To the Graduate Council:

I am submitting herewith a thesis written by Valerie Ling entitled "Effectiveness of Three Training Methods for Teaching Food Safety to Cooperative Extension Agents." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Recreation, Tourism, and Hospitality Management.

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EFFECTIVENESS OF THREE TRAINING METHODS FOR TEACHING FOOD SAFETY TO COOPERATIVE EXTENSION AGENTS

A Thesis
Presented for the
Master of Science Degree
The University of Tennessee, Knoxville

Valerie Ling
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DEDICATION

This thesis is dedicated to:

my parents,

Frederick and Linda Ling,

my sister,

Wendy Ling Chin,

and my God,

to whom I dedicate my life.

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I thank my parents, my sister, and my friends for their love and support. My parents have worked tirelessly and sacrificed much, so that I could achieve dreams that they could not. They were my role models, molding me to become who I am today. I thank my sister for her friendship and kindness. I'm grateful to my friends for bringing laughter to my heart and listening to me. I am proud of all of them and love them.

I thank God the father, Jesus, and the Holy Spirit, who gives me breath each day, a mind to reason, and fingers to type. I could not have finished this thesis without the ability and resources that he has given me. He is my creator, comforter, hope, counselor, strength, friend, king, foundation, savior, security, helper, peace, shelter, and joy. Although He knows my weaknesses and flaws, he considers me as worthy and changes me faithfully and patiently. He believes in me and has plans for me to join him to achieve great works, more significant than what I can imagine. He said the following words to sustain me and encourage me through difficult times:

Why do you say and complain,

"My way is hidden from the Lord; my cause is disregarded by my God"?

Do you not know?

Have you not heard?

The Lord is the everlasting God,

the Creator of the ends of the earth,

He will not grow tired or weary

and his understanding no one can fathom.

He gives strength to the weary

and increases the power of the weak.

Even youths grow tired and weary,

and young men stumble and fall;

But those who hope in the Lord

will renew their strength.

They will soar on wings like eagles;

they will run and not grow weary,

they will walk and not be faint.

- Isaiah 40: 27-31 (New International Version)

ABSTRACT

This study examined the effectiveness of three training methods used to teach food safety to cooperative extension agents. A secondary purpose was to explore the training formats and training aids that subjects considered effective to learn food safety. Food safety knowledge pretests, posttests, retention tests, and knowledge gained and retained were the variables used to measure effectiveness. The three methods examined were two-day training by lecture method, computer interactive training (one single treatment), and computer interactive training with weekly reviews. There were no significant differences in posttest and retention test scores among the three groups. All methods were shown to be equally effective in improving and retaining knowledge. Group assignment significantly affected how subjects ranked the effectiveness of the following formats: question and answer, workbook assignments, and computer-assisted instruction. Overall, subjects ranked lecture/speech, hands-on training, and computer-assisted instruction as effective training formats and ranked videotapes/films, CD-ROM, and manuals as effective training aids.

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CHAPTER 1

INTRODUCTION

Food safety continues to be a critical issue to industry, consumer groups, and federal agencies. Foodborne illness is such a serious public health threat that President Clinton proposed an increase of $74.8 million for the year 2000 for the President's Food Safety Initiative, which began in 1997. The initiative aims to 1) increase food safety research to decrease microbial contamination at the agricultural level 2) facilitate foodborne illness surveillance with a database tracking system 3) quicken responses to outbreaks by coordinating communication among agencies at all government levels 4) increase frequency of inspections 5) ensure compliance to Hazard Analysis Critical Control Point (HACCP) programs to reduce hazards where contamination may occur, and 6) provide more education to retail foodservice workers and consumers at high-risk for foodborne illness (http://www.foodsafety.gov/~fsg/fsiback.html). Trade organizations, consumer groups, and federal agencies have collaborated to create the Partnership for Food Safety Education geared to inform consumers at the grassroots level (Litwak, 1999).

The food industry has improved efforts to train employees about food safety and to comply with regulations for HACCP plans for seafood, meat, and poultry processing plants. The efficacy of food safety training in increasing food safety knowledge, inspection scores, and safe food handling behaviors has been demonstrated (Cochran-Yantis, Belo, McProud, Everly, & Gans, 1996; Cotterchio, Gunn, Coffill, Tormey, & Barry, 1998; Gaddis, 1997; Johnson, 1995). Mandatory HACCP plans have contributed

to a decline in campylobacter illnesses (15% drop between 1997 and 1998) and salmonella enteritidis infections (44% fall between 1996 and 1998), according to the U.S. Department of Agriculture (Anonymous, 1999). However, E.coli O157: H7 infections have decreased from 2.7 cases per 100,000 persons in 1996 to 2.3 in 1997, but increased to 2.8 per 100,000 in 1998.

Despite the changes to improve the safety of the food, in a survey of 738 consumers and 446 retail operators, over 40% of consumers believed that the risk of foodborne illness from restaurants was greater than five years ago. In the same study, 77% of operators have trained employees in safe food handling and 65% have required managers to be certified in food safety (Dulen, 1998a). About half of consumers and half of operators thought that training employees about safe food handling will improve food safety in restaurants.

State and federal governments are considering mandatory food safety training and HACCP programs for foodservice. In July 1998, the FDA proposed a pilot HACCP program for food establishments to examine how HACCP programs can be implemented at the retail level (Dulen, 1998b). Only a few states require food safety training for retail food operators. Recently, California passed a law requiring businesses that offer any prepared food must have at least one employee certified in food safety (PR Newswire Association, 1999). Although efforts have been made to train foodservice employees, the Centers for Disease Control estimated that restaurants are the source of 79% of foodborne illnesses (PR Newswire Association, 1999). Therefore, food safety training and HACCP programs are crucial to protect consumer health, elevate the image of the industry, and prevent costly lawsuits.

An extensive study in foodservice training conducted by Yankelovich Partners and funded by Nugget/Premier Distributors examined some of the problems of food safety training (PR Newswire Association, 1999). During the survey, foodservice managers identified time spent in training employees (78%) and high labor turnover (75%) as the most difficult problems in training. Lack of training designed specifically for employees was another hurdle for managers (59%) as well as the expense of training (57%). Employers, especially in the foodservice industry, need training that is time efficient, effective, convenient, and sensitive to the diversity of the labor force.

Computer interactive training solves these training problems. Companies have reported that this type of training shortens training time in the range of 40-60% compared to traditional methods because this training compressed training time and decreased travel time (Hall, 1996). Employers conserved time with software features that record and track employee training. Similarly employees conserved time because they progress at their own pace, access only needed lessons, and complete lessons when they fit into their schedules. Multimedia actively involved the employees and helped retention through sight, hearing, and practice in simulated work environments (Dennis, 1994; Hall, 1996). Different populations such as computer technicians, auditors, medical students, and foodservice workers have learned effectively through computer interactive training (Hall, 1996; Gaddis, 1997; Lilienfield & Broering, 1994).

Industry organizations and government agencies already have developed traditional methods of delivering food safety training, such as lecture. Within the past decade, industry has developed computer-based software to train employees about food safety. Nugget/Premier, a food distributor cooperative of 160 national members, based in

California, developed an interactive CD-ROM in English and Spanish to help foodservice operators comply with the new California food safety certification law (PR Newswire Association, 1999). In fall 1999, The National Restaurant Association Education Foundation will release a Compact Disc Interactive (CD-i) entitled "ServSafe Introduction to Food Safety." With an interactive track ball, the lessons can be run on a television (Hernandez, 1999). In addition, the Education Foundation will offer food safety courses online.

Because of the advent of technology and persistent problems in training foodservice employees, the value of computer-based food safety training must be considered, especially in an industry with limited time and resources. This research examined if computer interactive training would as effective as training by lecture method in improving the food safety knowledge and retention of cooperative extension agents. This study also identified the most effective training formats and training aids that facilitate learning, which can be implemented in future training efforts. After the extension agents are trained, they will convey their food safety knowledge to their constituents, such as foodservice operators and employees, who may live in rural areas and do not have access to food safety training programs. As an indirect result of this research, consumers will benefit through improvements in safer food handling.

CHAPTER 2

REVIEW OF LITERATURE

Incidences of Death and Disease

Foodborne illnesses are a serious problem in the United States. According to a recent report by the U.S. General Accounting Office, an estimated 6.5 to 81 million people experience foodborne illnesses each year (Allen, 1997). The Centers for Disease Control report that 9,000 deaths are associated with foodborne illnesses annually (Walkup, 1997). The FDA estimates that these illnesses cost up to $9 billion dollars annually in lost work productivity (Rubinstein, 1997). The USDA Economic Research Service estimates that lost productivity, medical costs, and loss of life can total up to $35 billion (Puzo, 1997).

Factors Related to Outbreaks

The factors that cause foodborne outbreaks the most frequently are the following: 1) improper cooling, 2) cooking to unsafe temperatures, 3) infected employees with poor hygiene, 4) preparing food a day before serving or earlier, 5) adding contaminated foods to ready-to-eat foods, 6) allowing food to stay in the danger zone for too long, 7) improper reheating, and 8) cross-contamination (Armstrong, 1995). Foodborne outbreaks result from changes in society, farming practices, and microbiology. Incidents of foodborne illness are increasing, according to Folkers, health-education consultant for the Centers for Disease Control (Walkup, 1997). Reasons for this rise include the increase in dual-income families who consume more meals away from home (Bolton, 1997a; Walkup, 1997). If a food safety hazard occurs with meal preparation at home, only the

household usually is affected. Since a restaurant prepares and serves a larger quantity of food than a household, more people can become ill if a food safety hazard occurs in a restaurant.

Foodborne outbreaks result from the contamination of foods. Biological hazards, chemical hazards, and physical hazards can contaminate food. Bacteria, a biological hazard, causes food contamination the most frequently. Potentially hazardous foods, which are moist foods that are high in protein, should be kept out of the danger zone (40 - 140° F) to prevent rapid bacterial growth (Armstrong, 1995).

Employees should come to work healthy and clean. Since humans are carriers of biological contaminants, employees should wash their hands thoroughly after sneezing, coughing, touching the body, using the restroom, eating, and smoking. Employees must cover cuts and sores with bandages and gloves because wounds and sores harbor bacteria. They also should wash their hands after handling raw food and touching the garbage can to prevent cross-contamination.

Employees should inspect all foods upon receiving for damages, appearance, odor, and temperature. A product may be contaminated if it has been damaged physically. Bacteria can grow quickly if the contaminated food spends time in the danger zone. When products pass inspection, employees should store foods immediately to prevent the product temperature from reaching the danger zone.

When storing food, employees should store according to the First In, First Out method in which old products are stored in front of new ones. The internal temperature of refrigerated foods should be 32 - 40° F. The temperature of the frozen storage unit should be at 0° F or below. Foods stored in one area should be stored in the following

sequence from top to bottom: cooked and ready-to-eat foods, raw seafood, raw unground beef, raw unground pork, raw ground beef and pork, and raw poultry. These safety measures are followed to prevent cross-contamination from raw meat juices.

Raw meats and seafood should be cooked to the minimum safe internal temperature to kill bacteria (Armstrong, 1995). Poultry, stuffing, stuffed meat, and stuffed pastas should be cooked to a minimum of 165° F (15 seconds). Cook ground meats, pork, and batches of eggs to reach 155° F (15 seconds). Beef roasts should be cooked to 145° F for 3 minutes, 140° F for 12 minutes, or 130° F for 121 minutes. Cook fish, seafood, shell eggs for single service, and other potentially hazardous foods to 145° F (15 seconds).

Improper cooling is the leading cause of food-borne illness. The FDA recommends that food be cooled in two steps. First cool food from 140° F to 70° F in two hours, then cool it to 41° F in another four hours. Foods should be reduced in size into smaller or shallower containers to facilitate faster cooling.

Cooked food that has been cooled must be reheated to 165° F to destroy bacteria before serving. Leftovers only should be reheated once, since the food has spent time in the danger zone three times. Only cooking equipment, not hot-holding equipment, must be used to reheat foods.

Furthermore, food safety problems can occur when customers do not refrigerate potentially hazardous leftovers from restaurants early enough to prevent rapid growth of bacteria in the danger zone. In addition, customers may neglect to reheat leftovers to the proper temperature to destroy bacteria that may be present.

Transportation is another reason associated with the increase in foodborne illnesses. More ready-prepared or pre-cooked foods are transported since catering functions are occurring more frequently. During the time the food is transported to the catering event, the temperature of food can approach the danger zone. Faulty hot-holding and cold-holding equipment at the catering event can cause the temperature of the food to reach the danger zone (Walkup, 1997).

Current farming practices create crowded conditions for animals. Because of this type of environment, animals become stressed and more vulnerable to infections. Infections spread easily to other animals nearby because of the crowded conditions. The increased quantity of food imported from other countries that follow different inspection regulations or less stringent sanitation conditions also may be associated with foodborne illnesses (Walkup, 1997; Bolton, 1997a).

The rise in foodborne illness can be attributed to other reasons. Some bacterial strains have increased their resistance to antibiotics and developed more potent virulence of some strains. Since foodborne illness now is more easily diagnosed and reported (Bolton, 1997a), the rise in foodborne illness may seem falsely elevated. However, the actual number of cases has risen (Bolton, 1997a). Consumers readily recognize foodborne illness because they are more aware of the symptoms and its causes through information presented by the media.

Negative Media Exposure

Consumers readily can recognize the symptoms because foodborne illness has received such extensive media coverage. Consumers are less confident about the safety of their food because of the negative publicity. A segment about an outbreak on the news

can seriously damage the reputation of a restaurant or chain as well as their profits. Shoney's lost more than $100 million in sales during the week in which ABC's "Prime Time Live" aired a five-minute report about Shoney's health inspection scores (Martin, 1997).

Surveys, as well as economic losses, indicate how media affects perception about food safety. The results of a survey of 1,003 Americans conducted by the Hepatitis Foundation International reflect the influence of media on public perception (Dulen, 1997). Six out of ten Americans surveyed responded that "they worry about getting sick from meals prepared away from home". In another survey, 96% of consumers placed the most responsibility for safe food on restaurant operators, followed by processors, manufacturers, and supermarkets (Dulen, 1997). According to the FDA, foodservice establishments are responsible for eighty percent of foodborne illnesses that occur, mainly because of employees who contaminate the food (Bolton, 1997a).

A survey of 738 consumers and 446 operators examined their views about food safety (Dulen, 1998a). The majority of consumers receive their information from newspapers and television as compared to 84% of operators who rely on government agencies or health departments for information. In regards to how likely foodservice is the source of foodborne illness compared to five years ago, 43% of consumers and 28% of operators thought the risk has increased. Media exposure of outbreaks and sanitary conditions of restaurants might have risen consumers' concerns. However, their fears remain unrelieved if they are unaware of restaurants' food safety measures. Twenty-two percent of consumers and 47% of operators believe that the likelihood of restaurants as the source of foodborne illness has decreased, possibly because operators are cognizant

of the industry's food safety efforts. The remaining respondents thought the risk was unchanged. Worker education was viewed as an "initiative that will definitely increase restaurant food safety" by 45% of consumers and 50% of operators. Because of consumers' and operators' perceptions, employee education is especially important.

Response to Media Exposure

To calm consumers' fears and prevent foodborne illness, in 1993 the National Restaurant Association established the Food Safety Task Force. The task force encourages managers and employees to complete food safety training programs (Anonymous, 1994). In addition, the Task Force educates the media and public about the industry's efforts to improve food safety. The Task Force recommends that restaurant operators show their support for food safety through posting window decals, including statements about food safety commitment on menus, and providing customers with food safety fliers. These efforts can be used as a marketing tool to build consumer confidence and increase patronage (Anonymous, 1994).

The National Restaurant Association Education Foundation established the International Food Safety Council, which became a founder and sponsor of The Partnership for Food Safety Education (Caldeira, 1998). The Partnership coordinates the mutual efforts of government agencies, industry organizations, and consumer groups to communicate food safety information to the public (Litwak, 1999). In 1998, the Partnership launched the Fight Bac campaign to educate the public through fact sheets, radio commercials, posters, newspaper articles, and free promotional items.

HACCP and Food Safety Training

The prevalence of foodborne illnesses and consumer demand for safer food has led to legislation to prevent the occurrence of foodborne illnesses. The U.S. Dept. of Agriculture (USDA) and the Food and Drug Administration (FDA) passed regulations that require seafood processors, and meat and poultry slaughter and processing plants to establish a Hazard Analysis Critical Control Point plan (HACCP). The purpose of a HACCP plan is to prevent the contamination of a food at critical points in the flow of food where hazards can occur. According to the FDA, the HACCP regulation for seafood processors will prevent 20,000 to 60,000 foodborne illnesses and save $116 million in medical costs per year (Allen, 1996a).

The rules will cost seafood processors $40 to $80 million annually, as estimated by the FDA. Although compliance is costly, the seafood industry agrees that it will benefit in the long term. Weddig, executive vice-president of the National Fisheries Institute, which represents 1000 seafood companies, noted that seafood companies that established HACCP plans before the regulations have "found them to be cost-effective and of true benefit to customers" (Allen, 1996a).

In an investigation of an outbreak, HACCP records of control measures used to prevent hazards can demonstrate that the processor is not the source of contamination. Although a food processor's adherence to a HACCP plan can yield a commercially sterile product, foodservice employees at the retail level can re-contaminate the food and negate the benefits of this revised law (Allen, 1996b). If the foodservice establishment at the retail level has a HACCP plan, employees may not know how to implement it unless they

receive training. Therefore, training employees about handling food safely is important to prevent foodborne illnesses.

Furthermore, food safety training is crucial because not only does it prevent foodborne illness, it can reduce an operator's liability and demonstrate legal evidence of the operator's good faith to protect consumers' health (Anonymous, 1994). Operators can suffer heavy financial losses from lawsuits. When legal fees, insurance payments, medical bills, and lost wages are calculated, an outbreak can cost a restaurant operator $75,000 (Bolton, 1997b). Therefore, training is important for financial reasons as well as for customer health.

Need for Food Safety Training

The need for food safety training is widespread. Managers are required to be certified in sanitation in nine entire states (Idaho, Illinois, Iowa, New Jersey, Oregon, Ohio, Rhode Island, Wisconsin, and Texas) and ninety-six counties (Cochran-Yantis et al., 1996). According to a survey of HACCP implementation by key foodservice chains, only 37% have implemented a HACCP program, 2% use a partial HACCP plan, 31% have a food safety checklist only, and 30% don't know or don't use HACCP. In response to the question, "Does your company mandate use of a food safety checklist at least twice daily?" 58% answered "Yes", 39% answered "No", and 3% answered "Don't know" (Farkas, 1996).

Foodservice establishments should implement HACCP and food safety training because it protects consumer's health, improves the image of the restaurant and the industry, and lessens operator's liability. Furthermore, it is probable that the FDA may propose HACCP regulations for foodservice establishments since they are often

responsible for foodborne illness. As Kauter of the FDA suggested, "Don't wait for the government to mandate it" (Rubinstein, 1997). In July 1998, the FDA proposed a pilot HACCP program for foodservice establishments that would study 50 retail operators and 50 government agencies (Dulen, 1998b).

Efficacy of Food Safety Training Programs

The efficacy of various training programs has been examined. Employees may become certified food handlers after they complete training and achieve a certain score on a written test. In Santa Clara County, California, researchers found that restaurants with "favorable health records" had a higher percentage of employees (44.4%, n=16) who were certified food handlers than those with "unfavorable" health records (23%, n=6) (Cochran-Yantis et al., 1996).

Another study compared restaurant inspection scores before and one year and two years after training ninety-four managers. There were three groups of managers: mandatory (attendance was required by the Boston Health Department), voluntary, and no training. Inspection scores of managers in the mandatory group improved significantly (increased 14.7 points out of 100 points) and maintained their scores two years later. Scores improved 7.5 points in the voluntary group, but not significantly. Inspection scores of the groups without training remained the same. One year after training the mandatory and voluntary groups, the mean number of critical violations, which may lead to foodborne illness, decreased significantly and was maintained the next year. Therefore, training can be effective in increasing inspection scores, which should reflect improved food safety conditions in restaurants (Cotterchio et al., 1998).

In a multiple baseline study conducted by Johnson (1995), observed performance of food safety behaviors by college foodservice employees improved after ServSafe food safety training (Educational Foundation of the National Restaurant Association) and motivational feedback from their supervisors. At the first baseline, the mean percentage of items performed safely was 35.6% with wide variation in behavior (SD = 12.7). During the three weeks after employees received food safety training, their performance of safe behaviors rose (M = 82.2%), but the performance was more varied (SD = 16.6).

During the second baseline, two-week period, they handled food slightly less safely (M = 79.7%) and the variation rose (SD = 17.5). In the following three-week motivational phase graphs that plotted performance were posted and supervisors acknowledged employees when they observed an employee handling food safely. During this period, performance increased (M = 98.3%) and variation declined (SD = 4.6).

In the third baseline phase, safe food handling slightly decreased (M = 94.9%) and variability rose (SD = 9.4). During the two-week sustainment period, supervisors discussed with employees the possibility of including those safe behaviors to their job standards and performance expectations. Performance increased slightly (M = 96.4%) and the variation in behaviors decline (SD = 7.3).

The National Restaurant Association offers the ServSafe program, the most widely used and recognized food safety and sanitation training program. Almost 900,000 foodservice professionals are ServSafe certified (Caldeira, 1998). Ninety-five percent of state and local health departments that require food safety training accept ServSafe and use the program to train inspectors. ServSafe also is used by 740 foodservice schools, companies, and associations (Anonymous, 1994). The ServSafe materials were improved

for 1999 and were based on the 1999 FDA Food Code (Hernandez, 1999). Products include a coursebook, activity book, instructor toolkit, compact disc interactive training, and Internet courses.

Overall Importance of Training and Employees' Training Needs

In one survey of hotel and foodservice companies, training directors at the corporate and property levels expressed that training is "the key to achieving customer satisfaction and employee retention" (Harris & Cannon, 1995). According to the American Society for Training and Development, organizations spend an estimated $210 billion to train employees (Dennis, 1994). The goal is to minimize training time to trim costs while ensuring that the training is effective (Dennis, 1994).

Changes in training need to be considered because the workforce demographics have been changing and will continue to change. By the year 2005, almost half of the new workers will be women, African- Americans, or foreign-born employees (Harris & Cannon, 1995). Based on adult learning theories and the future workforce, to be trained effectively, employees will need training that is "1) delivered in their own language, 2) delivered at their own pace, 3) convenient and efficient, 4) provide immediate feedback 5) communicated at their learning level 6) interactive, stimulating, and culturally sensitive, and 7) continuous over the period of employment" (Harris & Cannon, 1995).

Benefits of Computer Interactive Training

Interactive multimedia is defined as "the integration of text, audio, graphics, still image and moving pictures into a single, computer-controlled, multimedia product" (McCarthy, 1989). Computer interactive training can meet employees' training needs and benefit the hospitality industry because its workforce is "culturally, educationally, and

experientially" diverse (Harris, 1994). The interactive component of computer active training can address these diversity issues. Computer interactive training provides numerous benefits. It requires less time, costs less, and can be equally or more effective than traditional classroom training.

Interactive instruction decreases training time in the range of 20-75%, as reported by companies that used interactive instruction (Dennis, 1994). Most report a decrease of 40 - 60% (Hall, 1996). The time saved can be used for other activities that benefit the organization (Dennis, 1994; Stephenson, 1995).

Trainees have flexible access to computer interactive training. Users can conveniently fit the training into their work schedule and access the training whenever needed (Dennis, 1994, Dulworth, 1996). Computer interactive training also requires less time because trainees do not have to wait for a class (Stephenson, 1995).

Computer interactive training allow users to access only needed training areas. A training program is divided into segments or modules that teach specific skills or information (Dennis, 1994). Once employees demonstrate mastery at one skill or area of knowledge, they skip the training for that module. Trainees access only areas in which they need training as compared to traditional instruction in which trainees sometimes sit through information they do not need or already know (Dennis, 1994).

Computer interactive training programs are designed to be self-paced. An individual progresses through the training at his or her own pace according to ability level and knowledge level (Schroeder, 1992). Within a segment, trainees can rewind, fast-forward, or pause a lesson. In traditional classroom instruction, the trainer usually waits

for the last person to finish an activity or spends time explaining a concept or skill to a slower individual while the rest of the class waits (Dennis, 1994).

Employees can use this time for activities that benefit the company, such as activities that directly generate profits. Companies that conserve time conserve resources. It is estimated that a five percent reduction in training time could save eight billion dollars in employee time per year (Dennis, 1994).

Use of multimedia enhances the interactivity of computer training programs. Instruction that includes still frame and motion video, audio, graphics, and animation makes the information more interesting to the learner and easier to learn (Dennis, 1994). The enhanced interactivity promotes learning because trainees can immediately apply and practice what they have learned (Dennis, 1994).

Through the use of multimedia, computer programs create simulations through which learners experience and practice making decisions in real world situations without real world consequences (Dennis, 1994; Hall, 1996). Trainees test different decisions and learn from their mistakes after the computer provides feedback (Dennis, 1994; Franchi, 1992). Experiences that normally would take weeks or months to occur are compressed into minutes by computer simulations. Trainees retain information learned from simulations (Dennis, 1994).

Employers and trainees can benefit from the computer program's ability to monitor the progress of the user and adjust the instruction (Dennis, 1994; Franchi, 1992). During practice, once the user demonstrates mastery by correctly answering a certain number of questions, the practice will stop (Dennis, 1994; Stephenson, 1995). If the

trainee answers a question incorrectly, the program reviews the information (Stephenson, 1995).

The computer automatically can keep records of training activity, such as when a trainee logs onto the computer, and can create reports for managers (Dennis, 1994; Franchi, 1992). The manager can view trends and individual progress. If many employees were trained, manual record keeping would be a time consuming activity (Dennis, 1994). Furthermore, managers can use these records to evaluate the employee's strengths and place the employee in the appropriate position or promote the employee (Oz & White, 1993).

Computer interactive training is less expensive than gathering learners and trainers in one classroom (Hall, 1996). Computer interactive training costs less to deliver because of the decrease in training time and travel (Hall, 1996). Duplication of computer programs can be inexpensive and can reach many employees geographically.

A company that has benefited from computer interactive training is Storage Technology, which sells hardware for computers. Previously, a lecture/lab format trained its 1,500 technicians who traveled to Colorado for four to ten days. Training by this method required at least 28 hours. When the company began using computer interactive training, the multimedia training required 11.2 hours to complete. For the last four years technicians were trained by using this CD-ROM program at their workplaces. As a result, the company notes that because of the "compressed training time and travel expenses", it reduced training time by sixty percent and conserved resources. The company had spent $3.3 million to develop and deliver the traditional course over three years. In comparison, Storage Technology spent $1.7 million on the CD-ROM

development and training delivery over a three-year period (Hall, 1996). The difference in cost between the two training courses was $1.6 million, which is a substantial savings in company resources.

Price Waterhouse, which is an auditing, tax, accounting and business consulting company, also benefited from multimedia training (Hall, 1996). It implemented multimedia to train 7,000 auditing employees in 50 countries. Price Waterhouse calculated a return-on-investment analysis of total costs over five years. The analysis showed that it costs the company $106 to train an employee using multimedia as compared to $760 using traditional methods. Similar to Storage Technology, Price Waterhouse reported that multimedia training reduced training time by 50 percent over the traditional training.

Computer interactive training can be effective because students learn interactively and become involved with the information. In one study, students of a medical school physiology course were divided into control and experimental groups. The control group participated in the "wet" cardiovascular laboratory exercise while the experimental group used a two-hour interactive multimedia computer program to learn the cardiac cycle. The experimental group significantly improved their scores from pretest to posttest. Both groups performed about the same overall on the final exam. However, those in the experimental group achieved a significantly higher grade in the cardiovascular section of the final exam than those students in the control group (Lilienfield & Broering, 1994).

An annotated bibliography reported that interactivity influenced student achievement in postsecondary education regardless of whether the information was delivered in the classroom or through audio/video instruction (Zirkin & Sumler, 1995).

Achievement was not statistically different among types of interactive instruction. A meta-analytic review of fourteen studies which compared interactive videodisc with conventional instruction indicated that "interactive videodisc instruction was more effective than computer-based instruction without videodisc interaction".

Computer interactive training programs can be more effective because trainees are more likely to retain the information because they have to interact with the information (Stephenson, 1995). Interaction creates a direct link between learning and application. The multimedia aspect of computer interactive training enhances retention by inputting information to the different senses, such as sight, sound, and touch (Dulworth, 1996). Research reported that people remember 20% of what they see, 40% of what they see and hear, and 70% of what they see, hear, and do (Dulworth, 1996).

Oz and White (1993) reported that multimedia training provides increased retention of learned material. In their survey, executives responsible for multimedia projects at IBM, Bethlehem Steel, Federal Express, and Ford Motor Credit reported increased retention of learned material after implementation of a multimedia training system.

In addition to reduction in training time, decrease in training costs, and enhancement of instructional effectiveness, computer interactive training also provides other benefits. The computer can deliver information consistently, unlike human trainers (Dulworth, 1996; Stephenson, 1995). Since the training is standard, the manager knows how and what information is delivered (Stephenson, 1995).

Usually one individual sits at the computer and completes the training. Therefore, training can be private. This privacy encourages trainees to be more willing to ask

questions, try different decisions, and make mistakes during computer instruction than in a group of peers in a traditional classroom setting where they may feel embarrassed or threatened (Dulworth, 1996; Stephenson, 1995).

Programs can be customized, for example, to specific local regulations (Stephenson, 1995). They also can be changed inexpensively and easily to deliver information in other languages (Stephenson, 1995) to meet the needs of an ethnically diverse workforce.

These benefits seem to indicate that computer interactive training is a better alternative to traditional training. However, it is unlikely this type of delivery will replace traditional training in the hospitality industry as revealed by the low percentage of computer usage for training purposes. Interviews with fifty-five representatives from seventeen foodservice and lodging corporations indicated the frequency of methods and tools used in training (Harris & Cannon, 1995). Only 12% of these seventeen properties used computer training as a training method. In regards to traditional training methods, 100% used group training-lecture format, 100% used on-the-job-training, 71% used videotapes, and 18% used other methods.

In the same study, tools were defined as "items used to assist in the communication of training." Eighteen percent of the properties used computers as a training tool with the on-the-job-training method. Ninety-four percent used flipcharts; 88% used workbooks and manuals; 88% used VCR and television; 82% used overhead projectors and transparencies; 29% used chalkboards; and 6% used cassettes. Despite the high percentage of use of traditional methods and tools, some trainers responded that

"training needed to be more individually-based and learning level directed" (Harris & Cannon, 1995).

Limitations of Computer Interactive Training

Harris and Cannon (1995) reported that representatives from seventeen corporations provided reasons for not using more individual-based training. These reasons included: "1) cost of training materials, 2) cost of time invested by trainers to address specific needs, 3) tendency of employees to leave the organization, 4) hiring a full-time specialist to write learner-specific training materials, and 5) lack of dollars to invest, maintain, and develop programs for interactive equipment such as multimedia." The representatives provided reasons for continuing to use traditional methods and tools: "1) the traditional methods are familiar to employees, 2) employees enjoy lecture-pupil training because they enjoy learning with their peers, 3) on-the-job-training is quick and for most hourly positions, adequate, 4) the methods require few tools, 5) the training is comparatively inexpensive as to newer forms of training that involves technology, 6) computerized training tools become outdated too quickly and maintenance is too costly" (Harris & Cannon, 1995).

Despite its benefits, computer training costs more to develop (design and produce) than traditional training (Hall, 1996; Stephenson, 1995). A large number of trainees are needed to decrease the development cost per employee (Hall, 1996; Stephenson, 1995). Computer training actually may be more expensive than traditional training if trainees are located close geographically. Companies should conduct a cost-effective analysis with consideration of these factors.

Other limitations of computer interactive training include employees' reliance on reading skills, level of computer experience, and attitude. Employees may find that this type of delivery is confusing and disorienting. Employees ultimately need human contact at some point during training because hospitality continues to be a people-oriented business. Furthermore, establishments must have adequate space for computers.

Instruction and learning are complex and effectiveness depends on characteristics of the learner, teacher, subject, setting, instructional design and many other variables. Therefore, it is difficult for researchers to isolate variables and control for confounding variables in studies. Companies should determine if the increase in effectiveness justifies the cost of computer interactive training.

Summary

Foodborne illness continues to be a major serious health threat to Americans because of changes in society, farming practices, and microbiology. Restaurants are the source of 80% of foodborne illnesses. Therefore, foodservice employees should follow correct procedures to prevent contamination. Foodborne illnesses attributed to unsanitary conditions and improper food handling in restaurants have received negative publicity through the media.

The foodservice industry and government agencies have responded by offering training to foodservice employees and educating the public about food safety. Furthermore, the FDA and USDA have passed regulations requiring seafood processors, and meat and poultry slaughter and processing plants to establish Hazard Analysis Critical Control Point (HACCP) plans to prevent contamination of food. Although

HACCP plans will yield safer foods, employees still need training to prevent contamination of foods.

Food safety training is important because it protects consumers' health and improves the image of the food industry. Studies have demonstrated that food safety training is effective. Training has increased inspection scores, which reflected safer conditions and better employee performance of safe food handling behaviors.

To be effective, training should be tailored to employees' needs in an increasingly diverse workforce. To meet their needs training should be presented in their native language, self-paced, easy to use, designed for their education level, interactive, and time efficient. Computer interactive training can meet these needs. The major benefits of computer interactive training are that it requires less time, costs less, and is effective. Computer interactive training can be an effective tool to teach food safety to foodservice employees.

Specific Aims

This study investigated the effectiveness of different methods of training food safety concepts to cooperative extension agents.

Objectives:

1. To compare the effectiveness of three training methods through analysis of the knowledge gained and knowledge retained.
2. To explore which training formats and training aids were considered the most effective to learn food safety.

CHAPTER 3

METHODS

Problem Statement

The purpose of this study was to explore the effectiveness of three different methods used to train extension agents about food safety as measured by scores on knowledge pretests, posttests, and retention tests. The three different food safety training methods included:

1. Two-day training by lecture method developed by a national organization
2. Computer interactive training with one session only
3. Computer interactive training with a weekly review of two segments of the training for a total of five weeks

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Definition of Terms

Food Safety: Use of measures to protect the safety of the food supply and to prevent the contamination of the food supply.

Interactive computer training: Use of computers to train participants who learn information through interacting with computers.

Research Design

The independent variable investigated is the type of food safety training. The types of training examined were a two-day training by lecture method, computer interactive training with one session only, and computer interactive training with a weekly review of two training segments. A control group, which received no training, was included.

Dependent variables were examined to measure knowledge gained or lost. The first dependent variable, "intervention improvement," measures the knowledge gained or lost from pretest to posttest. The second dependent variable, "retention/treatment improvement," measures the knowledge gained or lost from posttest to retention test (six week period). The third dependent variable, "retention/initial improvement," measures the knowledge gained or lost from pretest to retention test. Dependent variables were calculated according to the following:

Intervention improvement = knowledge posttest scores minus pretest scores
Retention/treatment improvement = retention test scores minus posttest scores
Retention/initial improvement = retention test scores minus pretest scores

Sample

Approval for the use of extension agents in the study was given by the directors of Cooperative Extension in Tennessee. Tennessee Cooperative Extension is divided into four districts. District Program Directors were asked to select from each district eight extension agents, who lacked certification in food safety, to participate in the study. District Program Directors were asked to assign those eight subjects to four different treatment groups. Each treatment group would have two extension agents from each of the four districts.

The four groups were: 1) two-day training by lecture method group, 2) computer interactive training group with one session only, 3) computer interactive training group with a weekly review of two segments of the training, and 4) control group.

Program Directors did not randomly select all participants. Program Directors selected subjects for the training by lecture group from district agents who wanted to receive this two-day training. Subjects for the two computer interactive training groups were selected from agents who had computers with CD-ROM drives, other equipment needed to run the CD-ROM, and knowledge of how to use a mouse. Program Directors selected control group participants randomly from each district.

Thirty-two extension agents from Tennessee were assigned by their District Program Directors to one of the treatment groups or the control group. Each group initially consisted of eight participants. Two participants were dropped from each of the computer interactive training groups due to problems accessing the CD. One was dropped from the control group due to lack of compliance.

In mid-September, all participants received letters introducing them to the purposes of the study and the training (Appendix 1). Letters provided information that was relevant to that particular group. These letters informed them of their group assignment, scheduled training, and necessary equipment. The two-day training began late September and the computer interactive training began in early October.

Two-Day Training by Lecture Method

This two-day training by lecture methods consisted of mainly lecture, and included handouts, slides, videos, and a textbook. There also were some activities, such as group discussions of worksheets, case studies, and chapter review questions.

Extension agents in this group were trained by three professors from the University of Tennessee, Knoxville who are certified as food safety trainers. The professors have extensive knowledge in food safety principles and experience in food safety training. Each professor taught different topics, which followed the sequence of chapters in the textbook.

In mid-September, these trainees received a letter outlining the purposes and procedures of the study and their group assignment. The extension agents stayed in Knoxville, Tennessee during the two-day training period. On the first day, the agents were introduced to the research procedures and purposes and the training. The knowledge pretest and demographic survey were administered with the lecture training following. On the second day immediately after the training ended, the knowledge posttest was administered. The food safety certification exam was administered immediately after the posttest. This certification exam was not directly related to the research.

Six weeks later, in early November, participants of this group received a letter, knowledge retention test, and envelope stamped and addressed to the researcher (Appendix 3). A phone call and an e-mail message reminded them to complete the test, without assistance or referral to their materials.

Computer Interactive Training

The computer interactive software, The Foodhandler's Sanitation Interactive, consisted of ten segments. These segments instructed participants about hazards, employee hygiene, receiving foods, food storage, thawing of foods, cooking, serving, cross-contamination, record keeping, cooling foods, keeping leftovers, cleaning, and

sanitation. A menu on the screen allowed participants to click on the segment to be completed. A human face appeared on the screen and verbally taught about food safety while photographs or video appeared in the background. Each segment contained questions that the participants answered with a click of the mouse on the correct answer. Interactive exercises in most segments gave participants the opportunity to apply the information that they learned. For example, participants used the mouse to click and drag items to check packages during receiving. The entire computer interactive software required forty-five minutes to one hour to complete.

Subjects assigned to one of two computer interactive training groups and their supervisors were sent a letter concerning equipment needed to run the The Foodhandler's Sanitation Interactive CD. During late September, participants assigned to the computer interactive training groups received a letter, an envelope stamped and addressed to the researcher and the knowledge pretest (Appendix 1). The letter informed them about the purposes and procedures of the study, and when to start the training and complete the questionnaires. A phone call and an e-mail message reminded them to complete the pretest and send it.

Once the pretests were received, a knowledge posttest, stamped and addressed envelope, the food safety CD, and detailed instructions about how to install and start the CD were sent to the extension agents (Appendix 2). During early October, the individuals viewed the CD in its entirety. Immediately after completing the computer interactive training, both computer groups completed the posttest and mailed the posttest back in the envelopes provided. If the posttest was not received two weeks after the

initial computer training, participants who did not return the posttests received another phone call.

The knowledge posttests that were received over two weeks after the date of initial training were from two individuals, or one participant from each computer interactive training group. The individual in the group with the weekly review started both the training and the posttest late. It was unclear whether the other individual only sent the posttest late or started both the training and the posttest late.

The individuals who were to complete the weekly training refresher were instructed about which segments on the CD they were to review according to the following schedule:

Week of October 12:	Introduction and Hazards
Week of October 19:	Personal Hygiene and Receiving
Week of October 26:	Storage and Thawing
Week of November 2:	Cooking and Serving
Week of November 9:	Leftovers and Cleaning and Sanitation

Each week participants received a phone call to remind them about which segments to review.

Six weeks after the initial training, during mid-November, participants in both computer interactive training groups received a letter, the knowledge retention test, and an envelope stamped and addressed to the researcher (Appendix 3). These individuals also received a phone call reminding them to complete and return the knowledge retention tests. Participants who did not return their retention tests by late November, received another phone call.

Control Group

During mid-September, participants in the control group received a letter about the purposes and procedures of the study and group assignment. During late September, these individuals received a letter, a knowledge pretest and a stamped and addressed envelope to send to the researcher (Appendix 1). The control group received a phone call and an e-mail message reminding them to complete and send the pretest. After six weeks, during early November, these participants received a letter, the knowledge posttest, and an envelope stamped and addressed to the researcher and a phone call (Appendix 3). The phone call reminded them to complete the retention test. Control group participants who did not return their retention tests two weeks later, received another telephone call.

Development of the Survey Test Instrument

A questionnaire was written by the researcher to assess the food safety knowledge of all participants. The same knowledge questions were administered for the pretest, posttest, and retention test. To devise a standard test to compare the teaching methods, questions were developed from food safety information that was encompassed by both the two-day lecture training and the computer interactive training. No emphasis was placed on any specific topic.

The pilot test contained twenty-seven multiple-choice knowledge questions and some demographic questions. It was pilot tested with seventeen university students in a quantity food production class. Students were encouraged to write directly on the questionnaire to comment on the clarity of the questions and answer choices and the difficulty level of each question. After the pilot test, each question was analyzed to

determine if a high or low number of students answered it correctly or incorrectly. Questions that were too easy, too difficult, or unclear were eliminated or reworded.

The final survey test instrument used with the sample consisted of twenty-five knowledge questions (Appendix 4). One question was dropped early in the study because of vagueness. For data collection purposes, the questionnaires had an area to prompt participants to write the last four digits of their social security number, their initials, and the date when they completed the questionnaire.

A series of ten demographic questions followed the pretest (Appendix 4). This section contained questions about foodservice related work experience, previous food safety training experience, education, age, and training methods that they perceived were the most effective or from which they learned best. The four demographic questions which addressed the effectiveness of training methods on the pretest were used again on the posttest and retention test (Appendix 5). The four questions were based on a questionnaire developed by Foucar-Szcocki (1988). These data were compared to determine if there was a change in perceived effectiveness of training methods after the participants have received their interventions.

Statistical Analysis of Data

Tests were graded and re-graded to check for accuracy. Each test was scored using a point system. Test scores and answers to demographic questions were entered into the Statistical Analysis System (SAS) and SPSS. Test scores and answers to demographic questions were checked against hard copy for accuracy.

Immediately following the posttest, extension agents in the lecture method group completed an additional test to receive food safety certification from a national

organization. Scores achieved on the posttest and certification exam were correlated to examine a relationship between scores on the two tests and to determine the reliability of the food safety knowledge test.

Numerical values for dependent variables (as shown below) and means were calculated by SAS for each intervention group:

> Dependent variables to measure knowledge gained or lost:
> Intervention improvement = knowledge posttest scores minus pretest scores
> Retention/treatment improvement = retention test scores minus posttest scores
> Retention/initial improvement = retention test scores minus pretest scores

Analysis of variance (ANOVA) was used to determine if pretest, posttest, retention test scores, and dependant variables significantly among groups. The General Linear Model, which accommodates ANOVA, regression, and analysis of covariance (ANCOVA), was utilized to evaluate if knowledge test scores differed among treatment groups or significantly differed within individuals over time from pretest to posttest to retention test. These statistical tests assess if the difference in means between the intervention groups or within a participant is due to real differences that result from treatment or merely due to natural variation within an intervention group or individual.

To assess if the groups were similar in demographic characteristics, Fisher's Exact test was performed to ensure that variations in demographic characteristics may only have had minor differences on knowledge test scores. Spearman's correlation coefficient was used to explore associations between demographic characteristics and knowledge gained or lost.

Four demographic questions addressed the effectiveness of training formats and training aids. Formats refer to "various methods and techniques used in organizing

training activities" (Foucar-Szocki, 1988). Training aids are tools which "extend or increase the effectiveness of various formats." The first two questions asked participants to circle the food safety training aids and formats they received. The next two questions asked participants to rank the top three food safety training aids and formats that they felt were the most effective for them to learn food safety. Frequency tables for the ranking of format and aid items were constructed to determine the items perceived as most effective in teaching food safety. The General Linear Model was used to evaluate if rankings differed significantly among the three tests and among groups.

CHAPTER 4

RESULTS AND DISCUSSION

General Demographic Characteristics

The sample studied included twenty-nine Cooperative Extension agents from the four Cooperative Extension districts in Tennessee. The lecture group, computer interactive training group, computer interactive training with weekly reviews group, and control group, consisted of eight, seven, seven, and seven participants, respectively.

Demographic characteristics were obtained to describe the sample. Over half of the participants were forty-five to fifty-four years old (51.7%) (Table 1). The rest of the sample were under forty-five, including 20.7% between 35 to 44 years old, 10.3% between 25 and 34 years of age, and 17.2 between the ages of 20 and 24. Over half earned their master's degree (58.6%). Most of the participants (79%) had no experience or less than one year of experience in foodservice. Others had one to five years of experience (13.8%), six to ten (3.4%), and over twenty years experience (3.4%).

Over 89% of the sample received food safety training in the past. Federal grants have provided funding for previous food safety training. Cooperative Extension agents need to understand the principles of food safety because residents in their districts ask them questions about this topic. Of those who received training, 40% received up to ten hours of training, 24% received ten to thirty hours, and 36% received over thirty hours. Overall, most of the individuals in this sample were middle-aged, highly educated, lacked extensive experience in foodservice, and received previous food safety training.

Table 1. Demographic characteristics of extension agents in the lecture, computer interactive, computer interactive with weekly reviews, and control groups.

Characteristics	Lecture Group	Computer Interactive Training Group	Computer Interactive w/ Reviews Group	Control Group	Percentage of Participants	Frequency of Participants
Age (years)						
20-34	0	1	0	4	17.2	5
25-34	1	0	1	1	10.3	3
35-44	2	2	1	1	20.7	6
45-54	5	4	5	1	51.7	15
Education						
Bachelor's	0	2	0	5	24.1	7
Some Graduate Work	1	1	2	1	17.2	5
M.S. or M.A.	7	4	5	1	58.6	17
Years of Foodservice Experience						
Less than 1 yr.	7	5	7	4	79.3	23
1-5	1	1	0	2	13.8	4
6-10	0	0	0	1	3.4	1
Over 20	0	1	0	0	3.4	1
Type of Foodservice Experience						
Front of House	0	0	1	4	17.2	5
Back of House	1	1	0	1	10.3	3
Neither	7	6	6	2	72.4	21
Previous Food Safety Training						
No	0	1	0	2	10.7	3
Yes	8	6	6	5	89.3	25
Hrs. of Training						
Up to 10	5	2	1	2	40.0	10
10-30	2	1	2	1	24.0	6
Over 30	1	3	3	2	36.0	9

Demographic Characteristics and Group Assignment

In general, District Agents assigned extension agents to their groups regardless of demographic characteristics. Group assignment was independent of age ($p>0.05$), years of foodservice experience ($p>0.05$), previous food safety training ($p>0.05$), and hours of training ($p>0.05$). However, the type of foodservice experience ($p<0.05$) and educational degree were not independent of group assignment ($p<0.05$). Compared to the other groups, the control group had the highest percentage of participants who earned a bachelor's degree as the highest level of education achieved. Since the control group received no food safety training, the control group was excluded in another test for independence. Excluding the control group, education was independent of group assignment to the treatment groups ($p>0.05$). Overall, demographic characteristics could not predict which group each individual was assigned. Since groups were not significantly different in demographic characteristics, the variation may not have had any influence on knowledge test scores.

Knowledge Test Scores

Subjects in the lecture method, computer interactive training, and computer interactive training with weekly reviews, and control groups were given a knowledge pretest. After the three groups received the training, they completed the knowledge posttest. Posttest scores of the lecture method group were positively correlated with scores of the certification exam of a national organization ($p<0.05$). The relationship between the scores indicated that the posttest was a reliable instrument to test food safety knowledge. Six weeks later, the training three groups completed the knowledge retention test and the control group completed the posttest.

Participants in the lecture method, computer interactive training, and computer interactive training with reviews, and control groups achieved pretest scores of 56%, 60%, 63%, and 50%, respectively (Table 2). When the pretest scores were compared among all four groups, there were no significant differences ($p>0.05$) in food safety knowledge that individuals already possessed. This indicated that all participants began the study with similar amounts of food safety knowledge and that the groups began at the same baseline before training started.

After receiving training, participants trained by the lecture method, computer interactive training, and computer interactive with reviews improved their knowledge (posttest scores minus pretest scores) by 31%, 26%, and 25%, respectively (Table 2). Although the effect from training seems moderate, subjects in all treatment groups improved their scores significantly from pretest to posttest ($p<0.0001$). Gaddis (1997) also found that intervention improvement for quick service restaurant workers was 20.8% (lecture) and 15.7% (one treatment of computer interactive training) and for school foodservice workers was 18.3% (lecture) and 15.3% (computer interactive training). The intervention improvement in this study was slightly higher, possibly due to the difference in education.

All treatment groups significantly improved their knowledge, but posttest scores of these three groups did not significantly differ from each other ($p>0.05$). Intervention improvement (posttest scores minus pretest scores) also did not differ significantly among the three groups. This might have occurred because the lecture method utilized additional training formats and training aids to enhance effectiveness. Formats and aids

Table 2. Knowledge test scores for extension agents in the lecture method, computer interactive training, computer interactive training with reviews, and control groups.

Knowledge Test (% Correct)	Lecture Group	Computer Interactive Group	Computer Interactive with Reviews Group	Control Group
Pretest	55.73 [d]	60.12 [d]	63.10 [d]	50.00 [d]
Posttest	86.98 [e]	85.71 [e]	88.10 [e]	50.60 [d]
Intervention Improvement [a]	31.25 [g]	25.60 [g]	25.00 [g]	0.60 [j]
Retention Test	73.96 [f]	80.36 [f]	86.31 [f]	--
Retention/Treatment Improvement [b]	-13.02 [h]	-5.36 [h]	-1.79 [h]	--
Retention/Initial Improvement [c]	18.23 [i]	20.24 [i]	23.21 [i]	--

[a] Intervention Improvement = Posttest scores minus Pretest scores

[b] Retention/Treatment Improvement = Retention scores minus Posttest scores

[c] Retention/Initial Improvement = Retention scores minus Pretest scores

[de] Means within rows differ at $p<0.0001$

[def] Means within columns differ at $p<0.0001$

[gj] Means within rows differ at $p<0.01$

that supported the lecture method included question and answer periods, videotapes, slides, manuals, and handouts.

Similarly, Gaddis (1997) found that intervention improvement that resulted from computer interactive training was not significantly different from training by lecture method for school foodservice workers. No significant differences were found because of similarities between the lecture method and computer interactive training. The content of the lecture format was developed from the computer software. The lecture method included a workbook in which the content and sequence of information paralleled the computer interactive training software. In addition, the workbook included the same photographs used in the computer software. Since the lecturer trained the school foodservice employees in the food production areas at their workplaces, the lecturer added a visual component similar to the computer software and immediate relevance to their job.

The lack of significant differences in knowledge improvement suggested that computer interactive training completed in approximately fifty minutes was as effective as training by lecture method, which participants completed in two days. Compared to the lecture method, computer interactive training conserves time as demonstrated by studies in corporations (Hall, 1996; Stephenson, 1995). Reducing training time leads to savings in travel costs and training expenses, as experienced by such companies like IBM, Ford Motor Credit, and Price Waterhouse (Hall, 1996; Oz & White, 1993).

The posttest scores and intervention improvement of the treatment groups differed significantly over those of the control group ($p<0.0001$ and $p<0.01$, respectively). This suggested that the lecture method and computer interactive training were effective in

teaching food safety compared to no training. These extension agents could invest the food safety training they received to educate foodservice employees and the public to prevent foodborne illness. The education of these populations will result in better sanitary conditions and safe food handling behaviors (Cochran-Yantis et al., 1996; Cotterchio et al., 1998; Johnson, 1995).

The average increase in control group scores was 0.6% from pretest to posttest. Since each correct answer increases the score by 4.2%, the 0.6% increase was not significant. This demonstrated that all three training methods were effective in teaching food safety principles when compared to no training. Gaddis (1997) found that compared to the pretest, posttest scores of the school foodservice and quick service employees in the control groups decreased 2.7% and increased 4%, respectively. This change is equivalent to only one question or less on the knowledge test.

Six weeks later, retention test scores showed that all subjects who received food safety training lost a significant amount of knowledge since the posttest ($p<0.01$). The knowledge lost by the lecture method group, computer interactive group, and computer interactive with reviews group was 13%, 5%, and 2%, respectively (Table 2). When the retention test scores and knowledge lost (retention test minus posttest) were compared among treatment groups, there were no significant differences ($p>0.05$).

Similarly, Gaddis (1997) found that when retention test scores were compared to posttest scores, computer interactive and lecture method training groups of school foodservice workers did not significantly differ, but differed slightly for quick serve workers. Quick serve employees in the computer group retained the knowledge gained, but those who were trained by lecture method lost 2.3% of their knowledge gained.

Since this retention test was administered only one week after training, participants in that study retained most of the knowledge gained.

In this study it was expected that the knowledge lost by the computer interactive training with reviews group would differ significantly from other groups because of the weekly reinforcement of the food safety lessons. This repeated involvement of the learner with the material during computer interactive training was hypothesized to "enhance the ability to retain information" (Oz & White, 1993). However, in the current study, weekly reviews were not worth trainees' time or effort if reinforcement does not significantly improve retention of learned material.

When the retention test was compared to the pretest, participants trained by lecture method, computer interactive training, and computer interactive training with reviews gained 18%, 20%, and 23%, respectively (Table 2). All participants significantly gained food safety knowledge from pretest to retention test ($p<0.0001$). However, this increase did not differ significantly among groups. Although subjects lost a significant amount of knowledge from posttest to retention test, training was effective since participants increased their knowledge significantly from pretest to retention test. Likewise, Gaddis' (1997) study demonstrated that from pretest to retention test, quick service workers improved their knowledge by 18.5% (lecture) and 15.7% (computer) and school foodservice employees increased their knowledge by 16.0% (lecture) and 17.7% (computer).

Regardless of type of training used, all subjects in this study initially improved their knowledge significantly, but lost a significant amount of knowledge as time passed. Similarly, the food safety behaviors of college foodservice employees increased (35.6%

to 82.2%) with training by lecture method, but declined three weeks after training (82.2% to 79.7%). However performance rose with motivation from supervisors (to 98.3%) (Johnson, 1995).

Therefore, when efficiency, efficacy, cost-effectiveness, and convenience are considered, computer interactive training (without weekly reviews) would be the optimal choice. Companies have reported at least a 40% drop in training time with computer-based training due to the decrease in travel time (Hall, 1996). The decrease in travel and training time helps to conserve company resources. Training time is shortened since this training is self-paced and allows users to access only the segments they need to learn (Dennis, 1994). Employees can fit the training into their schedule or during slack periods (Dulworth, 1996; Gaddis, 1997). Because trainees are involved with the information through seeing, hearing, and doing, interactivity provided through multimedia promotes learning (Dennis, 1994).

Training Formats and Training Aids

Following the knowledge and demographic questions were two questions that asked participants to circle the food safety training formats and aids they had received in the past. These questions then asked participants to rank the three training formats and the three training aids that they felt were most effective for them to learn food safety.

Participants ranked hands-on training, lecture/speech, and question and answer as effective training formats to learn food safety on the pretest (Table 3). On the posttest, they ranked lecture/speech, hands-on training, and computer-assisted instruction as effective formats. Lecture might be viewed as effective because trainees are most

Table 3. Format items most frequently ranked as effective by test

Test	Format Item	# Subjects Ranked Item Most Effective	# Subjects Ranked Item 2nd Most Effective	# Subjects Ranked Item 3rd Most Effective	# Subjects Who Did Not Rank
Pretest	Hands-on Training	14	4	0	11
	Lecture/Speech	7	2	4	16
	Question and Answer	3	4	2	20
Posttest	Lecture/Speech	8	0	5	9
	Hands-on Training	5	5	1	11
	Computer Assisted Instruction	5	3	4	10

familiar and comfortable with this format which can enhance learning. Trainees also might feel that lectures are effective because they receive information from an expert. Some trainees might have selected hands-on training as an effective format because the training environment is the "performance setting" (Fisher, Schoenfeldt, & Shaw, 1996). Therefore, the training is relevant to the job and immediately applicable. Participants might have ranked computer-assisted instruction as effective because of the feedback provided by the computer when trainees answered questions. Feedback allows users to learn from their mistakes and provides motivation.

On pretests and posttests (Table 4), participants ranked videotapes or films as the most effective food safety learning aid, CD-ROM as the second-most effective aid and manuals as the third-most effective aid. Subjects might have ranked manuals as effective because they could easily retrieve information from manuals and refer to figures in the manual that depict how to handle food safety. Since the principles of handling food safely is more practical than abstract, visual learning aids with moving images, such as videotape and CD-ROM or videodisc, would facilitate learning. However, more subjects ranked videotape higher than CD-ROM or videodisc. This was surprising since Summers (1990) found that college students who were trained about pharmaceuticals via interactive video ranked their training aid significantly higher for "instructional promise" than did those trained by videotape. Instructional promise might refer to the interactive component of the training aid which involves the learner to practice with the material, actively maintains the learner's interest through multimedia, and is flexible with learner's needs (Lilienfield & Broering, 1994). The immediate feedback could motivate learning (Fisher et al., 1996).

Table 4. Aid items most frequently ranked as effective by test

Test	Aid Item	# Subjects Ranked Item Most Effective	# Subjects Ranked Item 2nd Most Effective	# Subjects Ranked Item 3rd Most Effective	# Subjects Who Did Not Rank
Pretest	Videotapes or Films	13	1	4	11
	CD-ROM or Videodisc	6	3	2	18
	Manuals	5	6	6	12
Posttest	Videotapes or Films	7	7	1	7
	CD-ROM or Videodisc	7	2	4	9
	Manuals	5	5	2	10

With regards to the questions that asked participants to rank the three training formats and training aids that they felt were most effective, subjects did not significantly rank either format or training aid items differently over time from test to test. This was surprising since it was expected that subjects in the computer interactive training groups would give a higher rank to "computer assisted instruction" format and "CD-ROM or Video Disc" aid after receiving their treatment.

Although there were no significant changes in participants' responses over time, their rankings were significantly different among treatment groups for training format items ($p<0.05$) but not for training aid items ($p>0.05$) when groups were compared. There were significant group differences between the treatment groups for the posttest and retention tests, but not the pretests. Treatment group had a significant effect on how the groups ranked the following format items ($p<0.05$): Question and Answer (trainees ask the trainer or expert questions), Computer Assisted Instruction (instruction using a computer), and Workbook Assignments (trainees complete written assignments with feedback given).

All of these significant differences occurred between the lecture method and computer interactive training groups or between the lecture method and computer interactive training with weekly reviews groups (Table 5). Treatment group influenced rankings because subjects might have felt these formats were useful after they experienced the formats in their training. The "Question and Answer" format was used during the lecture group, but not in the computer interactive training groups. As a result, the majority of lecture group participants ranked that format as more effective as compared to the majority of computer interactive training groups who did not rank it as

Table 5. Comparison of how groups ranked format items differently ($p<0.05$) for each test.

Test	Format Item	Group	# Subjects Who Did Not Rank	# Subjects Ranked Item Most Effective	# Subjects Ranked Item 2nd Most Effective	# Subjects Ranked Item 3rd Most Effective
Post	Question and Answer	Lecture	3 [a]	1	3	1
	Question and Answer	Computer Interactive Training	7 [b]	0	0	0
	Workbook Assignments	Lecture	3 [c]	0	3	2
	Workbook Assignments	Computer Interactive Training	7 [d]	0	0	0
Retention	Question and Answer	Lecture	2 [e]	1	3	2
	Question and Answer	Computer Interactive Training	6 [f]	0	1	0
	Question and Answer	Computer Interactive Training with Reviews	6 [f]	0	0	1
	Computer Assisted Instruction	Lecture	7 [g]	0	0	1
	Computer Assisted Instruction	Computer Interactive Training with Reviews	1 [h]	2	3	1

[ab] Frequencies differ at $p<0.05$
[cd] Frequencies differ at $p<0.05$
[ef] Frequencies differ at $p<0.05$
[gh] Frequencies differ at $p<0.05$

effective. "Computer Assisted Instruction" format was implemented in the computer interactive training groups. Therefore, most of the computer interactive training with reviews group ranked the format as effective while the lecture method group did not rank it. After the lecturer presented a chapter in the manual, the lecture method group was asked to circle the answers to the questions at the end of each chapter in their manuals. The answers were discussed aloud after the participants finished circling the answers. The computer interactive training groups did not experience this training format. None of these participants ranked "Workbook Assignments" as effective, but the majority of the lecture group method ranked it as an effective format.

CHAPTER 5

SUMMARY AND CONCLUSIONS

The main purpose of this study was to compare the effectiveness of three training methods used to teach food safety to cooperative extension agents. A secondary aim was to examine which training formats and training aids agents considered were the most effective for them to learn food safety.

Agents who were trained by the first method attended a two-day lecture seminar developed by a national organization. The second method consisted of one training session of the computer interactive training. For the third method, participants completed one training session of the computer interactive training and reviewed two lessons each week.

The two-day training by lecture method included mostly lecture presented through slides. Subjects were provided with manuals and viewed videos of safe food handling. There also were some activities, such as group discussion of worksheets, case studies, and chapter review questions.

The computer interactive software, entitled "The Foodhandler's Sanitation Interactive," consisted of ten lessons or segments. The segments instructed participants about hazards, employee hygiene, receiving foods, food storage, thawing of foods, cooking, serving, cross-contamination, record keeping, cooling foods, keeping leftovers, cleaning, and sanitation. A voice verbally taught about food safety as a video or photograph appeared on the screen. Each segment involved the participants through

questions that they answered with the click of a mouse or through tasks they performed to apply the information they learned.

To assess the effectiveness of these methods, a survey test instrument was developed. It consisted of 24 multiple choice questions about food safety. The knowledge questions inquired about information presented in both the two-day lecture method and the computer interactive training. Following the knowledge questions were ten demographic questions, including questions about the effectiveness of training formats and training aids.

The three treatment groups and the control group completed a knowledge pretest to establish a baseline. Pretest scores showed that all subjects began the study with a similar amount of food safety knowledge. Therefore, subjects started at the same baseline.

The demographic portion of the survey revealed that most of the participants were middle-aged, highly educated, lacked long-term work experience in foodservice, and received previous food safety training. Over half of the participants were 45-55 years old and earned their master's degree. Over three-quarters had no foodservice work experience or less than one year of experience. Almost 90% had received previous food safety training, 60% of which had over ten hours of training.

After receiving their training, participants completed a posttest. Control group participants completed a knowledge posttest six weeks after the pretest. Participants trained by the lecture method, computer interactive training, and computer interactive training with reviews improved their knowledge (posttest minus pretest scores) by 31%, 26%, and 25%, respectively. Although this improvement seems moderate, subjects

increased their scores significantly from pretest to posttest. However, when the posttest scores were compared, no significant differences were found. The intervention improvement also did not differ among groups. The additional training formats and aids (such as question and answer sessions, videotapes, slides, manuals, and handouts) that supported the lecture method to enhance effectiveness might explain this lack of significant differences. Although the scores and intervention improvement among treatment groups did not differ significantly, the three groups performed significantly better on the posttest than the control group. This suggested that the three methods are effective food safety training methods.

Six weeks later, participants who received food safety training lost a significant amount of knowledge, as shown on the retention test. The knowledge lost (retention test minus posttest scores) by the lecture method, computer interactive training, and computer interactive training with reviews groups were 13%, 5%, and 2%, respectively. When the retention test scores and knowledge lost were compared among groups, no significant differences were found.

When the retention test was compared to the pretest, participants trained by lecture method, computer interactive training, and computer interactive training with reviews gained 18%, 20%, and 23%, respectively. These are the amounts of knowledge retained after six weeks. Retention is important. Unless extension agents review food safety information over the long-term or refer to food safety materials, they will only convey the food safety knowledge that they remember to their constituents. Their constituents are ultimately responsible for serving safe food in foodservice establishments.

Other aspects examined were the training formats and training aids that participants considered the most effective for them to learn food safety. Subjects did not rank format or aid items differently from test to test. Although there were no significant ranking differences over tests, groups significantly ranked training formats differently on the posttest and retention test. However, groups did not rank training aids differently.

The lecture method and computer interactive training groups ranked formats differently. On the posttest, over half of the lecture method group ranked question and answer and workbook assignments as effective formats. None of the computer interactive training participants (one training session) ranked these formats as effective on the posttest. On the retention test, the majority of the lecture subjects ranked question and answer as effective while most of the two computer interactive training groups did not. Almost all of the participants in the computer interactive training with reviews group ranked computer-assisted instruction as an effective format, but almost all of the lecture group participants did not rank it as effective. Since no significant differences occurred on the pretest, groups may have possibly ranked these formats differently after they experienced these formats during their training.

Frequency tables were developed to determine the training formats and training aids that subjects, as a whole, considered effective. Subjects ranked hands-on training, lecture/speech, and question and answer as effective training methods to learn food safety on the pretest. On the posttest, they ranked lecture/speech, hands-on training, and computer-assisted instruction as effective formats. On both the pretest and posttest, subjects ranked videotapes or films as the most effective training aids, followed by CD-ROM as the second-most effective aid and manuals as the third-most effective aid.

Therefore, future training efforts should include some or all of these training formats and training aids.

The goals of this research were to determine which of the three training methods and training formats and aids were most effective to train extension agents about food safety. Based on the statistical analysis of test scores and knowledge gained and lost, the three methods were equally effective. However, when deciding among methods to use, not only should effectiveness be considered, but also other factors, such as time and resources.

The lecture method required two days to complete, not including travel time. The lecture method incurred costs of travel, lodging, meals, trainers, materials, and employee time. Multiple lecturers were required because of scheduling conflicts. With multiple lecturers, problems could arise in consistency of the quality of training and information conveyed. Even the most highly qualified and experienced trainer would not perform the same at every lecture. In two days, trainees might not have been able to process and remember such a vast amount of information. Although in six weeks their retention of knowledge did not significantly differ from the other groups, a fourth test a year after training may determine if the retention among groups will still remain the same.

Computer interactive training would be the best method of training when effectiveness and other factors are considered. Travel time and related costs were eliminated because CDs were sent to extension agents. The cost of a CD was $40 plus mailing expenses for each subject in the computer interactive training groups. The cost to train a participant through the two-day training by lecture method was almost seven

times the cost to train an extension agent using computer interactive training ($42 for a manual, $100 for hotel, $60 for meals, and $78 for gas per person).

The difference between the cost of the training methods would be even greater if employee time spent in training was considered. Extension agents completed the training at the convenience of their schedules and at their own pace. The CD only required about fifty minutes to complete, which was much shorter than the two-day training by lecture method.

Furthermore, these participants had easy access to virtual foodservice areas and interacted with foodservice equipment on the computer. This interactivity and realistic simulation encourages transfer of training to where the food safety principles would be applied. In contrast, participants who were trained by the lecture method sat in the classroom and saw videotapes of foodservice areas and equipment, but did not interact with any foodservice equipment. Although training by lecture method and computer interactive training were equally effective, when decreased costs and time, convenience, and interactivity are considered, computer interactive training appeared to be the better choice to teach food safety. Computer interactive training would complement perceived effective training formats and aids, such as hands-on training, question and answer session with a food safety expert, and manuals.

According to learning theories, automaticity is developed through repeatedly practicing a task (Fisher, Schoenfeldt, & Shaw, 1996). Automaticity is especially important in foodservice because once food is contaminated, the food might be difficult to salvage or should be thrown out. Computer interactive training is ideal for segments of practice over time because of the ease of use, convenience, time efficiency, and

consistent delivery. Fisher et al. (1996) reported research has demonstrated that for tasks that are "difficult, complex, meaningless, or must be remembered" in the long-term, practice which is divided into segments is better than one long practice session. The same principles might apply to learning food safety concepts.

Limitations

One limitation of the study is the small sample size of the groups. A major limitation is the lack of complete random assignment of subjects to the groups. These limitations hinder the extrapolation of these results to other extension agents and foodservice professionals. Another limitation is time. Retention test scores might be different in the long-term. Funding and cooperation from cooperative extension management would have increased the sample sizes and extended the study. Compliance, especially among computer interactive participants was another problem encountered during the study. Not all of these subjects completed their training on the same day.

Future Research

Future research should focus on the learner. Long term studies are recommended to determine retention of information. Many variables affect learning, such as the learner's previous knowledge, nature of the training topic, and conditions in the training environment. Organization of text and optimal length of program are other variables that influence learning that should be considered. Studies should control confounding variables to ensure that they do not interfere with dependant variables. Research should be based on cognitive science, the study of "how people think, learn, remember, and transfer information to new situations" (Williams & Brown, 1991). Studies should

examine if trainees transfer the knowledge they received during training to actual performance in the workplace. Research should also examine how motivation, reinforcement, and managerial support affect training and its transfer to performance.

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APPENDICES

APPENDIX 1

Initial Letters to Participants

Dear Extension Agent,

Cooperative extension administrators have selected you to receive food safety training through using a CD called the Food Handler's Sanitation Interactive.

To access the CD, you will need the following:

486/50 MHz or better	8 MB physical RAM
Windows 3.1 or higher	Compatible Video Driver
13" Color Monitor or larger	Sound Card
2 x CD-ROM Drive	Mouse, and limited knowledge of how to use one

Please notify us as soon as possible if you do not have any one of these.

The Food Handler's Sanitation Interactive training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Please **call or e-mail us immediately** if:

1. You **do not** have one of the equipment items listed above to access the CD, or
2. You **have received ServSafe training**, developed by National Restaurant Association Education Foundation. If you have received ServSafe training, let us know whether or not you were certified.

If you **have the proper equipment and have not received the ServSafe training, you do not need to contact us**. You will receive more information about the CD in the mail next week.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please do not refer to your CD, ServSafe, or any food safety materials during the project, except when you are to view the CD during the week of September 28.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling	Carol Costello, Ph.D.	William C. Morris, Ph.D.
Graduate Student	Professor	Professor

Dear Extension Agent,

Cooperative extension administrators have selected you to be a participant in the control group of a research project at the University of Tennessee.

Please **call or e-mail us immediately** if you **have already received ServSafe training,** developed by National Restaurant Association Education Foundation. If you have received ServSafe training, let us know whether or not you were certified.

If you **have not received the ServSafe training, you do not need to contact us.** You will receive more information about your participation in the mail next week.

A study is being conducted to explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety. Since you are assigned to the group that receives no food safety training, please do not refer to any food safety materials during the project.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please do not refer to ServSafe, or any food safety materials during the project. All responses are confidential and will not be linked to your name. At the completion of the study, an interactive food safety training CD will be sent to you as a reflection of our thanks for your participation.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling	Carol Costello, Ph.D.	William C. Morris, Ph.D.
Graduate Student	Professor	Professor

«FirstName» «LastName»
«JobTitle»
«Address1»
«Address2»
«Address3»
«City», TN «PostalCode»

September 18, 1998

Dear «MrMs» «LastName»:

As a cooperative extension agent, you educate your constituents about meaningful topics. One significant topic is food safety. Training foodservice employees about food safety can prevent foodborne illnesses from occurring. Therefore, it is important that you are trained in food safety and then educate foodservice employees. Cooperative extension administrators have selected you to receive food safety training through using a CD called the Food Handler's Sanitation Interactive, a fifty minute long program.

To access the CD, you will need the following:

486/50 MHz or better	8 MB physical RAM
Windows 3.1 or higher	Compatible Video Driver
13" Color Monitor or larger	Sound Card
2 x CD-ROM Drive	Mouse, and limited knowledge of how to use one

Please notify us as soon as possible if you do not have any one of these.

The Food Handler's Sanitation Interactive training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Please complete the enclosed knowledge test. Send it back within this week using the stamped and addressed envelope provided. Once received we will send you a letter, stamped and addressed envelope, knowledge test, and CD. During the week of September 28, you will complete the entire CD (about fifty minutes), only one time and in its entirety. Immediately after the training, you will complete the test and mail it back in the envelope provided.

Six weeks later, during the week of November 9, you will receive a letter, stamped and addressed envelope and knowledge test. Please complete the test and mail it back within the same week using the envelope provided. We will call to remind you to complete it.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please do not refer to your CD, ServSafe, or any food safety materials during the project, except when you are to view the CD during the week of September 28. All responses are confidential and will not be linked to your name.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling
Graduate Student

Carol Costello, Ph.D.
Professor

William C. Morris, Ph.D.
Professor

Date	What You Are Expected to Do
Week of Sept. 21	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail knowledge test back to UT
Week of Sept. 28	Receive letter, phone call, stamped and addressed envelope, knowledge test, CD Complete the entire CD one time only Complete and mail the test back to UT
Week of Nov. 9	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT

«FirstName» «LastName»
«JobTitle»
«Address1»
«Address2»
«Address3»
«City», TN «PostalCode»

September 18, 1998

Dear «MrMs» «LastName»:

As a cooperative extension agent, you educate your constituents about meaningful topics. One significant topic is food safety since reports of foodborne outbreaks on are the rise. Training foodservice employees about food safety can prevent foodborne illnesses from occurring. Therefore, it is important that you are trained in food safety and then educate foodservice employees. Cooperative extension administrators have selected you to receive food safety training through using a CD called the Food Handler's Sanitation Interactive, a fifty minute long program.

To access the CD, you will need the following:

486/50 MHz or better	8 MB physical RAM
Windows 3.1 or higher	Compatible Video Driver
13" Color Monitor or larger	Sound Card
2 x CD-ROM Drive	Mouse, and limited knowledge of how to use one

Please notify us as soon as possible if you do not have any one of these.

The Food Handler's Sanitation Interactive training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Please complete the enclosed knowledge test. Send it back within this week using the stamped and addressed envelope provided. Once received we will send you a letter, stamped and addressed envelope, knowledge test, and CD. During the week of September 28, you will complete the entire CD (about fifty minutes), only one time and in its entirety. Immediately after the training, you will complete the test and mail it back in the envelope provided.
For each of the following five weeks, you will spend about ten minutes viewing two segments of the CD. Please view the segments only once and in the order listed in the schedule below. You will be called each week to remind you.

During the week of November 9, you will receive a letter, stamped and addressed envelope and knowledge test. Please complete the test and mail it back within the same week using the envelope provided. We will call to remind you to complete it.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please do not refer to your CD, ServSafe, or any food safety materials during the project, except when you are to view the CD at the scheduled dates. All responses are confidential and will not be linked to your name.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling	Carol Costello, Ph.D.	William C. Morris, Ph.D.
Graduate Student	Professor	Professor

Date	What You Are Expected to Do
Week of Sept. 21	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail knowledge test back to UT
Week of Sept. 28	Receive letter, phone call, stamped and addressed envelope, knowledge test, CD Complete the entire CD one time only Complete and mail the test back to UT
Week of Oct. 5	Receive phone call, complete "Introduction" and "Hazards" once
Week of Oct. 12	Receive phone call, complete "Personal Hygiene" and "Receiving" once
Week of Oct. 19	Receive phone call, complete "Storage" and "Thawing" once
Week of Oct. 26	Receive phone call, complete "Cooking" and "Serving" once
Week of Nov. 2	Receive phone call, complete "Leftovers" and "Cleaning and Sanitation" once
Week of Nov. 9	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT

«FirstName» «LastName»
«JobTitle»
«Address1»
«Address2»
«Address3»
«City», TN «PostalCode»

September 28, 1998

Dear «MrMs» «LastName»:

As a cooperative extension agent, you educate your constituents about meaningful topics. One significant topic is food safety. Training foodservice employees about food safety can prevent foodborne illnesses from occurring. Therefore, it is important that cooperative extension agents are trained in food safety and then educate foodservice employees. Cooperative extension administrators have selected you to be a participant in the control group of a research project at the University of Tennessee.

A study is being conducted to explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety. Since you are assigned to the group that receives no food safety training, please do not refer to any food safety materials during the project.

Please complete the enclosed knowledge test. Send it back within this week using the stamped and addressed envelope provided.

Six weeks later, during the week of November 9, you will receive a letter, stamped and addressed envelope and knowledge test. Please complete the test and mail it back within the same week using the envelope provided. We will call to remind you to complete it.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please do not refer to ServSafe, or any food safety materials during the project. All responses are confidential and will not be linked to your name. At the completion of the study, an interactive food safety training CD will be sent to you as a reflection of our thanks for your participation.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling
Graduate Student

Carol Costello, Ph.D.
Professor

William C. Morris, Ph.D.
Professor

Date	What You Are Expected to Do
Week of Sept. 28	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail knowledge test back to UT
Week of Nov. 9	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT
Week of Nov. 16	Receive complimentary CD

APPENDIX 2

Additional Letters to Computer Interactive Training Participants

«FirstName» «LastName»
«JobTitle»
«Address1»
«Address2»
«Address3»
«City», TN «PostalCode»

September 28, 1998

Dear «MrMs» «LastName»:

Enclosed is a knowledge test and a CD-ROM called the Food Handler's Sanitation Interactive. To install the CD-ROM, follow the instructions on the last page of the booklet inside the CD-ROM case. After installing it, access the CD-ROM by clicking on <Start> on the Windows taskbar, <Programs>, <Food Training>, and then <FHSI-W95.exe>. Click on <Introduction> to begin. When you have completed the Introduction click on <Hazards>. Complete the rest of the segments of the CD-ROM in the following order: Personal Hygiene, Receiving, Storage, Thawing, Cooking, Serving, Leftovers, and Cleaning and Sanitation.

You are to complete the **whole CD-ROM** in its entirety **once** (about 50 minutes); complete the segments once only. Immediately after you complete the CD-ROM, complete the enclosed knowledge test. Send it back within this week using the envelope provided. We understand that you have other time commitments, but please complete the CD-ROM as soon as possible.

During the week of November 9, you will receive a letter, stamped and addressed envelope and knowledge test. Please complete the test and mail it back within the same week using the envelope provided. We will call to remind you to complete it.

The Food Handler's Sanitation Interactive training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please DO NOT refer to your CD, ServSafe, or any food safety materials during the project, except when you are assigned to view the entire CD once during this week. All responses are confidential and will not be linked to your name.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling	Carol Costello, Ph.D.	William C. Morris, Ph.D.
Graduate Student	Professor	Professor

Date	**What You Are Expected to Do**
Week of Sept. 21	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail knowledge test back to UT
Week of Sept. 28	Receive letter, phone call, stamped and addressed envelope, knowledge test, CD Complete the entire CD one time only Complete and mail the test back to UT
Week of Nov. 9	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT

«FirstName» «LastName»
«JobTitle»
«Address1»
«Address2»
«Address3»
«City», TN «PostalCode»

September 28, 1998

Dear «MrMs» «LastName»:

Enclosed is a knowledge test and a CD-ROM called the Food Handler's Sanitation Interactive. To install the CD-ROM, follow the instructions on the last page of the booklet inside the CD-ROM case. After installing it, access the CD-ROM by clicking on <Start> on the Windows taskbar, <Programs>, <Food Training>, and then <FHSI-W95.exe>. Click on <Introduction> to begin. When you have completed the Introduction click on <Hazards>. Complete the rest of the segments of the CD-ROM in the following order: Personal Hygiene, Receiving, Storage, Thawing, Cooking, Serving, Leftovers, and Cleaning and Sanitation.

You are to complete the **whole CD-ROM** in its entirety **once** (about 50 minutes); complete the segments once only. Immediately after you complete the CD-ROM, complete the enclosed knowledge test. Send it back within this week using the envelope provided. We understand that you have other time commitments, but please complete the CD-ROM **as soon as possible**.

For each of the following **five weeks**, you will spend about ten minutes viewing **two segments** of the CD. Please view the segments **only once** and in the order listed in the schedule below. You will be called each week to remind you.

During the week of November 9, you will receive a letter, stamped and addressed envelope and knowledge test. Please complete the test and mail it back within the same week using the envelope provided. We will call to remind you to complete it.

The Food Handler's Sanitation Interactive training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Since this is a research project, it is important that you diligently follow the schedule and instructions as well as fully complete and mail the tests on time, so that the information about the effectiveness of these training programs is as accurate as possible. Please DO NOT refer to your CD-ROM, ServSafe, or any food safety materials during the project, except when you are assigned to view the CD – the entire CD during this week and two segments for the next five weeks. All responses are confidential and will not be linked to your name.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135 or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling	Carol Costello, Ph.D.	William C. Morris, Ph.D.
Graduate Student	Professor	Professor

Date	What You Are Expected to Do
Week of Sept. 21	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail knowledge test back to UT
Week of Sept. 28	Receive letter, phone call, stamped and addressed envelope, knowledge test, CD Complete the entire CD one time only Complete and mail the test back to UT
Week of Oct. 5	Receive phone call, complete "Introduction" and "Hazards" once
Week of Oct. 12	Receive phone call, complete "Personal Hygiene" and "Receiving" once
Week of Oct. 19	Receive phone call, complete "Storage" and "Thawing" once
Week of Oct. 26	Receive phone call, complete "Cooking" and "Serving" once
Week of Nov. 2	Receive phone call, complete "Leftovers" and "Cleaning and Sanitation" once
Week of Nov. 9	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT

APPENDIX 3

Final Letters to Participants

«FirstName» «LastName»
«JobTitle»
«address1»
«City», TN «PostalCode»

November 4, 1999

Dear «MrMs» «LastName»,

Thank you very much for participating in the ServSafe Training Program and the research project. We appreciate the time effort you have taken to make this project a success.

The Servsafe training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Please complete the enclosed test and mail it in the envelope provided this week.

Please **DO NOT refer to your ServSafe or any food safety materials** during the project or during the test. You may view food safety materials only if your job requires you to do so. You may also view them after you send back this last test. All responses are confidential.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135, or vling@utk.edu.

Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling
Graduate Student

Carol Costello, Ph.D.
Professor

William C. Morris, Ph.D.
Professor

Date	What You Are Expected to Do
Week of Nov. 2	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT

«FirstName» «LastName»
«JobTitle»
«address1»
«Address2»
«Address3»
«City», TN «PostalCode»

November 13, 1998

Dear «MrMs» «LastName»,

Thank you very much for participating in the research project. We appreciate the time effort you have taken to make this project a success.

The interactive computer training program is one component of a research project at the University of Tennessee. The study will explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Please complete the enclosed test and mail it in the envelope provided this week.

Please **DO NOT refer to your CD-ROM or any food safety materials** during the project or during the test. You may view food safety materials only if your job requires you to do so. You may also view them after you send back this last test. All responses are confidential.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135, or vling@utk.edu.

Thank you for your assistance and cooperation. Have a wonderful Thanksgiving holiday.

Sincerely,

Valerie Ling Graduate Student	Carol Costello, Ph.D. Professor	William C. Morris, Ph.D. Professor

Date	What You Are Expected to Do
Week of Nov. 16	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT

«FirstName» «LastName»
«JobTitle»
«address1»
«Address2»
«City», TN «PostalCode»

November 5, 1998

Dear «MrMs» «LastName»,

Thank you very much for participating in the research project. We appreciate the time effort you have taken to make this project a success.

A study is being conducted to explore the effectiveness of different methods used to train extension agents about food safety as measured by scores on knowledge tests. This information will be used to develop better ways to teach food safety.

Please complete the enclosed test and mail it in the envelope provided this week. When we receive your completed test, an interactive food safety training CD will be sent to you as a reflection of our thanks for your participation.

Please **DO NOT refer to any food safety materials** during the project or during the test. You may view food safety materials only if your job requires you to do so. You may also view them after you send back this last test. All responses are confidential.

If you have questions, please feel free to contact us at (423) 974-6241, (423) 558-9135, or vling@utk.edu. Thank you for your assistance and cooperation.

Sincerely,

Valerie Ling Graduate Student	Carol Costello, Ph.D. Professor	William C. Morris, Ph.D. Professor

Date	What You Are Expected to Do
Week of Nov. 9	Receive letter, phone call, stamped and addressed envelope, knowledge test Complete and mail the test back to UT
Week of Nov. 16	Receive complimentary CD

APPENDIX 4

KNOWLEDGE PRETEST

<u>Part I.</u> Please write your initials, last four digits of your social security number, and the date.

Initials: _____ Last four digits of Soc. Sec. #: _____ Date: _____

For each question below, please circle the answer that you feel is correct. All of your answers will be kept confidential and will be used to create better food safety training methods.

1. Foodborne illnesses are most often associated with foods that are

   A. highly acidic, such as tomatoes.
   B. rich in protein, such as meat and dairy.
   C. not acidic, such as mushrooms and corn.
   D. dry, such as sugar and flour.

2. Foodborne illnesses are caused most often by

   A. infected employees who handle food.
   B. inadequate temperatures used to hold food.
   C. improper cooling of food.
   D. inadequate reheating of food.

3. Which of these statements about food infection and food intoxication is true?

   A. Eating food that contains harmful microorganisms can cause food intoxication.
   B. Eating food that contains poisons produced by bacteria can cause food infection.
   C. Salmonella causes food intoxication.
   D. Staphylococcus causes food intoxication.

4. Steaks, eggs, and fish should be cooked to a *<u>minimum</u>* internal temperature of

   A. 140 ° F
   B. 145 ° F
   C. 150 ° F
   D. 165 ° F

5. Dry food products must be stored at least _____ off the floor.

   A. 4 inches
   B. 6 inches
   C. 8 inches
   D. 10 inches

6. Which is a correct way to thaw frozen foods?

   A. In the refrigerator in a container
   B. At room temperature
   C. Under warm running water
   D. Under hot running water

7. A frozen item that is small should be thawed

   A. in a pot of hot water.
   B. in the microwave and then cooked immediately.
   C. in a clean and sanitized prep sink under cold running water for three hours.
   D. on the highest shelf in the refrigerator.

8. The food safety danger zone is

   A. between 40 ° F and 140 ° F.
   B. between 45 ° F and 145 ° F.
   C. between 55 ° F and 155 ° F.
   D. between 60 ° F and 160 ° F.

9. Which is the best way to clean your hands?

   A. Use soap and warm running water and rub all parts of your hands for 20 seconds.
   B. Wipe them on a clean apron or a towel.
   C. Dip them into a bucket or sink filled with soap and sanitizer solution for 30 seconds.
   D. Rinse them under warm water for 15 seconds and use a nail brush.

10. Which statement about gloves is true?

    A. Wash your gloves like you would wash your hands.
    B. Change gloves every hour.
    C. It is safe to handle raw vegetables then handle bread with the same gloves.
    D. Wash hands before putting on gloves.

11. Poultry, stuffed meats, and stuffed pastas should be cooked to a ***minimum*** internal temperature of

    A. 155 ° F
    B. 160 ° F
    C. 165 ° F
    D. 170 ° F

12. Which statement about holding and displaying food is true?

    A. Keep serving utensils in a clean container or surface in between uses on a serving line.
    B. Maintain hot foods and cold foods out of the danger zone.
    C. Check the temperature of the food every three hours using thermostats on holding equipment.
    D. Use hot holding equipment or steam tables to heat food to a safe temperature.

13. Cold foods should not be held at room temperature for more than

    A. one hour.
    B. two hours.
    C. three hours.
    D. four hours.

14. The fastest way to cool foods to a safe temperature is

A. in an ice bath.
B. on the counter with stirring.
C. in an ice bath with stirring.
D. in the refrigerator and covered.

15. Choose the correct statement about cooling.

A. Cool food from 140 ° F to 70 ° F in 2 hours and from 70 ° F to 40 ° F in 4 hours or less.
B. Cool food from 140 ° F to 90 ° F in 2 hours and from 90 ° F to 40 ° F in 4 hours or less.
C. Cool solid foods with a product depth of more than five inches in the freezer.
D. Cool food in the refrigerator on the bottom shelves.

16. Of these foods, you should put _____ on a higher shelf than the rest in the refrigerator.

A. raw chicken
B. raw pork
C. raw ground beef
D. fresh vegetables

17. Of these foods, you should put _____ on a higher shelf than the rest in the refrigerator.

A. cooked sauces
B. fresh fish
C. frozen fish
D. raw beef

18. Reheat leftover foods to a ***minimum*** temperature of

A. 140 ° F within 4 hours.
B. 155 ° F within 3 hours.
C. 160 ° F within 3 hours.
D. 165 ° F within 2 hours.

19. Choose the correct statement about sanitizing.

A. When a surface is sanitized, the visible soil is removed.
B. To sanitize food-contact surfaces, use a chlorine concentration of 20 parts per million.
C. To sanitize food-contact surfaces, use an iodine concentration of 10 parts per million.
D. Use test strips or kits to mix chlorine to the correct concentration.

20. Which is the correct order to wash dishes by hand?

A. Rinse, wash, sanitize, and towel dry.
B. Wash, rinse, sanitize, and towel dry.
C. Wash, rinse, sanitize, and air dry.
D. Wash, sanitize, rinse, and air dry.

21. Choose the correct statement.

    A. Equipment that is used continuously should be cleaned every five hours.
    B. Cleaning agents reduce harmful micro-organisms.
    C. Quaternary ammonia is a cleaning agent.
    D. Garbage cans should be washed at least once a day.

22. The correct thermometer to use to measure the temperature of food is a

    A. mercury liquid-filled thermometer.
    B. metal stemmed thermometer.
    C. glass thermometer.
    D. lucite thermometer.

23. To check how accurate a thermometer is, put it in ice water and the thermometer should read

    A. 0 ° F
    B. 15 ° F
    C. 32 ° F
    D. 40 ° F

24. Pork and ground beef should be cooked to a ***minimum*** internal temperature of

    A. 145 ° F
    B. 150 ° F
    C. 155 ° F
    D. 160 ° F

Part II.

1. What is the total number of years that you have worked in the foodservice industry? Please **exclude** years worked with cooperative extension.

    A. Less than one year or have never worked in foodservice
    B. 1 – 5 years
    C. 6 – 10 years
    D. 11 – 15 years
    E. 16 – 20 years
    F. Over 20 years

2. What type of work characterizes the majority of your foodservice experience? Please circle one.

    A. Front of the House (waiter or waitress, host or hostess, dining room manager)
    B. Back of the House (food preparation, dishwasher, kitchen manager)
    C. Neither

3. Have you received training about food safety and sanitation before? Please circle yes or no.

   A. No (please go to question 7)
   B. Yes (please go to question 4)

4. If you answered yes, how much training did you receive? Please circle.

   A. Less than one hour
   B. 1 – 5 hours
   C. 6 – 10 hours
   D. 11 – 15 hours
   E. 16 – 20 hours
   F. 21 – 25 hours
   G. 26 – 30 hours
   H. 35 – 40 hours
   I. 40 hours or more

5. Circle all type(s) of **food safety training** formats that you have received **in the past**. Training formats are ways to organize training activities.

   A. Lecture/speech
   B. Questions and Answers (trainees asks the trainer or expert questions)
   C. Demonstration (trainer shows how to perform a task)
   D. Hands-on Training (trainee, as an employee, is trained in the workplace)
   E. Case Study (use of examples from work situations)
   F. Role Playing (trainee improvises how an assigned role would be carried out)
   G. Skits (trainee watches short, rehearsed drama)
   H. Games (trainee participates in a competitive situation to reinforce learning)
   I. Computer Assisted Instruction (instruction using a computer)
   J. Workbook Assignments (trainee completes written assignments with feedback given)

6. Circle all the types(s) of **food safety training** aids that you have received **in the past**. Training aids are materials that enhance the effectiveness of training formats.

   A. Flip charts
   B. Chalkboards
   C. Overhead Transparencies
   D. Slides
   E. Videotape or Films
   F. Posters
   G. Manuals
   H. Textbooks
   I. Diagrams/Illustrations
   J. Photographs
   K. CD-ROM or Video Disc (discs that store motion video or audio)
   L. Resource Area/Reading Room (collection of reference materials in the workplace)
   M. Handouts (information on paper that is not part of a manual)

7. Please rank the **top three** training formats that you feel are the **most effective** formats for you to learn food safety. **ONLY RANK THE TOP THREE.** 1 = Most effective

_____ A. Lecture/speech
_____ B. Questions and Answers (trainees asks the trainer or expert questions)
_____ C. Demonstration (trainer shows how to perform a task)
_____ D. Hands-on Training (trainee, as an employee, is trained in the workplace)
_____ E. Case Study (use of examples from work situations)
_____ F. Role Playing (trainee improvises how an assigned role would be carried out)
_____ G. Skits (trainee watches short, rehearsed drama)
_____ H. Games (trainee participates in a competitive situation to reinforce learning)
_____ I. Computer Assisted Instruction (instruction using a computer)
_____ J. Workbook Assignments (trainee completes written assignments with feedback given)

8. Please rank the **top three** training aids that you feel are the **most effective** aids for you to learn food safety. **ONLY RANK THE TOP THREE.** 1 = Most effective

_____ A. Flip charts
_____ B. Chalkboards
_____ C. Overhead Transparencies
_____ D. Slides
_____ E. Videotape or Films
_____ F. Posters
_____ G. Manuals
_____ H. Textbooks
_____ I. Diagrams/Illustrations
_____ J. Photographs
_____ K. CD-ROM or Video Disc (discs that store motion video or audio)
_____ L. Resource Area/Reading Room (collection of reference materials in the workplace)
_____ M. Handouts (information on paper that is not part of a manual)

9. Please circle the highest level of education that you received.

A. Associate's Degree
B. Bachelor's Degree
C. Some Graduate Work
D. M.S. or M.A.
E. Ph.D.

10. Please circle your age.

A. 20-24
B. 25-34
C. 35-44
D. 45-54
E. 55-64

Thank you for your participation.

APPENDIX 5

KNOWLEDGE POST TEST AND RETENTION TEST

<u>Part I.</u> Please write your initials, last four digits of your social security number, and the date.

Initials: _____ Last four digits of Soc. Sec. #: _____ Date: _____

For each question below, please circle the answer that you feel is correct. All of your answers will be kept confidential and will be used to create better food safety training methods.

1. Foodborne illnesses are most often associated with foods that are

   A. highly acidic, such as tomatoes.
   B. rich in protein, such as meat and dairy.
   C. not acidic, such as mushrooms and corn.
   D. dry, such as sugar and flour.

2. Foodborne illnesses are caused most often by

   A. infected employees who handle food.
   B. inadequate temperatures used to hold food.
   C. improper cooling of food.
   D. inadequate reheating of food.

3. Which of these statements about food infection and food intoxication is true?

   A. Eating food that contains harmful microorganisms can cause food intoxication.
   B. Eating food that contains poisons produced by bacteria can cause food infection.
   C. Salmonella causes food intoxication.
   D. Staphylococcus causes food intoxication.

4. Steaks, eggs, and fish should be cooked to a ***<u>minimum</u>*** internal temperature of

   A. 140 ° F
   B. 145 ° F
   C. 150 ° F
   D. 165 ° F

5. Dry food products must be stored at least _____ off the floor.

   A. 4 inches
   B. 6 inches
   C. 8 inches
   D. 10 inches

6. Which is a correct way to thaw frozen foods?

   A. In the refrigerator in a container
   B. At room temperature
   C. Under warm running water
   D. Under hot running water

7. A frozen item that is small should be thawed

   A. in a pot of hot water.
   B. in the microwave and then cooked immediately.
   C. in a clean and sanitized prep sink under cold running water for three hours.
   D. on the highest shelf in the refrigerator.

8. The food safety danger zone is

   A. between 40 ° F and 140 ° F.
   B. between 45 ° F and 145 ° F.
   C. between 55 ° F and 155 ° F.
   D. between 60 ° F and 160 ° F.

9. Which is the best way to clean your hands?

   A. Use soap and warm running water and rub all parts of your hands for 20 seconds.
   B. Wipe them on a clean apron or a towel.
   C. Dip them into a bucket or sink filled with soap and sanitizer solution for 30 seconds.
   D. Rinse them under warm water for 15 seconds and use a nail brush.

10. Which statement about gloves is true?

    A. Wash your gloves like you would wash your hands.
    B. Change gloves every hour.
    C. It is safe to handle raw vegetables then handle bread with the same gloves.
    D. Wash hands before putting on gloves.

11. Poultry, stuffed meats, and stuffed pastas should be cooked to a ***minimum*** internal temperature of

    A. 155 ° F
    B. 160 ° F
    C. 165 ° F
    D. 170 ° F

12. Which statement about holding and displaying food is true?

    A. Keep serving utensils in a clean container or surface in between uses on a serving line.
    B. Maintain hot foods and cold foods out of the danger zone.
    C. Check the temperature of the food every three hours using thermostats on holding equipment.
    D. Use hot holding equipment or steam tables to heat food to a safe temperature.

13. Cold foods should not be held at room temperature for more than

    A. one hour.
    B. two hours.
    C. three hours.
    D. four hours

14. The fastest way to cool foods to a safe temperature is

A. in an ice bath.
B. on the counter with stirring.
C. in an ice bath with stirring.
D. in the refrigerator and covered.

15. Choose the correct statement about cooling.

A. Cool food from 140 ° F to 70 ° F in 2 hours and from 70 ° F to 40 ° F in 4 hours or less.
B. Cool food from 140 ° F to 90 ° F in 2 hours and from 90 ° F to 40 ° F in 4 hours or less.
C. Cool solid foods with a product depth of more than five inches in the freezer.
D. Cool food in the refrigerator on the bottom shelves.

16. Of these foods, you should put _____ on a higher shelf than the rest in the refrigerator.

A. raw chicken
B. raw pork
C. raw ground beef
D. fresh vegetables

17. Of these foods, you should put _____ on a higher shelf than the rest in the refrigerator.

A. cooked sauces
B. fresh fish
C. frozen fish
D. raw beef

18. Reheat leftover foods to a *minimum* temperature of

A. 140 ° F within 4 hours.
B. 155 ° F within 3 hours.
C. 160 ° F within 3 hours.
D. 165 ° F within 2 hours.

19. Choose the correct statement about sanitizing.

A. When a surface is sanitized, the visible soil is removed.
B. To sanitize food-contact surfaces, use a chlorine concentration of 20 parts per million.
C. To sanitize food-contact surfaces, use an iodine concentration of 10 parts per million.
D. Use test strips or kits to mix chlorine to the correct concentration.

20. Which is the correct order to wash dishes by hand?

A. Rinse, wash, sanitize, and towel dry.
B. Wash, rinse, sanitize, and towel dry.
C. Wash, rinse, sanitize, and air dry.
D. Wash, sanitize, rinse, and air dry.

21. Choose the correct statement.

    A. Equipment that is used continuously should be cleaned every five hours.
    B. Cleaning agents reduce harmful micro-organisms.
    C. Quaternary ammonia is a cleaning agent.
    D. Garbage cans should be washed at least once a day.

22. The correct thermometer to use to measure the temperature of food is a

    A. mercury liquid-filled thermometer.
    B. metal stemmed thermometer.
    C. glass thermometer.
    D. lucite thermometer.

23. To check how accurate a thermometer is, put it in ice water and the thermometer should read

    A. 0 °F
    B. 15 °F
    C. 32 °F
    D. 40 °F

24. Pork and ground beef should be cooked to a ***minimum*** internal temperature of

    A. 145 °F
    B. 150 °F
    C. 155 °F
    D. 160 °F

Part II.

1. Circle all type(s) of **food safety training** formats that you have received in the past, **INCLUDING the training you have just received**. Training formats are ways to organize training activities.

    A. Lecture/speech
    B. Questions and Answers (trainees asks the trainer or expert questions)
    C. Demonstration (trainer shows how to perform a task)
    D. Hands-on Training (trainee, as an employee, is trained in the workplace)
    E. Case Study (use of examples from work situations)
    F. Role Playing (trainee improvises how an assigned role would be carried out)
    G. Skits (trainee watches short, rehearsed drama)
    H. Games (trainee participates in a competitive situation to reinforce learning)
    I. Computer Assisted Instruction (instruction using a computer)
    J. Workbook Assignments (trainee completes written assignments with feedback given)

2. Circle all the types(s) of **food safety training** aids that you have received in the past, **INCLUDING the training you have just received**. Training aids are materials that enhance the effectiveness of training formats.

   A. Flip charts
   B. Chalkboards
   C. Overhead Transparencies
   D. Slides
   E. Videotape or Films
   F. Posters
   G. Manuals
   H. Textbooks
   I. Diagrams/Illustrations
   J. Photographs
   K. CD-ROM or Video Disc (discs that store motion video or audio)
   L. Resource Area/Reading Room (collection of reference materials in the workplace)
   M. Handouts (information on paper that is not part of a manual)

3. Please rank the **top three** training formats that you feel are the **most effective** formats for you to learn food safety. **ONLY RANK THE TOP THREE.** 1 = Most effective

   _____ A. Lecture/speech
   _____ B. Questions and Answers (trainees asks the trainer or expert questions)
   _____ C. Demonstration (trainer shows how to perform a task)
   _____ D. Hands-on Training (trainee, as an employee, is trained in the workplace)
   _____ E. Case Study (use of examples from work situations)
   _____ F. Role Playing (trainee improvises how an assigned role would be carried out)
   _____ G. Skits (trainee watches short, rehearsed drama)
   _____ H. Games (trainee participates in a competitive situation to reinforce learning)
   _____ I. Computer Assisted Instruction (instruction using a computer)
   _____ J. Workbook Assignments (trainee completes written assignments with feedback given)

4. Please rank the **top three** training aids that you feel are the **most effective** aids for you to learn food safety. **ONLY RANK THE TOP THREE.** 1 = Most effective

   _____ A. Flip charts
   _____ B. Chalkboards
   _____ C. Overhead Transparencies
   _____ D. Slides
   _____ E. Videotape or Films
   _____ F. Posters
   _____ G. Manuals
   _____ H. Textbooks
   _____ I. Diagrams/Illustrations
   _____ J. Photographs
   _____ K. CD-ROM or Video Disc (discs that store motion video or audio)
   _____ L. Resource Area/Reading Room (collection of reference materials in workplace)
   _____ M. Handouts (information on paper that is not part of a manual)

VITA

Valerie Ling was born in New York City, NY on February 14, 1975. She attended public schools in Queens County and Stuyvesant High School of Science in Manhattan. In May 1997, she graduated from Cornell University, College of Agriculture and Life Sciences with a Bachelor of Science degree in Nutrition, Food, and Agriculture. After three months, she began a Master of Science program in Foodservice and Lodging Administration and a Dietetic Internship at the University of Tennessee, Knoxville. During this time she worked with the Food Safety and Inspection Staff at Food Safety and Inspection Service, U.S. Department of Agriculture, in Washington, D.C.

Upon completion of her Masters degree in August 1999, she will pursue a Doctor of Philosophy degree in Food Science and Technology, with a concentration in Food Microbiology, at the University of Tennessee, Knoxville.