

FOOD SAFETY KNOWLEDGE, BELIEFS AND SELF-REPORTED HANDLING  
PRACTICES OF INTERNATIONAL COLLEGE STUDENTS AT A MIDWESTERN  
UNIVERSITY

by

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B.Ed., Moi University, 1995

A THESIS

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

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College of Human Ecology

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

2011

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## **Abstract**

International college students are becoming a sizable part of the overall college student population in American universities. Studies show that these students come to the United States (U.S) with food habits that could be in variance with the U.S. food safety norms. While food safety in the U.S. is among the safest in the world, foodborne illness has remained a growing concern. Food experts are showing increasing concern about how food habits associated with cultural and ethnic norms are impacting basic food safety practices in the U.S.

While minimal research regarding food safety has been conducted with college students in general, no studies have sought to understand food safety practices among international college students. This study investigated self-reported food safety practices of international college students. Specific objectives included: determine international college students' knowledge regarding basic food safety principles, evaluate international college students' belief towards food safety, and examine international students' current food safety practices.

The target population was international college students at Kansas State University. An online survey system was used to administer the questionnaires. The respondents were allowed two weeks to complete the questionnaires. To facilitate a higher response rate, two email reminders were sent, the first after one week and another two days prior to the expiration date.

SPSS (version 17.0) was used for data analysis. Descriptive statistics were computed to understand the nature of data and provide characteristics of international college students in the study. Independent Samples t-tests were used to examine differences between demographic characteristics. A One-way ANOVA was used to identify differences in food safety knowledge

and food handling practices among different ethnic groups regarding food safety. The Pearson correlation coefficient was used to measure association between variables.

The majority of the respondents did not answer correctly questions related to cooking foods adequately and keeping foods at safe temperatures. The study suggests that most participants had beliefs that enhanced good safety practices. Respondents rarely practiced using a thermometer to determine correct temperatures of cooked foods or using separate cutting boards when preparing raw and ready-to-eat foods. They also reported using towels that were available to others to dry their hands. No significant differences were found between training and self-reported food safety handling practices.

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## Acknowledgements

I would like to thank God for giving me strength and courage to make it through this process.

I would like to thank my wife, Kimberly, for believing in me even when, at times, I did not believe in myself. I so deeply thank you.

I would like to sincerely thank my committee chair, Dr. Kevin R. Roberts. I greatly appreciate your encouragement, and support throughout the completion of this thesis. Your patience with me has taught me more than any degree ever could. I sincerely thank you for that. Thank you for your confidence in me, advice, many hours of reading my many drafts and guiding me.

I would like to thank my committee, Dr. Carol Shanklin and Dr. Betsy Barret. I will always appreciate your experience in guiding me towards completing this program.

I would like to sincerely thank Dr. Deborah Canter. Without you I would never have completed this program.

I would like to thank John and Carolyn Mulder. I greatly appreciate the help you gave me.

I would like to thank Matt, Ying Zhoe, Pei Liu, Yee Ming, Wen Shen, Sooyang and Ju Won. I will always appreciate the help you gave me.

I would like to thank my dad. Getting in touch with me despite difficult circumstances and your pride in me kept me going.

I would like to thank my brother, George and his wife Julie. Your support for me cannot be empirically measured.

I would like to thank my niece, Emy. You believed in me. I believe in you too.

I would like to thank all my friends who stood with me.



## **Dedication**

I dedicate this thesis to my mother who taught me that it is not falling and remaining fallen that makes one to succeed. It is falling many times and standing back up every time one falls that is ultimately rewarding.

## **CHAPTER 1 - Introduction**

The United States (U.S.) is increasingly becoming a diverse nation. Nearly 70,000 foreigners arrive in the U.S. daily. These foreigners include visitors, tourists, business people, students, or foreign workers. While some return to their homes, many remain and become part of the population (Martin & Midgley, 1999).

Approximately 31 million foreign-born people live in the U.S., representing 11.3% of the population (United States Census Bureau, 2000). Reports have shown that this group of people is rapidly increasing in population. The same projections have been noted in the labor force too. Currently, 21 million foreign-born people, about 15% of the labor force, hold an array of jobs in the U.S. (Lowenstein, 2006). This workforce is projected to grow to 37% by 2020 and 47% percent by 2050 (Multicultural Foodservice & Hospitality Alliance, 2005).

Studies show that this group of people has food habits that could be in variance with the food safety norms in the U.S. A study conducted by Kittler and Sucher (2004) found that food handling and consumption behaviors associated with ethnic and cultural identity are most resistant to change. Buzby and Roberts (1999) found that food safety behaviors and perception of risk vary greatly among people from different countries because of differences in available technology, food production practices, cultural differences, and geographic differences. Food safety experts, especially in the U.S., are becoming interested in the overall impact of a shift in demographic patterns on food safety.

While food safety in the U.S. is among the safest in the world, foodborne illness has remained a growing concern. Approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths occur annually (Mead, et al., 1999). Annual medical costs and productivity losses

associated with such illnesses are between \$9.3 and \$12.9 billion (Buzby, Roberts, Lin, & Mac-Donald, 1996). Foodborne illnesses can occur when pathogens are eaten and established in the body, when the pathogens that produce harmful or deadly toxins are eaten, or when foods that contain intoxications are consumed (Buzby, Roberts, Lin, & Mac-Donald, 1996). It is impossible to ensure that food will be free from contamination in the food chain given that disease etiological agents have many opportunities to enter the food system. However, Morrone and Rathbun (2003) indicated that risks along the food chain can be minimized through educating consumers and employees on safe food handling.

Food safety education is a fundamental aspect of the overall food safety initiative. Without knowledge of food safety practices and proper food handling procedures, foodborne illnesses cannot be reduced (Redmond & Griffith, 2003). The overall impact of a shift in demographic patterns on food safety has become a concern in the U.S. To address the concern, educational interventions addressing food safety behaviors and risks should be developed. Fischer, Frewer, and Nuata (2006) argued that specific populations should be targeted to understand specific perceptions and behaviors.

Preliminary studies show an increasing concern regarding the impact of such food habits on basic food safety practices in the U.S. (Kwon, Roberts, & Shanklin, 2009; Reese and Nguyen, 2008; Rudder, 2006). This is true of international college students who are joining American universities at exponential rates and need to adapt to the food safety practices in their new environments. According to the Institute of International Education (IIE) (2009), a total of 623,805 international students enrolled in American universities in the 2007-2008 academic year, an increase of over 58,000 students from the 2004-2005 academic year. The sharpest annual increase noted was a 7% increase between the 2006-2007 and the 2008-2009 academic

years. Examining food safety knowledge, beliefs, and self-reported food handling practices among international students will help identify food safety perceptions and foodhandling practices that have been learned through cultural socialization processes that persist through time (Yiannas, 2008).

### **Justification**

International college students are becoming a sizable part of the overall college student population in American universities. The IIE report (2009) shows that in the academic year 2007-2008, the University of Southern California enrolled 7,189 international students, New York University enrolled 6,404, and Kansas State University enrolled 1,300. A total of 153 U.S. universities enrolled more than 1,000 students each for the 2007- 2008 academic year. Given that food safety is a global issue, it is imperative that international college students' food safety knowledge, beliefs and self-reported handling practices are determined to improve general food safety standards as well as create appropriate interventions that will adequately address behaviors that could be in variance with food safety norms.

Studies show that limited food safety research has been conducted on college students in general (Unklesbay, Sneed, & Toma, 1998; Cotterchio, Gunn, Coffill, Tormey, & Barry, 1998; Pettitt & Goldmon, 2004). No studies have sought to understand food safety practices among international college students specifically. Yiannas (2008) argues that food knowledge, beliefs, and handling practices associated with one's upbringing persist through time. Examining international college students' food safety, knowledge, practices and beliefs will help to better understand this population.

## **Purpose of the Study**

The purpose of this study was to investigate the self-reported food handling practices of international college students. The study also explored international college students' food safety knowledge and beliefs. Specific objectives included:

1. Determine international college students' knowledge regarding basic food safety principles,
2. Evaluate international college students' beliefs towards food safety, and
3. Examine international students' current food handling practices.

## **Research Questions**

The following research questions were addressed in this study:

1. What do international college students know about food safety?
2. What are the self-reported food safety practices of international college students?
3. What are international college students' beliefs about food safety?
4. Is there a correlation between international college students' food safety knowledge and self-reported food handling practices?
5. Is there a correlation between international college students' food safety beliefs and self-reported food handling practices?
6. Is there a relationship between international college students' demographic variables and their food safety knowledge?
7. Is there a relationship between international college students' demographic variables and belief about food safety?

8. Is there a relationship between international college students' demographic variables and self-reported food handling practices?

### **Significance of the Study**

Gaps in food safety knowledge and limited awareness in food safety issues exist among college students (Unklesbay et al., 1998; Morrone & Rathbun, 2003; Yarrow, 2006). In some cases, even when food safety knowledge is present, there are still disconnections between knowledge and self-reported food handling practices (Clayton, Griffith, Price, & Peters, 2002). Understanding international college students' food safety knowledge, beliefs, and self-reported food safety practices will help identify habits that are in variance with proper food safety principles. Results of this study will be important in the development of food safety guidelines and educational materials for international students.

### **Limitation of the Study**

This study was limited to international students at Kansas State University. Careful consideration should be taken to avoid generalizing the findings to all U.S. immigrants. While language barriers might have interfered with the interpretation and response of questions asked, careful consideration of question formulation and interpretation was taken into account.

### **Definition of terms**

**Beliefs:** Belief is the psychological state in which an individual holds a proposition or premise to be true (Bell, Halligan, & Ellis, 2006).

**Food Handling Practices:** Food handling practices is defined as the processing and manufacturing steps used to manage food products (The Arizona department of Health Services, 2008).

**Food safety:** Food safety refers to the conditions and practices that preserve the quality of food to prevent contamination and foodborne illnesses. It includes the production, processing, preparation and handling of food to ensure it is safe to eat (Griffith, 2000)

**Foodborne illness:** A foodborne illness is a disease transmitted to people by food (National Restaurant Association Educational Foundation, 2004).

**International College Students:** Individuals on a temporary visa who are enrolled in courses in the United States and are not immigrants, permanent residents, citizens, resident aliens, or refugees (IIE, 2010).

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## **CHAPTER 2 – Literature Review**

This chapter reviews relevant and related literature on the key concepts for this study. This includes studies that have been conducted on food safety in general and those that have been conducted with college students in particular. The literature review also explores college students' food safety knowledge, beliefs, and self-reported food handling practices in the U.S. Finally, the chapter has reviewed literature on international college students.

### **Status of Foodborne Illness in the United States**

The U.S. government has played a central role in ensuring food safety. It has done this by protecting the food supply in many levels of the food chain. The tasks are shared by the United States Department of Agriculture (USDA), U.S. Department of Health and Human Services (USDHHS), Center for Disease Control and Prevention (CDC), and the United States Environmental Protection Agency (USEPA) (Collins, 1997). Many government agencies and other related associations are constantly developing and implementing food safety programs, regulations, and training specifications (Meer & Misner, 2000).

In 1997, the U.S. government launched the Administration's Food Safety Initiative. The goal of the initiative was to improve food safety and reduce the incidence of foodborne illness to the greatest extent feasible. While the industry has the primary responsibility for the safety of the food it produces and distributes, federal, state, and local governments' roles are to verify that the industry is carrying out its responsibility and to initiate appropriate regulatory action if necessary. The initiative seeks to improve coordination, communication, and information exchange among federal, state, and local government agencies, and enhance collaboration between the public and private sectors. Since its launch, responses to outbreaks of illness caused

by contamination from bacteria, viruses, and parasites have improved significantly through better coordination and communication during traceback investigations (CDC, 2004).

Foodborne disease investigations have three components: epidemiological, laboratory, and environmental. Epidemiological investigations verify a diagnosis through case interviews and laboratory confirmation; identify the range of onset of symptoms; provide case definitions; conduct epidemiology studies (case control or cohort); and determine statistical associations between eating various foods and becoming ill. The laboratory component includes clinical analysis of food (if available) and environmental samples. The environmental component focuses on food preparation methods and the potential for temperature abuse or cross-contamination and the location of preparation. The environmental component also identifies possible modes of contamination at the food's source. Should the environmental investigation determine that the contamination most likely did not occur at the point of food preparation, then a traceback investigation may be initiated (Guzevich & Salsbury, 2000).

The sporadic surveillance of cases reported by clinical laboratories and physicians at the state and local level, and through Foodborne Diseases Active Surveillance Network (FoodNet) and food regulatory agency laboratories coordinated by the CDC (PulseNet) at the national level, has had a significant impact on food safety. This is the principal foodborne disease component of the Centers for Disease Control and Prevention (CDC) Emerging Infections Program (EIP). FoodNet is a collaborative project of the CDC, nine state sites (California, Colorado, Connecticut, Georgia, New York, Maryland, Minnesota, Oregon and Tennessee), the USDA, and the Federal Department of Agriculture (FDA). The project consists of active surveillance for foodborne diseases and related epidemiological studies designed to help public health officials better understand the epidemiology of foodborne illnesses in the U.S. PulseNet is a collaborative

project between CDC, FDA, USDA, and state health departments and uses a national computer network to confirm outbreaks of foodborne illness and to link cases/clusters occurring in multiple states. Public health laboratories across the country perform DNA “fingerprinting” on bacteria that may be foodborne and use the system to exchange findings when outbreaks of foodborne illness occur. The network permits rapid comparison of these “fingerprint” patterns through an electronic database at CDC. The DNA “fingerprinting” method is called pulsed-field gel electrophoresis (PFGE). These surveillance systems have enabled FDA and CDC to identify disease clusters with a tremendous degree of accuracy (CDC, 2004).

The FDA’s Food Code stipulates a set of guidelines and procedures that assist jurisdictions by providing a scientifically sound technical and legal basis for regulating the retail and foodservice industries, including restaurants, grocery stores, and institutional foodservice providers, such as nursing homes. Regulatory agencies at all levels of government in the U.S. use the FDA Food Code to develop or update food safety rules in their jurisdictions that are consistent with national food regulatory policy. According to the FDA, 49 of 50 states and three of six territories in the U.S., have adopted food codes patterned after one of the six versions of the Food Code, beginning with the 1993 edition (Food Code, 2009).

The U.S. government has continued to explore new ways of addressing food safety challenges. The recently passed Food Enhancement Act of 2009 in the Congress bears evidence to the argument that much more needs to be done to curb the increasing rate of foodborne illnesses. The bill in part seeks to address the following:

1. Improve traceability by significantly expanding FDA trace back capabilities in the event of a foodborne illness outbreak. The regulation gives FDA the mandate to

identify the history of the foodborne illness in as short a timeframe as practicable, but no longer than two business days.

2. Improve the science of food safety. FDA has been mandated to enhance foodborne illness surveillance systems to improve the collection, analysis, reporting, and usefulness of data on foodborne illnesses. It also seeks to provide greater coordination between federal, state, and local agencies.
3. Expand laboratory testing capacity. FDA will be required to establish a program to recognize laboratory accreditation bodies and to accept test results only from duly accredited laboratories.
4. Require unique identification numbers for facilities and importers to improve the accuracy of data and the ability of FDA to more quickly identify involved parties in a crisis situation.
5. Provide protection for whistleblowers that bring attention to important safety information. This will prohibit entities regulated by FDA from discriminating against an employee in retaliation for assisting in any investigation regarding any conduct, which, the employee reasonably believes constitutes a violation of federal law.
6. Provides strong, flexible enforcement tools. This provides FDA new authority to issue mandatory recalls of tainted foods. Strengthens penalties imposed on food facilities that fail to comply with safety requirements (The Library of Congress, 2009).

Despite all efforts made by the U.S government, foodborne illness has remained a public health concern. Researchers have not been able to determine the exact number of foodborne illnesses in the U.S given the current structure of reporting. The estimate most often cited indicate that foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths in the United States annually (Mead et al., 1999). These illnesses have led to deaths and severe infections in humans as a whole. Several factors have been associated with the severity of illness resulting from foodborne pathogenic microorganisms. The type of pathogen, number of microorganism ingested, and the consumers' susceptibility to the pathogen have been regarded as central to the severity of the illness (Mead et al., 1999).

The exorbitant costs incurred as a result of the foodborne illnesses have closed restaurants, driven families into bankruptcy, and have impacted the U.S. government greatly (Buzby, Roberts, Lin, & Mac-Donald, 1996; Knabel, 1995; Thayer, 1999). The U.S. Department of Agriculture Economic Research Service (USDA/ERS) has estimated annual medical costs, productivity losses, and costs of premature deaths for diseases total \$6.9 billion. This estimate only included the five most common foodborne pathogens: *Escherichia Coli* O157, Shiga-toxin producing *E. Coli*, *Campylobacter*, *Listeria Monocytogenes*, and *Salmonella* (USDA/ER, 2000).

The CDC defines a foodborne illness outbreak as an occurrence of two or more cases of a similar illness from the same food item (Bean, Goulding, Daniels, & Angulo 1997; Olsen, Mackinon, Goulding, Bean, & Slutsker, 2000). Outbreaks are classified by etiologic agents if laboratory testing of a specific agent is obtained and specified criteria are met. If the food source is implicated epidemiologically, but adequate laboratory confirmation of an agent is not obtained, the outbreak is classified as unknown etiology (Scott & Stevenson, 2006). Foodborne outbreaks are caused by contaminated food either intrinsically or during harvesting, processing,



or preparation (Guzewich & Ross, 1999). Any food, whether it is raw, processed to enhance quality and safety, or cooked, may carry some level of risk for foodborne illness if not properly handled before consumption. Everyone in the food system, from producers to consumers, must recognize the need for vigilance in controlling microbiological hazards to reduce the risk of foodborne illness (Knabel, 1995).

Among the cases of known etiology, viruses account for over 67% of all cases, 33% of hospitalizations, and 7% of deaths. *Salmonella* accounts for 26% and campylobacter 17% of hospitalizations. The organisms involved in the leading causes of death are *Listeria*, *Salmonella*, and *Toxoplasma* which account for 75% of foodborne deaths caused by known pathogens (Mead et al., 1999).

In the 2005 surveillance of foodborne disease, a total of 16,614 laboratory-confirmed cases of infections were identified, as outlined in Table 2.1. The percentage of outbreaks of unknown etiology has been relatively constant, between 61 and 63%, indicating the need for improved investigative techniques to identify unknown pathogens (Scott & Stevenson, 2006). The etiological agent was not confirmed in 60% of outbreaks from 1983 to 1987 (Bean & Griffin, 1990), 59% of outbreaks from 1988 – 1992 (Bean, Goulding, Daniels & Angulo, 1997), and 68% from 1993 – 1997 (Olsen, Mackinon, Goulding, Bean & Slutsker, 2000; C.D.C, 2006).

**Table 2.1 Surveillance of Foodborne Illnesses**

<i>Pathogen</i>	<i>Confirmed Cases of Infection</i>	Overall incidence (per 100,000 people)
<i>Salmonella</i>	6,471	14.55
<i>Campylobacter</i>	5,655	12.72
<i>Shigella</i>	2,078	4.67
<i>Cryptosporidium</i>	1,313	2.95
STEC O157	473	1.06
<i>Yersinia</i>	159	.36
STEC non-O157	146	.33
<i>Listeria</i>	135	.30
<i>Vibrio</i>	119	.27
<i>Cyclospora</i>	65	.15
TOTAL	16,614	37.36

### **Causes of Foodborne Illness**

There are several different types of contaminants that can cause foodborne illness. These contaminants include bacteria, viruses, parasites, and chemicals. Generally, contaminated food may look, smell, and taste safe even though it may be contaminated and could be capable of causing a foodborne illness. Foodborne illnesses may be classified as either a food intoxication or a food infection. Common symptoms in many foodborne illnesses are associated with the gastrointestinal tract, and include nausea, vomiting, abdominal cramps, and diarrhea are common symptoms in many foodborne diseases (CDC, 2005; Collins, 1997).

The most commonly recognized foodborne infections are *Campylobacter*, *Salmonella*, and *E. coli* O157:H7, and by a group of viruses called calicivirus, also known as the Norwalk

and Norwalk-like viruses. The leading cause of foodborne illness is Norwalk-like viruses, far outpacing the rest at 23 million cases per year. This is far more common because it does not have to be associated with a particular food. The virus is transmitted person-to-person through unhygienic practices and the contamination of food.

*Campylobacter* is the second most common bacteria to cause foodborne illnesses at 2.45 million cases of foodborne illness per year. This bacterium is associated exclusively with the cooking and handling of raw chicken.

The third most frequent is *Salmonella* at 1.4 million cases. *Salmonella* is commonly associated with chicken and eggs, but the bacteria can also be transmitted by activities such as visiting petting zoos and not washing hands before eating.

*E. coli* 0157:H7 is the fourth most common bacteria to cause foodborne illness with just over 73,000 estimated cases annually. *E. coli* resides in the digestive tracts of cattle and can contaminate beef during slaughtering. Undercooked ground beef or cross contamination are the most common causes (Mead et al. 1999).

### **Food Handling Practices Contributing to Foodborne Illness**

Medeiros, Hillers, Chen, Bergmann, Kendall, and Schroeder (2004) found improving food safety knowledge and belief through training had a positive effect on food handling practices. Particular emphasis was placed on five areas that contribute to foodborne illness: improving personal hygiene, cooking foods adequately, avoiding cross contamination, keeping food at safe temperatures, and avoiding food from unsafe sources.

#### **Personal Hygiene**

Personal hygiene is critical in preventing contamination of food and foodborne illness. Anytime a food handler's hands are contaminated by activities such as handling raw ground beef

or using the restroom, they must wash their hands properly to prevent contaminating other foods, and surfaces they touch. Consumers should wash their hands prior to preparing or consuming food and after using the toilet, changing diapers, and touching pets. Food items should be washed in running potable water just before cooking. Fruits and fresh vegetables should be washed before eating. Also, kitchen utensils such as cutting boards, knives, dishes, counter surfaces should be cleaned with hot water and soap after preparing each food item to prevent cross-contamination (Medeiros et al., 2001).

Research shows that poor personal hygiene causes more than 90% of foodborne illnesses. Improper hand washing alone accounts for more than 25% of all foodborne illnesses (Weinstein, 1991). Proper hand washing includes using water at a temperature of at least 100°F, applying enough soap to build a good lather, vigorously scrubbing hands together for a minimum of 20 seconds assuring that you scrub under your nails and between fingers, rinsing thoroughly under running water, and drying with a single use paper towel or warm air dryer (Snyder, 1998). Hand washing should always be completed after using the restroom; touching raw foods; touching the hair, face or body; sneezing, coughing, or using a tissue; smoking, eating, or chewing gum or tobacco; handling chemicals; taking out or handling trash; bussing or cleaning a table; touching clothing or aprons; and touching anything else that may contaminate hands (National Restaurant Association Educational Foundation [NRAEF], 2004).

### **Cooking of Food**

Several studies have reported that inadequate cooking of foods was one of the main factors contributing to foodborne outbreaks (Todd, 1997). More than three million cases of foodborne illness annually are attributed to pathogens associated with inadequate cooking of foods (Masami, Miriam, Sandra, & Virginia, 2006). Food safety experts acknowledge that foods are properly cooked when they are heated for a long enough time and at a high enough

temperature to kill bacteria that cause foodborne illness. The best way to determine if meat, poultry, or egg dishes are cooked to a safe temperature is to use a food thermometer. Using a food thermometer ensures that food has reached a high enough temperature to destroy bacteria and to determine doneness. Harmful micro-organisms in most foods can be killed by cooking them to temperatures between 140° F (70°C) and 180° F (90°C) (Medeiros, Hillers, Kendall & Mason, 2001).

### **Cross Contamination**

One of the most common causes of foodborne illness is cross contamination: the transfer of bacteria from food to food, hand to food, or equipment to food (Zain & Naing, 2002). Cross contamination can also occur when uncovered raw foods are stored directly adjacent to or above ready-to-eat foods in a refrigerator or other holding equipments. A review by Djuretic, Wall, Ryan, et al. (1995) identified cross-contamination as an important contributory factor in 36.3% (147/405) outbreaks of food-borne disease. Allwood, Jenkins, Paulus, Johnson and Hedberg, (2004) and Ryan, Wall, Gilbert, Griffin, and Rowe (1996) found that food preparers' hands have contributed in up to 39% of domestic foodborne illness outbreaks. To minimize cross contamination, cooked and ready-to-eat foods should be kept separate from raw products while shopping, preparing, and storing food items. Knives, cutting boards, and food preparation areas should be washed with hot soapy water after use for raw meat, fish, or poultry products. If possible, use separate cutting boards for raw meats, fish, or poultry and other ready-to-eat foods such as breads and vegetables (Medeiros et al., 2001).

### **Time/Temperature Control**

Time/temperature abuse while preparing food is known to result in foodborne illness (McSwane, Rue, Linton, & Williams, 2004). Time/temperature abuse occurs when food has been allowed to stand for an extended period of time at temperatures favorable for bacterial growth

(National Restaurant Association Educational Foundation, 2004). Time/temperature abuse include: insufficient amount of cooking or reheating time, improper holding temperature, and improper defrosting procedures (McSwane, Rue, Linton, & Williams. 2004).

### **The Challenge of Increasing Diversity on Food safety in the United States**

The importance of foodborne illness as a public health concern is underscored by the increasing diversity of the U.S. population. Nearly 70,000 foreigners arrive in the U.S. every day, including visitors, tourists, business people, students, and foreign workers. While some return to their homes, many remain and become part of the population (Martin & Midgley, 1999). Students, who compose a significant number of this group, may be at a disproportionately greater risk. Several studies indicate that young adults are the most likely age group to participate in risky food handling behavior (Altekruse, Yang, Timbo, & Angulo, 1999; Byrd-Bredbenner et al., 2007; Klontz, et al., 1995; Li-Cohen & Bruhn, 2002; Morrone & Rathbun, 2003; Patil, Cates, & Morales, 2005; Roseman & Deale, 2008). Studies have shown that consumers are the weakest link along the food chain when it comes to food safety. Koopmans and Duizer (2004) indicated that contamination of food could occur anywhere in the "farm-to-fork" continuum, but most foodborne illnesses can be traced back to infected persons who handle food improperly. While consumers are aware of the recommended food safety precautions, they have adopted high risk behaviors (Gauci & Gauci, 2005). According to Terpstra, Steenbekkefs, Maertelaere, and Nijhuis (2005), there is a need to teach consumers how to safely transport, store, handle, and prepare food in the home. This is particularly true among college students who appear to be at greater risk of foodborne illness than the general population due to their handling behaviors (Morrone & Rathbun, 2003).

## **Food Safety and Awareness among College Students**

Literature on food safety issues among college students (food safety knowledge, awareness, food handling practices, and self-reported behaviors) is limited. However, few studies have been done to assess students' food safety knowledge and behaviors.

Unklesbay, Sneed, and Toma (1998) conducted an in-class survey of 824 college students to assess beliefs, practices, and knowledge of food safety among college students in three U.S. geographic locations. Results showed that students scored poorly when asked if unsafe food could be identified by the way it looked and smelled. They incorrectly indicated that unopened processed meats could be refrigerated long-term without any risk of causing foodborne illness. When asked how they determined serving temperatures of leftovers, 24.3% of the respondents indicated that they relied on touching. Only 6% used thermometers to determine serving temperatures. Nutrition and dietetic students, food science, nutrition, and health majors had a more positive belief toward food safety than did students majoring in other disciplines ( $p \leq 0.05$ ). Those who had enrolled in food safety courses had a more positive belief and better practices of food safety than those who did not ( $p \leq 0.05$ ). Enrollment in this type of course led to both genders having significantly higher knowledge of food safety than those who did not take such a course ( $p \leq 0.05$ ). Results showed no significant differences among disciplines for the practice scores

A study conducted by McArthur et al. (2006) that assessed university undergraduates' frequency of compliance with food safety recommendations further supported previous statements that college students engage in preparation practices that place them at a greater risk to foodborne illness, including unsafe preparation practices for meats, eggs, and poultry. No significant difference was seen among students majoring in health-related disciplines and those

majoring in other areas of study. Key findings showed, for all classes of consumers, food safety knowledge did not correspond with actual practice.

Garayoa, Cordoba, Garcia-Jalon, Sanchez, and Vitas (2005) investigated the relationship between food safety knowledge and actual food handling practices among Spanish university students who regularly prepare food at home. The 562 students, the majority from the health science disciplines, were involved in food shopping and preparation of meals for their own consumption or for that of others. The questionnaire adapted from Alterkuse et al. (1999) and Jay and Govenlock (1999) was modified to comply with some specific Spanish cultural norms. Results showed that 60% of the responses had accurate knowledge of proper food handling such as proper storage of prepared meals, appropriate hand washing, and avoiding cross-contamination. However, the study found significant differences between knowledge and self-reported practices among students. Many participants demonstrated accurate knowledge of food handling, but only a few reported using safe foodhandling practices. Many of the younger students paid less attention to safe food preparation. Their findings suggested the need for improved and early food safety educational programs to ensure that knowledge acquired actually modifies consumer behaviors. The limitation with Garayoa et al. (2005) study is that they surveyed only students in the health sciences disciplines and not the entire student population.

Higgins, Remig, and Yarrow (2009) explored the relationships among food safety beliefs, knowledge, and self-reported food safety practices of college students in health and non-health majors before and after an educational intervention. Three food safety interactive educational modules were developed to determine whether such an educational intervention could improve food safety knowledge and practices. Fifty-nine participants completed a food safety pre- and post-questionnaire before and after the intervention. Prior to and after viewing each online module, each student completed an online pre-test and post-tests using a survey system. Results



indicated that the developed food safety online intervention improved college students' food safety beliefs, beliefs, and knowledge, with a stronger effect noted on health majors. Food safety knowledge, measured with three module pre-tests and post-tests, improved significantly after educational intervention for all students, with health majors having a greater increase. The intervention also resulted in improved food safety self-reported practices for health majors but not for non-health majors. However, college students could benefit from exposures to safe food handling interventions.

Knowledge and awareness of food safety issues and safe food handling practices are important in reducing foodborne illnesses. Food safety education for consumers is the easiest way to assist in the prevention of foodborne illnesses. The importance of food safety knowledge has increased with the increase in foodborne illness and the emergence of new pathogens (Tonova, 2001; Haapala & Probart, 2004). Thus, knowledge and awareness are essential in reducing foodborne outbreaks and illnesses that continue to occur among all consumers (Kendall, Medeiros, Hillers, Chen, & Dimiscola, 2003).

Insufficient food safety practices are major contributors to the transmission of foodborne illness (Mitchel, Fraser, & Bearon, 2007). Research shows that young adults have a greater propensity to participate in risky food handling behaviors, and are prone to violate many food safety precautions. Such behaviors include: inadequate washing of hands, using cutting boards to cut fruits and vegetables after contact with raw meat and chicken, eating undercooked hamburgers and eggs, and eating raw oysters (Altekruse, et al., 1999; Klontz, et al., 1995; Li-Cohen & Bruhn, 2002; Morrone & Rathbun, 2003). These risky food handling and consumption behaviors are a major concern for researchers and food safety educators.

Altekruse et al. (1999) pointed out that food mishandling is thought to be more acute among young adults and men. They ignore hazards associated with foodborne illness because of the common misconception that foodborne illness does not frequently occur in the home. Even if it does, it would affect just a small number of people and in most cases it would not be reported or detected by public-health surveillance system (Jay & Gvenlock, 1999).

A national food safety mail survey conducted by Li-Cohen and Bruhn (2002), which included college students/graduates, examined consumer handling of fresh fruits and vegetables. Investigators concluded that college students or college graduates were more likely to practice risky produce handling behavior, compared to those with less formal education. College students or students who have completed college were also less likely to wash the food preparation surface before cutting produce, meat, poultry, and fish (Li-Cohen & Bruhn, 2002). Unklesbay et al. (1998) surveyed college students and found that students rarely check temperatures of their refrigerators and freezers. Students also exhibited risky food consumption behaviors. An alarming 7% of the college sample consumed either raw fish or raw hamburger. Additionally, students consumed raw eggs (12.7%), unpasteurized eggnog (6.4%), and raw cookie dough (5.8%). When asked how they determined serving temperatures of leftovers, 24.3% of students indicated they relied on touching or feeling the food. Only 6% used thermometers to read food temperatures, and another 3% relied solely on microwave settings

Morrone and Rathbun (2003) conducted a survey to explore food handling behaviors of college students at Ohio University. They added 12 food safety questions from the Behavioral Risk Factor Surveillance Survey (BRFSS) developed in 1995 to characterize people at high risk of foodborne illness and to help in developing food safety educational interventions for consumers. To obtain a diverse sample of the student population, the authors targeted classes offered to juniors. A junior English class of 354 students completed the survey. Faculty members

who taught junior English classes were enlisted to help with the distribution of the surveys in class. The findings of the study suggested that students appeared to engage in food safety behaviors that place them at greater risk for illness than members of the general population. For example, one risky practice is consumption of undercooked hamburger; almost every student reports consuming undercooked hamburger and indicated they ate ground beef that is pink or red inside. Almost one-half (44%) of surveyed college students reported eating a hamburger in the past 12 months that was pink or red inside. A significantly higher proportion (60%) of male students reported eating undercooked hamburger that is pink or red inside than female students (32%). Morrone and Rathbun's (2003) study suggested health intervention programs to promote safe food handling methods on college campuses before students move into independent living situations. The authors indicated that there was a great need or concern for efforts to educate college students about food safety. Even though there are health educational programs on many campuses, food safety issues are generally not emphasized in the programs.

### **Disparities in Food Safety Knowledge and Self-Reported Food Handling Behaviors**

There is available information about the importance of safe food handling practices in the home, but research has shown that proper practices are not followed (Worsfold & Griffith, 1997). A high proportion of foodborne illnesses continue to occur even though there has been increase training for safe food handlers. In their research, Clayton, Griffith, Price, and Peters (2002) revealed barriers to food handling behavior change despite increased food safety knowledge acquired through training. Clayton, Griffith, Price, and Peters (2002) highlighted the need for training based around a risk-based approach with adequate resources.

Based on the observation of food safety behaviors of a sample of over 100 people in their homes, Worsfold and Griffith (1997) reported that many basic food handling procedures were

not conducted according to government's recommendations. Findings such as temperature abuse, failure to wash hands and ingredients before cooking, and the risk of cross-contamination were consistent in their study as participants appeared to be unaware of the correct practices.

Altekruse et al. (1996) conducted a study of home food preparers who included young adults. The study revealed that the proportion of people knowledgeable about safe food handling practices was greater than the proportion that reported actually implemented the same safe food handling practices. In their sample, 86% reported that they knew proper hand washing was important in preventing foodborne illness, while only 66% reported washing their hands after handling raw meats. In the same survey, 80% of those interviewed reported knowing that it would increase the risk of foodborne illness to place a cooked steak on a plate that previously held a raw steak, yet only 67% cleaned or sanitized the cutting board after using it to prepare raw chicken or beef

Raab and Woodburn (1997) found that a disparity exists between knowledge and self-reported practices. In a study of 1439 consumers that explored the knowledge and behavior of hamburger meat consumption, Christen and Acuff (1997) concluded that while better-educated people tend to choose health and safety as their reason for cooking preference, they were more likely to prefer their hamburgers to be less well cooked. Thus, the reasons for cooking preferences may be unaffected by either knowledge or mass media exposure. Twenty percent of respondents reported unsafe practices in their food preparation. This is despite the fact that 56% of the respondents knew that they could thoroughly cook food contaminated with salmonella to make it safe to consume and 59% knew this for *E. coli*.

Redmond and Griffith (2005) found in their review of food safety studies that men had less food safety knowledge and displayed risky hygienic and cooking practices more frequently than women. Also, Patil, Gates, and Morales' (2005) found considerable differences between

consumers' food handling practices and demographic groups with risky behaviors. For example, men reported greater consumption of raw or undercooked foods than women. They also reported having poor personal hygiene practices and poor practices to prevent cross-contamination than women. The study also revealed that women displayed having better defrosting practices than men. Sharp and Walker's (2005) microbiological survey of communal kitchens used by undergraduate students in shared university housing reported inadequate hygiene practices that suggested limited food safety knowledge. It is worth noting that these risky behaviors might result in foodborne illnesses.

### **Cultural Impact on Food-Related Behaviors**

Food culture has widely been thought to influence behavior (Fieldhouse, 1995; Kuczmarski & Cole, 1999; Kittler & Sucher, 2004). Such behaviors are difficult to change (Kittler & Sucher, 2004). International college students stem from areas where different food cultures are practiced. However, upon coming to the U.S., international college students need to adapt to the food habits of their new environment. This innovation of food and the changing food habits in a new environment may have an impact on college students' food safety behaviors.

Besides taste, cost, and convenience, food habits are integrated into a systematic pattern of life in different customs, which directly or indirectly influence behavior (Fieldhouse, 1995). Many aspects of food purchasing, handling, preparation, and eating of international college students may therefore be culturally defined. Individuals may consciously or unconsciously participate in these culturally defined practices to preserve traditions and ethnic or cultural identity (Kittler & Sucher, 2004).

## Conclusion

The majority of foodborne illness outbreaks can be traced to mishandling of foods by food handlers rather than food that was purchased contaminated. Consumer studies have shown that consumers are the weakest link along the food chain when it comes to food safety. While consumers are aware of the recommended food safety precautions, they have still adopted high risk behaviors

There are several different types of contaminants that can cause foodborne illness. These contaminants include bacteria, viruses, parasites, and chemicals. The first symptoms of a foodborne illness are nausea, vomiting, abdominal cramps and diarrhea. The most commonly recognized foodborne infections are those caused by the bacteria *Campylobacter*, *Salmonella*, and *E. coli* O157:H7, and by a group of Norwalk viruses. The leading cause of foodborne illness is Norwalk-like viruses, followed by *Campylobacter*, *Salmonella* and *E. coli* O157:H7.

Researchers have classified contributors to foodborne illness into five categories including: personal hygiene, cooking foods adequately, avoiding cross contamination, keeping food at safe temperatures, and avoiding food from unsafe sources. These categories have been used as the basis from which training materials have been developed.

Research conducted with college students found that college students are likely to indulge in risky behaviors. Many students pay less attention to safe food preparation and rarely use thermometers to determine optimum temperatures of foods. This risky behavior is a major concern for researchers and food safety educators. Studies show an increasing concern on the impact of such food habits on basic food safety practices in the U.S. Such situations are true to international college students, who are joining American universities at exponential rates and need to adapt to the food safety practices in their new environments

Studies show that limited food safety research has been conducted with college students in general. No studies have sought to understand food safety practices among international college students specifically. Understanding international college students' food safety knowledge, beliefs, and self-reported food safety practices will help identify habits that are in variance with food safety principles.

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## **CHAPTER 3 – Methodology**

### **Introduction**

This chapter presents the research design, target population, sampling procedure, research instruments, and methods of data analysis that were used to accomplish the research objectives. The purpose of this study was to investigate the beliefs of international college students regarding food safety issues. The study also explored international college students' food safety knowledge.

### **Population and Sample**

The target population was international college students at Kansas State University. The international students list was obtained from the International Student and Scholar Service spring enrollment report of 2010 available online. Total enrollment of international students at the time was 1,519 (Kansas State International Student and Scholar Service, 2010). All undergraduate and graduate students at the university were included in the study.

### **Development of the Survey Instrument using Previous Researchers**

The survey instrument was first developed by adapting statements from previous researchers (Appendix A). The first section contained ten questions that measured knowledge of food safety. Different aspects of food handling practices related to food safety were included in the study. Questions included personal hygiene, time temperature control, and cross contamination. These statements were adapted from Toro's (2005) research about food safety practices of foodservice employees in San Juan, Puerto Rico.



The second section identified self-reported food safety handling practices. A 5-point scale, ranging from never do (0) to always do (4) was used to assess actual handling practices of international college students regarding food safety issues. This section contained 16 statements and was adapted from a study by Stirtz (2001).

The third section assessed international college students' food safety beliefs and had eleven statements. A 5-point scale, ranging from strongly disagree (1) to strongly agree (5), was used to determine the beliefs of international students. The statements were adapted from a study by Medeiros et al. (2004) whose research resulted in belief scales for consumers for food safety. The demographic information in section four inquired about gender, age, ethnicity, food safety background, college major, and the length of stay in the U.S. Permission letters were acquired from those researchers (Appendix B).

### **Refining the Survey Instrument utilizing Focus Groups**

A convenient sample of twenty international college students participated in the four focus groups. The groups were designed for five people plus a moderator. Discussions were tape recorded. The composition of participants was representative to the target group diversity (Table 3.1). The Chinese students constituted approximately 35% of the focus group participants followed by the Japanese international college students who constituted 20%. Forty percent of the focus group participants were graduates students. The groups were formed in the fall semester 2009. To recruit participants, leaders of ethnic regions were consulted. Participants who indicated interest received a confirmation letter via email (Appendix C). Each group lasted approximately 60 minutes. Participants discussed all the survey questions in each of the four sections of the instrument: food safety knowledge, beliefs, self-reported food handling practices, and demographic information (Appendix D).

**Table 3.1 Country of Origin Focus Groups Represented**

<b>Country of Origin</b>	<b>Number</b>
<b>China</b>	7
<b>Japan</b>	4
<b>Kenya</b>	3
<b>Taiwan</b>	2
<b>Uganda</b>	1
<b>Ghana</b>	1
<b>India</b>	1
<b>Nigeria</b>	1

In order for the participants' comments to be understandable and useful, they were summarized to essential information using a systematic and verifiable process. All focus group tapes were transcribed and notes were inserted into transcribed material where appropriate. Transcripts were refined by stripping nonessential words. Each participant's comment was assigned a separate line. Common words were then identified and the recommendations were used to refine the survey instrument (Appendix D).

### **Focus Group Results**

#### **Meaning of words and statements**

Table 3.2 shows the changes that were made in the instrument. Participants were concerned with the meaning of some of the technical terms used in the instrument. They stated that they did not understand the meaning of some of the multiple choices given.

**Table 3.2 Changes made after Conducting Focus Groups**

<b>Original Instrument</b>	<b>Changes made using Focus Groups Data</b>
<b>The temperature danger zone</b>	The temperature danger zone is (the temperature danger zone is the most favorable temperatures for rapid growth of bacteria)
<b>Potentially hazardous food</b>	(Potentially hazardous food is food that requires special care to keep it safe as long as possible).
<b>32°F and 180°F</b>	32°F and 180°F (0°C and 82°C)
<b>Poultry</b>	Chicken
<b>Seafood</b>	Fish
<b>Thaw</b>	Defrost
<b>Pasteurized</b>	Processed
<b>Beef</b>	Meat

They also did not know how to identify temperatures in degrees Fahrenheit. Changes were therefore made to clearly explain all technical terms used in the instrument.

### **Meaning of statements**

Participants did not relate to some of the statements in the initial questionnaire. They argued that allowing the statements in the survey instrument would result to having flawed responses since they did not understand the meaning of some statements. For instance, students from African nations indicated not having an experience with alfalfa and would therefore not have context in answering questions related to alfalfa and sprouts. After having discussions on possible rephrasing of the statement with two focus groups that included international students from Africa, no conclusive solution was arrived at. A decision was then made to remove the two statements from the instrument. The two statements that were removed include: *“I am worried that I may get sick if I eat hot dogs right out of the package”* and *“I don’t worry that I may get sick if I eat alfalfa and other raw sprouts”*.

## Statements Inserted in the Instrument

Participants were asked to identify practices they thought needed to be included in the survey (Table 3.3). They were also allowed to give their general opinion about food safety. They suggested that changes be made to some statements in order to have a context in responding to them. For instance, instead of using the following statement: *“I am not concerned if I thawed perishable food on the kitchen counter,”* they suggested changing it to a statement they could easily identify with: *“I am concerned if I defrost frozen food on the kitchen counter”*. Participants also suggested the inclusion of some of the statements that had a direct impact on their perception to food safety. Since they all indicated having an interest in learning more about food safety, they wanted to find out the target population’s opinion. Other changes made included recoding the belief responses from the previous scale of (0 – 4) to the scale of (1 – 5)

**Table 3.3 Statements Added in the Instrument after Focus Group Discussions**

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### Statements Added to the Instrument.

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- After washing my hands, I dry them using a hand towel that is available to others (Practice).
  - It is important for me to dry my hands with a hand towel that is available to others (Belief).
  - I am confident I can serve safe foods to others (Belief).
  - I am interested in learning more about food safety (Belief)
- 

## Project Approval

Before collecting any data, approval from the Kansas State University Institutional Review board was obtained. The Approval letter is located in Appendix F

## **Pilot study**

An online survey was used to obtain data from international college students. A cover letter explaining the objective of the study, its goals, and time frame for completion was sent with a link to the questionnaire to the K-State International Student and Scholar Services staff for review (Appendix G). Given the sensitive nature of the research topic, each of the five member staff accessed the instrument and answered all the questions to ensure that no statements violated beliefs and principles of any of the participants. The pilot study had asked respondents to indicate their country of origin. Since all five staff members who reviewed and approved the questionnaire indicated that their country of origin was the U.S., the responses were identified by their country of origin and later discarded.

A pilot study was then conducted with a convenient sample of 21 international students at Kansas State University to evaluate the reliability of the instrument (Table 3.4). The number of international college students in the pilot study constituted 10% of the minimum sample size required in the study and was large enough to provide useful information about the aspects that are being assessed for feasibility (Thabane et al., 2010). In addition to the questionnaire, respondents were asked to complete a questionnaire about the survey to further assure that all questions were understandable and to determine the time required to complete the questionnaire. It took approximately 15 minutes to complete the questionnaire online.

## **Pilot Study Results**

The researcher reviewed all responses. All negatively-keyed items were identified and reverse-scored. Negatively-keyed items are items that are phrased so that an agreement with the item represents a relatively *low* level of the attribute being measured. Reverse-scoring the

negatively-keyed items ensured that all of the items that are originally negatively-keyed and those that are positively-keyed are consistent with each other, in terms of what an “agree” or “disagree” imply. This cleared inconsistencies.

Overall, participants indicated in their comments that they were generally satisfied with the instrument. However, most indicated that they had difficulty with two similar statements: “*After washing my hands, I dry them using a hand towel that is available*” (Practice) and “*It is important for me to dry my hands with a hand towel that is available*” (Belief). The two statements were refined further and then included in the final instrument: “*After washing my hands, I dry them using a hand towel that is available to others*” (Practice) and “*It is important for me to dry my hands with a hand towel that is available to others*” (Belief). The final questionnaire is located in Appendix H.

**Table 3.4 Country of Origin for Pilot Study Sample**

<b>Country of Origin</b>	<b>Number</b>
<b>China</b>	6
<b>India</b>	4
<b>Kenya</b>	2
<b>Taiwan</b>	1
<b>Uganda</b>	1
<b>Ghana</b>	1
<b>Japan</b>	1
<b>Nigeria</b>	1

## **Reliability Analysis**

Reliability of the pilot instruments used was tested using Cronbach's alpha coefficient. Items were analyzed to identify those that yielded low correlations with the sum of the scores. The dependent variable of food handling practices had a reliability coefficient of 0.718 with a total of 16 scale items. The dependent of food safety beliefs showed a coefficient value of 0.747 with a total of 13 items. The results indicated that the reliabilities of the scales used were acceptable and aligned with previous research (George & Mallery, 2003; Santos, 1999).

## **Questionnaire Administration**

An online survey system was used to administer the questionnaires to international college students. The target population was 1,645 international college students. A cover letter explaining the objective of the study, its goals, and time frame for completion was sent along with a link to the questionnaire in the K-State Survey System. Students were allowed two weeks to complete questionnaires. To facilitate a better response rate, students were sent an email reminder after one week, and again two days prior to the expiration date.

## **Data Analysis**

The researcher reviewed responses and deleted incomplete responses. SPSS (17.0) was used to compute descriptive statistics (means, frequencies and standard deviation), Independent samples t-test, One-way Analysis of Variance (ANOVA), and Pearson correlation, means, standard deviation, and frequencies were used to understand the nature of data and provide characteristics of international college students in the study. Independent t-tests were used to examine differences between demographic characteristics. A One-way ANOVA was used to

identify differences in food safety knowledge and food handling practice among different ethnic groups regarding food safety. The Pearson correlation was used to measure association between variables.

### **Conclusions**

The questions included items that measured food safety knowledge, beliefs and handling practices. The original instrument was first developed using instruments that have been administered by other researchers. Several items in the instrument were unfamiliar to the international college students. Some terms did not convey the same meaning as those conveyed by the target groups of previous researchers. Participants did not understand some statements. Some technical terms also required explanation. Also, participants felt the need to include some statement that had not been included in the previous survey instruments.



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## **CHAPTER 4 – Food Safety Knowledge, Beliefs and Handling Practices of International College Students at a Midwestern University**

### **Introduction**

While food safety in the United States (U.S.) is among the safest in the world, foodborne illness has remained a growing concern. Approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths occur annually (Mead, et al., 1999). Annual medical costs and productivity losses associated with such illnesses are between \$9.3 and \$12.9 billion (Buzby, Roberts, Lin, & Mac-Donald, 1996).

The U.S. government has played a central role in ensuring food safety. It has done this by protecting the food supply in many levels of the food chain. The tasks are shared by the United States Department of Agriculture (USDA), U.S. Department of Health and Human Services (USDHHS), Center for Disease Control and Prevention (CDC), and the United States Environmental Protection Agency (USEPA) (Collins, 1997). Many government agencies and other related associations are constantly developing and implementing food safety programs, regulations, and training specifications. (Meer & Misner, 2000).

In 1997, the U.S. government launched the Administration's Food Safety Initiative. The goal of the initiative was to improve food safety and reduce the incidence of foodborne illness to the greatest extent feasible. The initiative seeks to improve coordination, communication, and information exchange among federal, state, and local government agencies, and enhance collaboration between the public and private sectors. Since its launch, responses to outbreaks of illness caused by contamination from bacteria, viruses, and parasites have improved significantly through better coordination and communication during traceback investigations (CDC, 2004).

The sporadic surveillance of cases reported by clinical laboratories and physicians at the state and local level, and through FoodNet and PulseNet at the national level, has had a significant impact on food safety. These surveillance systems have enabled FDA and CDC to identify disease clusters with a tremendous degree of accuracy (CDC, 2004). Despite all efforts made by the U.S government, foodborne illness has remained a public health concern.

Foodborne illness is caused when toxic levels of pathogens or bacteria are present in food. Microbial foodborne illness is monitored closely because these cases of food illness far outweigh any other type of food contamination. In the case of an infection from a pathogen such as *Salmonella*, foodborne illness results when a pathogen in a food product multiplies and infects the human body after ingestion. These microorganisms can multiply in food during agricultural production, transportation, preparation, and storage, or within the digestive tract after a person eats the contaminated food (C.D.C, 2005).

The most commonly recognized foodborne illnesses are those caused by the bacteria *Campylobacter*, *Salmonella*, and *E. coli* O157:H7, and by a group of viruses called calicivirus, also known as the Norwalk and Norwalk-like viruses. The leading cause of foodborne illness is Norwalk-like viruses, far outpacing the rest at 23 million cases. This is far more common because it does not have to be associated with a particular food. The virus is transmitted person to person through unhygienic practices and the contamination of food. *Campylobacter* is the second most common bacteria to cause foodborne illnesses at 2.45 million cases of foodborne illness per year. This bacterium is associated exclusively with the cooking and handling of raw chicken. The third most frequent is *Salmonella* at 1.4 million cases. *Salmonella* is commonly associated with chicken and eggs, but the bacteria can also be transmitted by activities such as visiting petting zoos and not washing hands before eating. *E. coli* O157:H7 is the fourth most

common bacteria to cause foodborne illness with just over 73,000 estimated cases annually. *E. coli* resides in the digestive tracts of cattle and can contaminate beef during slaughtering. Undercooked ground beef or cross contamination are the most common causes (Mead et al. 1999).

The food safety behavior patterns in the U.S. are constantly being affected by the increasing diversity of the U.S. population. Nearly 70,000 foreigners arrive in the U.S. every day. These foreigners include visitors, tourists, business people, students, or foreign workers. While some return to their homes, many remain and become part of the population (Martin & Midgley, 1999).

Approximately 31 million foreign-born people live in the United States, representing 11.3% of the U.S. population (United States Census Bureau, 2000). Twenty-one million foreign-born, about 15% of the labor force, hold an array of jobs in the United States (Lowenstein, 2006). This workforce is projected to grow to 37% by 2020 and 47% percent by 2050 (Multicultural Foodservice & Hospitality Alliance, 2005).

A study conducted by Buzby and Roberts (1999) found that food safety behaviors and perception of risk vary greatly among people from different countries because of differences in available technology, plant and livestock host factors, food production practices, cultural differences, and geographic differences. With foodborne illnesses becoming more pronounced, food safety experts, especially in the U.S., are becoming interested in the overall impact on food safety due to a shift in demographic patterns.

International college students are a large percentage of the foreign-born population that live in the U.S. According to the Institute of International Education (IIE) (2009), a total of 623,805 international students enrolled in American universities in the 2007-2008 academic

year. During the same year, a total of 153 U.S. universities enrolled more than 1,000 international students.

This category of students has food practices and beliefs that were established early in life and were determined by cultural, psychosocial, and socioeconomic factors (Crockett & Sims, 1995). According to Yiannas (2008), food handling behaviors that have been learned through cultural socialization persist through time. These aspects include behaviors associated with food purchasing, handling, preparation, and eating. Given that food safety is a public health concern, it is imperative that international college students' food safety knowledge, beliefs, and self-reported handling practices are determined to improve general food safety standards as well as create appropriate interventions that will adequately address behaviors that could be in variance with food safety norms.

A few studies have evaluated food safety knowledge, beliefs, and handling practices of college students in general (Altekruse, 1999; Jay et al., 1999; Morrone & Rathbun, 2003 & Bryd-Brebenner). Researchers have indicated that young adults tend to engage in risky food handling behaviors. College students are more likely to practice unsafe food handling behaviors. Most admitted that they rarely washed fresh fruits before consumption and were less likely to wash their food preparation surface before cutting produce, meat, poultry, or fish (Li-Cohen & Bruhn, 2002).

Studies indicate an increasing concern about the number of food safety violations associated with the foreign-born population on basic food safety practices in the U.S. (Reese and Nguyen, 2008; Kwon, Roberts, and Shanklin, 2009; Rudder, 2006). Researchers and educators therefore have a responsibility to identify and design interventions that will effectively address and improve food safety behaviors that are in variance with recommended food safety practices.

Medeiros, Hillers, Chen, Bergmann, Kendall, Shanklin, and Schroeder (2004) found improving food safety knowledge and belief through training had a positive effect on food handling practices. Particular emphasis was put in five areas of foodborne illness control: improving personal hygiene, cooking foods adequately, avoiding cross contamination, keeping food at safe temperatures, and avoiding food from unsafe sources.

Despite the importance of food safety and handling practices among college students, no studies have sought to understand food safety knowledge and handling practices among international college students. The purpose of this study was to investigate the self-reported handling practices of international college students regarding food safety issues. The study explored international college students' food safety knowledge and beliefs on self-reported food handling practices. Specific objectives included: determining international college students' knowledge regarding basic food safety principles, evaluating international college students' belief towards food safety, and examining international students' current food safety practices. The following research questions were addressed in this study:

1. What do international college students know about food safety?
2. What are the self-reported food safety practices of international college students?
3. What are international college students' beliefs about food safety?
4. Is there a correlation between international college students' food safety knowledge and self-reported food handling practices?
5. Is there a correlation between international college students' food safety beliefs and self-reported food handling practices?
6. Is there a relationship between international college students' demographic variables and their food safety knowledge?

7. Is there a relationship between international college students' demographic variables and belief about food safety?
8. Is there a relationship between international college students' demographic variables and self-reported food handling practices?

Examining food safety knowledge, beliefs, and self-reported food handling practices among international students identified food handling practices that are at variance with recommended food safety practices.

### **Methodology**

The target population was international college students at a Midwestern university. The listserv used by the International Student and Scholar Services to reach international undergraduate and graduate college students in the spring of 2010 had a total of 1,645 subjects that included other non-degree populations. Those populations included: the target population of 1,519 international undergraduate and graduate students, spouses of the married international college students on J-1 visas (88), international non-degree seeking (2), and faculty and staff associated with International Students and Scholar Services who were not international students (37). The number of countries represented by international undergraduate students was 99. Graduate international students represented 33 countries. International students target population included students from China (41%), India (12.7%), Saudi Arabia (5.6%), and South Korea (5.4%). The remaining countries represented 33.6% of the population. Approximately 52% of the international student population was undergraduates while 61% was male (International Students Scholar office, 2010). A letter of invitation was sent to all international college students via



email. Participation was voluntary. A response of at least 180 international college students was sought to yield an adequate sample size recommended by Dillman (2000).

A four-part questionnaire was administered to international college students about food safety knowledge, beliefs, current food handling practices, and demographic information. The first section contained ten questions that measured food safety knowledge. Questions included personal hygiene, time temperature control, and cross contamination. These statements were adapted from a study by Toro (2005) that assessed food safety knowledge of restaurant employees in San Juan, Puerto Rico.

The second section identified self-reported food handling practices related to food safety. A 5-point scale, ranging from never do (1) to always do (5) was used to assess actual handling practices. The section had sixteen statements and was adapted from a study by Stirtz (2001). The third section assessed international college students' food safety beliefs and included 11 statements. A 5-point scale, ranging from strongly disagree (1) to strongly agree (5) was used to determine beliefs. These statements were adapted from a study by Medeiros et al. (2004). The demographic information in section four inquired about sex, age, ethnicity, food safety background, college major, and the length of stay in the U.S.

Approval was obtained from the Institutional Review Board. The questionnaire was then revised based on the focus group and pilot test results. Ambiguous items were reworded for clarity and relevance. Technical terms were defined and long items were shortened. Terms commonly used in the U.S. such as "poultry" and "thawing" were replaced with terms that are commonly used among international students such as "chicken" and "defrost." It took approximately 15 minutes to complete the questionnaire online.

An online survey system was used to administer the questionnaires to international college students. A screening question was used prior to beginning the survey to identify

international college students who were students at the time. Students were allowed two weeks to complete questionnaires. An introductory letter containing a link to the online questionnaire was emailed to all the international college students at the university. Two reminders were sent to facilitate a better response rate, after one week and again two days prior to expiration date.

Reliability of the instruments was tested by determining a Cronbach's alpha coefficient. Items were analyzed to identify those that yielded low correlations with the sum of the scores. The dependent variable of food handling practices had a reliability coefficient of 0.68 with a total of 16 scale items. The dependent of food safety beliefs showed a coefficient value of 0.71 with a total of 13 items. The results indicated that the reliabilities of the scales used were aligned with previous research (George & Mallery, 2003; Santos, 1999).

SPSS (version 17.0) for Windows was used for data analysis. Means, standard deviation, and frequencies were used to understand the nature of data and provide characteristics of international college students in the study. Independent t-tests were used to examine differences between demographic characteristics. A One-way ANOVA was used to identify differences in food safety knowledge and food handling practice among different ethnic groups regarding food safety. The Pearson correlation was used to measure association between variables.

## **Results**

### ***Demographic Characteristics***

A total of 237 international college students responded to the survey. Thirty-four responses were omitted after participants indicated that they were not international undergraduate or graduate students at the time. Fifty-seven responses were discarded for incomplete responses. The discarded responses included: 52 students who quit before completing

section one of the questionnaire, and the remaining five subjects who responded to approximately 30% of the questions in the questionnaire. Only 146 responses were usable. This was lower than a response of at least 180 international college students that was sought to yield an adequate sample size recommended by Dillman (2000).

The majority of the respondents were female (53.3%), between the ages 21 and 30 years of age (61.4%), and graduate students (71.2%) (Table 4.1). The majority of respondents lived either in on-campus apartments (40.29%) and off-campus housing (45.5%). Only 19.9% of the respondents indicated that they prepared food for other people daily, while 16.7% prepared food for other people two to three days a week, and 15.2% prepared food for other people weekly. Colleges in which respondents were enrolled were College of Agriculture (28.8%), College of Arts and Sciences (20.5%), College of Engineering (16.7%), College of Business Administration (12.9%), and College of Human Ecology (10.6%). Forty respondents (30.3%) indicated they had received food safety training, and 25% said they had been employed in the foodservice industry. Sixty-five percent of the respondents represented Asian countries, 30% South American countries, and 19% African countries.

The demographics among the sample are slightly different from the target population. Sixty-one percent of the sample population represented students from China, India, and South Korea. However, the response rates for other studies with college students were similar to this study with higher response rate by females than males. Similar margins of respondents who were food safety trained and who had food service experience were found (Curtis, 2008; Osborne, 2001 & St. John, 2009)

**Table 4.1 Demographic Characteristics of Subjects (n=146)**

<b>Characteristic</b>	<b>n</b>	<b>%<sup>a</sup></b>
<b>Sex</b>		
Male	56	42.4
Female	71	53.8
<b>Age</b>		
20 Years and Below	18	13.6
21 – 25 Years	41	31.1
26 – 30 Years	40	30.3
31 Years and Above	28	21.2
<b>Educational Level</b>		
Undergraduates	29	22.0
Graduates	98	74.2
<b>Living Accommodations</b>		
Residence Hall	10	7.6
Jardine Apartments	53	40.2
Off-campus Housing	60	45.5
Other	1	0.8
<b>College Enrolled</b>		
College of Agriculture	38	28.8
College of Arts and Sciences	27	20.5
College of Engineering	22	16.7
College of Business Administration	17	12.9
College of Human Ecology	14	10.6
College of Veterinary Medicine	4	3.1
College of Technology and Aviation	3	2.3
College of Education	1	0.8
College of Architecture	1	0.8
<b>Food Safety Training/Education</b>		
Yes	40	30.3
No	87	65.9
<b>Employed in Foodservice Industry</b>		
Yes	33	25.0
No	94	71.2
<b>Frequency of Preparing Food for Other People</b>		
Daily	26	19.7
Weekly	42	31.9
Monthly	38	28.8
Never	21	15.0

<sup>a</sup> Percentages may not total 100% due to missing data

**Table 4.1 demographic Characteristics of Subjects (n=146) Continued**

<b>Characteristic</b>	<b>n</b>	<b>%<sup>a</sup></b>
<b>Region of Origin</b>	65	45.8
Asia	30	21.1
South America	19	13.4
Africa	11	7.7
Middle East	9	6.3
Europe	8	5.6
Canada		

<sup>a</sup> Percentages may not total 100% due to missing data

### ***Food Safety Knowledge***

Table 4.2 presents the results of the knowledge questions. The questionnaire was categorized into four major contributors to foodborne illness: practicing personal hygiene, cooking foods adequately, avoiding cross-contamination, and keeping foods at safe temperatures.

Overall, the mean percentage of correct responses was 45%. Only 15.5% of the respondents obtained scores greater than 70%. The majority of the respondents (83.6%) obtained scores less than 69%, 10.9% obtained scores between 61-70%, and 4.7% obtained scores between 71- 80%. Only one (0.8%) respondent obtained a score of  $\geq 80\%$ . International college students' mean score was lower than Osborne (2001) and Bryd-Bredbenner et al. (2007) who reported that college students had food safety knowledge scores of 50-60%.

Over-two thirds of the respondents correctly answered questions related to the following: practicing proper personal hygiene (69.7%) and preventing cross contamination (60.35%). Participants' scores on specific questions related to cross contamination varied widely. The majority of the respondents correctly answered questions related to the practice most likely to result to cross contamination (76.5%). However, international students' knowledge of basic procedures for cleaning kitchen equipment (39.4%), identifying food with enough bacteria to cause contamination to cause sickness (35.6%), and risks for food contamination in the food flow

**Table 4.2 Food Safety Knowledge Responses (n=146)**

<b>Characteristic</b>	<b>n</b>	<b>%</b>
<b>Practicing Personal Hygiene</b>		
<i>When dirty, hands should be washed by...</i>		
a. Rinsing under warm water with soap for at least 10 seconds	23	17.4
b. Washing with soap and cool water for at least 10 seconds	10	7.6
c. Rinsing under warm water for at least 20 seconds	6	4.5
d. Washing with soap and warm water for at least 20 seconds*	93	70.5
<b>Cooking Foods Adequately</b>		
<i>Chicken is safe to serve if the internal temperature is:</i>		
a. 140 <sup>0</sup> F (60 <sup>0</sup> C)	23	17.4
b. 155 <sup>0</sup> F (68 <sup>0</sup> C)	20	15.2
c. 165 <sup>0</sup> F (74 <sup>0</sup> C)*	41	31.1
d. 180 <sup>0</sup> F (82 <sup>0</sup> C)	48	36.4
<i>Previously cooked leftover foods must be thoroughly reheated to:</i>		
a. 140 <sup>0</sup> F (60 <sup>0</sup> C)	14	10.6
b. 155 <sup>0</sup> F (68 <sup>0</sup> C)	22	16.7
c. 165 <sup>0</sup> F (74 <sup>0</sup> C)*	40	30.3
d. 180 <sup>0</sup> F (82 <sup>0</sup> C)	56	42.4
<i>Ground beef must be cooked to a minimum temperature of:</i>		
a. 140 <sup>0</sup> F (60 <sup>0</sup> C)	8	6.1
b. 155 <sup>0</sup> F (68 <sup>0</sup> C)	21	15.9
c. 165 <sup>0</sup> F (74 <sup>0</sup> C)*	40	30.3
d. 180 <sup>0</sup> F (82 <sup>0</sup> C)	63	47.7
<b>Preventing Cross contamination</b>		
<i>The practice most likely to result in sickness from food is:</i>		
a. Cleaning and sanitizing cutting boards after cutting raw chicken	13	9.8
b. Serving cooked chicken with a pair of tongs	3	2.3
c. Breeding raw chicken using clean disposable gloves, then refrigerating the chicken until the chicken is ready to be cooked	15	11.4
d. Using a cutting board to cut raw chicken for grilling, then to shred lettuce for a salad*	101	76.5
<i>The basic procedure for cleaning pots, pans, silverware, and other kitchen equipment is to:</i>		
a. Rinsing under warm water with soap for at least 20 seconds	17	12.9
b. Rinsing under hot water with soap for at least 20 seconds	26	19.7
c. Wash with hot soapy water after preparing each food item and before moving on to the next food*	52	39.4
d. Wash with warm soapy water after preparing each food item and before moving on to the next food.	37	28.0

<sup>a</sup> The overall mean percentage score was 45%

\*Correct response

**Table 4.2 Food Safety Knowledge Responses (n=146) Continued**

<b>Characteristic</b>	<b>n</b>	<b>%<sup>a</sup></b>
<b><i>Foods with enough bacterial contamination to cause sickness in susceptible persons:</i></b>		
a. have a color that is not characteristic of food	5	3.8
b. have distinctive smell	14	10.6
c. cannot be identified by sight or smell*	47	35.6
d. can be identified by sight or smell if contamination levels are high enough	66	50.0
<b><i>Risks for food contamination exist):</i></b>		
a. at each step in the flow of food( <i>Flow of food describes what happens to food from the time you buy it until it is served</i> *)	109	82.6
b. only during preparation and service of food	2	1.5
c. only with potentially hazard food ( <i>Potentially hazardous food is food that requires special care to keep it safe as long as possible</i> )	12	9.1
d. only when leftover foods are used	5	3.8
<b>Keeping Food At Safe Temperatures</b>		
<b><i>Raw meat that is defrosting should be stored:</i></b>		
a. on the top shelf of the refrigerator	50	37.9
b. on the middle shelf of the refrigerator	12	9.1
c. on the bottom shelf of the refrigerator*	45	34.1
d. any shelf of the refrigerator is acceptable	25	18.9
<b><i>The temperature zone is ( the temperature danger zone is most favorable temperatures for rapid growth of pathogens):</i></b>		
a. 32 <sup>0</sup> F and 180 <sup>0</sup> F (0 <sup>0</sup> C and 82 <sup>0</sup> C)	28	20.5
b. 40 <sup>0</sup> F and 140 <sup>0</sup> F (4 <sup>0</sup> C and 60 <sup>0</sup> C) *	27	15.2
c. 41 <sup>0</sup> F and 135 <sup>0</sup> F (5 <sup>0</sup> C and 57 <sup>0</sup> C)	57	43.2
d. 41 <sup>0</sup> F and 145 <sup>0</sup> F (5 <sup>0</sup> C and 63 <sup>0</sup> C)	20	15.2

<sup>a</sup> The overall mean percentage score was 45%  
\*Correct response

(22%) was low. They may have knowledge of practices that are likely to result in cross contamination, but have difficulty in identifying food with enough bacteria to cause contamination. Half of the respondents incorrectly indicated that food with enough bacteria to cause sickness can be identified with sight or smell if contamination levels are high enough.

Approximately 25% of the respondents did not correctly answer questions related to cooking foods adequately (26.6%) and keeping foods at safe temperatures (27%). The question with the lowest score was related to the minimum temperature required to cook ground beef. Only 15.9% of the respondents answered it correctly. These findings are similar to many studies,

which found that college students' scores were very low (Curtis, 2008; Kendall et al., 2001; McCabe-sellers & Beatie, 2004; sachs & Huleback, 2002)

### ***Self-Reported Food Safety Handling Practices***

Table 4.3 illustrates the mean of each of the food safety handling practice statements. A 5-point scale was used to measure self-reported food safety handling practices. The statements were categorized into five behavioral constructs: practice personal hygiene, cooking foods adequately, preventing cross-contamination, keeping foods at safe temperatures, and avoiding food from unsafe sources. The mean ( $3.54 \pm 0.46$ ) was used to determine whether the respondents' frequency ratings are positive, thus a mean score of greater than 3.54 was considered positive. Respondents with a score less than 3.54 were considered to have food safety handling behaviors that were less practiced.

Overall, most respondents more frequently practiced personal hygiene behaviors (4.42), and behaviors associated with avoiding foods from unsafe sources (3.97). The less practiced food safety behaviors by respondents were: preventing cross contamination (3.51), keeping foods at safe temperatures (3.43), and cooking foods adequately (2.41).

Specific food safety behaviors that were practiced most frequently were: washing plates used for raw meat, chicken, or seafood before putting cooked food on the plate or using a clean plate (4.64), and washing hands with soap and water after touching raw meat, chicken, or fish before preparing and cooking food (4.41) . Specific behaviors that were considered less frequently practiced included: using a thermometer to determine if leftover foods were thoroughly reheated (1.61), using a thermometer to determine if meat was thoroughly cooked (1.92), using a thermometer to determine the temperature of the refrigerator (1.98), and using



**Table 4.3 Food Safety Self-Reported Food Handling Practices Responses<sup>a</sup>**

<b>Current Food Safety Practices</b>	<b>Mean<sup>b</sup></b>	<b>±</b>	<b>SD</b>
<b>Practicing Personal Hygiene</b>			
I wash a plate used for raw meat, chicken, or fish before putting cooked food on the plate OR I use a clean plate.	4.64	±	0.81
Before preparing or handling food, I wash my hands with soap and warm water.	4.41	±	0.86
If I have a cut or sore on my hand, I cover it before preparing food	4.25	±	0.96
<b>Cooking Foods Adequately</b>			
I eat eggs with runny yolk or products containing raw eggs. *	3.65	±	1.30
I use a thermometer to determine if meat, chicken, and/or fish are thoroughly cooked.	1.92	±	1.36
I use a thermometer to determine if leftovers have been reheated thoroughly.	1.61	±	1.12
<b>Preventing Cross Contamination</b>			
I wash my hands with soap and water after touching raw meat, chicken, or fish before preparing and cooking food.	4.54	±	0.80
I use hot, soapy water to clean my countertops after preparing food.	3.54	±	1.25
I use the same cutting board when preparing raw meats, chicken, fish foods and vegetables.*	3.22	±	1.66
After washing my hands, I dry them using a hand towel that is available to others.*	2.67	±	1.42
<b>Keeping Food at Safe Temperatures</b>			
When buying food I check the “sell by” and “use by” dates .	4.45	±	0.09
I store my eggs at room temperature*.	4.43	±	1.13
I leave cooked foods, such as rice and beans, overnight on the counter to be used the next day. *	3.68	±	1.41
I put frozen meat and chicken on the counter in the morning so that it will be defrosted and be ready to cook in the evening. *	3.51	±	1.45
I throw away refrigerated leftovers after 3-4 days	3.46	±	1.24
I use a thermometer to determine the temperature of the refrigerator	1.98	±	1.43

<sup>a</sup> A five point scale was used for responses: 1=Never, 2=Rarely, 3=Sometimes, 4=Most of the time, 5=Always

<sup>b</sup> Overall Mean 3.54 ± 0.46. \*The statements were negatively keyed

separate cutting boards when preparing raw foods (3.22). Majority indicated drying hands using a hand towel that is available to others (2.67)

The results were similar to the findings of other researchers (Unklesbay, Sneed & Toma, 1998; Altekruise, Yang, Timbo & Angulo, 1999; Fein, Lin & Levy, 1995; Li-Cohen & Bruhn, 2002; & Morrone & Ruthbun, 2003). They noted that college students are likely to engage in risky food handling behaviors.

### ***Food Safety Beliefs toward Food Safety Practices***

A 5-point scale was used to measure food safety beliefs. Table 4.4 illustrates the mean for each food safety belief statements for the total sample. Because the mean was  $3.51 \pm 0.46$ , a mean score of greater than 3.51 was considered positive, respondents with a score less than 3.51 were considered to have beliefs that were deterrent to food safety. The results demonstrated that respondents had positive food safety beliefs regarding most of the statements.

Most participants had a mean score of greater than 3.51 on specific belief statements indicating that they had positive beliefs towards food safety. Those statements include; following food safety practices (4.37), refrigerating food in the refrigerator overnight (4.30), washing hands with warm soapy water for 20 seconds (3.91), serving safe foods to others (4.17), cooking eggs until the yolks were firm (3.66), cleaning counter tops and cutting boards after preparing raw meat or chicken (4.46), and learning more about food safety (3.98). They were on the other hand less positive in using disposable towels (2.87), keeping the refrigerator below 40°F (2.47), and concern relating to getting sick if they ate raw fish (2.58).

**Table 4.4 Food Safety Beliefs Responses<sup>a</sup>**

<b>Current Food Safety Practices</b>	<b>Mean<sup>b</sup></b>	<b>±</b>	<b>SD</b>
It is important to wash countertops, utensils and cutting boards after preparing raw meat or poultry.	4.46	±	0.74
Trying to follow proper food safety practice is important to me	4.37	±	0.74
Refrigerating food overnight to serve the following day is important to me.	4.30	±	0.92
I am confident I can serve safe foods to others.	4.17	±	0.91
I am interested in learning more about food safety	3.98	±	0.96
Washing my hands with warm soapy water for at least 20 seconds is a priority for me.	3.91	±	0.91
I am concerned if I defreeze frozen food on the kitchen counter.	3.75	±	0.99
Cooking and eating eggs that have firm yolks and whites is important for food safety.	3.66	±	1.04
Using cheese and yogurt made only from pasteurized milk is important to me	3.62	±	1.23
I am not interested in using a thermometer to find out if food is fully cooked. *	3.08	±	1.23
It is important to me to dry my hands with a hand towel that is available to others*	2.87	±	1.38
I am not concerned that I may get sick if I eat raw oysters or fish. *	2.58	±	1.45
I do not worry about keeping the refrigerator below 40°F (4°C).	2.47	±	1.32

<sup>a</sup> A five point scale was used for responses: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree

<sup>b</sup> Overall Mean 3.51 ± 0.56

\*The statements were negatively keyed

### ***Correlation between Food Safety Knowledge and Self-Reported Handling Practices***

A Pearson correlation coefficient was calculated to assess the relationship between the four knowledge and handling practices categories. Based on the results presented in Table 4.5, it

can be concluded that having knowledge of keeping foods at safe temperatures had a significant positive relationship with time/temperature control behaviors ( $p \leq 0.05$ ). Having knowledge of cross contamination showed a significant positive relationship with practices related to time temperature control ( $p \leq 0.05$ ) and personal hygiene practices ( $p \leq 0.05$ ). Personal hygiene knowledge had a significant positive relationship with cross contamination practices ( $p \leq 0.05$ ). Knowledge on cooking food adequately was not correlated with any of the four categories.

**Table 4.5 Correlation Between Food Safety Knowledge and Self-reported Food Safety Practices (n-146)**

Variables	Time temperature Knowledge	Cross Contamination Knowledge	Cooking foods adequately knowledge	Personal hygiene Knowledge
Cross Contamination Practices	0.032	0.130	0.069	0.329**
Time Temperature Practice	0.237**	0.251**	0.038	0.144
Cooking Food Adequately Practice	0.021	-0.138	-0.096	0.173
Personal Hygiene Practice	0.071	0.321**	-0.149	0.127

\* $P \leq 0.05$ . \*\* $P \leq 0.01$ .

A Pearson correlation coefficient was calculated to assess the relationship between average food safety knowledge score and average food safety self-reported practices score. A weak positive correlation was found ( $r = 0.210$ ,  $p < 0.05$ ), indicating that there is a significant linear relationship between the two variables. The findings indicated that as food safety knowledge increases respondents' food safety food safety practices increased. These results are similar to other reported findings, which have found that an increase in food safety knowledge

increased food safety practices (Jayaratne, 2009; Edmiston & Gillett-Fisher, 2006; Belcher, Watkins, Johnson, & Ialongo, 2007; Palojoki, 2007; Meer & Misner, 2000). However, the results are different from other reported findings, which found that an increase in food safety knowledge does not necessarily increase food safety practices (Patil, Cates & Morales, 200; Roberts et al., 2008)

***Correlation between Food Safety Beliefs and Handling Practices***

A Pearson correlation coefficient was calculated to examine the relationship between respondents’ handling practices and the average food safety beliefs score. Table 4.6 illustrates

**Table 4.6 Correlation between Overall Food Safety beliefs and Self-Reported Food Safety Practices**

<b>Variables</b>	<b>Food Safety Beliefs Average</b>
Personal Hygiene Practice Average	0.397**
Cross Contamination Practices	0.399**
Time Temperature Practice	0.353**
Cooking Food Adequately Practice	0.355**
Avoid Foods from Unsafe Sources	0.375**
Food Safety Beliefs Average	0.397**

\*\*P<0.01.

that food safety beliefs had a significant and positive relationship with personal hygiene behaviors for all the four major contributors to foodborne illness ( $p \leq 0.05$ ). A positive correlation ( $r = 0.611, p < 0.001$ ) was found between average food safety belief score and food safety practices scores. Results indicated a positive linear relationship and that food safety beliefs increases the amount of food safety practices.

## ***Demographic Factors and Food Safety Knowledge, Belief, and Self-Reported Handling Practices***

The independent-samples t-test was used to determine if there were any differences in respondents' knowledge, beliefs, and handling practices based on sex, educational level, food safety training, employment in the service industry, and years lived in the United States. No significant difference was found between food safety knowledge and sex of respondents (Table 4.7). This finding did not support results reported by Albrecht (1995) and Meer and Misner's (2000) who reported that females scored higher on knowledge test than males. Knowledge was not significantly different based on level of education, employment in the food industry, and the length of stay in the U.S. This finding does not support results reported by Cunningham (1993), whose research found that participants with higher educational level had higher food safety knowledge scores.

Significant differences were found for knowledge scores and respondents who had food safety training ( $M = 53\%$ ,  $SD = 18$ ) and those who did not ( $M = 42$ ,  $SD = 17$ ;  $p = 0.004$ ). The results revealed that food safety training improves food safety knowledge in this study. The findings support previous results of studies by Cochran-Yantis, et al. (1996); Williamson, Gravani and Lawless (1992); Manning, (1994); and Sneed et al., (2004) who also reported statistical significance in the relationship of food safety training and knowledge.

A significant difference between male and female beliefs towards food safety was found. This is based on ( $M = 3.98$ ,  $SD = 0.55$ ) for males and ( $M = 4.20$ ,  $SD = 0.56$ ;  $p = 0.036$ ) for females. Female respondents ( $M=4.20$ ) had food safety beliefs that were more inclined towards good food safety standards than male respondents ( $M=3.98$ ). The results are similar to Burger's (1998) findings, who reported that women had stronger food safety beliefs than males Graduate

**Table 4.7 Comparison of Demographic Factors with Knowledge, Beliefs, and Practices using Independent Sample t-test (N = 142)**

Variables	Knowledge				Beliefs				Practice			
	M% <sup>b</sup>	SD	t	p	M% <sup>b</sup>	SD	t	p	M% <sup>b</sup>	SD	t	p
<b>Gender</b>												
Male	42	17	-1.87	0.063	3.98	0.55	-2.10	0.036*	3.45	0.48	-1.94	0.056
Female	48	18			4.20	0.56			3.63	0.43		
<b>Education Level</b>												
Undergraduates	47	18	0.44	0.070	3.90	0.56	-2.22	0.032*	3.46	0.48	-1.23	0.267
Graduates	45	18			4.16	0.55			3.59	0.45		
<b>Food Safety training</b>												
Yes	53	18	3.00	0.004*	4.28	0.57	2.386	0.020*	3.63	0.49	1.19	0.446
No	42	17			4.02	0.54			3.51	0.44		
<b>Employed in Food service Industry</b>												
Yes	52	17	2.37	0.412	4.08	0.59	-2.84	0.778	3.50	0.48	-0.76	0.446
No	43	18			4.11	0.54			3.58	0.45		
<b>Years live in U.S.A</b>												
≤ 2 Years	43	16	-1.59	0.116	4.04	0.59	-1.11	0.269	3.50	0.49	-1.28	0.204
≥ 3 Years	47	20			4.16	0.54			3.61	0.42		

<sup>a</sup> Sample may not total 132 due to missing data

<sup>b</sup> Mean percentage knowledge score

\*P ≤ 0.05

students also had stronger food safety beliefs than undergraduates ( $M = 4.16$ ,  $SD = 0.55$ ;  $p = 0.032$ ). Students who had completed food safety training had stronger food safety beliefs ( $M = 4.28$ ,  $SD = 0.57$ ) than students who did not have any training ( $p = 0.020$ ). The results showed that food safety training can influence the respondents' belief towards food safety. No significant difference was found between respondents' food safety beliefs and their length of stay in the U.S and employment in the food service industry.

No significant differences were found for self-reported food safety practices and sex, level of education, employment in the food industry, or the length of stay in the U.S. These results are supported by Farrish, Kitterlin, Hertzman and Stefneli (2009) who found no significance differences between practice and demographic variables. However, the findings are not consistent with Stein, Dirks and Quinlan (2010) findings who reported that females demonstrated greater safe food handling practices.

A one-way analysis of variance test was performed to assess differences between food safety knowledge, beliefs, and handling practices based on age, academic college, living accommodation, and frequency of food preparation. The results are presented in Table 4.8. No significant differences were found between knowledge and the age groups, living accommodations, or frequency of food preparation. However, food safety knowledge was significantly different ( $p = 0.000$ ) among the five academic colleges. Tukey's post hoc analysis revealed that the students who were majoring in degree programs within the College of Human Ecology had significantly higher mean scores on food safety knowledge ( $M = 61\%$ ,  $SD = 16$ ) than students in the Colleges of Business Administration ( $M = 36\%$ ,  $SD = 18$ ), Engineering ( $M = 38\%$ ,  $SD = 15$ ), Arts and Sciences ( $M = 43\%$ ,  $SD = 14$ ), and Agriculture ( $M = 47\%$ ,  $SD = 18$ ). The results support research by Unklesbay et al (1998) and Yarrow (2006) who found that



students majoring in nutrition and dietetics, food science, nutrition, and health majors had significantly higher scores on food safety than did students majoring in other disciplines.

Only age influenced respondents' beliefs towards food safety ( $p = 0.0130$ ). Tukey's HSD was used to determine the nature of the differences between the age groups. The analysis revealed that respondents in the age group 20 years and below had less positive beliefs toward food safety ( $M = 3.83$ ,  $SD = 0.51$ ) than respondents of age group 26 – 30 years ( $M = 4.31$ ,  $SD = 0.49$ ). No significant difference in belief was found between living accommodation, college major, and frequency of food preparation.

### **Conclusion and Implications**

This study provided insights into food safety knowledge, practices, and beliefs of international college students.

#### **Food Safety Knowledge**

Overall, international college students' food safety knowledge score (45%) is lower than food safety knowledge scores on college students (50-60%) (Bryd-Bredbenner, Maurer, Wheatley, Cottone, & Clancy, 2007; Gayaroa, Cordoba, Garcia-John, Snachez, & Vitas, 2005; Osborne, 2001). The majority of respondents had low scores on questions related to cooking foods adequately (26.6%), keeping foods at safe temperatures (27%), basic procedures for cleaning kitchen equipment (39.4%), identifying food with enough bacteria to cause contamination to cause sickness (35.6), risks for food contamination in the food flow (22%), and the minimum temperature required for cooked ground beef (15.9).

**Table 4. 8 Comparison of Demographic Factors with Knowledge, Beliefs, and Practices using One Way ANOVA (N = 132)**

Variables	Knowledge				Beliefs				Practices			
	M% <sup>b</sup>	SD	F	p <sup>c</sup>	M% <sup>b</sup>	SD	F	p <sup>c</sup>	M% <sup>b</sup>	SD	F	p <sup>c</sup>
<b>Age</b>												
20 and below	48	20	1.20	0.313	3.83	0.51 <sup>x</sup>	3.765	0.013*	3.41	0.38	1.34	0.265
21 – 25	42	18			4.02	0.63 <sup>y</sup>			3.50	0.49		
26 – 30	47	18			4.31	0.49 <sup>y</sup>			3.67	0.46		
31 – and above	49	17			4.10	0.51 <sup>y</sup>			3.56	0.44		
<b>Academic College</b>												
Human Ecology	61	16x	5.76	0.000*	4.21	0.52	2.375	0.056	3.71	0.46	0.63	0.643
Agriculture	47	18y			4.20	0.50			3.51	0.47		
Arts and Sciences	43	14y			4.07	0.59			3.59	0.51		
Engineering	38	15y			4.10	0.59			3.50	0.50		
Business Adm	36	18y			3.78	0.56			3.45	0.38		
<b>Accommodation</b>												
Off campus Apartments	48	18	.892	0.412	4.08	0.51	.041	0.960	3.61	0.46	2.62	0.078
Residence Hall	44	18			4.12	0.83			3.67	0.64		
On campus Apartments	43	18			4.10	0.56			3.41	0.35		
<b>Frequency of Food Preparation</b>												
Daily	49	16	1.31	0.272	4.13	0.54	1.2	0.292	3.56	0.43	0.80	0.528
2-3 Days a Week	47	15			4.22	0.72			3.62	0.53		
Weekly	48	14			4.21	0.56			3.65	0.46		
Monthly	45	20			4.06	0.54			3.53	0.43		
Never	38	18			3.90	0.41			3.39	0.46		

<sup>a</sup> Sample may not total 132 due to missing data

<sup>b</sup> Mean percentage knowledge score

\* P ≤ 0.05

Note: means with different superscripts (x,y series) differed significantly by Tukey's Post hoc test, p ≤ 0.05

Significant differences were found for knowledge scores and respondents who had food safety training indicating that food safety training improves food safety knowledge. International students in the College of Human Ecology had significantly higher mean scores on food safety knowledge than students in Colleges of Business Administration, Engineering, Arts and Sciences, and Agriculture.

No significant difference was found between food safety knowledge and sex of respondents between male and female respondents. Knowledge was not significantly different based on level of education, employment in the food industry, and the length of stay in the U.S.

### **Self –Reported Food Handling Practices**

Specific food safety behaviors that were less frequently practiced by respondents included: using a thermometer to determine if leftover foods were thoroughly reheated, using a thermometer to determine if meat as thoroughly cooked, and using a thermometer to determine the temperature of the refrigerator. They indicated using a hand towel that is available to others and using same cutting boards when preparing raw foods. No significant differences were found for self-reported food safety practices and demographic variables.

### **Food Safety Beliefs**

Most participants had strong beliefs towards following food safety practices, refrigerating food in the refrigerator overnight, washing hands with warm soapy water for 20 seconds, serving safe foods to others cooking eggs until the yolks were firm, cleaning counter tops and cutting boards after preparing raw meat or chicken, and learning more about food safety. On the other hand, respondents had less positive beliefs regarding using disposable towels, keeping the refrigerator below 40°F, and concern relating to getting sick if they ate raw fish.

Significant differences were found between belief and sex, level of education, and training. Female respondents had food safety beliefs that indicated they were more inclined towards good food safety standards than male respondents. Students who had completed food safety training had more positive food safety beliefs than students who did not have any training. No significant difference was found between respondents' food safety beliefs and their length of stay in the U.S and employment in the food service industry. Younger adults (20 years or below) had less positive belief toward food safety. No significant differences were found between food safety beliefs and the length of stay in U.S. and employment in the food industry.

### **Conclusion**

Results of this study are similar to the findings of other studies that target college students. Findings have indicated that international college students have a problem with adequately practicing behaviors related to preventing cross contamination, keeping foods at safe temperatures, and cooking foods adequately. The study has shown that younger college students have less positive beliefs towards food safety. The study has also shown significant differences between students in the college of Human Ecology and other colleges.

The study has been useful in providing baseline data regarding the food safety knowledge, beliefs, and self-reported handling practices of international college students, a group that is increasingly becoming important to reach because of their current and future roles as part of the entire U.S. population. It has offered some insights regarding how international college students' beliefs have influenced practice. For instance, most international college students who indicated having less positive beliefs in using disposable towels also indicated using a towel that is available to others to dry hands.

## **Implications for International College Students at K-State**

This study asked whether participants had interest in learning more about food safety. Since interest in learning more about food safety existed among participants, food safety educators should take advantage of participants' desire since their willingness is likely to produce positive results.

Food safety educators need to evaluate the type of training international participants receive in order for them to increase their knowledge of food safety, improve food safety practices, and address beliefs that may be deterrent to food safety principles. This study asked participants about their belief in using disposable towels. Most participants indicated having less positive beliefs in using disposable towels.

Since this study found a positive relationship between participants who had completed food safety training and food safety practices, food safety educators have a responsibility of training participants from other colleges about food safety. Results indicated significant differences between students in the college of Human Ecology and other colleges.

## **Limitations and Recommendations**

The study was limited by the use of convenience sampling. Since this type of sampling was used in the study, it may not be representative of the entire population. Another limitation of this study is based on the use of self-reported data, which is susceptible to social desirability bias.

This study therefore suggests further research to explore international college student beliefs regarding food safety. In addition, further research that investigates actual behavior of international college students should be done. This observational approach should be conducted in a normal kitchen environment. Food safety training programs should be taught among international college students of colleges that do not offer food safety training.

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## **CHAPTER 5 – Summary and Conclusions**

Although many studies have been conducted regarding food safety knowledge and handling practices in general, few studies focus on college students. Fewer studies have been conducted on international college students described in this study. The purpose of this study was to investigate the self-reported handling practices of international college students regarding food safety issues. The study also explored international college students' food safety knowledge and beliefs about self-reported food handling practices.

A list of all international college students at a mid western university was obtained from the International Students Scholar Office in the spring of 2010. Total enrollment of 1,519 for this time period was international college students (International Students Scholar office, 2010). Both undergraduate and graduate students were included in the study. A four-part self administered questionnaire was administered to international college students about food safety knowledge, beliefs, current food handling practices, and demographic information. A total of 237 (15.6%) international college students responded to the survey. After discarding 91 incomplete responses, 146 (9.6%) usable surveys remained.

### **Major Findings**

#### **Food Safety Knowledge**

Overall, the mean percentage of correct responses was 45%. Only 15.5% of the respondents obtained scores of greater than 70%. The majority of the respondents (83.6%) obtained scores less than 69%, 10.9% obtained scores between 61-70, and 4.7% obtained scores between 71- 80. Only one (0.8%) respondent obtained a score of  $\geq 80\%$ . International college students' mean scores were lower than scores reported by Osborne (2001) and Bryd-Bredbenner et al. (2007). The researchers also found out that college students reported less than optimal food

safety knowledge scores of 50-60%. Over-two thirds of the respondents correctly answered questions related to the following: practicing proper personal hygiene (69.7%) and preventing cross contamination (60.35%). Participants' scores on specific questions related to cross contamination varied widely. The majority of the respondents correctly answered questions related to the practice most likely to result to cross contamination (76.5%). However, international students' knowledge of basic procedures for cleaning kitchen equipment (39.4%), identifying food with enough bacteria to cause contamination to cause sickness (35.6), and risks for food contamination in the food flow (22%) was low. Approximately 25% of the respondents did not correctly answer questions related to cooking foods adequately (26.6%) and keeping foods at safe temperatures (27%). The question with the lowest score was related to the minimum temperature required to cook ground beef. Only 15.9% of the respondents answered it correctly, 47.7% selected 180°F as the correct answer.

### **Self-Reported Food Safety Handling Practices**

Overall, most respondents more frequently practiced personal hygiene behaviors (4.42), and behaviors associated with avoiding foods from unsafe sources (3.97). The risky food safety behaviors practiced by respondents were: preventing cross contamination (3.51), keeping foods at safe temperatures (3.43), and cooking foods adequately (2.41). Specific food safety behaviors that were practiced most frequently were: washing a plate used for raw meat, chicken, or seafood before putting cooked food on the plate or using a clean plate (4.64), and washing hands with soap and water after touching raw meat, chicken, or fish before preparing and cooking food (4.41). Specific behaviors that were less frequently practiced included: using a thermometer to determine if leftover foods were thoroughly reheated (1.61), using a thermometer to determine if meat as thoroughly cooked (1.92), using a thermometer to determine the

temperature of the refrigerator (1.98), drying hands using a hand towel that is available to others (2.67), and using separate cutting boards when preparing raw foods (3.22).

### **Food Safety beliefs**

The overall mean was  $3.51 \pm 0.46$ . A mean score of greater than 3.51 was considered positive. Most participants had a positive beliefs towards following food safety practices; refrigerating food in the refrigerator overnight (4.30), washing hands with warm soapy water for 20 seconds (3.91), serving safe foods to others (4.17), cooking eggs until the yolks were firm (3.66), cleaning counter tops and cutting boards after preparing raw meat or chicken (4.46), and learning more about food safety (3.98). They demonstrated less positive beliefs regarding using disposable towels (2.87), keeping the refrigerator below 40°F (2.47), and concern relating to getting sick from eating raw fish (2.58).

### **Correlation between Food Safety Knowledge and Self-Reported Handling Practices**

A Pearson correlation coefficient was calculated to assess the relationship between the four knowledge and handling practices categories. Overall, a weak positive correlation was found ( $r = 0.210$ ,  $p < 0.05$ ), indicating that an increase in food safety knowledge tends to improve food safety practices.

### **Correlation between Food Safety Beliefs and Self-Reported Handling Practices**

A Pearson correlation coefficient calculated for the relationship between average food safety belief score and average self-reported food safety practices score found a strong positive correlation ( $r = 0.611$ ,  $p < 0.001$ ). Results indicated a positive linear relationship between the two variables. The findings indicated that the more respondents had positive beliefs related to food safety the more positive their food safety practices were.

## **Demographic Factors and Food Safety Knowledge, Self-Reported Handling Practices, and Beliefs**

Significant difference was found between male and female beliefs towards food safety. Female respondents ( $M = 4.20$ ) had food safety beliefs that were more inclined towards good food safety standards than male respondents ( $M = 3.98$ ). Graduate students had more positive food safety beliefs than undergraduates ( $M = 4.16$ ,  $SD = 0.55$ ;  $p = 0.032$ ). Students who had completed food safety training had more positive food safety beliefs ( $M = 4.28$ ,  $SD = 0.57$ ) than students who did not have any training ( $p = 0.020$ ). The results showed that food safety training can influence the respondents' beliefs towards food safety. Students who were majoring in a degree program within the college of Human Ecology had significantly higher mean scores on food safety knowledge than other colleges.

### **Conclusions and Recommendations**

Results of this study are similar to the findings of other studies that target college students. Findings have indicated that K-State University international students have a problem with adequately practicing behaviors related to preventing cross contamination, keeping foods at safe temperatures and cooking foods adequately. The study has shown that younger K-State University International students have less positive beliefs towards food safety. The study has also shown significant differences between students in the college of Human Ecology and other colleges.

The study has been useful in providing baseline data regarding the food safety knowledge, beliefs, and self-reported handling practices of K-State international students, a group that is increasingly becoming important to reach because of their current and future roles as part of the entire U.S. population. It has offered some insights regarding how international college students' beliefs have influenced practice. For instance, most international college



students who indicated having less positive beliefs in using disposable towels also indicated using a towel that is available to others to dry hands.

### **Implications for International College Students at K-State**

This study asked whether participants had interest in learning more about food safety. Since interest in learning more about food safety existed among participants, food safety educators should take advantage of participants' desire since their willingness is likely to produce positive results. Food safety educators need to therefore develop training materials for international participants in order for them to increase their knowledge of food safety, improve food safety practices, and address beliefs that may be deterrent to food safety principles. This study asked participants about their belief in using disposable towels. Most participants indicated having less positive beliefs in using disposable towels.

Since this study found a positive relationship between participants who had completed food safety training and food safety practices, food safety educators have a responsibility of training participants from other colleges about food safety. Results indicated significant differences between students in the college of Human Ecology and other colleges.

### **Limitations and Recommendations**

The study was limited by the use of convenience sampling. Since this type of sampling was used in the study, it may not be representative of the entire population. Another limitation of this study is based on the use of self-reported data, which is susceptible to social desirability bias. Studies that have measured actual behavior have found different results (Kwon, Roberts, & Shanklin, 2009)

This study therefore suggests further research to explore international college student beliefs regarding food safety. In addition, further research that investigates actual behavior of international college students should be done. This observational approach should be conducted

in a normal kitchen environment. Food safety training programs should be taught among international college students of colleges that do not offer food safety training.

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## **Appendix A- Adapted Instrument**

**Food Safety Knowledge, Beliefs, and Handling Practices of  
International College Students at  
Kansas State University**



**Department of Hospitality Management & Dietetics  
104 Justin Hall Manhattan, KS 66502**

**Dear International Student,**

My name is Caleb Angolo, a graduate student in the College of Human Ecology at Kansas State University. I am conducting a study to determine food safety issues among international college students at K-State. As an international college student, I am particularly concerned with the high rate of foodborne illness outbreaks involving ethnic restaurants and restaurants employing ethnic employees. Given that international college students are a microcosm of ethnic employees, your contribution to this study will be useful in helping restaurant managers and researchers better understand ethnic employees.

Below, you will be asked to respond to questions about your beliefs and knowledge of performing behaviors relating to food safety practices. ***Please carefully read each question and do not leave any items blank.*** By completing this survey, consent to be included in the research is understood. Your participation is voluntary, refusal to participate will involve no penalty and you may discontinue participation at any time without penalty. Individual responses will be completely anonymous. Please be assured that your responses will be confidential and all data will be reported as group data.

Your response is very important to the success of this study and to the quality of future food safety education. Should you have any questions about the study, please contact Caleb Angolo at (785) 410-9024 or Dr. Kevin R. Roberts at (785) 532-2399. If you have any questions about the rights of individuals in this study or about the way it is conducted, you may contact the University Research Compliance Office at (785) 532-3224. Thank you for your time and assistance.

Cordially,

**Caleb M. Angolo**  
Graduate Student  
Dept. of Hospitality  
Management & Dietetics

**Kevin R. Roberts, PhD**  
Assistant Professor  
Dept. of Hospitality  
Management & Dietetics

## Section I: Food Safety Knowledge

**Instructions:** Please read each question carefully and select all one correct answer for each statement.

- 1. Risks for food contamination exist:**
  - a. at each step in the flow of food
  - b. only during preparation and service of food.
  - c. only with potentially hazardous food.
  - d. only when leftover foods are used.
  
- 2. Food with enough bacterial contamination to cause foodborne illness in susceptible persons:**
  - a. have a color that is not characteristic of food.
  - b. have a distinctive smell.
  - c. cannot be identified by sight or smell.
  - d. can be identified by sight or smell if contamination levels are high enough.
  
- 3. The temperature danger zone is:**
  - a. 32°F and 180°F
  - b. 40°F and 140°F
  - c. 41°F and 135°F
  - d. 41°F and 145°F
  
- 4. Raw meat that is thawing should be stored:**
  - a. on the top shelf of the refrigerator.
  - b. on the middle shelf of the refrigerator.
  - c. on the bottom shelf of the refrigerator.
  - d. Any shelf in the refrigerator is acceptable.
  
- 5. Poultry is safe to serve if the internal temperature is:**
  - a. 140°F
  - b. 155°F
  - c. 165°F
  - d. 180°F
  
- 6. Previously cooked foods must be thoroughly reheated to:**
  - a. 140°F
  - b. 155°F
  - c. 165°F
  - d. 180°F

- 7. When contaminated, hands should be washed by**
- Rinsing under warm water with soap for at least 10 seconds
  - Washing with soap and cool water for at least 10 seconds
  - Rising under warm water for at least 20 seconds
  - Washing with soap and warm water for at least 20 seconds
- 8. The basic procedure for cleaning utensils and other kitchen equipment is to:**
- Rinsing under warm water with soap for at least 20 seconds
  - Rinsing under hot water with soap for at least 20 seconds
  - Wash with hot soapy water after preparing each food item and before moving on to the next food.
  - Wash with warm soapy water after preparing each food item and before moving on to the next food.
- 9. The practice most likely to result in foodborne illness is:**
- Cleaning and sanitizing cutting boards after cutting raw poultry.
  - Serving cooked chicken with a pair of tongs.
  - Breading raw chicken using clean disposable gloves, then refrigerating the chicken until the chicken is ready to be cooked.
  - Using a cutting board to cut raw chicken for grilling, then to shred lettuce for a salad.
- 10. Ground beef must be cooked to a minimum temperature of**
- 140°F
  - 155°F
  - 165°F
  - 180°F



## Section II: Current Food Safety Practices

**Instructions:** Please select the number that represents what you do now; circling 0 means you “never do” and 4 means you “always do”, and 5 means it does not apply to you.

	Never (0%)	Rarely (≤ 30%)	Sometim es (30%- 70%)	Most of the time (71%- 89%)	Always (100%)	Does Not Apply to Me
1. Before preparing or handling food, I wash hands with soap and warm water.	0	1	2	3	4	5
2. If I have a cut or sore on my hand, I cover it before preparing food	0	1	2	3	4	5
3. I wash my hands with soap and water after touching raw beef, poultry, or seafood my hands before I continue cooking.	0	1	2	3	4	5
4. I wash a plate used for raw meat, poultry, or seafood before putting cooked food on the plate OR I use a clean plate.	0	1	2	3	4	5
5. I use the same cutting board when preparing raw meats, poultry, sea foods and vegetables.	0	1	2	3	4	5
6. I put frozen meat and poultry on the counter in the morning so that it will be thawed and ready to cook in the evening.	0	1	2	3	4	5
7. I leave cooked foods, such as rice and beans, overnight on the counter to be used the next day.	0	1	2	3	4	5
8. I store my eggs at room temperature.	0	1	2	3	4	5
9. I use hot, soapy water to clean my countertops after preparing food.	0	1	2	3	4	5
10. I use a thermometer to determine the temperature of the refrigerator.	0	1	2	3	4	5
11. I use a thermometer to determine if meat, poultry, and/or seafood are	0	1	2	3	4	5

thoroughly cooked.						
12. I use a thermometer to determine if leftovers have been reheated thoroughly.	0	1	2	3	4	5
13. I eat eggs with runny yolk or products containing raw eggs.	0	1	2	3	4	5
14. I throw away refrigerated leftovers after 3-4 days	0	1	2	3	4	5
15. When buying food I check the “sell by” and “use by ” dates.	0	1	2	3	4	5

### Section III: Food Safety Beliefs

**Instructions:** Please select the number that best represents your opinion; circling 1 means you “Strongly Disagree” and 5 means you “strongly agree”.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Trying to following proper food safety practices is important to me.	1	2	3	4	5
2. Refrigerating food overnight to serve the following day is important.	1	2	3	4	5
3. Washing my hands with warm soapy water for at least 20 seconds is a priority for me.	1	2	3	4	5
4. I do not worry about keeping the refrigerator below 40°F.	1	2	3	4	5
5. I am not interested in using a thermometer to find out if food is fully cooked.	1	2	3	4	5
6. Cooking and eating eggs that have firm yolks and whites is important for food safety.	1	2	3	4	5
7. It is important to wash countertops, utensils and cutting boards after preparing raw meat or poultry.	1	2	3	4	5
8. I am not concerned if I thaw perishable food on the kitchen counter.	1	2	3	4	5
9. Using cheese and yogurt made only from pasteurized milk is important to me.	1	2	3	4	5
10. I am not concerned that I may get sick if I eat raw oysters or fish.	1	2	3	4	5
11. I am worried that I may get sick if I eat hot dogs right out of the package	1	2	3	4	5
12. I don't worry that I may get sick if I eat alfalfa and other raw sprouts	1	2	3	4	5

#### **Section IV: Demographic Information**

**Instructions:** Please answer each of the following questions about yourself. This information will be used for research purposes only.

1. **What is your gender?**
  - A. Male
  - B. Female
  
2. **What is your age?** \_\_\_\_\_
  
3. **What is your country of origin?** \_\_\_\_\_
  
4. **Which of the following best describes your highest completed educational level?**
  - A. Freshman (*less than 30 credit hours completed*)
  - B. Sophomore (*between 30 and 59 credit hours completed*)
  - C. Junior (*between 60 and 89 credit hours completed*)
  - D. Senior (*90 or greater credit hours completed*)
  - E. Master's Student
  - F. Doctoral Student/Candidate
  
5. **Which best describes your living accommodations?**
  - A. Residence Hall
  - B. University Housing
  - C. Off-campus Housing
  - D. Other (please Specify) \_\_\_\_\_
  
6. **What college is your major area in?**
  - A. College of Agriculture
  - B. College of Architecture, Planning and Design
  - C. College of Arts and Sciences
  - D. College of Business Administration
  - E. College of Education
  - F. College of Engineering
  - G. College of Human Ecology
  - H. College of Technology and Aviation
  - I. College of Veterinary Medicine
  - J. Graduate School
  
7. **Have you ever had any formal food safety training and/or education?**
  - A. Yes
  - B. No
  
8. **How many years (combined) have you lived in the United States?**  
\_\_\_\_\_

## **Appendix B – Permission Letters**

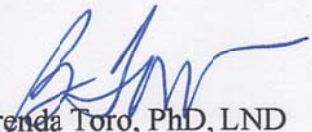
November 1<sup>st</sup>, 2010

Caleb Angolo  
152 Justin Hall  
Kansas State University  
Manhattan, KS 66506

Dear Mr. Angolo:

I am writing this letter to grant permission to use the questionnaire developed for my thesis, entitled "*Food safety knowledge, attitudes, and behaviors of restaurants employees in San Juan, Puerto Rico,*" in your study. This permission allows you to recreate the questionnaire and to revise it to specifically meet your research needs. I do request that you properly cite the source in your thesis.

Cordially,



Brenda Toro, PhD, LND  
Assistant Professor / Assistant Director  
Didactic Program in Dietetics  
University of Puerto Rico  
College of Natural Sciences  
PO Box 23341  
San Juan, PR 00931-3341

Kelly J. Whitehair  
Van Zile Dining Center  
104 Pittman Building  
Kansas State University  
Manhattan, KS 66506

Caleb Angolo  
152 Justin Hall  
Kansas State University  
Manhattan, KS 66506

Dear Caleb,

I am writing this letter to grant you permission to use the questionnaire developed for my thesis, entitled "*Food Handling Practices and Barriers to Improving These Practices in Independent Living Older Adults in Kansas*," in your study. This permission allows you to recreate the questionnaire and to revise it to specifically meet your research needs. I do request that you properly cite the source in your thesis.

Cordially,

  
Kelly J. Whitehair

## **Appendix C – Focus Groups Confirmation Letter**



## **Focus Group Confirmation Letter**

November 11, 2009

Dear \_\_\_\_\_,

Thank you for your willingness to participate in our focus group. As discussed on the phone, we would like to hear your opinion regarding a survey instrument to use to collect data from International College Students. You will be in a group with six. Your responses to the questions will be kept confidential. The date, time, and place are listed below.

DATE

TIME

PLACE

If you need directions to the focus group or will not be able to attend for any reason please call \_\_\_\_\_.  
Otherwise I look forward to seeing you.

Sincerely,

Caleb Mwakha Angolo

Moderator

## **Appendix D – Focus group question guide**

## **Focus Group Question Guide**

### **WELCOME**

Thanks for agreeing to be part of the focus group. We appreciate your willingness to participate.

### **INTRODUCTIONS**

#### **Moderator**

### **PURPOSE OF FOCUS GROUPS**

I am conducting this focus groups to refine this survey instrument that I am about to send out for piloting. I need your input and want you to share your honest and open thoughts.

### **GROUND RULES**

#### **1. WE WANT YOU TO DO THE TALKING.**

We would like everyone to participate.

I may call on you if I haven't heard from you in a while.

#### **2. THERE ARE NO RIGHT OR WRONG ANSWERS**

Every person's experiences and opinions are important.

Speak up whether you agree or disagree.

We want to hear a wide range of opinions.

#### **3. WHAT IS SAID IN THIS ROOM STAYS HERE**

We want folks to feel comfortable sharing when sensitive issues come up.

#### **4. WE WILL BE TAPE RECORDING THE GROUP**

We want to capture everything you have to say.

We don't identify anyone by name in our report. You will remain anonymous.

### **Guiding Questions**

1. How do you find the meaning of words used in each of the four parts of the Instrument?
2. How do you find the meaning of the statements used in each of the four parts of the instruments
3. Is there a difference in some of the practices indicated in the instrument what you practice
4. What is your feeling on food safety
5. Is there anything else you would like to say about food safety?

This concludes our meeting. Thank you for your contributions. Have a good evening.

## **Appendix E – Refined Research Instrument after the having Focus Groups**

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## AXIO SURVEY

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### Food Safety Knowledge, Beliefs, and Handling Practices of International College Students at Kansas State University

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#### Survey Description

My name is Caleb Angolo, a graduate student in the College of Human Ecology at Kansas State University. I am conducting a study to determine food safety issues among international college students at K-State. As an international college student, I am particularly concerned with the high rate of foodborne illness outbreaks involving ethnic restaurants and restaurants employing ethnic employees. Given that international college students have food safety behaviors beliefs that have been influenced by our upbringing, this study will be useful in helping researchers to identify such behaviors and come up with interventions that will best address them.

Below, you will be asked to respond to questions about your beliefs and knowledge of performing behaviors relating to food safety practices. Please carefully read each question and do not leave any items blank. By completing this survey, consent to be included in the research is understood. Your participation is voluntary, refusal to participate will involve no penalty and you may discontinue participation at any time without penalty. Individual responses will be completely anonymous. Please be assured that your responses will be confidential and all data will be reported as group data.

Your response is very important to the success of this study and to the quality of future food safety education. Should you have any questions about the study, please contact Caleb Angolo at (785) 410-9024 or Dr. Kevin R. Roberts at (785) 532-2399. If you have any questions about the rights of individuals in this study or about the way it is conducted, you may contact the University Research Compliance Office at (785) 532-3224. Thank you for your time and assistance.

Cordially,

Caleb M. Angolo  
Graduate Student  
Dept. of Hospitality  
Management & Dietetics

Kevin R. Roberts, PhD  
Assistant Professor  
Dept. of Hospitality  
Management & Dietetics

## Opening Instructions

Please answer all questions honestly. The survey should take only 15 minutes of your time.

Page 1

---

Question 1 \*\* required \*\*

---

Are you currently an international undergraduate OR graduate student at Kansas State University?

- No
- Yes

Page 2

---

Question 2

---

---

### Section I: Food Safety Knowledge

**Instructions:** Please read each question carefully and select only one correct answer for each statement.

---

Question 3

---

#### **Risks for food contamination exist:**

- at each step in the flow of food (Flow of food describes what happens to food from the time you buy it until it is served).
- only during preparation and service of food.
- only with potentially hazardous food (Potentially hazardous food is food that requires special care to keep it safe as long as possible).
- only when leftover foods are used.

Question 4 \*\* required \*\*

---

#### **Food with enough bacterial contamination to cause sickness in susceptible persons:**

- have a color that is not characteristic of food.
- have a distinctive smell.
- cannot be identified by sight or smell.

- can be identified by sight or smell if contamination levels are high enough.

Question 5 \*\* required \*\*

---

**The temperature danger zone is (the temperature danger zone is the most favorable temperatures for rapid growth of bacteria):**

- 32°F and 180°F (0°C and 82°C)  
 40°F and 140°F (4°C and 60°C)  
 41°F and 135°F (5°C and 57°C)  
 41°F and 145°F (5°C and 63°C)

Question 6 \*\* required \*\*

---

**Raw meat that is defrosting should be stored:**

- on the top shelf of the refrigerator.  
 on the middle shelf of the refrigerator.  
 on the bottom shelf of the refrigerator.  
 Any shelf in the refrigerator is acceptable.

Question 7

---

**Chicken is safe to serve if the internal temperature is:**

- 140°F (60°C)  
 155°F (68°C)  
 165°F (74°C)  
 180°F (82°C)

Question 8

---

**Previously cooked left over foods must be thoroughly reheated to:**

- 140°F (60°C)  
 155°F (68°C)  
 165°F (74°C)  
 180°F (82°C)

Question 9

---

**When dirty, hands should be washed by**

- Rinsing under warm water with soap for at least 10 seconds.  
 Washing with soap and cool water for at least 10 seconds.

- Rinsing under warm water for at least 20 seconds.
- Washing with soap and warm water for at least 20 seconds.

Question 10

---

**The basic procedure for cleaning pots, pans, silverware, and other kitchen equipment is to:**

- Rinsing under warm water with soap for at least 20 seconds
- Rinsing under hot water with soap for at least 20 seconds
- Wash with hot soapy water after preparing each food item and before moving on to the next food.
- Wash with warm soapy water after preparing each food item and before moving on to the next food.

Question 11

---

**The practice most likely to result in sickness from food is:**

- Cleaning and sanitizing cutting boards after cutting raw chicken.
- Serving cooked chicken with a pair of tongs.
- Breeding raw chicken using clean disposable gloves, then refrigerating the chicken until the chicken is ready to be cooked.
- Using a cutting board to cut raw chicken for grilling, then to shred lettuce for a salad.

Question 12

---

**Ground beef must be cooked to a minimum temperature of**

- 140°F (60°C)
  - 155°F (68°C)
  - 165°F (74°C)
  - 180°F (82°C)
- 
-



**Section II: Current Food Safety Practices**

**Instructions:** Please select the number that represents what you do now; circling 0 means you “never do” and 4 means you “always do”, and 5 means it does not apply to you.

Question 13

1 - Never (0%) | 2 - Rarely (≤ 30%) | 3 - Sometimes (30%-70%)  
 4 - Most of the time (71%-89%) | 5 - Always (100%) | 6 - Does Not Apply to Me

	1	2	3	4	5	6
13.1 Before preparing or handling food, I wash my hands with soap and warm water.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.2 If I have a cut or sore on my hand, I cover it before preparing food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.3 After washing my hands, I dry them using a hand towel that is available.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.4 I wash my hands with soap and water after touching raw meat, chicken, or fish before preparing and cooking food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.5 I wash a plate used for raw meat, chicken, or seafood before putting cooked food on the plate OR I use a clean plate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.6 I use the same cutting board when preparing raw meats, chicken, fish and vegetables.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.7 I put frozen meat and chicken on the counter in the morning so that it will defrost and be ready to cook in the evening.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.8 I leave cooked foods, such as rice and beans, overnight on the countertop to be used the next day.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.9 I store my eggs at room temperature.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.10 I use hot, soapy water to clean my countertops after preparing food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.11 I use a thermometer to determine the temperature of the refrigerator.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.12 I use a thermometer to determine if meat, chicken, and/or fish are thoroughly cooked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.13 I use a thermometer to determine if leftovers have been reheated thoroughly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.14 I eat eggs with runny yolk or products containing raw eggs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13.15 I throw away refrigerated leftovers after 3-4 days	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.16 When buying food I check the “sell by” and “use by ” dates.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Section III: Food Safety Beliefs

**Instructions:** Please select the number that best represents your opinion; circling 1 means you “Strongly Disagree” and 5 means you “strongly agree”.

Question 14 \*\* required \*\*

1 - Strongly Disagree | 2 - Disagree | 3 - Neutral | 4 - Agree  
5 - Strongly Agree

	1	2	3	4	5
14.1 Trying to follow proper food safety practices is important to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.2 Refrigerating food overnight to serve the following day is important.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.3 It is important for me to dry my hands with a hand towel that is available.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.4 Washing my hands with warm soapy water for at least 20 seconds is a priority for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.5 I am confident I can serve safe foods to others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.6 I do not worry about keeping the refrigerator below 40°F (4°C).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.7 I am not interested in using a thermometer to find out if food is fully cooked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.8 Cooking and eating eggs that have firm yolks and whites is important for food safety.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.9 It is important to wash countertops, utensils and cutting boards after preparing raw meat or chicken.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.10 I am concerned if I defrost frozen food on the kitchen counter.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.11 Using cheese and yogurt made only from pasteurized (Processed) milk is important to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.12 I am not concerned that I may get sick if I eat raw oysters or	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

fish.					
14.13 I am interested in learning more about food safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 14

---

**Section IV: Demographic Information**

**Instructions:** Please answer each of the following questions about yourself. This information will be used for research purposes only.

---

Question 15

**What is your gender?**

- Male  
 Female

Question 16

**What is your age?**

Characters Remaining:

Question 17

**Which of the following best describes your current educational level?**

- English language program  
 Freshman (0 to 30 credit hours completed)  
 Sophomore (between 30 and 59 credit hours completed)  
 Junior (between 60 and 89 credit hours completed)  
 Senior (90 or greater credit hours completed)  
 Master's Student  
 Doctoral Student/Candidate

Question 18 \*\* required \*\*

**Which best describes your living accommodations?**

- Residence Hall  
 Jardine Apartments  
 Off-campus Housing

Other:

Question 19

---

**What college is your major area in?**

- College of Agriculture
- College of Architecture, Planning and Design
- College of Arts and Sciences
- College of Business Administration
- College of Education
- College of Engineering
- College of Human Ecology
- College of Technology and Aviation
- College of Veterinary Medicine

Question 20

---

**Have you ever had any formal food safety training and/or education?**

- Yes
- No

Question 21

---

**Have you ever been employed in a foodservice industry**

- Yes
- No

Question 22

---

**How many years (combined) have you lived in the United States?**

Characters Remaining:

Question 23

---

**How often do you prepare food for other people?**

- Daily
- 2 - 3 days a week

- Weekly
- Monthly
- Never

Question 24

---

**What meals do you prepare ? (Answer all that apply)**

- Breakfast
- Lunch
- Dinner
- Other:

Question 24

---

### **Pilot Test Questionnaire**

---

Question 25

---

How many minutes did it take you to complete the survey?

Characters Remaining:

Question 25

---

Did the cover letter provide a clear understanding of the purpose of the study?

- Yes
- No

---

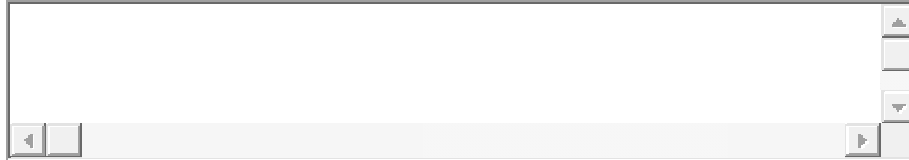
Fill out this page only if you answered:

- No on question 25. Did the cover letter provide a cle.. on page 7 .
- AND Yes on question 1. Are you currently an international.. on page 1 .

Question 26

---

If your answer is "No", please explain.



Characters Remaining:

---

Fill out this page only if you answered:

- Yes OR No on question 25. Did the cover letter provide a cle.. on page 7 .
- AND Yes on question 1. Are you currently an international.. on page 1 .

Question 27

---

Are the instructions for completing the survey clear?

- Yes
- no

---

Fill out this page only if you answered:

- no on question 27. Are the instructions for completin.. on page 9 .
- AND Yes on question 1. Are you currently an international.. on page 1 .

Question 28

---

If your answer is "No", please explain.



Characters Remaining:

---

Fill out this page only if you answered:

- Yes on question 27. Are the instructions for completin.. on page 9 .
- AND Yes on question 1. Are you currently an international.. on page 1 .

### Question

Are the questions clearly stated?

Yes

No

Fill out this page only if you answered:

- No on question 29. Are the questions clearly stated? on page 11 .
- AND Yes on question 1. Are you currently an international.. on page 1 .

### Question 30

If your answer is "No", please explain.

Characters Remaining:

Fill out this page only if you answered:

- Yes OR No on question 29. Are the questions clearly stated? on page 11 .
- AND Yes on question 1. Are you currently an international.. on page 1 .

### Question 31

Please provide any additional comments or suggestions below.

Characters Remaining:

Thank you for your time and interest in this study. Unfortunately, we are only looking for International students at this time.

If you would like a summary of the results, please contact Mr. Caleb M. Angolo at [mwakha@ksu.edu](mailto:mwakha@ksu.edu).

---

Closing Message

Thank you for your participation. If you would like a summary of the results, please contact Mr. Caleb M. Angolo at [mwakha@ksu.edu](mailto:mwakha@ksu.edu).

- End of Survey -

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## **Appendix F – Project Approval**



University Research  
Compliance Office  
203 Fairchild Hall  
Lower Mezzanine  
Manhattan, KS 66506-1103  
785-532-3224  
Fax: 785-532-3278  
[www.k-state.edu/research/comply](http://www.k-state.edu/research/comply)

TO: Kevin Roberts  
HMD  
104 Justin

Proposal Number: 5429

FROM: Rick Scheidt, Chair  
Committee on Research Involving Human Subjects

DATE: April 7, 2010

RE: Proposal Entitled, "Food Safety Knowledge, Attitudes and Handling Practices of International College students at KSU"

The Committee on Research Involving Human Subjects / Institutional Review Board (IRB) for Kansas State University has reviewed the proposal identified above and has determined that it is EXEMPT from further IRB review. This exemption applies only to the proposal - as written - and currently on file with the IRB. Any change potentially affecting human subjects must be approved by the IRB prior to implementation and may disqualify the proposal from exemption.

Based upon information provided to the IRB, this activity is exempt under the criteria set forth in the Federal Policy for the Protection of Human Subjects, **45 CFR §46.101, paragraph b, category: 2, subsection: ii.**

Certain research is exempt from the requirements of HHS/OHRP regulations. A determination that research is exempt does not imply that investigators have no ethical responsibilities to subjects in such research; it means only that the regulatory requirements related to IRB review, informed consent, and assurance of compliance do not apply to the research.

Any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Committee on Research Involving Human Subjects, the University Research Compliance Office, and if the subjects are KSU students, to the Director of the Student Health Center.

## **Appendix G – Pilot Study Questionnaire**

**Pilot Study Questionnaire**

1. How long did it take you to complete the survey?

2. Did the cover letter provide a clear understanding of the purpose of the study?

Yes

No, Please Explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

3. Are the instructions for completing the survey clear?

Yes

No, Please Explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

4. Are the questions clearly stated?

Yes

No, Please Explain: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

5. Please provide any additional comments or suggestions below.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Thank you for your time and assistance!**

## **Appendix H – Final Questionnaire**

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## AXIO SURVEY

---

---

### Food Safety Knowledge, Beliefs, and Handling Practices of International College Students at Kansas State University

---

#### Survey Description

My name is Caleb Angolo, a graduate student in the College of Human Ecology at Kansas State University. I am conducting a study to determine food safety issues among international college students at K-State. As an international college student, I am particularly concerned with the high rate of foodborne illness outbreaks involving ethnic restaurants and restaurants employing ethnic employees. Given that international college students have food safety behaviors beliefs that have been influenced by our upbringing, this study will be useful in helping researchers to identify such behaviors and come up with interventions that will best address them.

Below, you will be asked to respond to questions about your Beliefs and knowledge of performing behaviors relating to food safety practices. Please carefully read each question and do not leave any items blank. By completing this survey, consent to be included in the research is understood. Your participation is voluntary, refusal to participate will involve no penalty and you may discontinue participation at any time without penalty. Individual responses will be completely anonymous. Please be assured that your responses will be confidential and all data will be reported as group data.

Your response is very important to the success of this study and to the quality of future food safety education. Should you have any questions about the study, please contact Caleb Angolo at (785) 410-9024 or Dr. Kevin R. Roberts at (785) 532-2399. If you have any questions about the rights of individuals in this study or about the way it is conducted, you may contact the University Research Compliance Office at (785) 532-3224. Thank you for your time and assistance.

Cordially,

Caleb M. Angolo  
Graduate Student  
Dept. of Hospitality  
Management & Dietetics

Kevin R. Roberts, PhD  
Assistant Professor  
Dept. of Hospitality  
Management & Dietetics

## Opening Instructions

Please answer all questions honestly. The survey should take only 15 minutes of your time.

Page 1

---

Question 1 \*\* required \*\*

---

Are you currently an international undergraduate OR graduate student at Kansas State University?

- No
- Yes

Page 2

---

Fill out this page only if you answered:

- Yes on question 1. Are you currently an international on page 1 .

Question 2

---

---

### Section I: Food Safety Knowledge

**Instructions:** Please read each question carefully and select only one correct answer for each statement.

---

Question 3

---

**Risks for food contamination exist:**

- at each step in the flow of food (Flow of food describes what happens to food from the time you buy it until it is served).
- only during preparation and service of food.
- only with potentially hazardous food (Potentially hazardous food is food that requires special care to keep it safe as long as possible).
- only when leftover foods are used.

Question 4

---

**Food with enough bacterial contamination to cause sickness in susceptible persons:**

- have a color that is not characteristic of food.

- have a distinctive smell.
- cannot be identified by sight or smell.
- can be identified by sight or smell if contamination levels are high enough.

Question 5

---

**The temperature danger zone is (the temperature danger zone is most favorable temperatures for rapid growth of pathogens):**

- 32<sup>0</sup>F and 180<sup>0</sup>F (0<sup>0</sup>C and 82<sup>0</sup>C)
- 40<sup>0</sup>F and 140<sup>0</sup>F (4<sup>0</sup>C and 60<sup>0</sup>C)
- 41<sup>0</sup>F and 135<sup>0</sup>F (5<sup>0</sup>C and 57<sup>0</sup>C)
- 41<sup>0</sup>F and 145<sup>0</sup>F (5<sup>0</sup>C and 63<sup>0</sup>C)

Question 6

---

**Raw meat that is defrosting should be stored:**

- on the top shelf of the refrigerator.
- on the middle shelf of the refrigerator.
- on the bottom shelf of the refrigerator.
- Any shelf in the refrigerator is acceptable.

Question 7

---

**Chicken is safe to serve if the internal temperature is:**

- 140<sup>0</sup>F (60<sup>0</sup>C)
- 155<sup>0</sup>F (68<sup>0</sup>C)
- 165<sup>0</sup>F (74<sup>0</sup>C)
- 180<sup>0</sup>F (82<sup>0</sup>C)

Question 8

---

**Previously cooked left over foods must be thoroughly reheated to:**

- 140<sup>0</sup>F (60<sup>0</sup>C)
- 155<sup>0</sup>F (68<sup>0</sup>C)
- 165<sup>0</sup>F (74<sup>0</sup>C)
- 180<sup>0</sup>F (82<sup>0</sup>C)

Question 9

---

**When dirty, hands should be washed by**



- Rinsing under warm water with soap for at least 10 seconds.
- Washing with soap and cool water for at least 10 seconds.
- Rinsing under warm water for at least 20 seconds.
- Washing with soap and warm water for at least 20 seconds.

Question 10

---

**The basic procedure for cleaning pots, pans, silverware, and other kitchen equipment is to:**

- Rinsing under warm water with soap for at least 20 seconds
- Rinsing under hot water with soap for at least 20 seconds
- Wash with hot soapy water after preparing each food item and before moving on to the next food.
- Wash with warm soapy water after preparing each food item and before moving on to the next food.

Question 11

---

**The practice most likely to result in sickness from food is:**

- Cleaning and sanitizing cutting boards after cutting raw chicken.
- Serving cooked chicken with a pair of tongs.
- Breeding raw chicken using clean disposable gloves, then refrigerating the chicken until the chicken is ready to be cooked.
- Using a cutting board to cut raw chicken for grilling, then to shred lettuce for a salad.

Question 12

---

**Ground beef must be cooked to a minimum temperature of**

- 140°F (60°C)
- 155°F (68°C)
- 165°F (74°C)
- 180°F (82°C)

Page 3

---

Fill out this page only if you answered:

- Yes on question 1. Are you currently an international on page 1.

Question 12

**Section II: Current Food Safety Practices**

**Instructions:** Please select the number that represents what you do now; circling 0 means you “never do” and 4 means you “always do”, and 5 means it does not apply to you.

Question 13

1 - Never (0%) | 2 - Rarely (≤ 30%) | 3 - Sometimes (30%-70%)  
 4 - Most of the time (71%-89%) | 5 - Always (100%) | 6 - Does Not Apply to Me

	1	2	3	4	5	6
13.1 Before preparing or handling food, I wash my hands with soap and warm water.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.2 If I have a cut or sore on my hand, I cover it before preparing food	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.3 After washing my hands, I dry them using a hand towel that is available to others.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.4 I wash my hands with soap and water after touching raw meat, chicken, or fish before preparing and cooking food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.5 I wash a plate used for raw meat, chicken, or seafood before putting cooked food on the plate OR I use a clean plate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.6 I use the same cutting board when preparing raw meats, chicken, fish and vegetables.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.7 I put frozen meat and chicken on the counter in the morning so that it will defrost and be ready to cook in the evening.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.8 I leave cooked foods, such as rice and beans, overnight on the countertop to be used the next day.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.9 I store my eggs at room temperature.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.10 I use hot, soapy water to clean my countertops after preparing food.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.11 I use a thermometer to determine the temperature of the refrigerator.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.12 I use a thermometer to determine if meat, chicken, and/or fish are thoroughly cooked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

13.13 I use a thermometer to determine if leftovers have been reheated thoroughly.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.14 I eat eggs with runny yolk or products containing raw eggs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.15 I throw away refrigerated leftovers after 3-4 days	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.16 When buying food I check the “sell by” and “use by ” dates.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Page 4

Fill out this page only if you answered:

- Yes on question 1. Are you currently an international on page 1.

Question 13

**Section III: Food Safety Beliefs**

**Instructions:** Please select the number that best represents your opinion; circling 1 means you “Strongly Disagree” and 5 means you “strongly agree”.

Question 14

1 - Strongly Disagree | 2 - Disagree | 3 - Neutral | 4 - Agree  
5 - Strongly Agree

	1	2	3	4	5
14.1 Trying to follow proper food safety practices is important to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.2 Refrigerating food overnight to serve the following day is important.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.3 It is important for me to dry my hands with a hand towel that is available to others.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.4 Washing my hands with warm soapy water for at least 20 seconds is a priority for me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.5 I am confident I can serve safe foods to others	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.6 I do not find it necessary to keep the refrigerator below	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

40°F(4°C).					
14.7 I am not interested in using a thermometer to find out if food is fully cooked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.8 Cooking and eating eggs that have firm yolks and whites is important for food safety.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.9 It is important to wash countertops, utensils and cutting boards after preparing raw meat or chicken.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.10 I am concerned if I defrost frozen food on the kitchen counter.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.11 Using cheese and yogurt made only from pasteurized (Processed) milk is important to me.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.12 I am not concerned that I may get sick if I eat raw oysters or fish.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.13 I am interested in learning more about food safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Page 5

Fill out this page only if you answered:

- Yes on question 1. Are you currently an international on page 1.

Question 14

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**Section IV: Demographic Information**

**Instructions:** Please answer each of the following questions about yourself. This information will be used for research purposes only.

---

Question 15

**What is your gender?**

- Male
- Female

Question 16

**What is your age?**

Characters Remaining:

Question 17

---

**What is your country of origin?**


Characters Remaining:

Question 18 **\*\* required \*\***

---

**Which of the following best describes your current educational level?**

- English language program
- Freshman (0 to 30 credit hours completed)
- Sophomore (between 30 and 59 credit hours completed)
- Junior (between 60 and 89 credit hours completed)
- Senior (90 or greater credit hours completed)
- Master's Student
- Doctoral Student/Candidate

Question 19 **\*\* required \*\***

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**Which best describes your living accommodations?**

- Residence Hall
- Jardine Apartments
- Off-campus Housing
- Other:

Question 20 **\*\* required \*\***

---

**What college is your major area in?**

- College of Agriculture
- College of Architecture, Planning and Design
- College of Arts and Sciences
- College of Business Administration
- College of Education
- College of Engineering
- College of Human Ecology
- College of Technology and Aviation

College of Veterinary Medicine

Question 21

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**Have you ever had any formal food safety training and/or education?**

Yes

No

Question 22

---

**Have you ever been employed in a foodservice industry**

Yes

No

Question 23

---

**How many years (combined) have you lived in the United States?**

Characters Remaining:

Question 24

---

**How often do you prepare food for other people?**

Daily

2 - 3 days a week

Weekly

Monthly

Never

Question 25

---

**What meals do you prepare? (Answer all that apply)**

Breakfast

Lunch

Dinner

Other:

Page 6

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Fill out this page only if you answered:

- No on question 1. Are you currently an international on page 1.

Thank you for your time and interest in this study. Unfortunately, we are only looking for International students at this time.

If you would like a summary of the results, please contact Mr. Caleb M. Angolo at [mwakha@ksu.edu](mailto:mwakha@ksu.edu).

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#### Closing Message

Thank you for your participation. If you would like a summary of the results, please contact Mr. Caleb M. Angolo at [mwakha@ksu.edu](mailto:mwakha@ksu.edu).

- End of Survey -

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