dining facility", *Food Control*, Vol. 57, November, pp. 35-40.
13. Department of Health, Executive Yuan, R.O.C. (Taiwan). Food Safety Control System (HACCP). Available at, <http://consumer.fda.gov.tw/Law/Detail.aspx?nodeID¼518&lang¼1&lawid¼38;2007> [accessed 31.03.13].
14. Food and Agricultural Organization. (2001). Fortalecimiento de los comités nacionales del Codex y aplicación de las normas del Codex Alimentarius. Taller subregional de formación de capacitadores sobre aplicación de Buenas Prácticas de Manufactura (BPM) y Sistemas de Análisis de Peligro y Puntos Críticos de Control (HACCP). San José, Costa Rica.
15. Food and Agricultural Organization. National Food Safety Systems in the Near East—A Situational Analysis. Available online: [ftp://ftp.fao.org/es/esn/food/meetings/NE\\_wp3\\_en.pdf](ftp://ftp.fao.org/es/esn/food/meetings/NE_wp3_en.pdf) (accessed 4 July 2019).
16. Griffith, C.J., Livesey, K.M. and Clayton, D.A. (2010a), "Food safety culture: the evolution of an emerging risk factor?", *British Food Journal*, Vol. 112 No. 4, pp. 426-438.
17. Haapala, I.; Probart, C. (2004) "Food safety knowledge, perceptions, and behaviors among middle school students". *J. Nutr. Educ. Behav.*, 36, 71–76.



18. Healthy People( 2020) (n.d.), "Healthy People 2020: Food Safety, United States Department of Health and Human Services", Office of Disease Prevention and Health Promotion, Washington, DC.
19. Howes M, McEwen S, Griffiths M, Harris L. (1996) "Food handler certification by home study: Measuring changes in knowledge and behavior". *Dairy, Food Environ Sanit*;16(11):737-44.
20. Hsu, C. and Huang, S. (1995), "Sanitation knowledge, attitudes, and behaviors of food service workers in big ten universities", *Journal of the National Association of College and University Food Services*, Vol. 17, pp. 23-32, available at: [www.nacufs.org/resources-overview/](http://www.nacufs.org/resources-overview/)
21. Hinsz, V.B. and Nickell, G.S. (2015), "The prediction of workers' food safety intentions and behavior with job attitudes and the reasoned action approach", *Revista de Psicología Del Trabajo y de Las Organizaciones*, Vol. 31 No. 2, pp. 91-100.
22. Jeng HY, Fang JT. Food safety control system in Taiwan e the example of food service sector. *Food Control* 2003;14:317e22.
23. Junchao Lu a,b, Xiao-Hui Pua a, Chi-Te Liu c, Che-Lang Chang d, Kuan-Chen Cheng, Xiao-Hui Pua, Chi-Te Liu, Che-Lang Chang, Kuan-Chen Cheng "The implementation of HACCP management system in a chocolate ice cream plant", *Journal of food and drug analysis* 22 ( 2014 ) 391e398, Available online at [www.sciencedirect.com](http://www.sciencedirect.com).
24. Kolodinsky, J., Green, J., Michahelles, M. and Harvey-Berino, J.R. (2008), "The use of nutritional labels by college students in a food-court setting", *Journal of American College Health*, Vol. 57 No. 3, pp. 297-302.
25. Laksanalamai, P., Joseph, L.A., Silk, B.J., Burall, L.S., Tarr, C.L., Gerner-Smidt, P. and Datta, A.R. (2012), "Genomic characterization of *Listeria monocytogenes* strains involved in a multistate listeriosis outbreak associated with cantaloupe in US", *PLoS One*, Vol. 7 No. 7, p. e42448.
26. Lee, H.K., Halim, H.A., Thong, K.L. and Chai, L.C. (2017), "Assessment of food safety knowledge, attitude, self-reported practices, and microbiological hand hygiene of food handlers", *International Journal of Environmental Research and Public Health*, Vol. 14 No. 1, pp. 55-68.
27. Lin, S. and Sneed, J. (2005), "University foodservice employees' food safety knowledge, attitudes, practices, and training", *Journal of Foodservice Management and Education*, Vol. 1 No. 1, pp. 2-22, available at: <http://fsmec.org/wp-content/uploads/2011/09/LinSneed22005.pdf>
28. Manning, L. (2018), "The value of food safety culture to the hospitality industry", *Worldwide Hospitality and Tourism Themes*, Vol. 10 No. 3, pp. 284-296.
29. Martins RB, Hogg T, Otero JG. (2012) "Food handlers' knowledge on food hygiene": The case of a catering company in Portugal. *Food Control*. 23(1):184-90.
30. McElroy, D. M., & Cutter, C. N. (2004), "Self-report changes in food safety practices as a result of participation in a statewide food safety certification program. *Food Protection Trends*", 24,150-161.
31. Medeiros, C.O. and Salay, E. (2013), "A review of food service selection factors important to the consumer", *Food and Public Health*, Vol. 3 No. 4, pp. 176-190.
32. Ministry of Health Portal, Saudi Arabia. Available online: <http://www.moh.gov.sa/en/Ministry/Pages/default.aspx> (accessed on 17 July 2019).
33. Mahmoud M. El Tawila, Mansour A. Balkhyour and AlaaJ. Batoubara, (2010), Assessment of Current Practices in Jeddah Northern Slaughterhouse and Ways of Its Development through Application of HACCP System, King Abdulaziz University, Jeddah, Saudi Arabia.
34. Morrison, P, Caffin, N., Wallace, R., (2018), "Small food service establishments still in amber light for adopting Australian HACCP-based food safety code". *British Food Journal* 100 (8), 364-370.
35. Nouaimeh, N., Pazhanthotta, R.T., Taylor, J.Z. and Bulatovic-Schumer, R. (2018), "Measuring and improving food safety culture in a large catering company: a case study", *Worldwide Hospitality and Tourism Themes*, Vol. 10 No. 3, pp. 358-368.
36. Rimal, A., Fletcher, S.M., McWatters, K.H., Misra, S.K. and Deodhar, S. (2001), "Perception of food safety changes in food consumption habits: a consumer analysis", *International Journal of Consumer Studies*, Vol. 25 No. 1, pp. 43-52.
37. Saenz, M. (2001), "Diagnóstico general sobre la situación de inocuidad de los alimentos en Costa Rica". INCAP: San José, Costa Rica.
38. Sanlier, N. (2009), "The knowledge and practice of food safety by young and adult consumers", *Food Control*, Vol. 20 No. 6, pp. 538-42.
39. Scallan, E., Griffin, P.M., Angulo, F.J., Tauxe, R.V. and Hoekstra, R.M. (2011), "Foodborne illness acquired in the United States - unspecified agents", *Emerging Infectious Diseases*, Vol. 17 No. 1, pp. 16-22.
40. Scharff, R.L. (2012), "Economic burden from health losses due to foodborne illness in the United States", *Journal of Food Protection*, Vol. 75 No. 1, pp. 123-131.

41. Seaman P, Eves A., (2010) "Perceptions of hygiene training amongst food handlers, managers and training providers–A qualitative study". *Food Control*. 21(7):1037–41.
42. Siddig, H. and Al-Juhaimi, F.Y.2005. Microbial contamination and spoilage of tomato fruits collected from a farm in the gulf region of Saudi Arabia. *Khartoum Journal of Agricultural Sciences*, 13(3), 409-421.
43. Taylor, J. (2011), "An exploration of food safety culture in a multi-cultural environment: next steps?" *Worldwide Hospitality and Tourism Themes*, Vol. 3 No. 5, pp. 455-466.
44. Tambekar, D.H., Kulkarni, R.V., Shirsat, S.D. and Bhadange, B.D. (2011), "Bacteriological quality of street vended food panipuri: a case study of Amravati city (MS) India", *Bioscience Discovery*, Vol. 2 No. 3, pp. 350-354.
45. US Department of Agriculture Economic Research Service (2014), "Sales of meals and snacks away from home by type of outlet", available at: [www.ers.usda.gov/datafiles/Food\\_Expenditures/ Food Expenditures/table15.xls](http://www.ers.usda.gov/datafiles/Food_Expenditures/Food_Expenditures/table15.xls) (accessed January 5, 2019).
46. US Food and Drug Administration (2000), FDA Retail Food Program Database of Foodborne Illness Risk Factors, available at: [www.cfsan.fda.gov/dma/retrsk.html](http://www.cfsan.fda.gov/dma/retrsk.html) (accessed October 22, 2019).
47. Wie, S. H., &Strohbehn, C. H. (1997). The impact of a sanitation and food safety course on attitudes and knowledge of hospitality students. *Hospitality and Tourism Educator*, 9(2), 65-73.
48. World Health Organization (2015), "The estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015", available at: [http://apps.who.int/iris/bitstream/10665/199350/1/9789241565165\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/199350/1/9789241565165_eng.pdf) (accessed 3 July 2019).
49. Worsfold, D., (2016), "Consumer information on hygiene inspections of food premises". *Journal of Foodservice* 17 (1), 23–31.
50. Yatsco, T. J. (2000), "Desafíos para la seguridadalimentariaen Costa Rica. Primera ConferenciaInternacional de la Fundación Nacional de la Salubridad (NSF) sobreseguridadalimentariaentráfico y turismo. Barcelona, España", 2000.
51. Yiannas, F. (2009), *Food Safety Culture: Creating a Behavior-Based Food Safety Management System*, Springer, New York, NY.
52. Zandonadi, R.P., Botelho, R.B.A., Sávio, K.E.O., Akutsu, R.D.C. and Araújo, W.M.C. (2007), "Risk attitudes in self-service restaurants", *Revista de Nutrição*, Vol. 20 No. 1, pp. 19-26.
53. Zanin, L.M., Thimoteo, D., Cunha, D., Vera De Rosso, V., Dias Capriles, V. and Stedefeldt, E. (2017), "Knowledge, attitudes and practices of food handlers in food safety: an integrative review", *Food Research International*, Vol. 100, Part 1, pp. 53-62.