

## Identification of College Students' Food Safety Awareness and Perceived Barriers to Proper Food Handling Practices

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### Abstract

The purpose of this study was to investigate culinary arts and hospitality students' food safety practice behaviors, intentions, attitudes, and barriers to food safety compliance. This descriptive study used the self-report questionnaire. The convenience sample was composed of 266 college students majoring in culinary arts and hospitality. The students indicated that they never or rarely use a thermometer to determine if meats have been adequately cooked. Examples of positive food handling behaviors were hand washing, sanitation of fruits and vegetables, discarding of food past its expiration date, counter top sanitation, and proper food storage. Students strongly agreed it is their responsibility to practice food safety and to educate their employees about food safety. The primary barrier to proper food safety as ranked by student respondents is the misunderstanding about food labeling. Previous food safety education and internship experience appeared to improve the student respondents' perceived attitudes toward following the principles of food safety practices ( $p < 0.05$ ), although behaviors and intentions to use the correct food safety practices were not affected. The findings of this study suggest that programs should consider integrating information and experiential learning opportunities in their courses that would be enhance student understanding about food safety. The outcomes of this study can be applied to develop food safety education materials and programs for culinary arts and hospitality students.

**Key words:** food safety, college students, educational program

### INTRODUCTION

Illnesses caused by foodborne pathogens are a widespread challenge to the clinical and economic status of consumers in Korean society. Current estimates of the number of patients with foodborne illnesses range upward from 2,980 (2002), and the number of outbreaks and patients are increasing at rates of 46% and 161% annually, respectively, in Korea (1). The cost of foodborne illnesses, including the costs of medical treatment, productivity loss, pain and suffering of affected individuals, and industry losses for those who experience mild foodborne diseases, make it extremely important that the problem be minimized (2).

Food safety lapses may occur at many levels within the food chain: producers, processors, grocers, foodservice, and consumers (3). Furthermore, communication, education, and the development of acceptable programs are all essential in order to achieve the common goal of reducing foodborne illness outbreaks (3). The foodservice industry, namely its producers and processors, is charged

with the greatest responsibility for food safety practices to reduce the number of foodborne illness outbreaks (4). Food safety experts believe most foodborne illnesses occur at restaurants and foodservice establishments (5). Common food safety mistakes can lead to serious foodborne illness, and proper food-handling practices are critical in the prevention of foodborne disease. Food safety research has identified the following as the most common food-handling problems: food obtained from unsafe sources, inadequate cooking or heating procedures, improper cooling, intervals of 12 hours or more between preparation and eating, and poor hygiene (6).

Today's culinary and hospitality students will be the leaders in foodservice industries, so they have a unique opportunity to discuss safe food-handling tips with consumers who take food home (7) and to train foodservice employees to promote safe food-handling as food safety educators (8). The educational foundation of the national restaurant association has stated that food service managers must take responsibility for food safety and employee training (9). Lynch et al. (10) suggested that

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workers and management staff should have a thorough understanding of safe food-handling practices, and Cochran-Yantis et al. (11) reported that food handlers who have received proper education and training showed more favorable attitudes and higher levels of knowledge about food safety. The researchers asserted that education of foodservice operators is key to curtailing the occurrence of foodborne illness (11). Herman Cain, former chief executive officer and president of the national restaurant Association, says food safety is non-negotiable (12).

Therefore, students who major in culinary and hospitality disciplines should be well prepared to practice safe food-handling and consumer counseling in employment settings. Unklesbay et al. (13), measured the food safety practices of college students, concluding that those majoring in dietetics, food science, nutrition, and health programs had significantly higher practice scores than other students. However, the range of practice scores was only 74% to 79% of the total possible score, which suggests that practical skills still need to improve. Scheule (8) asserted that dietetics and hospitality students should be confident in the understanding of how critical their roles are in the prevention of foodborne illness. The vast majority of previous research supported that future foodservice professionals need to be educated to properly respond to the demands of improving safe food-handling practices among foodservice employees and consumers (14-16).

Medeiros et al. (17) suggested there are five major pathogen control factors, all of which lead to the highest number of foodborne illnesses and most serious consequences, that should be emphasized in food safety education curricula. These control factors include the following: practicing personal hygiene, cooking foods adequately, avoiding cross-contamination, keeping foods at safe temperatures, and avoiding foods from unsafe sources. In order to develop and provide the most effective educational and training programs to the students, hospitality educators must learn specific students' behaviors associated with each control factor. Currently, little information is available about specific unsafe students' behaviors, intentions, and attitudes toward food-handling practices and their perceptions of barriers to safe food practices in Korea. Most studies have researched the population as whole with little emphasis on students who will have professional careers in foodservice areas to promote food safety.

This study identified key practice behaviors of hospitality and culinary students associated with each pathogen control factor, intentions and attitudes to keep food safety principles, and perceived barriers toward follow-

ing the principles of safe food practices. This study could provide valuable information that will be beneficial to food safety educators and foodservice practitioners in the development of food safety curricula.

## SUBJECTS AND METHODS

The population for this study was college students majoring in culinary and hospitality management at 4 colleges in the Southern Korea.

To facilitate the development of a survey instrument, relevant literature was reviewed to determine important concepts and key determinants of food safety practices and perceived barriers toward safe food-handling. The questionnaire contained four sections: 1) food safety practice behaviors, 2) intentions and attitudes toward safe food-handling, 3) perceived barriers to following safe food-handling, and 4) demographic information. The safe food-handling behavior statements were based on the studies of Scheule (8) and Medeiros et al. (17). Each statement contained five possible replies on a Likert scale, with anchors of 1=never, 2=rarely, 3=some of the time, 4=most of the time, 5=always. The practice score was calculated by adding responses to the 20 items, with a possible range of scores from 20 to 100. Four negative statements were reverse coded to allow the scale to demonstrate proper behaviors which had a higher rating, and which indicated more proper behaviors. These statements provided insight into the common food-handling practices of the respondents. In the second section, four items were developed to determine the intentions to follow proper food safety practices, and another four items to determine the attitudes toward the importance of following proper food safety practices. Responses to eight questions were given on a 5-point scale: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree. Perceived barriers to following proper food safety practices were assessed in the third section. Responses were given on a five-point Likert scale: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree. These questions allowed the researcher to determine the barriers respondents took in practicing safe food-handling techniques. A demographic section included questions about the respondents' genders, ages, majors, and experiences in taking courses related to food safety and internships in the foodservice areas. This section was used to compare food-handling behaviors, intentions, and perceived attitudes to use proper practices between various demographic factors.

A pilot test was conducted with 80 college students in two college classes before data collection. The questionnaire was subsequently modified to improve reli-

ability and clarity of wording based on the results of a pilot study.

With the permission of the instructors, the researchers administered the survey in the following classes from entry level to upper level: Topics of hospitality management, Food production management, and principles of food science. Prior to administering the survey, one of the researchers announced the purpose of the study and encouraged students to participate.

Statistical programs and procedures of SPSS for Windows were used for all analyses. Initial data analysis included the calculation of frequencies, means, and standard deviations for all questions including several demographic variables. Cronbach's alpha coefficient was determined to test for the internal reliability of each scale. T-test and ANOVA will be conducted to compare means of practices, intentions, perceived attitudes and barriers by gender, major, age, internship experience, and food safety courses taken.

## RESULTS AND DISCUSSION

A total of 290 questionnaires were distributed: 266 were returned for a response rate of 91.7%. The mean

age of respondents was  $21.83 \pm 4.45$  years. Table 1 presents the demographic characteristics of respondents and their mean scores of behaviors, intentions, and attitudes toward following important principles of food safety practices. The mean behavioral scores of student respondents was  $72.55 \pm 9.45$ , showing no significant differences between majors, genders, academic levels, and previous experience, including the acquisition of prior coursework and licenses relating to food safety and internships. The mean intention score toward following the principles of proper food safety practices were based on major, gender, academic level, and previous experience resulted in insignificant differences between academic levels (juniors and seniors). In addition, survey respondents' perceived attitudes toward following the principles of proper food safety practices were significantly different depending on academic levels, courses taken relating to food safety, and internship experiences in food-service establishments and hotels ( $p < 0.05$ ). The findings from the behavior scores in this study suggest a strong need for more effective learning opportunities across the hospitality and culinary curriculum focusing on food safety. Results showed that students at higher academic levels had significantly higher ( $p < 0.05$ ) intention and

**Table 1.** Mean practices, intentions, and perceived importance scores by demographic information

Demographic information	Practices <sup>1)</sup>	Intentions <sup>2)</sup>	Perceived Attitudes <sup>2)</sup>
	Mean $\pm$ SD <sup>3)</sup>	Mean $\pm$ SD	Mean $\pm$ SD
Total	72.55 $\pm$ 9.45	16.56 $\pm$ 3.39	16.64 $\pm$ 3.22
Majors			
Culinary students (n=141)	72.09 $\pm$ 9.99	15.96 $\pm$ 3.67	16.20 $\pm$ 3.57
Hospitality students (n=125)	72.99 $\pm$ 9.32	17.14 $\pm$ 3.09	17.06 $\pm$ 2.95
Gender			
Male (n=107)	72.09 $\pm$ 10.00	16.36 $\pm$ 3.42	16.43 $\pm$ 3.23
Female (n=159)	72.79 $\pm$ 9.46	16.61 $\pm$ 3.48	16.72 $\pm$ 3.37
Academic level			
Junior (n=182)	71.44 $\pm$ 9.68	16.31 $\pm$ 3.78 <sup>x</sup>	16.45 $\pm$ 3.61 <sup>y1</sup>
Senior (n=84)	74.83 $\pm$ 9.30	16.95 $\pm$ 2.59 <sup>x</sup>	16.95 $\pm$ 2.51 <sup>y1</sup>
Took course relevant to food safety			
Yes (n=162)	74.23 $\pm$ 9.11	16.78 $\pm$ 3.20	17.05 $\pm$ 2.82 <sup>y2</sup>
No (n=104)	69.84 $\pm$ 9.95	16.09 $\pm$ 3.79	15.91 $\pm$ 3.87 <sup>y2</sup>
Internship experience			
Yes (n=66)	74.00 $\pm$ 9.36	16.89 $\pm$ 3.05	16.91 $\pm$ 2.80 <sup>y3</sup>
No (n=200)	72.03 $\pm$ 9.75	16.39 $\pm$ 3.57	16.50 $\pm$ 3.47 <sup>y3</sup>
Acquisition of license relating to food safety			
Yes (n=58)	73.67 $\pm$ 10.53	16.76 $\pm$ 3.58	16.93 $\pm$ 3.06
No (n=208)	72.19 $\pm$ 9.42	16.45 $\pm$ 3.42	16.51 $\pm$ 3.38

T-Test and ANOVA was applied for statistical test.

<sup>1)</sup>Total possible score was 100, based on 5-point scale (1=never to 5=always).

<sup>2)</sup>Total score is 20, based on 5-point scale (1=strongly disagree to 5=strongly agree).

<sup>3)</sup>Standard deviation.

<sup>x</sup>Indicates significant difference ( $p < 0.05$ ) between academic levels toward intentions.

<sup>y1</sup>Indicates significant difference ( $p < 0.05$ ) of perceived attitudes between academic levels.

<sup>y2</sup>Indicates significant difference ( $p < 0.05$ ) of perceived attitudes according to previous experience taken courses relating to food safety.

<sup>y3</sup>Indicates significant difference ( $p < 0.05$ ) of perceived attitudes according to previous internship experience.

perceived attitude scores for following the principles of proper food safety practices, indicating that upper level students have a better understanding of the implications of food safety as a result of their training. Moreover, the didactic classes and professional experiences during their academic years significantly affected their perceived attitudes toward food safety, which demonstrates the benefits of both coursework and internship experience that emphasize the importance of food safety. However, both coursework and internship experiences must be enforced to improve students' behaviors and

intentions toward food safety.

Table 2 illustrates the food-handling behaviors of the student respondents. No significant differences were found between students majoring culinary and hospitality disciplines. Therefore, the culinary and hospitality students' scores were combined and then analyzed for further differences or comparisons regarding food-handling behaviors. The mean frequency of using correct food handling behaviors was 3.6 (SD ± 0.48) on a 5-point scale with 1 being "never" and 5 being "always". The average responses ranged from 2.03 when asked about

**Table 2.** Food safety practice scores

	Mean scores	Disagree		Neutral		Agree	
	Mean ± SD	N	%	N	%	N	%
Personal hygiene ( $\alpha=0.7253$ )							
Q1. I wash my hands with soap and warm running water before preparing food.	3.45 ± 1.11	53	19.9	76	28.6	137	51.5
Q2. If I have diarrhea, I don't prepare meals for others.	3.41 ± 1.26	58	21.8	77	28.9	131	49.3
Q3. After using restrooms, I wash my hands with soap and warm running water.	4.22 ± 1.00	19	7.1	35	13.2	212	79.7
Q4. If I have a cut or sore on my hand, I cover it before preparing food.	3.72 ± 1.18	42	15.8	60	22.6	164	61.7
Cook foods adequately ( $\alpha=0.7439$ )							
Q5. I use a thermometer to determine if meats have been cooked enough.	2.09 ± 1.30	173	65	45	16.9	48	18.0
Q6. I use a thermometer to determine if leftovers have been reheated enough.	3.77 ± 1.13	32	12.0	67	25.2	167	62.8
Q7. I heat leftover foods to 75°C before serving.	3.25 ± 1.16	61	22.9	90	33.8	115	43.3
Avoid cross-contamination ( $\alpha=0.7182$ )							
Q8. To refrigerate or freeze the leftovers, I completely wrap up the foods.	4.00 ± 1.04	23	8.6	60	22.6	183	68.8
Q9. I clean countertops with hot, soapy water before/after preparing foods.	4.06 ± 0.98	18	6.8	58	21.8	190	71.4
Q10. I wash my hands with soap and warm running water after working with raw meat, chicken, or seafood and before I continue cooking.	4.18 ± 0.99	15	5.7	50	18.8	200	75.2
Q11. I don't wash the plate used to hold raw meat, poultry, or seafood with hot, soapy water before returning cooked food to the plate, or I use a clean plate (R).	3.74 ± 1.05	27	10.2	82	30.8	157	59.1
Keep foods at safe temperatures ( $\alpha=0.7035$ )							
Q12. I check the temperature of my refrigerator or freezer.	2.03 ± 1.21	173	65.0	58	21.8	35	13.1
Q13. I serve foods immediately after they are cooked.	3.54 ± 1.02	40	15.0	76	28.6	150	56.3
Q14. I don't leave cooked foods on the countertop overnight to be used the next day (R).	4.10 ± 0.75	1	0.4	60	23.0	205	77.0
Q15. I don't thaw meat products on the counter overnight rather than in the refrigerator to be used the next day (R).	4.00 ± 0.86	6	2.3	77	28.9	183	88.8
Q16. I refrigerate leftovers immediately (within 2 hours) after a meal is eaten.	3.46 ± 1.14	53	19.9	77	28.9	136	51.2
Avoid food from unsafe sources ( $\alpha=0.7122$ )							
Q17. I follow label instructions for storing and preparing packaged foods.	3.35 ± 1.08	51	19.2	87	32.7	128	48.1
Q18. I discard food that has past its expiration date.	4.12 ± 1.15	29	10.9	39	14.7	198	74.4
Q19. I never eat eggs with a runny yolk or products containing raw eggs.	3.88 ± 1.20	42	15.8	54	20.3	170	63.9
Q20. I always wash the fruits and vegetables to be consumed (R).	4.15 ± 0.85	1	0.4	75	28.2	190	71.4

Note: (R) means reversed statements.

Scales: 1=never, 2=rarely, 3=some of the time, 4=most of the time, and 5=always.

how to check the temperatures of refrigerators and freezers (Q3) to 4.22 concerning proper hand washing techniques after using the restroom (Q12). The respondents indicated that they never or rarely use a thermometer to determine if meats have been cooked enough. Examples of positive food-handling behaviors were hand washing (Q10), sanitizing fruits and vegetables (Q20), discarding food past its expiration date (Q18), sanitizing countertops (Q9), and storing food properly (Q14).

According to Medeiros et al.'s research (17), identifying key behaviors associated with major pathogen control factors, such as washing one's hands before preparing foods, are the most crucial factors associated with personal hygiene. Considering that hand washing is especially important when foods are eaten without heating, and that fecal contamination is most likely to occur in such cases (18), it is appropriate that this behavior is ranked first in this study.

Cooking foods adequately is the only means available to consumers to kill pathogens on many foods (17). Although the most important behavior relating to this factor is to use a thermometer to make sure that meat and poultry are cooked at a safe temperature, only a small portion of respondents, 18%, stated that they use a thermometer. Similarly, the American Dietetic Association and the Conagra Foundation (19) found that few consumers reported using a food thermometer.

In review of research done by the Food Marketing Institute on foodborne illnesses, the most common cause of foodborne illness is the cross-contamination of cooked foods with raw foods (20). About two-thirds of the student respondents reported they cleaned food and food

preparation areas, and that they never used the same plate for raw and cooked meat. This study contrasts with a multi-state survey in which 19% of respondents did not wash their cutting boards with soap after cutting meat (21). Because of the outbreaks associated with raw fruits and vegetables (22), rinsing fresh products should be emphasized.

The majority of the surveyed students reported correct knowledge on keeping and thawing foods at safe temperatures, including two-hour time interval between preparation, serving, and refrigeration. However, based on the fact that cold temperatures are a crucial condition for controlling pathogen growth, the finding that only 13% of students checked for correct refrigerator and freezer temperatures, demonstrates that this is a practice that culinary arts and hospitality students need to be made aware of.

Some foods have a high enough probability of being contaminated with pathogens that their consumption is not advised such as: mislabeled foods, foods past their expiration date, foods containing raw eggs, and unwashed fruits and vegetables. Over 70% of students stated that they ensure safe food sources, but fewer students (63%) indicated they never eat raw eggs. Raw eggs are a known source of *Salmonella* Enteritidis (23), and the consumption of which leads to outbreaks, a lesson that should be taught in educational programs.

Students had positive intentions and favorable attitudes toward following proper principles of food safety techniques, scoring  $4.13 \pm 0.95$  and  $4.16 \pm 0.92$  on a 5-point scale, respectively (Tables 3 and 4). Students strongly agreed with statements identifying their responsibility to practice food safety and to educate future employees

**Table 3.** Intentions to follow proper food safety principles

	Mean score	Disagree		Neutral		Agree	
	Mean $\pm$ SD	N	%	N	%	N	%
I will follow the principles of food safety.	4.08 $\pm$ 1.04	24	9.0	36	13.5	206	77.5
I will make efforts to follow the principles of food safety.	4.16 $\pm$ 0.88	14	5.3	30	11.3	225	83.6
As foodservice managers and chefs, I will make efforts to follow the principles of food safety.	4.16 $\pm$ 0.93	17	6.4	30	11.3	219	82.4
As foodservice managers and chefs, I will encourage employees to follow the principles of food safety.	4.11 $\pm$ 0.98	23	8.6	25	9.4	218	81.9

Scales: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

**Table 4.** Attitude toward practicing food safety principles

	Mean score	Disagree		Neutral		Agree	
	Mean $\pm$ SD	N	%	N	%	N	%
It is my duty to practice the food safety principles.	4.14 $\pm$ 0.89	11	4.1	40	15.0	215	80.9
It is valuable to me that I practice the food safety principles.	4.15 $\pm$ 0.96	16	6.0	36	13.5	214	80.5
It is important that I practice the food safety principles.	4.13 $\pm$ 0.99	20	7.5	32	12.0	214	80.5
It is meaningful that I practice the food safety principles.	4.19 $\pm$ 0.88	13	4.9	34	12.8	219	82.3

Scales: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

**Table 5.** Barriers to following proper food safety principles

	Mean score	Disagree		Neutral		Agree	
	Mean $\pm$ SD	N	%	N	%	N	%
Misunderstanding of food labeling	3.59 $\pm$ 0.96	36	13.5	66	24.8	164	61.7
Economic burden caused by practicing food safety	2.91 $\pm$ 1.07	91	34.2	95	35.7	80	30.1
Large portion of food	2.95 $\pm$ 1.01	92	34.6	91	34.2	83	31.2
Habitual problems not reflected by food safety	3.10 $\pm$ 1.14*	83	31.2	67	25.2	116	43.6
Professional knowledge toward food safety	3.27 $\pm$ 1.11	68	25.6	60	22.6	138	51.8
Lack of courses including food safety	3.17 $\pm$ 1.08	78	29.3	69	25.9	119	44.8
Deficiency of perceived importance toward food safety	2.99 $\pm$ 1.14	104	39.1	61	22.9	101	37.9
Inconvenience followed by usage of safety equipment	2.94 $\pm$ 1.15	104	39.1	69	25.9	93	35.0
Lack of confidence toward importance of food safety	2.73 $\pm$ 1.15	131	49.2	62	23.3	73	27.5
No motivation to practice food safety	3.00 $\pm$ 1.10	95	35.7	73	27.4	98	36.9
No economic reward toward practicing food safety	2.97 $\pm$ 1.17	102	38.3	73	27.4	91	34.2

Scales: 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree.

\*Significant difference ( $p < 0.05$ ) between majors was found.

about food safety. This finding supports research of Unklesbay et al. among 824 college students in which students stated food service management has a responsibility to educate its employees about personal hygiene and sanitation in order to make sure the food served in its restaurant is safe to eat (13). Not only attitudes but also intentions are important constructs to predict many behaviors (24). In order to improve behavior with regards to food safety, one needs to understand students' attitudes and behaviors prior to providing information for them (25). Therefore, understanding the students' behaviors and attitudes may help academics to develop educational efforts, create awareness of students' safe food-handling practices, and evaluate progress toward risk reduction (2).

Eleven questions were used to determine the reason the respondents did not use correct food-handling procedures (Table 5). The first barrier ranked by student respondents was a misunderstanding about food labeling, and the components of which include inadequate knowledge toward food safety, lack of food safety courses, and habitual problems not reflected by food safety. Although today's consumers reported that their knowledge of food safety has increased (26), student respondents in this study stated their lack of knowledge toward food labeling is the most critical barrier to practicing correct food safety principles, indicating that students need to be educated on using food labels correctly. Moreover, considering the fact that consumers reported that they often rely on food labels for food safety information (26), educational efforts should also be focused on food label education for culinary and hospitality students in order to fulfill their roles as consumer educators successfully. Food safety education appears to have a positive influence on food-handling and safe food-consumption behaviors. Changes in how we educate food safety professionals will ensure they have the knowledge and the

skills to maximize effectiveness in reducing foodborne illness outbreaks. Therefore, it appears that continued and improved food safety training programs need to be directed at this population. The specific needs of hospitality and culinary arts students must be addressed to decrease the occurrence of foodborne disease. Research and educational messages and materials on the prevention of foodborne disease especially targeting college students should be a priority.

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