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DEVELOPMENT AND ASSESSMENT OF PILOT FOOD SAFETY
EDUCATIONAL MATERIALS FOR HISPANIC WORKERS IN THE
MUSHROOM INDUSTRY USING THE HEALTH ACTION MODEL

A Thesis in
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by
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ABSTRACT

Pennsylvania accounts for 55 percent of the total volume of mushroom sales in the United States. Mushroom farming and packing involve intense manual labor in all phases of production. Approximately 98% of the mushroom workers in southeast PA are Mexicans. Education and training of food handlers is needed to prevent foodborne illnesses since food handlers’ mishandling has caused many outbreaks reported in the food industry. Sometimes educational materials do not work because they are designed without examining the worksite social and environmental factors affecting the target audience. Educational materials based on application of theory-based models may address more effectively the cause of food safety problems. The Health Action Model (HAM) identifies five constructs or systems that represent conditions surrounding mushroom workers: Baseline food safety knowledge, normative system, motivational system, food safety/belief system, and appropriate working environment and conditions. An opportunity to test the HAM plus Expectancy Theory (HAM-ET) arose when the Pennsylvania mushroom industry requested a food safety education program to be implemented industry wide. For this thesis research, a food safety education program for the mushroom industry was developed and factors, such as ethnic background, motivation, and peer role models were evaluated to determine how they would affect food safety educational programs.
The first objective was to design and carry out a food safety needs assessment in the mushroom industry using the HAM as a framework. Some refinements of the motivational construct for its use in this research were made. All mushroom companies (packers, growers, or both) affiliated with the American Mushroom Institute were sent a fax explaining the project. Companies were contacted in the order derived from a randomized list to determine interest. Ultimately seven companies and its subsidiaries agreed to be part of the project. The information gathering process included an observation exercise and a focus group at each worksite (n=7) and 10-12 interviews/worksite (N=100 total). Each method explored one or more systems of the model. The information was triangulated across the HAM and the findings were helpful to identify factors that should be taken into account in designing an educational intervention for the target audience. The needs assessment is reported in Chapter 2.

Additionally, no reports of an ‘observation method’ applicable to conducting a needs assessment for food safety training in a food production setting were found. To address this gap in methodology, we developed a ‘Worker-Experience Protocol’, in which a person, unconnected to either the regulatory system or the food company, served as a ‘worker’ as a way to make direct observations of company operations and worker behaviors. It was postulated that this protocol would provide valuable and unique information that would be useful in designing a food safety program. The effectiveness of this protocol is reported in Chapter 3.
Evaluation of program impact is needed to show the worth of a program. The HAM model can also be helpful in the evaluation process considering that the literature indicates debate about the effectiveness of food safety training programs. The objectives in this part of the study were to develop, implement and evaluate a pilot food safety educational program for the mushroom industry target audience.

Because of mushroom production unit time constraints, four lesson modules, each 25-40 minutes long, were developed based on specific learning objectives derived from the needs assessment. Each lesson in the program included visual aids and a script outlining presentation content that addressed the learning objectives. Risk perception and principles of adult education were introduced through discussion topics, demonstrations, and hands-on activities. The impact of three independent variables was tested in the pilot test: (1) the effect of the food safety lessons themselves as knowledge score; (2) item 1 plus altering employee motivation through increasing expectancy (supervisors were to encourage and enforce the desired behaviors and were to also act as role models by practicing the behavior themselves thus increasing the expectancy) and increasing instrumentality (supervisors were to praise workers when they perform the desired behavior); and (3) item 1 and 2 plus altering the employee motivational valence by examining the effect of a economic incentive on the dependent variables (Actions), three different handwashing opportunities plus jewelry and hairnet usage. One observer collected the pre-post and delayed post
intervention data to assess the effect of the food safety program on food safety behaviors change over the time. For comparison, a control group received no treatment. A pre-post knowledge test was given to each participating worker. Three months after the end of the waiting period, retrospective scripted interviews were conducted.

Based on the findings of the current study, there was a significant knowledge increase after the intervention on workers who completed the program. No effect of the monetary incentive was observed. Expectancy (as enforcement and role modeling) seems to be more effective in the mushroom industry. Instrumentality was not evident in supervisory actions as reported by both supervisors and workers. This observation may reflect the cultural expectations of the Hispanic workers when employed in a hierarchical unit. It was concluded that training must be followed by the involvement of the supervisory personnel to enforce behavioral rules. Ultimately, management support of the supervisory role will increase the success in any food safety program within the industry.

Based on these findings the HAM model can be used as a guide to develop customized food safety educational materials at a variety of different settings and target audiences in food production facilities.
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PREFACE

This thesis is presented in the scientific-papers format approved by the Penn State University Graduate School. The first chapter presents an up to date literature review, the statement of the problem in this field and with this target audience, and the objectives and hypotheses.

Three chapters follow where a paper that has been published or is in the process of being submitted for publication to peer-reviewed journals is presented. Each chapter is related to the other. Each chapter contains its own references that can be found at the end of each chapter. The references are presented in the journal's original format. This practice is approved by Penn State's graduate school.

The last chapter includes the general conclusions, limitations and recommendations for future research. At the end of chapter 5 a glossary of terms is included.
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CHAPTER 1
LITERATURE REVIEW

1.1 CURRENT SITUATION

A foodborne illness is a disease that is transmitted through the consumption of a contaminated food. Foodborne illnesses are one of the most widespread and overwhelming public health problems (WHO, 2000; Tauxe, 1997). In the United States, the Center for Disease Control and Prevention (CDC) estimates that foodborne diseases cause approximately 76 million illnesses, 325,000 hospitalizations, and 5,000 deaths each year (Mead, et al., 1999). In general, foodborne illnesses have increased as the U.S. food system has changed. Currently the distance from farm-to-table is longer and more complicated than ever. It includes many steps that were not present 50 years ago. The food system now includes farm production, processing, marketing, and distribution, restaurant and institutional food service, and home preparation (Forsythe, 1996). This scenario could introduce new and more resistant foodborne pathogens into the food chain due to changing production methods, processes, practices, and habits (Kaferstein and Abdussalam, 1999).

In addition, Tansey and Worsley (1995) cited six societal changes that are having a great influence on the food system: (1) increasing longevity; (2) increasing urbanization; (3) globalization of the food market; (4) increasing technological change; (5) changes in attitudes and values; and (6) the decline on the traditional women staying at home for house keeping roles. These changes have impacted the face of food safety, resulting in the need for adaptive changes
to the current system to keep the food supply safe (Shank and Carson, 1997). These changes make it more complicated to deal with existing food safety issues.

A changing consumer lifestyle has led to changes in eating habits and patterns. The increased availability of both domestic and imported foods has made food hazards a more complex health risk. Some nations see the United States as a market for their agricultural and food products (Troxell and Buckner, 1995). In addition, food is not produced and consumed locally, therefore a contaminant can be introduced at any step of the production chain. Recently, there has been a marked increase in the consumption per capita of fresh and lightly processed produce in the United States; from 1972 to 1980 to 1996 fresh vegetables consumption, per capita, has climbed from about 108 to 110 to 146 pounds, respectively (Beuchat and Ryu, 1997). This increase is due, in part, to imports that make almost any kind of produce available year around. Some of this produce comes from countries where sanitation product standards for growing and handling are not as high as in the US. An imported product from a single producer can be easily distributed across the country (Beuchat, 1996). In the event it is contaminated, the risk of an outbreak is much greater.

In addition, consumers are demanding foods that are a) ready-to-eat; b) minimally processed, such as salads or vegetables; c) take out foods; and d) “open it, heat it, and eat it” meal solutions (Troxell and Buckner, 2000). Consumers now view these types of foods as necessities, since they are constantly rushed due to work, commuting distances that are greater than ever
and time consuming, or simply because they don’t want to cook anymore. One of the problems that these types of foods face is that they require more surveillance to keep them safe, because they are often minimally processed (Troxell and Buckner, 2000). And consumers are definitely concerned and conscious about the safety and quality of their groceries. They want to purchase food that is as safe as possible (Wheelock, 1998, Senauer, 2001). Most consumers view food quality and safety as an attribute of purchased food (Cahill, 2000).

Human resources are another problem, since many more people are handling our food than before. The low-paying, food-related jobs are filled by less educated people. This sector has the highest employee turnover rates. So, to assure food safety in the system, there is a need to allocate resources in many areas (Troxell and Buckner, 2000).

All of the above issues have increased the number of challenges required to keep food safe and making these challenges even more difficult to control and more specific. Even though this is a more modern world, the chances of food becoming contaminated with foodborne pathogens are higher than ever.

Consequently, food safety is a major issue in all sectors of the food system, from farm-to-table. As such, it must be approached through strategies that take into account every single step along the food chain. Hernandez-Ledezma (1999) stated that food safety control strategies need not depend on the use of sophisticated and expensive technologies. In fact the World Health Organization (WHO) (2000) has suggested that education and training of food handlers and consumers is a good approach to prevent foodborne illnesses since mishandling
by food handlers’ causes most of the outbreaks. Food safety education is a key to success in avoiding foodborne illnesses. The lack of food safety education also could lead to significant risks in premises where food handlers do not have adequate food safety skills (Seaman and Eves, 2005). Forsythe (1996) reported that less illnesses, death and human suffering can be the result of good food safety education. Forsythe (1996) suggested that the land-grant institutions must play a key role in these efforts, since they have extensive experience in food safety research and a large network of highly educated specialists qualified to train people in food safety. Finally, Roever (1999) notes that there is a need for practical, tailored training programs at all steps of the food production chain.

The focus of this thesis is food safety education for the mushroom industry and factors, such as ethnic background, motivation, and peer role models, that affect food safety educational programs.

1.2 THE MUSHROOM INDUSTRY AT-A-GLANCE

According to the USDA National Agricultural Statistics Services (NASS, 2005), the value of sales of the 2004-05 U.S. mushroom crop totaled $908 million, based on sales of 853 million pounds at an average price of $1.06 per pound. This figure represents all Agaricus mushrooms, plus specialty mushrooms. The USDA-NASS (NASS, 2005), also reported that 275 mushroom growers across the USA produced in 2004-05 season a crop valued at $908 million, based on sales of 853 million pounds at an average price of $1.06 per pound. This figure represents all Agaricus mushrooms plus specialty mushrooms. Sales of fresh market Agaricus mushrooms were 696 million pounds
valued at $862 million while sales of Agaricus mushrooms for processing were 142 million pounds. Sales for specialty mushrooms (shiitake, oyster and all other exotics) were $46.1 million, totaling 15 million pounds at an average price of $3.06 per pound. Pennsylvania accounted for 59 percent of the total volume of sales and second-ranked California contributed 14 percent of all Agaricus mushrooms.

1.2.1 Mushroom Growing and Packing Practices

Mushrooms are vegetables with no chlorophyll, therefore they have no ability to use energy from the sun. Their nutrients come from decaying organic matter (Beyer, 2003). The mushrooms are grown in mushroom houses, using decomposed organic matter, which includes horse manure, hay, corn cobs, cotton and cocoa seed hulls, and straw. These materials are rich in nutrients that must be composted to transform them into nutrient rich substrate compost that the mushrooms can utilize (Beyer, 2003).

Figure 1.1 includes a flowchart of the typical mushroom growing unit operations. The mushroom growing process consists of 6 basic stages.

1) Phase I: Aerated Mushroom Compost Preparation. At this stage, the ingredients are mixed and aerobically fermented. Rapid microbial growth results in high temperatures and a series of chemical reactions that transforms nutrients to make them more available to mushrooms.

2) Phase II: Compost preparation and compost finishing. This step includes pasteurization to eliminate mushroom pathogens and ammonia removal. It was found that this step also eliminates human pathogens as well (Weil et al.,
The compost is transferred into tunnels or in trays where there are more chemical reactions and microbial activity, and finally, pasteurization takes place. In this step, the center of the tray, filled with compost, should reach 60°C (140°F) for a minimum of 2 hours.

3) **Spawning.** In this step, mushroom mycelia are uniformly seeded in the compost within the mushroom houses. Mushroom spawn are cereal grains that have been cooked, sterilized, cooled and inoculated with mushroom mycelia. The common used starter is *Agaricus* mycelia.

4) **Casing.** In this step, the operation changes the mushroom mycelia from a vegetative phase to reproductive state. A layer of suitable material is applied over the mushroom colonized in the growing beds. This casing layer consists of peat soil modified with calcium carbonate and water.

5) **Pinning.** In the pinning stage, rhizomorphs have grown throughout the substrate and into the casing layer. When these structures expand, the mushroom primordial or pins, start to develop from a pre-button stage to mature mushrooms. Mushrooms can be harvested 15-21 days after applying the casing layer.

6) **Harvesting.** At this step, mushrooms are picked in cycles called flushes or breaks. Mushrooms are picked by hand before the cap becomes soft. However, it has been noted that size is no indication of mushroom maturity (Beyer, 2003). Each mushroom house has three flushes that can be controlled by managing the watering, carbon dioxide level, and temperature.
Figure 1.2 includes a flowchart of the typical mushroom packing unit operations. After harvest, the mushrooms are transported to the packing houses where they are cooled, sorted, weighed and shipped. After the harvesting and the production cycle is over, the mushrooms houses are heat steamed before removing the spent substrate (Beyer, 2003). This type of “pasteurization” helps to eliminate any biological activity (i.e., molds, bacteria, etc.) that might interfere with the subsequent crop or neighboring mushroom houses. All these operations require extreme care and very controlled atmospheric conditions to avoid possible product contamination and maximum yield (Beyer, 2003; Chikthimmah, 2006).

Most mushroom growers do some sort of pre-sorting when harvesting the mushrooms (authors' personal observations). As such, mushrooms arrive at the packing houses in boxes for foodservice operations containing different retail sizes (small, medium, larges, silver dollar, extra large, stuffer, etc.) and weights (3, 5 or 10 lbs). Furthermore, mushrooms also can be harvested and placed into plastic baskets that have different uses in the packing plant (i.e. washed mushrooms, sliced mushrooms, used to complete partial orders, etc.).

Mushrooms arrive at the packing houses stacked in wood pallets, are weighed, and vacuum cooled. Depending upon the day’s demand and customer orders, the mushrooms can be moved directly to the weighting and packing lines or they can be stored in the cooler room for later use. Most mushrooms are sorted and weighed by hand, while others are plastic sealed, passed through a metal detector, and then placed in boxes. These boxes are stacked in a pallet until the
customer order is completed. Finally, the mushrooms are placed in refrigerated rooms before leaving the packing house.

As illustrated above, there are several steps in the mushroom production chain where mushrooms can be contaminated. Therefore Good Agricultural Practices and Good Manufacturing Practices should always be taken into account when growing and packing mushrooms (LaBorde, 2003).

1.2.2 Mushroom Contamination and Food Safety Concerns

Even though there have not been any reported foodborne outbreaks related to fresh mushroom consumption in the US, there have been reported outbreaks due to consumption of processed mushrooms. In 1989, outbreaks of staphylococcal foodborne disease at several foodservice establishments across the nation were associated with the consumption of canned mushrooms from China (CDC, 1989). The Staphylococcal enterotoxin was found in samples of remaining mushrooms and in unopened cans at the different locations where the outbreaks occurred. The FDA banned the imports of Chinese institutional sized cans of mushrooms and recalled certain imported mushrooms cans (CDC, 1989).

There is a need for food safety education as a preventive measure to avoid contamination on fresh mushrooms since other foodborne pathogens such as C. jejuni have been isolated from raw mushrooms samples taken from grocery stores in the Midwest (Doyle and Schoeni, 1986). Other studies have demonstrated that Staphylococcus aureus can grow and produce enterotoxin in unventilated fresh packaged mushrooms under different conditions (Martin and Beelman, 1996). Since humans are the most likely source of contamination, this
latter contamination can be avoided with proper training of the mushroom workers (Martin and Beelman, 1996). The contact of fresh mushrooms with raw materials during picking and packaging, as well as the frequent hand contact involved in all the processing, represents a high risk of contamination (Martin and Beelman, 1996). For instance, in 2001, a number of catering and wholesale mushroom samples tested positive for an uncommon strain of Salmonella (Salmonella kedougou) in Preston, Lancashire, UK (FSAI, 2001). This incident led the Food Safety Authority of Ireland (FSAI) to advise consumers to cook mushrooms before consumption. In this particular outbreak, the apparent source of contamination was the casing layer (FSAI, 2001, 2001a). In 2003, the food laboratory of the Georgia Agricultural Department found Listeria monocytogenes in two samples of sliced fresh mushrooms in a routine sampling operation at a grocery store (FDA, 2003).

Even though it is not known how some foodborne pathogens, such as Listeria monocytogenes, Salmonella, Campylobacter, and E. coli O157:H7, can grow and survive on fresh mushrooms after harvesting (Chikthimmah, 2006), it is necessary to take preventive measures to minimize the risk of contamination by these microorganisms.

In addition to these possible risks of contamination, mushroom buyers are requesting their produce suppliers, including the mushroom industry, to provide third party food safety audits and proof of implementation of food safety programs in their facilities to assure safe produce to their consumers. LaBorde (2001) suggested that the key for producing safe mushrooms is sanitation and
keeping the mushrooms away from any physical, chemical or microbiological hazards. Also, it was noted that companies, in which sanitation is a priority, have accomplished higher productivity, quality, customer satisfaction, and worker morale.

1.2.3 Pennsylvania Mushroom Workers

Pennsylvania has roots in the mushroom industry dating back to the 1890’s (Wall, 1999), and it has been the number one cash crop in the state. Kennett Square, PA is known as the birthplace of the mushroom industry and still claims the title of “Mushroom Capital of the World” (Flammini, 1999).

Mushroom farming and packing involve manual labor in all phases of production. It is a very dirty and demanding job. The workers who perform these jobs are on the lowest end of the nation’s socioeconomic hierarchy, since no one else wants to do the job. Flammini (1999) described the evolution of the mushroom industry in Pennsylvania. In the beginning, mushrooms were picked by friends and family of the Pennsylvania Quakers. Then, as business grew during the 1920’s, Italian immigrants took the jobs. The Italians moved on and took other positions, with some of them starting their own farms. By the 1930’s and 40’s, Italians employed local African-Americans and whites as laborers. During the 1950’s, poor southern whites and African-Americans were recruited to work on the mushroom farms. By the late 1950’s until the late 1970’s, Puerto Ricans who initially came from work on sugar cane fields, were employed by the mushroom industry. Finally, Mexicans gradually replaced Puerto Ricans as laborers. Today approximately 98% of the mushroom workers in southeast PA
are Mexicans. One common feature associated with these waves of immigrants is that they work in the mushroom industry until they find a better employment opportunity.

In general, Mexican workers who migrate to the United States are originally from economically depressed areas in Mexico. Most of these Mexican migrant workers in the United States are men between 25 and 34 years old, originating from the Mexican states of Jalisco, Oaxaca, Michoacan, and Guanajuato (Aguayo, 2000). This Hispanic group has low income, low educational level and little political influence in the U.S., but their socio-economical level here is still higher than in Mexico (Aguayo, 2000). In 2005, remittances that were sent by Mexican workers back to their families in Mexico totaled about $20 billion (Banco de México, 2006). The Mexican workers who currently work in the mushroom industry share their wages with their families in Mexico. In fact, most of the workers employed by the Pennsylvania mushroom industry originate from the Mexican state of Guanajuato (Nieto-Montenegro et al., 2005)

1.3 THE TYPE OF FOOD SAFETY EDUCATION OFFERED

Food safety education is defined as the delivery of the necessary knowledge and skills to any person who manipulates food at any step of the food system, with a final goal to avoid foodborne illnesses (Hazelwood and McLean, 1994). Non-formal food safety education often takes place as “staff development” by employers. Since large companies are not willing to lose business if any of their food products were the cause of a foodborne illness outbreak, food safety education has become a lucrative business, (Nieto-Montenegro, et al., 2000).
Food companies know that there would not be a second chance, so they view food safety education as critical to business stability and longevity; partially from a liability standpoint, but also as part of good manufacturing practices (Nieto-Montenegro, et al., 2000). On the other hand, some small food companies, food retailers and foodservice companies feel that food safety education is an investment with no tangible benefits (Nieto-Montenegro, et al., 2000). But, food safety programs are necessary to protect the consumer and should be included in all food production companies, becoming an integral part of a company’s strategic plan.

In 1997, the United States President William Clinton launched the Food Safety Initiative for Health Improvement. One of the seven key objectives of this initiative was to increase food safety education to a variety of audiences (McNamara, 2000). This document states that food safety education is considered one of the most important elements needed to assure wholesome food for the people in the US.

After reviewing food safety educational materials available at the FDA-USDA Foodborne Illness Education Information Center (USDA-FDA, 1999), it was concluded that food safety education tends to be more specific than ever by focusing on a variety of topics and should take into account the characteristics of the audience, including language, age, type of operation performed, and field of study of the learner. Currently, there is a wide variety of educational materials available for food safety education, ranging from the general – wide variety of concepts covered- to very specific, depending on where they are going to be
used. As of January of 2001, the database of the FDA-USDA Foodborne Illness Education Information Center, listed 336 different food safety educational programs available throughout the world (USDA-FDA, 1999). Among these were 85 educational programs in languages other than English, such as Spanish, French, Cantonese, Mandarin, German, Italian, Portuguese, Turkish, Russian, Swedish, Dutch, Danish, Serbo-Croatian, Hungarian, Thai, Arabic, Vietnamese, Bengali, Hindi, Urdu, Gujarati, and Punjabi (USDA-FDA, 1999a). This point underscores the importance of worldwide efforts to deal with food safety issues. However, there is a lack of information to evaluate the effectiveness of English or non-English food safety educational programs on employees (WHO, 2000).

Delivery methods for these USDA-catalogued programs are very diverse. They include new and traditional presentation techniques (lectures, computer-based learning, video, displays, slides, films, audio cassettes, exhibits), discussion techniques (case or problem solving discussion), simulation techniques (role playing, critical-incident process), and skill practice exercises. Despite the volume of available training programs, a combination of teaching techniques has been recommended to teach food safety. Soneff et al. (1994) found a significant short term improvement in food safety short-term audit scores in adult care facilities. In this study, the employees knew when the audit would take place. When a combination of a workshop plus a manual was used, employees scored higher on the audit than employees who had been trained using only the manual (Soneff et al., 1994).
Because there are significant differences in cultural, economical and social factors, it is impossible to apply the same approach to food safety education in all possible situations. If improvement in food safety is to be achieved, it must be recognized that socio-cultural factors and beliefs of the audience must be considered (Foster and Kaferstein, 1985).

1.3.1 The Food Safety Target Audience – Hispanic Workers in the Mushroom Industry

Educational materials for basic food safety instruction are readily available, depending on the geographic area. However, most of these materials are not designed for a specific ethnic group. Instead some of them are translations from English into another language without attention to social context or colloquial use of language. The success of this approach is questionable since it is believed that food safety education is most effective when it is designed specifically for the audience and the particular hazard of interest (Medeiros, et al., 2001). Altekruse et al. (1999) suggested that targeted educational efforts might reduce the prevalence of risky food handling behaviors among consumers. An example of a specifically designed food safety intervention was conducted by Worsfold (1992) who trained senior citizen volunteers with no formal background in catering to train about 69,000 people across the United Kingdom. To be more effective as educators, it was necessary that food safety instructors altered their teaching styles and the learning environment to accommodate adult learners needs (Worsfold, 1992). In addition to understand the learning needs of the students, these researchers took into account other components, such as group size,
length of training sessions, learning environment, and selection of room and teaching materials (Worsfold, 1992).

The term “Hispanic” is the result of a decision by the Office of Management and Budget (OMB) in 1978 to provide a label for people of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture origin, regardless of race (Marin and Marin, 1991) and was first used in the 1980 census. Hispanics share a language and some cultural values, but there are also differences in socioeconomic and cultural characteristics, depending upon the place of origin (Weinstein, 1999). While Spanish is spoken in most Latin-American countries, one word can have different meanings, depending on the country and the context in which that word is used. Some food safety jargon has been translated grammatically into Spanish, without taking into account the context in which the words are used or the nationality of the audience that is going to use the material. Due to this diversity within the Hispanic population, it may be difficult, or even impossible, for them to understand the materials that are being presented.

Sloppy translations can make it more difficult for people with little formal education to understand important food safety messages, making the learning process more difficult. Because some people in this target audience may be functionally illiterate, caution must be taken when developing or teaching food safety programs. Low literacy could contribute to misunderstandings or the lesson being presented inappropriately. It is possible that inadequate training might impact more negatively than not receiving any training (Ackerley, 1989).
Several studies have demonstrated that educational level positively correlates to food safety knowledge, although these studies were completed among US citizens (Altekruse et al., 1996, and Williamson et al., 1992). Smith and Shillam (2000) found that language or reading barriers could have impacted a role in how well participants who completed a pre and post test during their video-based food safety training intervention. The barriers to Hispanic participation in educational programs prevail in other health fields, such as cancer support and clinical trial programs (Stevenson-Perez, 1998). These include financial, linguistic, transportation, and cultural barriers (Stevenson-Perez, 1998, Swanson and Ward, 1995). Language and communication problems are some of the barriers that might be present while trying to provide food safety training to non-English speaking audiences (Woteki and Kineman, 2003). Other problems have emerged during the implementation of food safety educational program among non-English speakers. Personal hygiene and food safety perception varies from culture to culture (Woteki and Kineman, 2003). Cultural values and beliefs tend to be different in every culture. It is thought that poverty and inequity might contribute to poor health and poor health in less developed countries is related to foodborne illnesses (Kaferstein and Abdussalam, 1999). In some societies, the relationship between diarrhea and food intake is not well understood. Factors such as social infrastructure, taboos, poverty, and lack of food, safe water, and sanitation can increase the risks of foodborne disease in developing countries (Motarjemi, 1993).
For example, people in Mexico consume food sold on the streets by street vendors. In 1996, approximately 538,000 street food vendors were employed in Mexico (Costarrica and Moron; 1996). Several economic, social and cultural factors fuel this trend, including migration toward the urban areas, high levels of unemployment, the growth of cities, recurrent economic crises, and the disappearance of state programs that subsidize milk and tortillas (Munoz, et al., 2000). The food sold on the street can easily be contaminated since it is exposed to dust, held at inadequate temperatures, and many times, the person who is in charge, exhibits poor personal hygiene. These factors may result in a high risk of foodborne illness to the consumer's health. However, many times when people get sick, the illness is not reported, and passes unnoticed. Since auto-medication or self care is a common practice, people may not connect foodborne illnesses with poor hygiene and sanitation practices. This observation may be due, in part, to the lack of education. Not much it is known about Mexican beliefs about foodborne illness. So it may be necessary to educate people and explain the origin of foodborne illnesses. Statements, such as “If we did not get sick in Mexico, why would we get sick here?” are common among immigrants. (Anonymous, 2001).

Not much it is known about Hispanics’ food safety knowledge and practices, since most national surveys about food safety knowledge, attitudes, and perceptions have not targeted this group. Meer and Misner (2000) found that white participants in the Expanded Food and Nutrition Education Program (EFNEP) in Arizona had higher food safety knowledge than Hispanics. The study
also indicated that women had higher food safety knowledge than men, agreeing with other published studies (Altekruse et al., 1996; 1999). In these studies, food safety knowledge level did not always lead to the desired behavior and correct behavior was not always found in the higher socioeconomic groups. This latter observation is consistent with a multi-state survey of consumer food-handling practices conducted by Altekruse et al. (1999) that found that women were less likely to perform risky practices than men. The riskiest behaviors were performed more often as the socioeconomic status increased (Altekruse et al., 1999).

An educational program in Spanish for pesticide management used by the mushroom industry was found to be outdated and stereotypical (Steel, 1992). On the other hand, Bell et al. (1999) conducted a food safety program to Hispanics in Yakima County, Washington. This train-the-trainer program was designed to reduce the incidence of foodborne illnesses due to consumption of queso fresco (fresh-cheese) made from raw milk. The educators trained grandmothers (abuelas) who were asked to train at least 15 members of their local community about safe cheese production methods. Besides the educational program, hundreds of pamphlets were distributed and a mass media campaign was launched (Bell et al., 1999). The researchers determined that participants who were involved in the abuela project were more likely to obtain queso fresco at the grocery store and less likely to buy queso fresco made from raw milk than those people who had not participated in the programs (Bell et al., 1999). Through training, the abuelas were able to create awareness among their community about this food safety problem. One reason for success in this area is that
*abuelas* are a group of people that is highly respected in the institutional Mexican family (Bell et al., 1999). Another study demonstrated that a bilingual mail survey can be used to effectively learn about food practices among Hispanics, but any instrument used to explore food practices with this target audience must be carefully designed, culturally sensitive, and understandable by the respondents to obtain accurate information (Weinstein et al., 1999).

Poor food handling practices are just as prevalent among the population in general. Some practices, such as poor personal hygiene, are common worldwide (Foster and Kaferstein, 1985). A study conducted by Audits International (Daniels et al., 2001) investigated all events involved in making a meal (preparation, clean-up, handling/storage of leftovers, etc.) in a sample of 115 households. According to participant’s responses to ‘Why the violation had happened?’, the researchers categorized the participants violations into three groups: 1) educational factors, the participant had never heard about this food safety principle; 2) lack of awareness, the participants knew the food safety principle but they were not thinking of it at the time; and 3) motivation, typified by the participants not believing that the food safety principle was applicable, even though they knew about it. Twenty percent said that they just ignored the rule. Some people said “I don’t believe that food safety principle. I’ve always prepared food this way.” The authors concluded that a person’s food safety practices may be closely related to practices and hygiene conditions prevailing at home, as well as the environment surrounding it (Daniels et al., 2001).
1.4 PERSONAL HYGIENE AND HANDWASHING PRACTICES- THE FOODBORNE ILLNESSES RISK DECREASERS

According to Webster’s dictionary (1995), hygiene is a system of principles for preserving health. Personal hygiene at a food processing facility would include a person’s overall cleanliness and practices that must be followed to keep the food safe. In fact, every single book or document related to food sanitation includes a whole chapter on personal hygiene, thereby pointing out its importance in the business of keeping a safe food supply.

If a food safety program for the mushroom industry, that is focused on the Hispanic audience is going to be implemented, it would be necessary to conduct a thorough needs assessment since little is known about the practices in this industry. It is expected the program will need to address food safety essentials and Good Manufacturing Principles (GMP’s). Medeiros et al. (2001) suggested four critical factors that could control foodborne illnesses: 1) personal hygiene, 2) adequate cooking /avoid cross-contamination, 3) keep food at safe temperatures, and 4) avoid food from unsafe sources. Personal hygiene and how it relates to day-to-day practices and beliefs could be a key factor affecting the mushroom industry since poor personal hygiene is one negative practice that affects food safety worldwide (Foster and Kaferstein, 1985). The pathogens from human feces may be transmitted due to poor personal hygiene (Medeiros, 2001).

Personal hygiene is a topic that has to be covered with extreme delicacy since some people may feel offended. But this topic is an essential part of any food safety program. Program design must take into account the specific needs of the
target audience in order to create awareness and change behaviors, which would be part of the ultimate goal of this project.

The FDA-USDA “Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables” (1998) emphasizes the importance of personal hygiene for all workers. In this document, all employees must be trained to follow good hygienic practices, must have a good knowledge of basic sanitation and hygiene principles, and each producer must develop a written food safety program for their employees. Such programs should include the following topics: the importance of good personal hygiene, the use of proper handwashing techniques, and the importance of using toilets.

Guzewich and Ross (1999) reported that most foodborne disease outbreaks associated with workers were due to the transmission of the pathogen to food by their hands. In health care, handwashing is considered the main weapon in infection control (Texier, 2000). The main objective of handwashing is to reduce the microbial load on hands so that the risk of infection or transmission to others is decreased (Texier, 2000). Appropriate, but simple scientific knowledge, management commitment, and employees training are required for proper removal of transient pathogenic microorganisms on workers' hands (Snyder, 1998). Interestingly, if food handlers were effectively convinced by food safety educators to wash their hands after bowel movements, the incidence of foodborne illnesses would undergo a considerable decrease (Medeiros et. al., 2001).
Handwashing is an excellent example on how difficult it is to change a behavior, independent of the ethnic background. A study conducted by Wirthlin Worldwide for the American Society for Microbiology (2000) reported that 95% of Americans surveyed during a phone interview (n=1,021) said they always wash their hands after using a public restroom; however when people were observed (n=7,836) after using of a public restroom, only 67% actually washed their hands. Women (97%) were more likely than men (92%) to say they always wash their hands after using public restrooms and women (75%) were more likely than men (58%) to practice this behavior in public restrooms. These results demonstrated no significant changes from a replica study conducted during 1996 when handwashing behavior was reported by 94% of participants, while only 68% were observed washing their hands (Wirthlin and ASM, 2000). The study also demonstrated that people from Chicago were more likely to wash their hands after using a public restroom (83%), followed by people in San Francisco (80%), while in both New Orleans and Atlanta, only 64% of people practiced this behavior; New Yorkers were the least likely to wash their hands (49%) (Wirthlin and ASM, 2000). When compared to the 1996 study, 86% of those surveyed reported that they always wash their hands after using the restroom at home, 78% indicated that they wash their hands after changing a diaper. Seventy seven percent of people reported performing this behavior before handling or eating food vs. 81% in 1996. Forty five percent of the participants reported handwashing after petting an animal, coughing or sneezing (31%), or handling
money (20%). These last three behaviors were the similar in reporting to the 1996 study (Wirthlin and ASM, 2000).

Another Japanese study conducted in public restrooms and at a sink in an elementary school reported that only 9-46% used any kind of soap for washing their hands at these locations (Toshima et al., 2001).

Poor handwashing techniques affect not only the food industry but also the health care business too. Teare et al. (1999) reported the difficulties in some United Kingdom (UK) hospitals of meeting the handwashing requirement and the importance of role models in this setting. For example, one employee, who has been educated and washes his/her hands as a common practice, can easily change this behavior and then abandon the habit when he/she observes that no one else is washing their hands. Pittet (2000) reported an estimated handwashing compliance of below 50% in several hospitals settings. In a review of 11 studies, Pittet (2000) found that the range of handwashing compliance in hospitals ranged from 16-81%. The reasons given by employees for avoiding handwashing included believing that wearing gloves eliminated the need for handwashing, inaccessible supplies, forgetfulness, ignorance of guidelines, high workload, lack of personnel, and lack of handwashing stations (Pittet, 2000). Finally, a study conducted by Drankiewicks et al. (2003) found a 63% handwashing compliance rate among female college students and suggested that peer pressure might help to increase handwashing rates.

As demonstrated in these studies, handwashing is one of the most important behaviors in any food safety program and the problem of poor handwashing
compliance is universal. Given this limitations, a multimodal intervention that includes education, motivation, and system change would improve handwashing practices of mushroom employees since it would cover various psychosocial parameters that influence handwashing behavior.

Since a major component of food safety educational process is changing an individual’s behaviors it must be a continuous process and followed day-to-day at the work place.

1.5 FOOD SAFETY EVALUATION

Extension educators do an excellent job of researching the needs and developing educational/training programs for their clientele. However, when it comes to evaluation tools for such programs, there are several barriers (time, lack of resources, loss of clientele) that they need to overcome to demonstrate the effectiveness of a program (Radhakrishna and Martin, 1999). A food safety program would be incomplete without any form of evaluation. Ehiri (1997) stressed the need to know if a food safety program really works. Therefore, evaluation is critical to demonstrate the impact of any food safety program. There are several studies that have evaluated food safety programs but most of this research has been done in the foodservice and hospitality industry (Capunzo, 2005; Costello, 1997; Ehiri, Morris, and McEwen, 1997; Kirby and Gardiner, 1997; Hennum, Lawrence and Snyder, 1983; Martin, Knabel, and Mendenhall, 1999; McElroy and Cutter, 2004; Rennie, 1994; Smith and Shillam, 2000).

To identify the key to success in food safety education, Rennie (1994) reviewed several articles that evaluated the impact of food safety education
programs in the UK, the United States, Arabia, and Romania. She found that in some instances, there was no evidence of improvement in food safety practices, although the author suggested that it was necessary to always have a food safety program in place and to present a good public image. She suggested that employers need to provide a physical and social environment that supports food safety compliance. Training should be oriented to the work environment as a whole, not to just the provision of knowledge. In addition, Rennie (1995) also concluded that it is necessary to use reliable evaluation methods and that the effectiveness of training should be monitored regularly after the program has been completed.

In a review, Seaman and Eves (2005) reported that limited research had been conducted on food safety evaluation. Published studies provided evidence of good hygiene when staff was trained, but confounding variables make it impossible to define if good food safety practices were due to the training program or to other factors such as adequate facilities or management commitment (Seaman and Eves 2005). Other weaknesses in evaluation were the lack of long-term follow-up on acquired food safety knowledge and/or change in behaviors (Seaman and Eves 2005). These limitations demonstrate that behaviors need to be assessed immediately and long term.

1.5.1 Food Safety Knowledge, Behavior and the Importance of Skills

Food safety training programs can provide a wealth of knowledge but even the best training program can’t assume or assure that a behavior change will occur just because people went through that food safety training program. A
behavior can be defined as the way an individual acts. It involves cultural beliefs and practices that may have been done one’s whole life (Baron and Kalsher, 1997). Very little research has followed up food safety programs specifically to see if there have been any changes in the long-term behaviors of workers.

Behavior change has become one of the major challenges in the implementation of food safety educational programs. In one study that conducted a follow-up survey, McElroy and Cutter (2004) found that many participants who took food safety instruction did report changes in food safety behaviors and implemented some of the learned food safety practices after several months had passed. However these researchers concluded that translation of knowledge to proper food safety behaviors involves environmental changes and financial resources at the workplace.

Regardless of the size of the company, employee behavior affects both small and large processors and any kind food business. There is little evidence that food safety practices will improve directly due to training programs (Rennie, 1994). Several authors conclude that just the provision of information and the collection of self-reported practices do not necessarily result in change in behaviors (Clayton et al., 2002, Rennie, 1994). Furthermore, Coleman and Roberts (2005) suggested that to increase training program effectiveness, it is necessary to first understand the current food handler’s behavior and how this behavior interacts with their beliefs and levels of knowledge.

Because the relationship between knowledge and behavior is not clear, it is complicated to evaluate the cost effectiveness and appropriateness of food
safety training (Coleman, 2000). In one of the few studies to look at long-term effects, Jay et al. (1999) conducted a survey among consumers and then monitored them using a video camera in each respondent’s kitchen. There was a significant difference between the answers provided and the practices followed during meal preparation. Interestingly, one of the most common unsafe practices was lack of handwashing (Jay et al., 1999).

Most of the evaluation research that has been conducted, including that on educational programs, has focused on the knowledge, attitudes, and practices of food service workers or consumers immediately after training. Other studies have collected baseline data, not related to training, on current food safety knowledge, attitude and self reported behaviors. However, these studies did not evaluate changes in behavior over time, a critical element to assuring safe food. To examine current food safety knowledge, home-food preparation practices, and food safety attitudes and perceptions, Williamson et al. (1992) surveyed 869 consumers and found that consumers who correctly identified food safety terms or concepts did not necessarily follow through with the correct preparation practice. Barret et al. (1996) provided a training program to Extension educators in Kansas who demonstrated a significant gain in knowledge based on pre- and post-tests. A follow-up questionnaire was mailed to Extension educators to determine the impact of the training program at the local level. Forty percent of the Extension educators had conducted food safety training programs in their communities, involving approximately 3,400 people. The Extension educators reported some anecdotal behavior changes at the community level, but no formal
methodology was used to draw these conclusions. For example, an educator who ran a handwashing demonstration at a school reported that he saw signs posted during a follow-up visit. Through non-formal observations, rather than recording data, educators discovered better practices and improvements at county fairs, schools child care centers and even one educator reported that the smell at a convenience store – clean rather than smoky- was better after they trained the manager. Although these are perceivable changes, more formal research is needed to evaluate the impact of food safety training programs. McIntosh et al. (1994) found that awareness of the consumption of undercooked hamburgers as well as knowledge of both foodborne pathogens and proper practices had no impact on willingness to avoid consumption of undercooked hamburger among a sample of Texans. However, Texans who were better-educated, female and Hispanic, and those who used mass media, were more likely to report willingness to change their behavior in regard to cooked hamburgers (McIntosh et al., 1994). The authors also suggested that application of the health belief model, which is a model that addresses a person’s perceptions of the threat of a health problem and the accompanying appraisal of a recommended behavior for preventing or managing the problem -, could improve prediction of willingness to change food safety practices. Another study conducted with paid and volunteer workers from emergency food relief organizations in New York State demonstrated an increase in participants’ food safety knowledge after taking a food safety-training program. The food safety program was tailored for emergency food program workers and was based on
the provision of knowledge through an educational program. The authors believed that the provision of knowledge would help people to make informed decisions. However, the authors recognized that further research was needed to follow-up on participants’ knowledge and behavior retention over the time. Since a self-report was used to collect data about behaviors, the researchers suggested that further validation of the instruments should be done through direct observations and that further testing was needed (Finch and Daniel, 2005). This work was based solely on the provision of facts using the typical approach based on the provision of knowledge.

There is mixed evidence that knowledge can translate into alterations in behavior in the food service industry. Smith and Shillam (2000) provided videotaped food safety instruction in 28 restaurants to 240 employees. They demonstrated a significant increase in post-tests scores and health department inspection scores in establishments that viewed the videotape. A one-year follow-up study also demonstrated higher scores than prior to the videotaped instruction. In contrast, Ehiri (1997) examined the effect of a food safety program, delivered using the traditional lecture approach, on food service worker knowledge, attitudes and opinions. The author concluded that the provision of just information was not likely to lead to a change in attitudes and behaviors (Ehiri, 1997).

Another evaluation effort in the United Kingdom examined the current food safety knowledge of 444 food handlers in small food businesses (Walker et al., 2003). The researchers found that although people knew or were aware of the
necessity of good personal hygiene, food handlers demonstrated poor knowledge and lack of understanding of cleaning procedures, temperature abuse in cooking, and food storing activities (Walker et al., 2003). The authors concluded that if a Hazard Analysis and Critical Control Point (HACCP) plan were to be implemented in small businesses, a major barrier could be the lack of food safety knowledge and poor understanding of food safety principles (Walker et al., 2003). This study reflected not only the workers lack of knowledge but also the lack of skills that are necessary to produce safe food. To make a food safety educational program effective, it should focus on the provision of skills—which are abilities that have been acquired by training and hands-on activities.

Experts in the field of adult education (Kowalski and Vaught, 2002; Edmunds et al., 1999) suggest that it is important to use educational materials that are relevant to the lives of students when teaching adults. A theme-based approach that integrates concepts with real life problems has the advantage that this will integrate skills instead of abstract concepts that the adult will then learn to use in real life situations (Kowalski and Vaught, 2002; Edmunds et al., 1999). One of the problems with the provision of food safety knowledge instead of skills is that food workers might 'get a fact' but it might never be translated into practice. Several authors have suggested that just the provision of information aimed at increasing knowledge does not necessarily lead to change in behaviors (Clayton et al., 2002; Rennie, 1994, 1995; Ehiri, 1997). For example, a food worker can learn that it is important to wash their hands after using the restroom because there might be fecal contamination and “E. coli” under their nails but the
assessment should include addressing both knowledge and behavior after completion of training. A correct handwashing procedure must be established in the training sessions and then each participant must be trained to the point where they are capable of demonstrating this procedure. Participants must practice the handwashing procedure during the training session. Using this approach, handwashing practice would make training sessions not just a “passing the facts” session, but an active learning environment.

There are very few published studies that discuss the importance of skills to food safety education. Currently, studies report current knowledge and/or pre-then-post knowledge after completing a program. An example of hands-on training is a study conducted by Bell et al. (1997) where a training program to reduce the incidence of *Salmonella* Typhimurium infections due to consumption of queso fresco (fresh-cheese) made from raw milk. This successful program was based on workshops and hands-on demonstrations. The researchers took a traditional “fresco cheese” recipe and modified the recipe to inhibit microbial growth, increase shelf life and made it easier to prepare. The final product was pilot tested among Hispanics for sensory characteristics and then adjusted through processing until a desirable product was obtained. An illustrative (step-by-step with graphics) pamphlet demonstrating “how-to-make cheese” was developed and distributed in the community (Bell et al., 1997). Train-the-trainer workshops for making cheese were developed for grandmothers (*abuelas*) and provided hands-on sessions (cheese production activities), interactive activities and discussions. After completing the training, “abuelas” conducted a workshop
to train their groups to produce safe “fresco cheese.” The implementation of this training program resulted in the decrease of the incidence of *Salmonella Typhimurium* in the populations and a decrease in consumption of fresco cheese made with raw milk. This study demonstrated that hands-on training is a good way to train people in food safety practices and corroborates what adult educators suggest (Bell et al., 1997). This program was repeated with good success in other counties in Washington (Clark et al., 2004).

Although it lacks a strong evaluation methodology, a study conducted by Lilquist et al. (2005) focused on skill provision. Their study demonstrated that a participatory handwashing training program conducted with food handlers in Utah had a greater effect on knowledge scores than the traditional lecture-video approach. The authors pointed out that they did not know how the food handlers performed at work on a daily basis (no follow-up was conducted) but they recommended including hands-on activities for handwashing training.

Furthermore, Rhodes (1988) has suggested that an effective educational model for adults must develop “skills” that will help them to produce safe food. She suggested that training strategies that take into account adult learning styles would be more successful. Training programs should take into account adult education principles such as the need for practical application and practice of acquired knowledge (Rhodes, 1998). A challenge to food safety instructors would be to incorporate adult education learning theory that calls for skills development. Objectives of training programs should be developed around the desired skill level (i.e. there are several handwashing techniques, pick one and teach it until
everyone demonstrates that technique). The strategies used to develop these skills must be adult learner centered. To accomplish this approach, the author suggested that a variety of teaching techniques could be helpful and/or activities could be developed. Rhodes (1998) concluded that: “a model for effective adult food safety education will address the skills and competencies needed to achieve goals.”

There is no single approach for improving food safety practices and consequentially, to avoid foodborne illnesses. However, the literature indicates research is needed to explore what sort of information could affect behaviors. It is hypothesized that the provision of facts during a food safety training session would not be enough to encourage a change in behavior. The provision of skills through hands-on activities and demonstrations might be an important part of a food safety program, but some other activities that involve the working environment and norms should not be left out of the program. In addition, direct observations of worker behaviors after training must be used in future research to obtain a more accurate measure of the knowledge-behavior relationship and to assess the effectiveness of a food safety program.

1.5.2 Direct Observations – An overlooked Evaluation Tool in Food Safety Programs

Researchers agree that observations can be a useful method to assess the real food safety practices of people handling food. Redmond and Griffith (2003) conducted an extensive review of consumer food safety studies that have been published in the literature. Findings from different studies demonstrated that
consumer food safety behaviors were inconsistent and depended on the data collection methodology used (Redmond and Griffith, 2003). Self-reported behaviors obtained through surveys did not match behaviors obtained through direct observations. The authors suggest that direct observations are the most reliable method for assessing food safety behaviors, although this can be expensive and time consuming. Coleman, Griffith, and Botterill (2000) also concluded that direct observations or other in-depth qualitative methods would help to evaluate how the food safety attitudes and beliefs, obtained through surveys of caterers in the UK, were sustained in the kitchens.

The objective of conducting an observation is to record basic information about the particular physical and verbal behavior of the workers, their working environment, and the norms of the management and workers at any particular setting (Stufflebeam, 1985). Observations can be a useful tool since they can be flexible, focus at the worksite, provide real information that is more trustworthy than self-report, and help to set up other data collection techniques during a needs assessment (Rosset, 1987). Henerson et al. (1988) proposed an observation methodology which includes: (1) Identification of program objectives; and thus the information to obtain; (2) choice of the method for obtaining the information: systematic observation, anecdotal records, or observation by experts; (3) selection of the observers and development of the instruments; (4) determination of who will be observed and when, and (5) making the arrangements for conducting the observations.
The anecdotal records procedure, a semi-structured procedure, is a good way to collect research data. It has the advantage that it can be used when it is not possible to define the precise behaviors or information that one is looking for (Henerson et al., 1988). In this method, the observer records either behaviors of specific individuals, or specific activities, events or social interactions. One of the main problems that the observation procedure faces is that people often modify their behavior when they know they are being observed (Gupta, 1999). A good observer with a good idea of the final research goals might prevent people from changing their behavior. Due to the nature of the observation methodology, Rosset (1987) suggests that an observer should have characteristics such as curiosity, patience, tact, and willingness to blend. The observer has also to be able to perform several operations at the same time, to look for details that are not in the observation guide, and finally, to examine the sequence of things that is being observed, and to consider the influence that this approach can have on the overall objective of the observation that is being conducted (Rosset, 1987).

Kiernan (2004) suggested that, in the Cooperative Extension System, direct observations are an underused method for collecting data during a needs assessment and/or program evaluation. Clayton et al. (2002) noted that is necessary to conduct research using direct observations of the food workers within their day-to-day operations. As an example of the use of this methodology, Byrnes et al. (2004) measured the effectiveness of the ServSafe® certification course in traditional and non-traditional food service environments using direct observations. This approach allowed the observers (County based Extension
educators) to elucidate the real barriers that food service kitchens have to overcome to comply with food safety requirements.

Another study conducted in assisted living facilities in Iowa (Sneed et al., 2004) evaluated food safety practices by direct observations and workers’ food safety attitudes, as well as knowledge by a survey. Observations were used to record both appropriate and inappropriate food handling practices in assisted living-facilities in Iowa. Although the authors demonstrated high food safety knowledge scores, observers found that food handling practices were not always consistent with what they ought to be (Sneed et al., 2004). Finally, a study conducted by Teng et al. (2003) used direct observations of cheese vendors’ practices at farmers’ markets to determine if food safety was an issue. The observations provided an accurate picture of cheese vendors’ practices in farmers markets. Problems identified included the lack of handwashing, placing cooked and raw products next to each other, and lack of adequate refrigeration (Teng et al, 2003). The authors suggested that further research, in collaboration with the health authorities, should be conducted to inspect cheese vendors more in depth. This kind of research could provide lots of useful information to determine refrigeration practices at the cheese stands and observations could be good resource to reach their goals.

Ehiri (1997) notes that a realistic approach in the food industry should take into account the social and environmental factors of the workplace when implementing any food safety program. In addition, he suggests that the use of health education theories and models could increase the effectiveness of food
safety training. Direct observations could provide a more accurate assessment of actual food safety practices. Therefore, combining direct observations and the theories that are used in social sciences can be an alternative to assess and improve the effectiveness of a food safety program and/or to understand the food safety needs in a specific industry setting.

1.6 THEORY BASED INTERVENTIONS

1.6.1 Theory

“A theory is a set of interrelated concepts, definitions, and propositions that present a systematic view of events or situations by specifying relations among variables, in order to explain and predict events or situations” (National Cancer Institute, 2001, p. 4). The application of theory-based models in the development of educational materials can illuminate the root of the problem that is being addressed. Theories can provide “Why’s”: (why people are not following a desired behavior) “What’s”: (concepts to be addressed in an intervention and what needs to be evaluated) and “How’s”: (how an intervention must be designed for having impact on the target population) (National Cancer Institute, 2005). Other fields have applied several models based on theories to develop educational materials. In the nutrition field, researchers have used the Stages of Change (Transtheoretical) Model, which focuses on individual’s predisposition to change or attempt to change toward healthy behaviors; the Health Belief Model which “addresses a the individual’s perceptions of the threat posed by a health problem (susceptibility, severity), the benefits of avoiding the threat, and factors influencing the decision to act (barriers, cues to action, and self-efficacy)
(National Cancer Institute, 2005, p. 12); and the Theory of Planned Behavior, which “examines the relations between an individual’s beliefs, attitudes, intentions, behavior, and perceived control over that behavior” (National Cancer Institute, 2005, p. 13).

Several authors (Stanton et al., 1992; Ehiri et al., 1997; Rennie, 1995; Seaman and Eves, 2005) are urging research into designing, implementing and evaluating food safety programs using models and theories that have been widely applied in other health education fields (Janz and Becker, 1984, Jenner et al., 2002, Contento, 1995). Lo et al. (2004) proposed pedagogical concepts and models along with primary trait analysis to assess a HACCP training program. The use of theory in food safety programs at work would help to understand all the factors surrounding the worker.

Only a few studies in the food safety education field have used theory to predict food safety behaviors. Schafer, et al., (1993) and Hanson and Benedict, (2002) used the Health Belief Model to examine food safety attitudes and behaviors about food safety of adults in the US. Clayton et al. (2002) used elements of psychosocial theories to evaluate food safety beliefs and self-reported practices of food handlers in Wales, UK. In this study, a survey was designed based on constructs of the Theory of Planned Behavior and The Health Belief Model. Authors concluded that training by itself will not lead to behavioral change and the training needs to include a risk-based approach. It was mentioned that “food hygiene training needs to embody the concept of risk in order to emphasize to food handlers, especially those in managerial role, the
level of risk associated with their business” (Clayton et al., 2002). Adequate resources and a receptive management culture are also fundamental to applying good food safety practices (Clayton et al., 2002).

On the other hand, Stanton et al. (1992) took two theories (Health Belief Model and Behavioral Theory) and applied them to two simulated scenarios. The authors developed two handwashing interventions to avoid diarrheal diseases for consumers and described how theory was applied to develop these hypothetical interventions. Using the two proposed interventions, they demonstrated that theories or models developed in the social sciences can contribute to this field. Finally, the authors suggested that theory could guide researchers on the paths they have to take in each stage of any intervention.

The most common framework used in nutrition and health education is the knowledge, attitude and practices or KAP model (Rennie, 1995). It is based on a cognitive approach and assumes that just by providing information, an individual will alter attitudes, leading to the adoption of the right behaviors. Most of the food safety training programs that are currently used rely on this KAP approach. The weakness of this model is its linearity and unidirectional nature (Rennie, 1995). The KAP model also does not take into account the cultural, social, and environmental factors surrounding the workers (Ehiri et al., 1997, Rennie, 1995). That omission makes this model less useful for developing a working framework for the mushroom industry. Worsfold and Griffith (2004) found in an Environmental Health Officers’ survey that environmental factors, such as supervisory support, were considered to be key when implementing a food safety
program in the industry. In addition to worker knowledge, food safety education must look at other factors that are involved in a food production facility. A health education model is needed; one that takes into account not only the provision of knowledge but also the social, cultural, environmental and economic factors that surround food safety, to design a food safety educational program within an industry setting. The Health Action Model appears to fit these criteria and therefore is suitable for further testing in the industry.

1.6.2 The Health Action Model

The Health Action Model (HAM) developed by Tones, provides a framework where the variables that influence health choices and actions and their interrelationships are categorized and described (Figure 1.3). This model has been used in the context of prevention of drug misuse (Tones, 1987). The model condenses two other models that have been widely used in the field of nutrition education: the Health Belief Model and Fishbein’s Theory of Reasoned Action (Tones et al., 1990).

At the bottom of the model, there are three major systems influencing any behavior: the belief system, the motivation system, the knowledge system, and the normative system. Tones et al. (1990) notes that the term “norm” describes “cultural, sub cultural, and group behaviors together with the various values, beliefs and routines associated with such behaviors.” The actual observable behaviors may be termed statistical norms, while the beliefs held by the relevant population about such behaviors may be called the social “norm.” Being at the
bottom of the model, the normative system has influence on any behavior that is
taking place. The normative system has a direct influence on the belief and the
motivational system. These two concepts interact, and have direct influence on
the behavioral intention, which, if the appropriate social and environmental
conditions and skills are present, could lead to an action (Tones et al., 1990).

Beliefs are defined within the context of the HAM as cognitive variables
(Tones et al., 1990). Fishbein defines a belief as “a probability judgment that links
some object or concept to some attribute” (Tones et al., 1990). In the context of
food safety, this approach could be exemplified as the belief that proper
handwashing (concept) will prevent foodborne illnesses (attribute). Within the
HAM, the belief system could be considered the core of the framework since it
has a direct influence on behavioral intentions (Tones et al., 1990). However, it is
interrelated with the motivational system, the normative system, and the
individual’s knowledge. The motivational system determines an action or the
intent to adopt an action by describing a series of affective elements (Tones et
al., 1990). The individual’s value system is included among these affective
elements; the values are acquired through socialization and will have influence
on attitudes (Tones et al., 1990). In fact, each value embraces a large number of
attitudes.

The HAM model takes into account the social (norms) and environmental
factors that surround the individual. These two factors can be considered
facilitating factors within the model. They may also be considered uncontrollable
variables, unless sufficient resources are available to change these conditions
(Tones et al., 1990). For example, despite the behavioral intent, handwashing will never occur if there are no handwashing facilities.

For use in food safety research, Rennie (1995) adjusted the definitions of the Health Action Model, all of which influence behavior, as follows: a) knowledge system: baseline food safety knowledge; b) normative system: worksite norms and rules, i.e., the social interactions and expectations among worksite members; c) motivational system: motivational elements in the company; d) belief system: values and beliefs of the target audience; and e) worksite environmental system: worksite physical conditions (Figure 1.4).

Attitudes or beliefs are real but they cannot be directly observed. It is possible to assess them by looking at workers behaviors (Baron and Kalsher, 1997). People’s behavior is partly driven by motivation, since most behaviors are learned. There are several psychological theories addressing individual’s motivation but no single theory of motivation can cover all factors that are involved (Burns, 1995). Expectancy theory is closely related to industrial and organizational psychology and to the field of adult education. Vroom’s expectancy-valence model was predicted to be the dominant motivational theory in the field of organizational psychology (Campbell and Pritchard, 1983). In fact, it could be the most researched theory of work motivation (Tubbs, et al., 1993). Concepts from Expectancy Theory (ET) as defined by Vroom (Campbell and Pritchard, 1983; Tubbs, et al., 1993) were added to HAM to define the motivational system (See figure 1.5). Motivation is an internal process that activates, guides and maintains behavior over time. ET is used in industrial and
organizational psychology and adult education to motivate people (Baron and Kalsher, 1997; Goad, 1982; Burns, 1995). It is hypothesized that company motivational practices can directly affect employees’ beliefs and can lead to adoption of behaviors supporting food safety practices. ET includes three concepts; valence, instrumentality and expectancy (Smith, et al., 2000). Expectancy is the belief that extra effort will lead to improved performance (i.e. taking time to wash their hands after breaks). Instrumentality is the belief that good performance will be noticed or rewarded (i.e. supervisors will notice and recognize this behavior). Valence is the value placed on the rewards offered (i.e. a significant incentive would be used to reward people who wash their hands after breaks). These three affective elements expressed as the motivational system include values and beliefs that support the core belief system as well as influence behavioral intent (Tones et al., 1990).

To summarize, HAM is grounded “in the assumption that a person’s behavior is determined through an examination of their beliefs, attitudes and norms and that these factors need to be examined within social and environmental conditions” (Clayton et al., 2002). Although Rennie (1995), Ehiri, (1997), and Seaman and Eves (2005) did propose a HAM framework for food hygiene education, no research using this model has been published to date.

1.7 CONCLUSIONS - STATEMENT OF THE PROBLEM

Consumers are demanding safer food (Senauer, 2001). Changing production and processing methods, as well as eating habits, have made food contamination easier than ever. The literature review reveals that food safety
education of food handlers can play a key role in preventing foodborne illnesses. But, it should be part of a bigger and broader effort from food companies to offer safer food to consumers. Mushrooms growing and packing are complicated operations, but at the same time, these operations are a big business. Despite the abundance of food safety educational materials, this literature review suggests that there is a need for educational materials that take into account the social and environmental background of the Hispanic mushroom workers. Most of the materials available are directed towards English speaking audiences with no materials designed specifically for the produce industry or the mushroom industry. The mushroom industry requires specific educational interventions (LaBorde, 2000; LaBorde, 2004). As discussed earlier in this review, the mushroom workers are primarily a Hispanic audience, which makes it even more difficult to find material that fits their needs. Hence, there is a need for developing and assessing materials for food safety training that take into account specific cultural attributes of Hispanic audiences in their specific workplace.

On the other hand, no materials directed toward English speaking audiences or Hispanic audiences were found that used any theoretical framework within the field of food safety education. Other health education fields, such as nutrition education, have used theories and models for developing educational materials (Janz and Becker, 1984; Jenner et al., 2002; National Cancer Institute, 2005; Townsend et al., 2003). The modified version of Health Action Model (HAM) appears suitable for the proposed research since it takes into account factors that have to be addressed in designing and implementing an appropriate
intervention for the specific food industry target. Factors such as values and beliefs of the audience, environmental conditions, norms, motivational system will be considered within the context of this framework. Greater understanding of the sociological and physical environment that surrounds the Hispanic mushroom workers could permit researchers to discover the motivations and the beliefs of the mushroom workers. Food safety issues that exist in the mushroom industry could be addressed more effectively with an adequate intervention. Therefore, a modified version of the HAM model (figure 1.6) was chosen in the design and evaluation of a food safety educational program specifically designed for the Hispanic workers in the mushroom industry. Such an intervention should be designed within a context that can be understandable to the workers and use a practical approach. Since little was known about the mushroom industry, a needs assessment based on the modified version of HAM was conducted to learn about the knowledge, normative, motivational and belief system, as well as examining the environmental conditions in the companies. This approach helped the researchers to obtain data to design a pilot food safety program for the mushroom industry.

Different approaches have been taken to evaluate food safety education, although the outcomes have not always been desirable. It is not clear as to the relationship between knowledge and behaviors. Many studies demonstrated increase in knowledge after program participation, but others have demonstrated that just the provision of information that increases knowledge does not affect application in the worksite environment of what was learned in a classroom.
Therefore it is not known, in reality, if a food safety program works after the instructor leaves. A food safety program developed for Hispanic mushroom workers should just provide information to the students. It must be an active learning experience that provides the workers with skills that can be applied within their daily operation. It is fundamental to teach skills to decrease the likelihood of transmission of bacteria and other contaminants to mushrooms. This approach can be done through hands-on training, demonstrations and activities that demonstrate the relationship between personal behaviors and bacterial infection of mushrooms.

Information provision that leads to change in knowledge does not necessarily mean changes in behavior. Therefore, it is important to incorporate into the food safety program other concepts and aides that address not only the workers, but all the other factors that surround them. The Health Action Model will be helpful for doing so, but the program should include other elements. Some authors suggested the incorporation of the concept of risk concept associated with company policies and the concept of management commitment. One of the main advantages of the mushroom industry is that it provides year-around jobs for its employees. So, a foodborne outbreak traced back to one mushroom company might be a disaster for the whole mushroom industry. Therefore, the concept of risk perception (loss of jobs) should be incorporated in the food safety educational program. Involvement of the upper and lower management should also be part of the program since some authors suggested that they play a key role in program implementation (Clayton et al., 2002; Seaman and Eves, 2005).
The modified version of the HAM model can also be helpful during the evaluation process. Evaluation of program impact is needed to demonstrate the worth of a program. Additionally, the literature debates the effectiveness of food safety training programs. Therefore, it is important not to only develop a tailored food safety program for this specific target audience but to test it within an industry setting to learn what concepts or factors contribute to program success or failure.

1.8 OBJECTIVES

The general objective of this research project is:

- To develop and evaluate a food safety training program and a strategy that takes into account specific cultural attributes of Hispanic workers in the mushroom industry.

The specific objective for the first part of this research is:

- To design and carry out a food safety needs assessment in the mushroom industry based on the HAM model.

The specific objectives for the second part of this research are:

- To develop a pilot food safety educational program for Hispanic mushroom workers using the results of the needs assessment; and
- To implement and evaluate the effectiveness of this skill-based, pilot food safety educational program (knowledge system) plus elements of the motivational system of the HAM in the mushroom industry.
1.9 RESEARCH QUESTIONS

Prior to developing the food safety educational materials, it is important to understand:

- What do the workers know about food safety? (Knowledge system)
- What are the norms and rules followed in the mushroom growing and packing facilities? (Normative system)
- What factors motivate the workers to follow the food safety rules? (Motivational system)
- What are their beliefs and attitudes about food safety and foodborne illness? (Food safety belief system)
- What is the worker’s working environment like? (The worksite environmental system)

These research questions will be addressed in the needs assessment carried out in cooperating mushroom facilities within the framework of the HAM and reported in Chapter 2.

In this needs assessment, day-to-day food safety operations and worker food safety behaviors in the mushroom production and processing facilities were evaluated. No reports of an ‘observation method’ applicable to conducting a needs assessment for food safety training in a food production setting were found in the existing literature. To address this gap in methodology, a ‘Worker-Experience Protocol’ was developed (WEP). Using the WEP, a person unconnected to either the regulatory system or the food company, served as a ‘worker’ as a way to make direct observations of company
operations and worker behaviors. It was hypothesized that this protocol would provide valuable and unique information that would be useful in designing a food safety program. The effectiveness of this protocol is reported in Chapter 3.

After answering the research questions and developing the ‘Worker-Experience Protocol’, a pilot food safety educational program was developed and evaluated. The following research questions were addressed:

• Does improving food safety knowledge and skills (knowledge/skills) increase compliance with desired food safety behaviors (i.e. handwashing)?

• Can a combination of increased worker ‘knowledge/skills’ and ‘supervisory motivation’ (acting as a role model, enforcing and reinforcing correct behavior) increase compliance with desired food safety behaviors to a greater degree than increased ‘knowledge/skills’ alone?

• Does an economic incentive provide an independent effect on desired behavior beyond ‘knowledge/skills’ and ‘supervisory motivation’?

The specific hypotheses tested in this step of the project were:

• H1: Workers completing the pilot food safety program will achieve significantly higher scores on a knowledge/skill test than workers with no exposure to the program immediately post program.

• H2: Handwashing frequency at critical points in the workday [(1)-before starting work in the morning, (2) after using the restroom, and (3) at the end of breaks] will not differ significantly between companies in which most workers participate in the pilot food safety program and those with no exposure to the program at 8 weeks post program.
• H3: Companies in which most workers participate in the pilot food safety program and where supervisory motivation occurs will demonstrate greater handwashing frequency at critical time points in the workday [(1)-before starting work in the morning, (2) after using the restroom, and (3) at the end of breaks] than those companies exposed to the program where supervisory motivation does not occur at 8 weeks post program compared to pre program.

• H4: Among companies in which most workers participate in the pilot food safety program and supervisory support occurs, those in which an economic incentive is offered will demonstrate greater handwashing frequency at critical points in the workday [(1)-before starting work in the morning, (2) after using the restroom, and (3) at the end of breaks] than those companies receiving no economic incentive at 8 weeks post program compared to pre-program.

Pilot program development, testing of the above hypotheses and other research questions and evaluation were carried out in cooperating mushroom facilities within the framework of the HAM and reported in Chapter 4.
1.10 REFERENCES


• Rhodes, L.B. (1988). *Competency-based adult learning in food safety programs in food protection technology II*. Ed. Rhodes, M.E. Lewis Publishers: Chelsea, MI


1. Receive compost materials
2. Store

3. Receive water
4. Phase I Substrate preparation
5. Recycle leachate

6. Transfer substrate to mushroom houses

8. Receive spawn
9. Store
10. Spawning

11. Receive casing materials
12. Store

13. Casing
14. Receive pesticides/fungicides
15. Store
16. Prepare

17. Receive CaCl₂
18. Store
19. Prepare
20. Receive Ca hypochlorite
21. Store
22. Chlorinate water
23. Growing

24. Receive back-hauled lugs or trays

25. Store

26. Receive tills or boxes from suppliers
27. Store

28. Harvesting / Pack into lugs/tills/boxes
29. Stack
30. Palletize
31. Transport mushrooms
32. Pasteurize used substrate
33. Take out
34. Distribute

Figure 1.1 Example of the typical mushroom growing unit operations.

(Adapted from LaBorde, 2001)
Figure 1.2 Example of the typical mushroom packing unit operations.

(Adapted from LaBorde, 2001)
Figure 1.3. Tones’ Health Action Model (Tones, 1979).
Figure 1.4. The Health Action Model framework purposed by Rennie (1995) for working on food safety education.
Expectancy – Belief that extra effort will lead to improved performance

Instrumentality – Belief that good performance will be noticed and rewarded

Valence – Value placed on rewards that are offered

Motivational System – Incentive to change practices i.e. workplace rewards

Belief System e.g. concern about adverse effects of current practices

Influence of Norms and Significant Others – support for change from other workplace personnel

Behavioral Intention

Knowledge gain from food hygiene course

Appropriate Environment and Conditions – Worksite provides good and appropriate facilities

Figure 1.5. The expectancy theory concept fitted into the Health Action Model.
Figure 1.6. The Health Action Model for the Hispanic mushroom worker needs assessment.
CHAPTER 2

USING THE HEALTH ACTION MODEL TO PLAN FOOD SAFETY EDUCATIONAL MATERIALS FOR HISPANIC WORKERS IN THE MUSHROOM INDUSTRY

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2.1 ABSTRACT

Sometimes educational materials do not work because they are designed without examining the worksite social and environmental factors affecting the target audience. Educational materials based on application of theory based models may address more effectively the cause of food safety problems. The objective of this project was to use the Health Action Model (HAM) as a framework for developing food safety educational materials for Hispanic workers in the mushroom industry. HAM identifies 5 constructs or systems that represent conditions surrounding mushroom workers: Baseline food safety knowledge, normative system, motivational system, food safety/belief system, and appropriate working environment and conditions. Some refinements of the motivational construct were made for its use in this research. The Health Action Model provided a framework in which the variables that influence food safety behaviors were identified and described. The findings provided by using this framework were helpful to identify factors that should be taken into account in designing an educational intervention for Hispanic workers in the mushrooms industry. It is felt that the HAM model can be used as a guide to develop customized food safety educational materials at a variety of different settings and target audiences in food production facilities.

KEYWORDS: Health Action Model, food safety education, Hispanic workers, Mushroom Industry.
2.2 INTRODUCTION

Foodborne illnesses are an overwhelming public health problem in the US costing the food industry billions of dollars yearly. Education and training of food handlers is critical since worker mishandling caused most of the outbreaks reported in the food industry (WHO, 2000). The Pennsylvania (PA) mushroom industry began a pro-active process to institute worker food safety training in 2002.

2.2.1 The PA Mushroom Industry Workforce

Pennsylvania accounted for 56% of the $889 million in US mushroom crop sales in 2002-03 (USDA, 2003), mainly due to mushroom companies located in Kennett Square, PA, the self described ‘Mushroom Capital of the World’ (Flammini, 1999). Manual labor is involved in all phases of mushroom farming and packing. Currently, approximately 95% of the mushroom workers in southeast PA are Mexicans coming from economically depressed areas in Mexico. Most Mexican migrant workers in US are men between 25 and 34 years of age. This Hispanic group has low income, low educational level and little political influence in US, but their socio-economical level is still higher than in Mexico (Aguayo, 2000). The Central Mexican Bank (Banco de Mexico) reported that, in 2003, the Hispanic workforce of Mexican in the USA sent $13.266 billion back to Mexico (Banco de Mexico, 2004). Although, there have been no foodborne outbreaks attributed to consumption of fresh mushrooms in the US, mushroom buyers are requesting that their suppliers provide third party food
safety audits of their facilities to assure safe produce for their consumers, thus creating a need for food safety training.

2.2.2 Food Safety Education Materials

Currently, hundreds of food safety educational materials are available, but none has been specifically designed for the mushroom industry and most materials were designed for English speaking audiences. Not much is known about food safety knowledge and practices of Hispanic workers, since only a few consumer studies involving Hispanics have examined food safety issues (Bell, et al., 1999, 1999a; Diaz-Knauf, et al., 1995; Meer and Misner, 2000; Penner, 2001).

Unfortunately, differences in cultural, economic and social factors associated with workers themselves make it difficult to use the same educational food safety program in all situations (Foster & Kaferstein, 1985). Additionally, educational materials may not be effective if they are designed without looking at the worksite social, physical, and environmental factors surrounding the target audience. Food safety education is most likely to be effective when it is designed specifically for the audience (Hispanic Workers) and the particular hazard of interest (mushroom handling) (Medeiros, et al., 2001). The mushroom industry therefore needs food safety training materials that take into account the cultural attributes and worksite environment of their Hispanic workforce.

Sociologists suggest examining target audience food safety beliefs and behaviors before planning any food safety intervention (Foster & Kaferstein, 1985). Theory can provide a framework for relating beliefs to other individual and
worksite factors that affect worker behavior and help identify the sources of the problem for which educational materials are being developed. Other health-related fields have relied heavily on theoretical frameworks as guides to develop educational materials and to predict individual's behaviors (Janz and Becker, 1984). Although a few studies in the food safety education field have used theory to predict food safety behaviors (Schafer, et al., 1993; Hanson and Benedict, 2002), more research using theoretical frameworks would benefit the food safety education field.

2.2.3 The Health Action Model (HAM)

HAM was chosen as the framework for development of a food safety educational intervention for Hispanic mushroom workers. Developed by Tones, the HAM conceptually incorporates the Health Belief Model and Ajzen and Fishbein's Theory of Reasoned Action (Tones, 1990). For use in food safety research, Rennie (1995) adjusted the definitions of its five constructs or systems, all of which influence behavior, as follows: a) knowledge system: baseline food safety knowledge; b) normative system: worksite norms and rules; c) motivational system: motivational elements in the company; d) belief system: values and beliefs of the target audience; and e) worksite environmental system: worksite physical conditions (See Figure 1). The normative system influences both the motivational system and the belief system. The motivational system can also influence both the belief system and the outcome of the belief system, behavioral intent. If the relevant skills and knowledge and the appropriate environment are present, then behavioral intent can lead to action. The belief system is the core of
the framework since it is interrelated with the normative system, the motivational system and baseline knowledge. HAM takes into account the social and environmental factors that surround the individual. These factors can facilitate or hinder actions depending on the resources available to change these conditions. For example, despite behavioral intent, workers will not wash their hands if hand-washing facilities are not available.

Concepts from Expectancy Theory (ET) as defined by Vroom (Campbell and Pritchard, 1983; Tubbs, et al., 1993) were added to HAM to define the motivational system (See Figure 1). Motivation is an internal process that activates, guides and maintains behavior over time. ET is used in industrial and organizational psychology and adult education to motivate people (Baron and Kalsher, 1997; Goad, 1982; Burns, 1995). Company motivational practices can directly affect employees’ beliefs and can lead to adoption of behaviors supporting food safety practices. ET includes three concepts: valence, instrumentality and expectancy (Smith, et al., 2000). Expectancy is the belief that extra effort will lead to improved performance. Instrumentality is the belief that good performance will be noticed or rewarded. Valence is the value placed on the rewards offered. These three affective elements include values and beliefs that support the core belief system as well as influence behavioral intent.

This modified version of HAM was used in this research to design and conduct a needs assessment in the PA mushroom industry to provide data upon which a food safety education program would be based. The objectives of this paper are to report a) the way this needs assessment was designed, b) what was
learned from the needs assessment and c) to assess the value of HAM in this process.

2.3 METHODOLOGY

Based on HAM five research questions were developed, four of which focused on one of the model systems and one on target audience baseline knowledge. To answer these questions, the needs assessment used three methods: (1) observations, (2) individual interviews, and (3) focus groups, all of which were conducted in Spanish. Table 2.1 lists each research question and which methods helped to answer it. The relationship of the research questions to the HAM model systems is shown in Figure 2.1. The Penn State University Office of Research Protections approved all procedures (Appendix A).

2.3.1 Company Sample

All mushroom companies (packers, growers, or both) affiliated with the America Mushroom Institute (AMI) were sent a fax by AMI explaining the project. The study was also publicized at the Penn State Mushroom Workshop in Spring 2002. Subsequently, all eligible companies were contacted in the order derived from a randomized list to determine interest. Finally, a meeting was set up with the management staff of each interested company to provide a detailed explanation of the project, the instruments and the commitments involved and to request a formal letter of agreement from the company. Ultimately, seven companies agreed to participate in this stage of the project. Each provided a letter of agreement, although one company required a confidentiality agreement.
2.3.2 Observations at Companies

One observer conducted an ‘observation procedure’ at each participating company that examined all production steps, from growing to finished product, as well as the workers’ practices during work and break time. The observer was free to move within the mushroom packing facilities or the growing farms. Two full days of observation were conducted at companies that had both a packing room and growing farms. If the company only grew mushrooms, the observation period was shortened to one day. The observer worked 1-3 hours at every employee workstation and position in a mushroom packing company. At the farms, the observer picked mushrooms and worked with some of the crews performing different tasks. The amount of time spent at each station or with each crew could vary depending on the information that was being collected. As the observer worked, short notes were taken of observations and at the end of the observation period, these were transformed into anecdotal records according to Henderson, et al. (1988). This ‘procedure’ allowed the observer to record the particular physical and verbal behavior of the workers, descriptions of their working environment, the details of production steps, and the norms of the managers and workers (Nieto-Montenegro, et al., 2004).

2.3.3 Individual Interviews

2.3.3.1 Subjects

Each company (A-G) contributed a number of participants to the total sample (N=100) that reflected company size (number of employees), the gender distribution and proportion of people who worked as pickers or packers. The final
number of participants per company was A (16), B (2), C (12), D (14), E (6), F (21) and G (29). To accommodate company work schedules, a convenience sample of workers who were not busy at the time of interviews was invited to participate. The researcher, who did not know the workers, walked into the facilities and approached people from each of the existing workstations in the company. After hearing the purpose of the interview, the worker could decide whether or not to participate in the interview. This was repeated until the quota for that company was reached.

2.3.3.2 Interview Instrument

Based on information from the direct observations and adapting some questions from relevant literature (Angelillo, et al., 2001; Altekruse, et al., 1999; Bruhn, C.M. and H.G. Schutz. 1999; Fein, et al., 1995; Meer and Misner, 2000; Unklesbay, et al., 1998; Williamson, et al., 1992; Woodburn and Raab, 1997), a survey instrument (Appendix B) addressing knowledge, attitudes and norms pertaining to mushroom food safety issues was developed to be completed in individual face-to-face interviews. To assure content validity, seven individuals with expertise in food safety and food microbiology reviewed the draft instrument. Their comments were incorporated into a revised survey instrument, which was translated into Spanish and pilot tested with mushroom workers (N =10) in two mushroom companies to assure its clarity and accuracy and to practice the interview methodology. Comments and experiences were recorded and used to modify the instrument. The final survey instrument contained questions addressing five main categories in the following order: (1) workers’ attitudes
about rules and norms at work (i.e., handwashing practices, gloves, and hairnets); (2) attitudes/beliefs about microorganisms and their relationship with the environment, food, handwashing and foodborne illnesses; (3) evaluation of workplace facility cleanliness; (4) knowledge of food safety principles and foodborne illness; and (5) demographic information. Attitude and belief statements were evaluated using a five-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). Workplace facilities were evaluated using a 100-point scale (0 = extremely dirty, 100 = extremely clean). Each knowledge question was assessed using five multiple-choice options, where one option was ‘do not know.’ A final section contained open-ended questions designed to examine workplace norms and policies related to food safety and hygiene practices and procedures.

2.3.3.3 Instrument Administration

One hundred instruments were administered using in-person oral interviews after obtaining informed consent. The interviewer read each question to the respondent, who recorded their answer on an answer sheet. Visual aids were used for all sections to help respondents understand the survey questions and indicate the answers of their choice. Culturally compatible analogies were also used to explain the mechanics of the interview and the scales used. Each interview of closed-ended questions lasted 35-75 minutes. The researcher chose a sub-sample of 20 individuals to answer the open-ended questions based first, on the workers’ availability, and second, on certain characteristics key to a successful interview. The researcher noted these characteristics (approachable,
outgoing, respectful, decision making or leadership ability) during the observation period and/or the pre-interview process. Open-ended responses were tape-recorded. All participants completing the interviews received a $10 calling card.

2.3.4 Focus Groups

2.3.4.1 Subjects

To avoid gender dominance, four focus groups were done with men only and three with women only. The sex of focus group participants from each company was determined using a drawing. Participants were recruited within each company without management involvement through a combination of workers’ availability and interest and personalized invitations based on discussions with workers.

2.3.4.2 Focus Group Conduct

One focus group was conducted at each participating company (N=7) according to Krueger (2000). The same moderator led all seven discussions during work hours and each group consisted of 6 to 10 participants. Groups were conducted using a script of open-ended questions with probes and were tape recorded for their analysis. The questions in the script explored the workers’ motivation for following food safety rules including the role of incentives, worksite food safety norms and working environment and conditions (Appendix C). All focus groups participants received a $10 calling card.
2.3.5 Analysis

2.3.5.1 Quantitative Data

Interview data were entered into an Excel™ (Microsoft, Redmond, WA) database, coded, compiled as descriptive statistics (frequencies, percentages, means, and standard deviations) and standard statistical procedures (inferential statistics T-tests and Chi-square tests) were conducted using SPSS 10 for Macintosh (SPSS Inc., Chicago, Ill.).

2.3.5.2 Qualitative Data

Data tapes were transcribed and then translated from Spanish into English for analysis. Using the constant comparative method (Glaser & Strauss, 1967), one researcher developed a list of thematic codes and sub-codes for each sex that was applied to all focus group scripts. A second researcher then independently coded the transcripts using the coding list. Finally, the results were compared and any disagreements were resolved. A similar process was used for the open-ended interview data except coding categories were the same for each sex. One researcher wrote thematic summaries that were checked by the second researcher. Final themes and representative quotes were developed by consensus.

2.4 RESULTS

2.4.1 Baseline Food Safety Knowledge (See research question # 1 on Table 2.1)

Interviews: Demographic characteristics of participants are shown in Table 2.2. Educational attainment was low. Participants’ scores on the ten knowledge
questions indicated inadequate baseline food safety knowledge (mean 5.01±1.71), even though women attained a significantly higher mean knowledge score than men (5.44±1.68 vs. 4.68±1.67, respectively). Over 80% did not understand two basic concepts (people mishandling food cause most outbreaks; food containing harmful bacteria may not smell bad) and a third of participants (36%) did not connect pathogens with foodborne illness. Participants did not know the difference between cleaning and sanitizing. On the other hand, more than half of participants knew that humans were most likely to contaminate mushrooms and that heating food can kill bacteria. Almost all recognized that unwashed hands are the biggest source of bacterial contamination (93%). In the open-ended interview questions (and the focus groups), workers could list the personal hygiene rules they were expected to follow (wear hairnets, not chewing gum, wash hands after using the restroom) as well as the food handling rules. However, it was clear they did not understand the reasons behind the rules. Interviewees also confused food safety rules with product handling rules and/or occupational safety rules.

2.4.2 The Normative System (See research question # 2 in Table 2.1)

*Interviews*: Reponses to the quantitative attitude statements used to measure norms generally followed a pattern of agreement with statements supporting good personal hygiene and company cleanliness and no significant difference between men and women emerged. (See Table 2.3). But there was also agreement that cleaning tasks were done to make the company look good in case an inspector visits and that cleanliness of restrooms reflected the company
attitude toward hygiene. Workers generally agreed that supervisors served as role models for personal hygiene and showed commitment to keeping workstations clean but they were more ambivalent about coworkers being role models. In the open-ended questions, people reported that workers had good attitudes towards food safety rules and considered them important. Most workers stated that everyone should report possible sources of contamination to their supervisors. However, some workers indicated they would be unlikely to do this. Interviewees also reported that food safety training varied greatly across companies.

**Observations:** Cleanliness of restrooms and other worker facilities as well as worker hygiene did vary across companies. Hairnets were usually worn but sometimes not properly. Jewelry and fingernail polish were common adornments among women workers. Inconsistent enforcement of personal hygiene rules was noted and supervisor’s poor Spanish speaking skills created a barrier to enforcement in some companies. Some supervisors and workers could serve as role models for personal hygiene and others could not. No efforts to promote good role models were evident in most worksites.

**Focus groups:** Both men and women were receptive to having food safety rules and could recite the personal hygiene rules they were expected to follow. They even agreed that it was important to follow the rules for their own sake and that of the company. But enforcement was not uniform and mainly based on informal warnings to individual workers. Many complained that supervisors were not courteous when providing instructions or corrections, something very important
for women workers (i.e., “More than anything that they would use manners and good words to tell you stuff, not being angry. They (supervisors) go to you and humiliate you in front of everyone. We do not like this, the way they sometimes treat us, because we work hard”). Workers were more willing to follow a supervisor’s instructions if he/she used good manners while addressing them.

Workers complained that not everyone was willing to follow the rules (i.e., “Sometimes for only one bad person we all get in trouble”). Some delinquent workers cleverly followed the rules only at critical times and corrective actions were not applied. This created perceptions of inequity and unfairness and reduced worker interest in playing by the rules. Workers reported supervisors displayed favoritism in decisions about enforcing the rules and applying punishment for rule infractions. Some workers considered the decision to follow rules (especially personal hygiene) to be a personal matter and not the business of management or fellow workers. Yet some participants said that personal hygiene is important to protect the product (i.e., “Right now we are used to this (following the rules). We are conscious about what this is”; “There are some who like to eat with their hands dirty….they like doing this”). In some companies, supervisors asked workers to report rule infractions but workers, especially women, were not willing to ‘snitch’ on co-workers, possibly because of retaliatory social pressures. So food safety infractions seen by workers on the production floor were not communicated to supervisors and, as a result, supervisors were often not aware of issues and events on the production floor.

In contrast to the interview findings, focus group participants reported that
good supervisor and worker role models for food safety were absent in worksites. However, workers thought that good role models would be helpful to insure compliance. Finally, the ability of supervisors to inform workers of proper food safety practices varied greatly across the companies, largely due to language barriers and inefficient communication channels.

2.4.3 The Motivational System (See research question # 3 on Table 2.1)

Focus groups: Expectancy (Extra effort will lead to better performance).

Workers perceived inequities in discipline and rule enforcement by supervisors and wanted this corrected. Not surprisingly, workers saw little reason to follow the rules when someone else got away with breaking them. Most blamed ‘another worker’ for any rule infractions. For instance, packers blamed pickers for any debris found in the boxes of mushrooms that were sorted into containers for sale while pickers blamed packers for not understanding the restraints on their job and the circumstances for picking imposed by the facilities. Little team spirit existed and, although individual workers could see some benefit to following the rules, this was merely part of the job, not something that could benefit the company as a whole. This lack of team spirit seemed to be partially due to language barriers and lack of communication channels between workers and management. Workers also indicated that supervisors treated them like children, not adults who might have ideas to contribute to improving the company. However, in one company, expectancy was high due to an outstanding supervisor who was considered very fair. He made it clear that if the workers performed well on the job, their position would be waiting for them after their
yearly trip to Mexico. He also involved the workers in decisions by holding group meetings to discuss problems and corrective actions.

*Instrumentality* (Good performance noticed and rewarded). Workers felt that supervisors who showed favoritism did not recognize good behavior (following the rules). Workers wanted recognition of good working habits and many felt their conscientious efforts to follow the rules were ignored. In most of these companies, workers felt that good performance would also not be rewarded, making it worthless to follow the rules all the time. In several companies, workers reported that something had been promised for hard work (a jacket or bonus) and then took months to materialize, resulting in worker cynicism and low morale.

Morale was low in one company that had adopted a punitive point system to enforce food safety practices. In addition to feeling punitive points were not assigned fairly, workers felt this system focused on the recognition of infractions at the expense of positive reinforcement of desired behavior.

*Valence* (Value placed on rewards offered). Most of these companies did not have a formal on-going incentive program. However workers were aware of incentive programs in other companies due to their community networks. They could clearly separate quality incentives from tokens with little value. Quality incentives were different for each sex. Men mainly desired monetary incentives like paid holidays or better salaries (i.e., “…is that they would give us a little bit more money”), while women were more likely to appreciate symbolic incentives like diplomas or certificate of awards. However, both men and women wanted recognition for hard work and good performance from management (i.e., “That
the owner would go there (the packing lines) and say this is for you because you work harder than anyone.”). Valued incentives did not have to be expensive. In one company, employees valued access to extra work (to earn more money) and use of the company car for errands as rewards for good performance.

2.4.4 The Belief System (See research question # 4 on Table 2.1)

*Interviews:* Mean attitude/belief scores registered between “neutral” and “agree” for both sexes, although women had significantly higher scores than men (See Table 2.3). Respondents believed that following the personal hygiene rules and avoiding unsanitary practices, like skipping hand washing after using the restrooms or spitting, would prevent mushroom contamination. They agreed that eating food while working or sores on their hands could contaminate mushrooms. They also believed that humans can transfer bacteria that cause illness to food and cleaning chemicals that get on mushrooms might make people sick. Comparison of knowledge and attitude/belief responses to related questions revealed that the term ‘bacteria’ seemed to affect response. If the term ‘bacteria’ was in an attitude statement, this evoked a desirable response, despite poor knowledge of what these do. In agreement with the knowledge questions, workers believed that cleaning is the same as sanitizing and that a food that smells or tastes normal would not cause a foodborne outbreak. In the open-ended questions, participants indicated that food safety rules were important for the sake of the company and consumers. Although most people expressed positive attitudes towards food safety, some reported there were ‘bad apples’ who did not believe food safety related issues were important.
Focus groups: Certain ideas emerged that contradicted the interview findings about beliefs and attitudes. Women actively complained about restrictions on eating candies or chewing gum in the packing room while working (i.e., “We want to chew gum and they do not allow us.”). Workers expressed concern about cleaning/sanitizing chemicals and mushrooms chemicals, complaining about rashes. Despite responses to belief statements, workers expressed ignorance of the relationship between diarrhea and consumption of contaminated food and did not see foodborne illness as a real health threat. A male focus group participant indicated: “Well, there are always bad food or an overload because you ate a lot, and this will make you sick”. On the other hand, women focus group participants indicated little concern about getting a foodborne illness: “It is nothing more than a diarrhea …”, “yes, diarrhea is normal.”

2.4.5 The Worksite Environmental System (See research question # 5 on Table 2.1)

Observations: These mushroom companies had the physical resources to implement food safety rules, i.e., the cleaning supplies and manpower. At some companies, workers were responsible for cleaning their workstation. Other companies had a crew hired to take care of the cleaning tasks. For example, workers at some farms move from picking site to picking site without cleaning because a cleaning crew follows. In some packing facilities, a specific crew cleans and sanitizes all the equipment after workers quit for the day. Worker follow through on clean up, routine safety practices and personal hygiene varied within and across companies. Floors and workstations ranged from littered to
spotless. Restrooms varied in cleanliness and were non-existent in some picking facilities. Sufficiency of cleaning routines varied depending on the worker doing the job. Posters or signs that might inspire proper behavior were often not relevant to the mushroom industry and used poor Spanish creating a communication gap. For example, signs were posted at the growing farms showing out-of-date pesticide handling practices in vegetable fields.

**Focus groups:** Workers indicated the supplies and equipment needed to follow the food safety rules were readily available. Workers also were generally receptive to food safety rules, realizing that some were needed (i.e., “If they (management) say that we would have to wear it (hairnets) to pick mushrooms, we will have to do it. You are supposed to do it”). However, workers indicated that communication about rules and their reinforcement was poor and ineffective. Food safety training varied from seeing a video (with no other interaction) to listening to an outside consultant lecture once a year about the safety rules, and education was related to general food safety issues, not mushrooms safety problems. Some participants indicated -- “Well a little bit of it (training) because he showed us a video, but it was not similar to the work we do”; “They just told me how to pick mushrooms I was never trained”; “We have always seen videos related to the meat packaging industry”. In other companies, participants indicated -- “They gather a group of people here in this room, they use drawings and posters about how we have to work”; “We have HACCP classes that are offered every two months”; “They give us a talk and also the written rules.” Some received no official training at all and instead got a sheet of printed rules with no
skill training or reinforcement. Here workers learn from one another --"The truth is that no one has taught us anything, we have all learned on our own." Some workers expressed a desire for food safety training and several even suggested an approach to use in their worksite. One participant suggested that food safety education would be more effective if the instructor provided the reasons for following the food safety rules, instead of just telling workers they have to do this or that.

Workers reported rule enforcement methods ranged from none to a punitive point system. Workers were particularly unhappy about the latter feeling that there was no real logic (that they could see) to how points were awarded. If sufficient points were accumulated, one could be dismissed from their job, i.e., “They (supervisors) give you a warning, then the next time a written warning, then at the third one you are done.” Some workers also felt that the chain of command was not clear because different people keep track of different things, i.e., “When we get here in the morning, there is always a person (supervisor) checking that people are washing their hands”; “They (supervisors) do not say anything in that area.” Despite complaints, workers liked the security of mushroom work (mushrooms grow all year round) and wanted to please company management (i.e., “The best part is to know that you are OK with the owners, to work knowing the boss considers you a good worker, so if you go to Mexico and come back your job will be waiting for you.”).
2.5 DISCUSSION

2.5.1 Baseline Food Safety Knowledge (Research question #1 in Figure 1)

It is not clear how knowledge affects practice in this sample, but other surveys, regardless of ethnic mix, found that level of education is related to food safety knowledge scores (Altekruse, et al., 1999; Meer and Misner, 2000; Williamson, et al., 1992; Woodburn and Raab, 1997). However, not understanding the role of pathogenic bacterial in foodborne illness or that their hands could be the source of pathogenic bacteria could lead to unsafe practices. Therefore, the educational intervention intended for this target audience should provide specific and basic information about food safety principles. This might impact their belief system and affect behavioral intent.

2.5.2 Normative System (Research question #2 in Figure 1)

Success of any intervention will depend on fair enforcement and courteous communication of rules by supervisors. Maintaining the rules will require supervisors and key workers to serve as role models. Supervisor cooperation and skills will be key to the success (or failure) of the food safety education program implemented. To insure cooperation, they should be involved in program development. To insure skills, they should participate in the food safety training and receive additional instruction in communication and management skills.

2.5.3 Motivational System (Research question #3 in Figure 1)

Another key program element would be to establish expectancy that improved performance will benefit the worker (by insuring continued company productivity
and steady employment) and that workers receive recognition through an incentive system that provides something of value in an even-handed manner. Again management/supervisory involvement will be critical. Food safety performance incentives could make a difference in compliance but this incentive system must be carefully planned and structured to avoid misunderstanding and favoritism when the rewards are given to the workers.

2.5.4 Belief System (Research question #4 in Figure 1)

This educational intervention should provide information and the opportunity to discuss food safety issues in order to alter food safety related beliefs based on fallacies about eating on the job, food, bacteria, cleaning/sanitizing and foodborne illness. Establishing the relationship between contaminated food and foodborne illnesses is fundamental to understanding the other intervention objectives. Others have reported similar attitudes about foodborne illness among immigrants, i.e., “If we did not get sick in Mexico, why would we get sick here?” (Anonymous, 2001). If people do not understand the relationship between food intake and diarrhea, then the restrictions placed on individuals by poverty, poor health, lack of food, clean water and sanitation as well as societal mores and taboos, can lead to acceptance of diarrhea as normal (Kaferstein & Abdussalam, 1999). Certain routine practices acceptable in their home society, where the food safety consequences are not understood, could have devastating food safety consequences in the workplace (Motarjemi, 1993). Altering their beliefs may affect behavioral intention.
2.5.5 Worksite Environmental System (Research question #5 in Figure 1)

In many companies, training is not uniform or sufficient to support good food safety practices. Poor and inconsistent communication between supervisors and workers appears to contribute to lack of follow through and confusion about chain of command. Evenhanded reinforcement of rules could build on worker receptivity to clearly defined rules to improve food safety practices. There is a need to consult with supervisors to define appropriate communication channels, enforcement and reinforcement of rules. In addition, supervisors need to receive food safety training so all members of the food safety team are on the same page.

2.6 CONCLUSIONS

Although problems were evident among the companies, the proactive stance of management and worker’s positive view of employment in the mushroom industry provides fertile ground for implementing a consistent food safety program. Use of the HAM and these three methods of assessment provided a more realistic picture of the situation in which these employees work than use of any particular method alone. Using three methods of assessment allowed triangulation of results to confirm or refute findings. The research questions (RQ) outlined in Table 2.1 were answered as follows.

RQ1-Knowledge System: Workers did not achieve good scores on the knowledge test, indicating poor understanding of the reasons why rules might be followed.
RQ2- Normative System: Scores on normative interview questions indicated socially acceptable agreement with good food safety practices. However, focus groups indicated rules were not necessarily followed and there was little social support among the workers or from management to actively follow the rules. Few role models were evident. Supervisors generally were not even handed in enforcing the rules and lack of courtesy contributed to poor worker morale. Observations generally confirmed that food safety practices were not consistently followed and that few role models existed.

RQ3-Motivational System: Focus groups revealed extra effort did not lead to team building and support of correct practices (expectancy low), that many workers felt ‘following the rules’ was not recognized or rewarded (instrumentality low), and that, if rewards were offered, these had little value to workers (valence low). Most companies did not have an active incentive program to increase motivation.

RQ4- Belief System: Socially acceptable responses on the interview belief questions did not agree with the findings from focus groups. Resentment of restrictions on personal behavior surfaced and misconceptions about cleaning and sanitizing, food spoilage and foodborne illness emerged. Their beliefs did not support connections between their personal actions and possible bad food safety outcomes.

RQ5-Enviromental System: Observations indicated that infractions of food safety rules and behaviors were common. Physical resources were available to support sanitation but degree of cleanliness of worksite, restrooms and personnel
varied across companies. Workers were aware of these resources and were receptive to following rules but training and communication about rules and their enforcement was generally poor. Most companies needed to create a more supportive environment for food safety practices.

Knowledge, attitudes, and beliefs that influenced the practices observed in this study are likely to be similar to those present in many other food production and processing facilities. The specific advantages of using HAM to design a needs assessment include a) broadening an investigation to the social and physical environment in addition to just examining worker characteristics, b) allowing data triangulation which can explain why something is or is not happening, and c) exposing connections between the various players in the worksite. This model therefore has wide applicability to a variety of industry settings and thus can be used to develop food safety training programs for other production and processing situations.

This needs assessment does have limitations. It focused on the workers and gathered limited data on management through observations and the informal introductory meetings that were held at each participating company. Future work should include interviews with supervisors and other members of the management team. In addition the sample size used in this project was small and may not be totally representative of the situation in all the facilities within the mushroom industry. The sample involved in the interviews and focus groups may not have represented the knowledge and views of all workers in participating companies. The number of focus groups was determined by funding and not by
saturation of the data. Since the observer performed all the tasks in a company within a couple of days the observation period might not have been long enough to detect subtle patterns in workers behaviors.

Nevertheless, the authors believe that a HAM based needs assessment provides a sound basis for designing a food safety training program for Hispanic mushroom workers.

2.7 ACKNOWLEDGEMENTS

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2.8 REFERENCES


http://courses.wcupa.edu/jones/hs480/reports/mushroom.htm


Table 2.1 Research Questions and addressing method

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Questions (Health Action Model System)</th>
<th>Methodology Used to Address the Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>What do the workers know about food safety? (Knowledge system)</td>
<td>Individual Interviews</td>
</tr>
<tr>
<td>2</td>
<td>What are the norms and rules followed in growing and packing facilities? (Normative system)</td>
<td>Individual Interviews, Direct Observations, Focus Groups</td>
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<tr>
<td>3</td>
<td>What factors motivate the workers to follow the food safety rules? (Motivational system)</td>
<td>Focus Groups</td>
</tr>
<tr>
<td>4</td>
<td>What are the workers beliefs and attitudes about food safety and foodborne illness? (Food safety belief system)</td>
<td>Individual Interviews, Focus Groups</td>
</tr>
<tr>
<td>5</td>
<td>What is the worker’s working environment like? (The worksite environmental system)</td>
<td>Direct Observations, Focus Groups</td>
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Table 2.2 Demographic Characteristics of Interviewed Mushroom Workers

<table>
<thead>
<tr>
<th>Variable</th>
<th># of Participants (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPANY</strong></td>
<td>N=100</td>
</tr>
<tr>
<td>A</td>
<td>16 (16.0%)</td>
</tr>
<tr>
<td>B</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>C</td>
<td>12 (12%)</td>
</tr>
<tr>
<td>D</td>
<td>14 (14%)</td>
</tr>
<tr>
<td>E</td>
<td>6 (6%)</td>
</tr>
<tr>
<td>F</td>
<td>21 (21%)</td>
</tr>
<tr>
<td>G</td>
<td>29 (29%)</td>
</tr>
<tr>
<td><strong>JOB POSITION</strong></td>
<td></td>
</tr>
<tr>
<td>Packing</td>
<td>57 (57%)</td>
</tr>
<tr>
<td>Picking</td>
<td>43 (43%)</td>
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<tr>
<td><strong>SEX</strong></td>
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<td>Male</td>
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<tr>
<td>Female</td>
<td>43 (43%)</td>
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<tr>
<td><strong>AGE</strong></td>
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<tr>
<td><strong>YEARS WORKING for the COMPANY</strong></td>
<td>4.01 ± 3.71</td>
</tr>
<tr>
<td><strong>YEARS in USA</strong></td>
<td>8.54 ± 8.23</td>
</tr>
<tr>
<td><strong>EDUCATION</strong></td>
<td></td>
</tr>
<tr>
<td>0 to 6 years</td>
<td>57 (57%)</td>
</tr>
<tr>
<td>6.1 to 9 years</td>
<td>23 (23%)</td>
</tr>
<tr>
<td>9.1 to 12 years</td>
<td>15 (15%)</td>
</tr>
<tr>
<td>Some College or Bachelor Degree</td>
<td>5 (5%)</td>
</tr>
<tr>
<td><strong>MARITAL STATUS</strong></td>
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</tr>
<tr>
<td>Married</td>
<td>60 (60%)</td>
</tr>
<tr>
<td>Other</td>
<td>40 (40%)</td>
</tr>
<tr>
<td><strong>INCOME</strong></td>
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<tr>
<td>$20,000 or lower</td>
<td>33 (34.7%)</td>
</tr>
<tr>
<td>$20,001 - $30,000</td>
<td>55 (57.9%)</td>
</tr>
<tr>
<td>$30,001 or higher</td>
<td>7 (7.4%)</td>
</tr>
<tr>
<td><strong>ORIGIN</strong></td>
<td></td>
</tr>
<tr>
<td>Moroleón Area, Guanajuato</td>
<td>70 (70%)</td>
</tr>
<tr>
<td>Other Guanajuato State Areas</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>Other Mexican States (8 different)</td>
<td>17 (17%)</td>
</tr>
<tr>
<td>Other Countries (3 different)</td>
<td>4 (4%)</td>
</tr>
<tr>
<td>USA</td>
<td>2 (2%)</td>
</tr>
<tr>
<td><strong>Place of Residency</strong></td>
<td></td>
</tr>
<tr>
<td>Kennett Square Area, PA</td>
<td>82 (82.9%)</td>
</tr>
<tr>
<td>Delaware</td>
<td>14 (14.1%)</td>
</tr>
<tr>
<td>Other (Philly, Media, etc)</td>
<td>3 (3.0%)</td>
</tr>
<tr>
<td><strong>HOUSING</strong></td>
<td></td>
</tr>
<tr>
<td>On-Site</td>
<td>22 (22%)</td>
</tr>
<tr>
<td>Off-Site</td>
<td>78 (78%)</td>
</tr>
<tr>
<td><strong>Number of people in the household</strong></td>
<td>5.82±2.79</td>
</tr>
</tbody>
</table>
Table 2.3 Mean Scores of Interviewed Mushroom Workers on Food Safety Attitudes and Norm Scales

<table>
<thead>
<tr>
<th>Variable</th>
<th>Worksite Food Safety Norms and Rules (N)</th>
<th>Attitudes/beliefs about Food Safety (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach’s alpha reliability coefficient (24 items)</td>
<td>0.7571</td>
<td>0.7759</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3.39±0.38 (56)</td>
<td>3.58±0.45&lt;sup&gt;a&lt;/sup&gt; (56)</td>
</tr>
<tr>
<td>Female</td>
<td>3.42±0.37 (43)</td>
<td>3.78±0.36&lt;sup&gt;a&lt;/sup&gt; (43)</td>
</tr>
</tbody>
</table>

*Scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree
**Cronbach’s alpha is a statistical test used to evaluate if the items in the same section are interrelated and evaluating the same construct or idea.
<sup>a</sup>Significant at the 0.05 level (p = 0.020)
Figure 2.1 The Health Action Model for the Hispanic mushroom worker needs assessment.
CHAPTER 3

EVALUATING FOOD SAFETY NEEDS IN THE FOOD INDUSTRY USING A “WORKER-EXPERIENCE PROTOCOL”

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Luke L. LaBorde, Ph.D.

Keywords: food safety, observations, food industry, model

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This chapter has already been published:

3.1 ABSTRACT

Company food safety needs must be evaluated in order to implement successful food safety-training. Customizing a program to address unique situations and needs in the food industry requires studying day-to-day food safety operations and worker food safety behaviors. Most inspection methods inspire alterations in worker behaviors. To develop a more unobtrusive approach, we examined the usefulness of an ‘observation method’, called the Worker-Experience Protocol (WEP), in conducting a needs assessment in a food production setting to plan a food safety training program. The objectives of this paper are to a) outline the steps in the WEP, in which a person unconnected to either the regulatory system or the food company, served as a ‘worker’ in order to make *direct observations* of company operations and worker behaviors; b) compare the findings from this observation protocol with those of focus groups conducted with workers at the same companies; and c) outline the unique insights that WEP provides for food safety needs assessment. Both methods highlighted current strengths and weaknesses that are reported under the major themes: Implementing proper food safety practices; adequate plant/farm sanitation; worker food safety behavior; and communication channels. While the WEP identified the physical situation and personal behaviors and interactions that might contribute to problems, the focus groups illuminated the workers attitudes and commitment and reasons why problems occur. While both methods provide valuable information for designing food safety programs, the WEP offers a fast, inexpensive method to gain a well-rounded impression of worker and management actions and interactions around
food safety at one time point or repeated time points. WEP also avoids short-
term behavior modification as often occurs during an audit or plant inspection.
Food professionals could use this protocol to obtain valuable information
regarding food safety needs in their operations.

3.2 INTRODUCTION

Food safety training of workers is increasingly important because the complex
food handling and processing of today’s more convenient foods make
management of food hazards more difficult. Foodborne diseases still cause
nearly 76 million illnesses, 325,000 hospitalizations and 5000 deaths a year (15).
Although health experts believe that much foodborne illness is due to consumer
mishandling, some foodborne outbreaks have been traced back to company
practices. Such outbreaks can be extremely costly. For instance, a *Listeria
monocytogenes* outbreak traced to poor sanitation practices at Bil Mar Foods, a
Sara Lee subsidiary, resulted in approximately 100 illnesses and 21 deaths
across 22 states between August 1998 and February 1999. In addition to paying
a fine, Sara Lee Corp paid ill victims, who consumed contaminated hot dogs from
this plant, individual settlements as high as $50,000 per person. (8,19). Now,
proactive companies are demanding that suppliers meet certain food safety
standards for both their workforce and their products. Suppliers are turning to
outside consultants to assess the situation in their companies and to design an
appropriate remediation program that usually includes worker education and
training.
However, such training has to be customized to the specific commodity and food establishment in order to be successful. Even though the key to safe commodities is keeping the product away from any physical, chemical or microbiological hazard (22), this will depend on the physical layout of the plant, the relationships between management and employees, the commitment to implementing and enforcing safe practices, and the resources available as well as the specific food safety training. To implement a customized and ultimately successful food safety-training program, a company's situation and needs must be carefully evaluated. An outside consultant can discover specific issues and patterns that could be overlooked by a company food safety officer, who may be inured to day-to-day operations, and then make recommendations for an appropriate food safety-training program. The outside consultant must consider the needs assessment methods available plus their strengths and weaknesses.

The consultant can evaluate company practices by conducting a formal audit, a survey using print questionnaires, individual interviews or focus groups. However, the 'punitive' atmosphere associated with audits can inspire 'unusual' compliant behavior and obscure the real food safety problems. Surveys or interviews often rely on self-reported behaviors where responses are more often driven by social desirability than accuracy. Focus groups can identify problems perceived by the participants but are time consuming to conduct and analyze. An often, overlooked method of gathering data on a situation is observation.

The objective of 'observation' in social science is to record realistic information about a situation (18) in an unobtrusive manner (in direct contrast to
an audit). Direct observation has been used widely to collect data on human and animal behaviors in education, psychology, anthropology and the behavioral sciences (Aspland and Gardner, 2003 and Gest, et al., 2003). Many studies of consumer food safety behavior are available but most rely on self-reported data (2,3,4,7,10,16,21,24,25). Recently, observational studies have been used to assess consumer food safety behaviors (9,12,20,26), revealing that consumers often slip into risky food practices in familiar situations. In a recent review of the extensive consumer literature, Redmond and Griffith (17) suggest that observations could provide more accurate assessments of actual food safety practices of consumers than the more commonly used self-report instruments. In contrast, far fewer studies of the food safety behaviors of workplace food handlers are available (1,5,23) and most of these rely on self-reported behaviors. This indicates two things: a) a need to more closely study day-to-day food safety operations and worker food safety behaviors in the food production and processing industry, and b) a need to develop and examine the usefulness of an ‘observation method’ in conducting a needs assessment in a food production setting to plan a food safety training program.

To address this gap in methodology, we developed a ‘Worker-Experience Protocol’, in which a person unconnected to either the regulatory system or the food company, served as a ‘worker’ as a way to make direct observations of company operations and worker behaviors. We postulated that this protocol would provide valuable and unique information that would be useful in designing
a food safety program. We used this protocol in a case study of several food production and processing units handling the same commodity.

The objectives of this paper are to a) outline the steps in the Worker-Experience Protocol; b) compare the findings from this observation protocol with those of focus groups conducted at the same companies; and c) outline the unique findings that this protocol provides for food safety needs assessment.

3.3 METHODOLOGY

Seven companies and their subsidiaries (N = 12) volunteered to participate in a needs assessment to develop a food safety-training program for members of their commodity group. Among these seven companies, five had both growing farms and packing facilities while two companies had only growing farms.

A total of seven focus groups or one per company were conducted, four with male workers and three with female workers, according to Krueger (14). To avoid gender dominance, men and women were placed in separate focus groups. A random drawing of company names was used to determine the sex to recruit for the focus group at each company. Participants were recruited within each company through a combination of worker’s availability and interest, and presence at working station using personalized invitations to insure representation of all company workstations occupied by that sex of worker. Focus group participants (N=45) were Mexican Hispanics, with a mean age of 31.9 years. Most (70%) had 9 years or less of education and 55.5% were male. One moderator conducted all seven focus groups during work hours, using a script of open-ended questions with probes that explored, among other things,
worker’s perceptions of the importance and practice of food safety rules within the company, worksite food safety norms and role models, availability of food safety materials (cleaning supplies, gloves, etc.), facilities (restrooms) and cues (like posters) and the general working environment in the company. Participants received a phone calling card as an appreciation for participation. All focus groups were tape-recorded, transcribed and analyzed using qualitative thematic analysis. The Penn State University Office of Research Protections approved all procedures used in this research work.

The Worker-Experience Protocol (WEP) observations were recorded using an anecdotal records procedure (13) in which the observer records ‘incidents’ using a pocket notepad during a defined observation period. This is a semi-structured procedure in which the observer uses a list of possible areas or issues, e.g. use of gloves, hairnets, workstation cleanliness, to guide his observations. After the observation period, the details surrounding each incident were recorded. At the end of the day of observations, all these incidents were summarized into categories. This method was chosen after reviewing the literature about observational procedures and data collection because it is simple and allows the observer to focus on what is happening at the workstations in the company.

One researcher conducted the WEP at all companies using the following steps.

3.3.1 Training the Observer – Prior to visiting any company, the observer became familiar with published observational procedures and methods for collecting data and practiced the recording procedure in locations having similar
levels of activities and noise as might exist in the companies. In addition, the observer reviewed literature from companies producing the commodity to learn the how the commodity is generally handled and the usual harvesting and processing flow or steps. Finally, the observer developed a plan of how to approach the workers and explain his presence at their workstations and practiced this approach. The observer must always use the same approach and explanations to avoid employee behavior modifications.

3.3.2 Company Orientation – The observer presented a detailed explanation of the observation protocol and its purpose to the management at each participating company prior to visiting the facilities. The observer answered all questions and provided assurances of the confidentiality of the process to build management trust in the Protocol.

3.3.3 Observer Orientation to Each Worksite – Upon arrival at each company, the person in charge (manager, director, owner, etc.) gave a 30 minute tour of the company’s facilities and introduced the observer to key personnel (foremen, supervisors, production line leaders, or group leaders) at the harvesting site or on the production floor. The observer was introduced to these company personnel as a person interested in the commodity who was ‘researching’ their facility and the employees were asked to help him out during his stay at company. When workers specifically asked the observer why he was there, he always provided the same story, that he was experiencing the work environment to develop employee-training materials for the industry. This tour is a key step in the WEP because it is the first contact with the company’s employees and facilities. In
addition, it provides an overview of the facility layout and operational procedures that will be used in the next step to decide how the observations will take place over the day.

3.3.4 Identifying Workstations, Observation Sites and Sequence- After the tour, the observer defined the operational steps and identified the workstations or harvesting sites within each step in which he would work and record observations. In companies that only had farm facilities (rather than both packing and farm facilities) the number of crews was identified and equal time intervals were allocated to observe them. The sequence of observation sites and the key items to observe were outlined.

3.3.5 Observation - All the companies gave complete freedom of access to the observer. The observer conducted two days of observations at the companies with both a packing facility and farms or one day if the company only grew the commodity. The observer worked 1-3 hours at every company workstation. At the farms, the observer assisted with harvesting and worked with some of the crews performing various tasks critical to crop rotation and maintenance. In the packing facility, the observer washed, packed, and stored the commodity and performed cleanup duties. During the breaks, the observer recorded notes on his pocket notepad about relevant observed food safety issues. There was no specific order of visiting workstations and the period of time at each workstation could vary depending on the information that was being collected. The observer approached the workers as the daily activities in the company allowed, introducing himself as an observer learning how to improve handling of this commodity for the company.
and exchanged small talk to increase comfort with his presence. Although the observer was as unobtrusive as possible, sometimes the workers initiated conversation with the observer and provided valuable information that enriched the data analysis.

3.3.6 Data analysis – The notes recorded between each site or workstation observation period formed the data, which included observations of specific individuals, social events or interactions as well as details about food safety related activities and practices. These notes were examined for themes across similar workstations at each company. Then the themes were summarized across the companies and a final report was written assessing the situation for all participating companies.

3.4 RESULTS

The findings from WEP and focus groups are reported under major themes.

3.4.1 Implementing Proper Food Safety Practices Varies across Companies

The key items examined included management and worker commitment, extent of worker training, and sufficiency of resources (washroom facilities, adequate supplies, etc.).

WEP Observations: Comments from top managers prior to the observations indicated their commitment to having an effective food safety program. From worker comments, it appeared that some companies provided some formal training in food safety practices while others did not. Some companies had rules posted on a bulletin board. Most companies had adequate cleaning and sanitizing supplies and workers were instructed to inform their supervisor if items
needed replenishment. However, the size and cleanliness of restrooms, the availability of towels and soap and, on the farms, the availability of hand washing facilities to workers varied. In some companies, workers appeared disinclined to inform management when towels and soap were depleted. Conduct rules for restroom breaks were not evident and, in some cases, hand washing could not be observed, as the station was not outside the restroom. At the farms, appropriate restrooms were often not available.

**Focus Groups:** Participants indicated that food safety training could range from a formal lecture or video provided once a year to only receiving a print sheet of food safety rules on the day they were hired. Workers felt that few managers were role models for appropriate food safety behavior and that, in some cases, worker suggestions or requests for supplies were ignored. Workers could list the food safety rules and knew they should be followed if they wanted to retain their jobs but did not understand why following the rules was important. Although packing participants reported that restrooms were cleaned regularly, participants felt that thoroughness varied depending on production goals.

### 3.4.2 Adequate Plant/Farm Sanitation

The key items examined were cleaning of workstations, equipment, floors and holding bins at appropriate time intervals and controlling insect infestation.

**WEP Observations:** In some companies, it was difficult to keep the holding bins used to transport the commodity from farm to packing plant clean. In others, a cleaning protocol for these bins was established and followed. Packing plant sanitation was usually done at night when packing lines were down. In many
companies, beginning and ending times for operations were fluid and cleaning schedules were disrupted. Only a few packing plants had additional cleaning times scheduled during the day and when it was not done more often, the cleanliness of some equipment and floors became problematic. Floors could become covered with standing water and wood surfaces saturated, which could promote bacterial growth. No insects were observed in the packing plants except for flies on the loading docks. At the farms, cleaning protocols for the facilities were generally not practical, except for the restrooms. However, the bins holding the harvested commodity for shipment to the packing house were a key control point and were kept very clean in some, but not all companies.

**Focus Groups:** Participants knew the holding bins should be kept clean and that cleaning the plant was important but they did not know why these procedures were important. They also felt that harvesting and packing (output) were top priority during the day and that cleanliness of workstations was low priority. On the farms, harvesting productivity and sanitation aimed at keeping the growing areas free of disease organisms that would decrease commodity output were more important than practices that would protect the ultimate consumer.

### 3.4.3 Worker Food Safety Behavior

Key items examined were workers practice and supervisors enforcement of good personal hygiene and of good manufacturing practices when handling the commodity and status of break/lunch areas.

**WEP Observation:** Personal hygiene was a problem for some workers, especially those working at the farms. Only one farm required that farm workers wear
jumpsuits over their regular clothes when handling the commodity. Certain
groups of workers in the packing facility were required to wear smocks but the
cleanliness of these smocks varied. The routine for changing and cleaning
smocks or jumpsuits was obvious in some companies but not in others. Most
workers in packing facilities wore hairnets and gloves. However, many did not
wear the hairnets correctly. Hairnets and gloves were not evident at most farms.
Appropriate use of jewelry and nail polish was a problem in most packing
facilities. Inappropriate consumption of snacks or candy while working was a
major problem at both farm and packing units. Facilities for breaks and lunch
varied in quality and cleanliness across the companies. Some had very clean
lunch/break rooms with clean equipment like microwave ovens, while others
were rather dirty. In some companies, personal hygiene rules were enforced and
correct behavior noted verbally by supervisors. In others, these rules were not
enforced and supervisors did not seem to be aware of infractions or sometimes
chose to ignore them.

**Focus Groups:** Participants recognized that some workers exhibited poor
personal hygiene but many felt this was a personal matter and not something
that company personnel could rectify. They reported that responsibility for
cleaning smocks and jumpsuits varied across worksites. Both packers and farm
workers indicated that wearing gloves was no problem. However, some did not
like hairnets and women were conscious of how these detracted from their
appearance. Both male and female workers liked wearing jewelry, especially
rings and necklaces, and resented rules that limited this self-expression. Women
also resented restricting use of nail polish. Many felt they should be allowed to chew gum or have snacks to eat at their workstations. Some noted that supervisors also chewed gum or had snacks. Participants felt that enforcement of rules was subjective and unfair so that all suffered because of a few bad apples. Some felt that supervisors had favorites who could get away with infractions that would be punishable for others. Others felt that their good behavior went unnoticed by both the middle and top management.

3.4.4 Communication Channels

Key items examined were presence of communication channels, direction of communication, and communication incidents involving enforcement of rules. 

*WEP Observations:* Language was a barrier between the English speaking management and the non-English-speaking workers. Although some companies relied on ethnically identical supervisors who could also speak English, many did not have a management member or supervisor who spoke the worker’s language. Workers were more likely to converse with supervisors who spoke their language than those who could not. Communication with management or supervisors might be channeled through a fellow worker who used broken English and reception by the superior could vary from reasonable understanding to misunderstanding. More often, workers would turn to one another to learn how to do something or find something. Few signs or posters in workers native languages were evident on inspection of company facilities. What posters were present were out-dated, poorly translated and were not directly relevant to the
production and packing of this commodity. Most posters seemed to be ignored by the workers.

**Focus Groups:** In most companies, participants made it clear that communication was top down and that worker suggestions or concerns were often ignored. The lack of communication between the workers and the top management was not all attributed to language differences. Some felt they got no recognition for following the rules and that enforcement by the middle management was inconsistent. Others reported over enforcement of rules through punitive bookkeeping systems. Women participants were especially resentful of the lack of manners exhibited by some middle managers in enforcing rules. Some reported that management had promised workers certain rewards (e.g. jackets) that were not delivered or had offered rewards that were considered silly (e.g. key chains).

Some participants felt the posters were not relevant to them and many ignored those posted for some time.

### 3.5 Discussion and Conclusions

The ‘Worker-Experience Protocol’ clearly allowed the observer to identify both strengths and weaknesses in the food safety environment in each company. The factors evaluated included

- The physical facilities, their cleanliness and the resources devoted to food safety practices.
- The cleaning and sanitizing protocols used and their degree of efficiency.
- Critical control points or situations to consider for preventive action.
- The range of worker behavior around food safety protocols.
- The degree of interaction between workers and management.
- The extent of reinforcement of appropriate behavior by supervisors and visual aids.

The WEP clearly illuminated problems across companies and offered the following unique features:

- Pin-points the specific steps, sites and personnel to be involved in solving a problem. This provides a framework for practical solutions to the problem.

- Records actual behaviors, with little of the behavior modification that might occur in a more formal audit. These behaviors can be used as real life examples in subsequent food safety training.

- Identifies specific operations where poor communication might contribute to problems. This helps identify the personnel to involve in correcting the problems.

- Highlights good practices in operations common to this commodity so that corrections suggested have relevance.

- Provides an overview of the 24-hour operation and highlights dovetailing or lack thereof of food safety procedures, something overlooked in less complete evaluations of company procedures.

In contrast, the focus groups enabled the moderator to examine some of the reasons for the weaknesses or strengths observed. In particular he examined

- The training provided the workers and how this affected their behaviors.
- Degree of worker commitment to food safety practices.
- The extent of role models among management and workers.
- How communication ‘worked’ from the workers viewpoint.
- Worker feelings about personal hygiene, its relevance to food safety and why infractions might occur.

The focus groups were critical to explaining how:

- Sufficiency of food safety training affected beliefs about performing food safety behaviors, especially in understanding why certain things must be done.
- Lack of management role models negatively affects worker behaviors.
- Poor communication as well as the manner of communication can affect worker moral and willingness to follow through. Their design also highlighted male and female differences in expectations about communication and motivation.

- Beliefs about personal hygiene, feelings about personal appearance and access to breaks, snacks, and appropriate facilities (lunch room and restroom) can affect behaviors.

An effective food safety program requires sufficient resources, appropriate facilities, relevant training, good communication channels, and motivated workers and management to succeed. We feel that both the WEP and focus groups make unique contributions to an assessment of the food safety needs of a company or group of companies. Thus, we would not recommend relying on just one of these methods when gathering baseline data for a needs assessment. Instead, we recommend using both to provide a more complete picture of a company environment.
However, the WEP does offer some unique advantages for monitoring and evaluating the implementation of a food safety program. These include

- Offering a fast, inexpensive method to gain a well rounded impression of worker and management actions and interactions around food safety at one time point or repeated time points.
- Permitting an outsider with ‘new’ eyes to evaluate an operation and provide a fresh perspective on operations.
- Allowing periodic examination of company operations so that emerging food safety problems can be addressed.
- Allowing periodic examination of behavioral outcomes of any food safety training so that problems that persist can be corrected.

We feel others would find the WEP useful and could extend its usefulness through further testing.* Figure 1 shows a step-by-step outline of implementation of the WEP. The data generated by the WEP is also valuable for designing food safety education materials and for planning food safety programs within the food industry. Cost of the WEP will depend on company size. A well-trained observer could complete this in 1-2 days. A focus group would require an additional half-day with setup and data analysis. Total cost would depend on hourly pay for the observer. These costs should be worth the information gained.

* Contact the first author for references on the use of observations.

3.6 ACKNOLEDGEMENTS

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participating companies. In addition this work was partially funded by USDA CSREES Agreement No. 2001-51110-11370.

3.7 REFERENCES


Figure 3.1 Implementation steps of the Worker-Experience Protocol.
CHAPTER 4
DEVELOPMENT AND PILOT TESTING OF FOOD SAFETY EDUCATIONAL MATERIALS AND TRAINING STRATEGIES FOR HISPANIC WORKERS IN THE MUSHROOM INDUSTRY

4.1 INTRODUCTION

4.1.1 Foodborne Illnesses and the Food Industry

It is estimated that foodborne infections cause nearly 76 million illnesses, 325,000 hospitalizations and 5000 deaths a year (Mead et al., 1999). Changes in food production and consumption practices and resulting foodborne illnesses outbreaks mean that the food industry must take steps to avoid being the source of a foodborne outbreak. Unfortunately, there is no direct economic benefit to a food company for implementing a food safety program (Nieto-Montenegro, et al., 2000). Therefore, the company’s incentive for implementing a food safety program is to gain or retain a sufficient market share and to fulfill customers’ requirements rather than profit. Food safety education does not directly provide profits to a company (Nieto-Montenegro, et al., 2000). But a single outbreak can affect the economics of the whole industry as is described by Calvin et al., 2004. Several Hepatitis A outbreaks in the US in 2003 were associated with green onion consumption. After these outbreaks, the entire green onion industry suffered a steep drop in demand and a 72% price decrease in just 26 days resulting from food safety concerns (Calvin et al., 2004). The market impact of these outbreaks lasted 1-4 months and affected growers’ green onions.
shipments, sales and profit because consumer confidence in the product was low (Calvin et al., 2004).

### 4.1.2 Food Safety Education

Education and training of food handlers is critical since worker mishandling is considered the cause of most of the outbreaks reported in the food industry (WHO, 2000). Costa (2003) stated that food safety training is critical to ensure employees use proper food safety behaviors, referred to as “safe workers.” But training by itself will not guarantee the success of a food safety program, since there is no evidence that food safety practices will improve directly due to training programs (Rennie, 1994). Several authors have suggested that just the provision of information aimed at increasing knowledge does not necessarily lead to change in behaviors (Clayton et al., 2002; Rennie, 1994,1995; Ehiri, 1997).

Training programs should take into account the unique characteristics of adult learners. A challenge to food safety instructors would be to incorporate adult education learning theory that calls for skills development (Rhodes, 1988). Experts in the field of adult education (Kowalski and Vaught, 2002; Edmunds, et al., 1999) suggest that when teaching adults, it is important to use educational materials that are relevant to the lives of students. A theme-based approach that integrates concepts with real life problems has the advantage that this will integrate skills instead of abstract concepts that the adult will then learn to use in real life situations. One of the problems with the provision of food safety knowledge is that food workers might ‘get a fact’ but it might never be translated into practice. For example, a food worker can learn that it is important to wash
their hands after using the restroom because there might be fecal contamination and “E. coli” under their nails, but the assessment should include assessing both knowledge and behavior after completion of training. A correct handwashing procedure must be established in the training sessions and then each participant must be trained to the point where they are capable of demonstrating this procedure. Participants must practice the handwashing procedure during the training session. Using this approach, handwashing practice would make training sessions not just a “passing the facts” session, but an active learning environment.

On the other hand, Clayton et al. (2002) concluded that training by itself will not lead to behavioral change and the training needs to include a risk-based approach. The authors mentioned that “food hygiene training needs to embody the concept of risk in order to emphasize to food handlers, especially those in managerial role, the level of risk associated with their business”. (Clayton et al., 2002, p. 37) Adequate resources and a receptive management culture also are fundamental to applying good food safety practices. Training must focus on the provision of skills, increase risk perception and take into account social and environmental factors that surround the food worker. Finally, program evaluation should not be left out of the program.

**4.1.3 Food Safety Training Programs- Effectiveness in the Food Industry**

There is little research about food safety program impact on food safety behaviors within an industry setting. Some published studies in food industry settings describe program implementation or training strategies utilized, but do
not focus on program evaluation (Boccas, 2001; Harris et al., 2004; Rushing et al., 1996; Gall et al., 2004; Hicks et al., 2004). For instance, Boccas (2001) described a HACCP training program that was conducted for the Lithuanian dairy industry. Rushing et al. (1996) described how a HACCP model was implemented in the tomato industry in South Carolina. Hicks et al. (2004) worked with the smoked seafood industry and presented training strategies that were used to minimize *Listeria* contamination in these food products. However, no evaluation methods or results were reported in these studies. In the one food industry study that utilized evaluation, Fenton (2005) used a pre– and immediate post-knowledge and attitude questionnaire to compare the effectiveness of computer-based training as compared to face-to-face training on food safety knowledge and attitudes at three food-processing plants in Pennsylvania.

On the other hand, there are published studies in the foodservice and hospitality industry or with workers from these industries who have attended food safety workshops (Capunzo, 2005; Costello, 1997; Ehiri, Morris, and McEwen, 1997; Kirby and Gardiner, 1997; Hennum et al., 1983; Martin, Knabel, and Mendenhall, 1999; McElroy and Cutter, 2004; Rennie, 1994; Smith and Shillam, 2000). Most have only evaluated pre- and immediate post-intervention knowledge and self-reported behaviors. As such, program planning, implementation and evaluation need to go further. There is no certainty that only the provision of information works. Workers need to learn food safety skills that can be used in their daily operations and monitoring must follow to assure they
are applying these skills in a workplace setting. In addition, training should insure each worker can perform the skill being taught.

Because the relationship between knowledge and behavior is not clear, it is complicated to evaluate the cost effectiveness and appropriateness of food safety training (Coleman, 2000). Workers are not the only factor involved in food safety training; external factors also affect food safety behaviors. A realistic approach should take into account the social and environmental factors when implementing any food safety program (Ehiri, 1997). In addition, the author suggests the use of theories and models to improve food safety training effectiveness.

Clayton et al. (2002) suggested that research be conducted using direct observations of the food workers, during their day-to-day operations. Redmond and Griffith (2003) also suggested that observational studies can be useful to elucidate real food safety practices. Additional studies have used observations to assess consumer food safety behaviors (Daniels et al., 2001; Jay et al., 1999; Toshima et al., 2001; Worsfold, 1997). These researchers found that self-reported behaviors obtained through surveys did not match behaviors obtained through direct observations.

It is hypothesized that using social science theories could improve the effectiveness of a food safety program and direct observations would provide more accurate and reliable assessment of actual food safety practices.
4.1.4 Theory in the Food Safety Education Field

Coleman and Roberts (2005) question the ability of food safety training program approaches that are currently used to alter behavior. They suggested that to increase training program effectiveness, it is necessary to first understand the current food handler’s behavior and how this behavior interacts with their beliefs and levels of knowledge. The application of theory-based models in the development of educational materials can illuminate the root of the problem that is being addressed through examining why, what and how the program functions (National Cancer Institute, 2005). Several authors (Stanton et al., 1992; Ehiri et al., 1997; Rennie, 1995; Seaman and Eves, 2005) are urging research into design, implementation and evaluation of food safety programs using models and theories that have been widely applied in other health education fields (Janz and Becker, 1984; Jenner et al., 2002; Townsend et al., 2003). Some research studies in food safety education of consumers have used educational theories and models for developing and assessing food safety programs (Athearn, 2004; Hanson and Benedict, 2002; Takeuchi et al., 2005; Schafer, et al., 1993). However, research is needed that incorporates theory and models when developing and assessing food safety educational programs in an industry setting.

4.1.5 The Health Action Model

Ehiri (1997), and Seaman and Eves (2005) suggest that the Health Action Model (HAM), developed by Tones (Tones et al., 1990) and adjusted by Rennie (1995) for use in the food safety field, could contribute to the development and
application of effective food safety-training programs. Seaman and Eves (2005, p. 12) stated that “The Health Action Model probably gives the most thorough description of factors that may influence behavior change following training, including hygiene training.” The HAM conceptually incorporates the Health Belief Model and Ajzen and Fishbein's “Theory of Reasoned Action” (Tones et al., 1990). For use in food safety research, Rennie (1995) adjusted the definitions of its five constructs or systems, all of which influence behavior, as follows: a) knowledge system: baseline food safety knowledge; b) normative system: worksite norms and rules; c) motivational system: motivational elements in the company; d) belief system: values and beliefs of the target audience; and e) worksite environmental system: worksite physical conditions (See Chapter 2, Figure 2.1).

The normative system influences both the motivational system and the belief system (Tones et al., 1990). The motivational system can also influence both the belief system and the outcome of the belief system, or behavioral intent. If the relevant skills and knowledge and the appropriate environment are present, then behavioral intent can lead to action. The belief system is interrelated with the normative system, the motivational system and baseline knowledge. HAM takes into account the social and environmental factors that surround the individual (Tones et al., 1990). These factors can facilitate or hinder actions, depending on the resources available to change these conditions. For example, despite behavioral intent, workers will not wash their hands if hand-washing facilities are not available. Worsfold and Griffith (2004) demonstrated in an Environmental
Health Officers survey that environmental factors such as supervisory support were considered to be key when implementing a food safety program in the industry. Hennum, Lawrence and Snyder (1983) demonstrated that management has a key role during the implementation and follow-up of a food safety program. As noted above, HAM also takes into account the environmental system.

The motivational system appears critical to influencing behavioral intent, as demonstrated in some nutrition education interventions (Gribble et al., 2003; Miller et al., 2002). To increase the specificity of the HAM construct of motivational system, expectancy theory (ET), as defined by Vroom (Campbell and Pritchard, 1983; Tubbs et al., 1993), can be added. Motivation is an internal process that activates, guides and maintains behavior over time (Baron and Kalsher, 1997). ET is used in industrial and organizational psychology and adult education to motivate people (Baron and Kalsher, 1997; Goad, 1982; Burns, 1995). Company motivational practices can affect directly employees’ beliefs and can lead to adoption of behaviors supporting food safety practices. ET includes three concepts; valence, instrumentality and expectancy (Smith et al., 2000). Expectancy is the belief that extra effort will lead to improved performance (A worker would wash their hands when required by supervisors). Instrumentality is the belief that good performance will be noticed or rewarded (The supervisor will notice the workers action and will come to him to recognize his effort). Valence is the value placed on the rewards offered (An economic incentive with value to the worker might be offered to encourage handwashing at work. These three affective elements include values and beliefs that support the core belief system.
as well as influence behavioral intent (Tones et al., 1990). To summarize, HAM is grounded “in the assumption that a person’s behavior is determined through an examination of their beliefs, attitudes and norms and that these factors need to be examined within social and environmental conditions” (Clayton et al., 2002, p.26). Although Rennie (1995), Ehiri, (1997), and Seaman and Eves (2005) did propose a HAM framework for food hygiene education, no research using this model in a food industry setting has been published to date.

An opportunity to test the HAM plus ET arose when the Pennsylvania mushroom industry requested a food safety education program to be implemented industry-wide. For the purpose of this work, the modified version of HAM (HAM plus ET) will be called HAM. As this endeavor was implemented, the objectives were:

- To develop a pilot food safety educational program for Hispanic mushroom workers using the results of a needs assessment; and
- To implement and evaluate the effectiveness of this pilot program plus elements from the knowledge and motivational systems of the HAM in the mushroom industry.

4.2 METHODOLOGY

The Penn State University Office of Research Protections approved all the materials and procedures used in this study (Appendix A).

4.2.1 Research Framework - The HAM System

The educational program, the delivery method, and pilot test methodology were based on a needs assessment designed around the modified version of the
Health Action Model (HAM) which was implemented at 12 cooperating mushroom companies (Nieto-Montenegro et al. 2006).

Figure 4.1 describes the model and indicates what systems were addressed in the educational program and the intervention. The intervention addressed two of the key components of the HAM that influence behavioral intent. The educational program (interactive lessons) addressed the knowledge system. It was also attempted to influence the motivation system at selected worksites as described later.

4.2.2 PROGRAM MATERIALS

4.2.2.1 Lessons Development and Program Delivery

Because of time constraints, five lesson modules, each 35-45 minutes long, were developed, based on specific learning objectives derived from the needs assessment (See chapter 2). Each lesson in the program included visual aids and a script outlining presentation content with the learning objectives. Risk perception and principles of adult education were introduced through discussion topics, demonstrations, and hands-on activities. The lessons addressed: 1) Foodborne Outbreaks Traced to Produce; 2) Mushroom Contamination; 3) Personal Hygiene I; 4) Personal Hygiene II; and 5) Handwashing at Work. Drafts of scripts and visuals were prepared to match learning objectives, reviewed by two food science professionals and then revised. The visual aids were created using a clip art website, pictures and Photoshop® elements 2.0 (Adobe Systems Inc., San Jose, CA) using some pictures of actual situations within the mushroom industry. These pictures were obtained by the author during previous visits to the
plants and used with permission by the participating companies. Visual aids were produced as large posters and duplicated in a PowerPoint® presentation. Materials were produced in English and Spanish.

The Spanish draft educational lessons were tested by presenting lessons to two different groups of workers: 11 workers from a mushroom packing facility, and 14 harvesters from a mushroom farm. The packing facility was an active participant in the second phase of the program, the pilot test. The harvesters were workers from different crews of workers who did not participate in the second phase of the program. The main objectives of the test were to: (1) determine if the teaching methodologies were appropriate in the mushroom industry setting; (2) ensure that the lesson lengths and the resources needed for delivering the lessons were suitable and available for the final pilot test; and (3) obtain participant’s feedback about the lesson presentation and visuals.

The lesson content was identical for both groups, but three variations in the visual aids were tested: (1) the inclusion or exclusion of some text and headlines; (2) variations in font, font size and font color; and (3) the use of PowerPoint® slides vs. 12” X 18” color posters, a low technology option. Both groups received the same lessons with the same variations in similar sections.

At the end of each lesson, the instructor asked the workers for their feedback using scripted questions. Based on the results, minor revisions were made to the lesson visuals. All the workers preferred the PowerPoint® slides to the posters, and felt the five-lesson format was somewhat lengthy. Based on these comments, personal hygiene II was combined with original lesson 5 to produce a
The final four-lesson set in PowerPoint® format that still met the learning objectives. The PowerPoint® slides were predominately pictures containing single words (i.e., coins, handwashing, etc) or a short 3-8 word sentence (i.e., proper clothing and coverings, etc). Table 4.1 presents the lesson learning objectives and activities for each lesson.

Lessons were to be delivered orally by the author, using the PowerPoint® slides as visual aids. Lesson one was specifically designed to increase awareness of the risk posed to their jobs by a foodborne illness associated with mushrooms. Each lesson included one or more hands-on activities and discussion sessions that allowed the instructor to create an environment for worker participation, thereby facilitating active learning to meet the learning objectives. Hands-on activities were developed to provide the workers with skills that could be applied in their daily operation. The variety of activities used in each lesson insured learner involvement. For instance, the use of 3M Petri Film for microbial growth shocked participants and evoked curiosity about microbes in general. To demonstrate handwashing efficacy, Petri Film plates were inoculated with swabs taken from unwashed and washed hands and the plates with microbial growth were shown during the handwashing class, approximately 24-48 hours later. Glo-germ™ (lotion with fluorescent particles) was used to demonstrate how hands could transfer contaminants to the mushroom surfaces as well as the efficacy of handwashing. Discussions were generated around foodborne illness experience, inappropriate behavior in the worksite and controlling physical contaminants using actual examples (i.e. cigarettes, hair,
bolts, food, nuts, etc) shown in the class. The exercises evoked discussions of how microbial cross contamination might be controlled.

4.2.3 Company Sample

Eight companies and their subsidiaries (a total of 11 different worksites) that participated in the needs assessment also agreed to participate in the pilot test. All companies' worksites had different locations and/or different working crews. For the research design, each worksite was treated as an independent entity from its parent company. All 8 companies provided a letter of agreement, although one company required an additional confidentiality agreement. Orientation meetings were held with all management staff from each company to provide a detailed explanation of the evaluation project, the instruments, the commitment involved for participation, and to answer any questions. To protect confidentiality, a number and a random color were assigned to each of the participating worksites (n =9) from 7 different companies. To maintain balance in worker numbers among our testing tracks (see 4.2.4.1), one company with two worksites had to be excluded from the study. However, food safety training was provided to all of its workers at the end of the project. In the remainder of this document, the term worksite is interchanged with the term company and it means a specific physical place where mushrooms are picked or packed.

4.2.4 The Pilot Test Design

Certain elements of the HAM were included in the design of the pilot test. To assess the effectiveness and impact of the program with and without HAM elements, knowledge as a marker for attention to the lesson content, and behaviors were measured before the program and immediately after the program for knowledge and 8
weeks after the program for behaviors. A single skill (proper hairnet usage) was also evaluated at the end of the program. A detailed explanation of the evaluation activities is provided in the next sections of this document.

4.2.4.1 The Testing Tracks

The mushroom companies were purposefully assigned to four different tracks (tracks, A, B, C, and D) in order to test different variables.

The companies were placed into one of four tracks based on a) the number of workers in the packing and picking facilities in order to achieve about 120 worker per track; b) the environmental conditions (visible handwashing stations in the packing plants); c) willingness of supervisors and management to work with the researchers; d) having a combination of one or more mushroom packing-houses and one mushroom farm crew (called picking facility or site) per track; and e) having a packing and picking site from the same company in close proximity to each other.

Cooperativeness of management and supervisors was a key factor in assignment. For instance, one company had indicated more enthusiasm about an economic incentive and it was assigned to track A. Companies in Track B and Track C were assigned to this track in order to fulfill the targeted number of workers per track.

Yellow 7 was assigned to the control group for two reasons, a) it had met GMP standards more thoroughly than the other companies and was likely to have reasonably good compliance; and b) the management would only agree to participate if placed in the control group.

The impact of three independent variables was tested in the pilot evaluation: (1) the effect of the food safety lessons on knowledge score; (2) item 1 plus altering employee
motivation through increasing expectancy (supervisors were to encourage and enforce the desired behaviors and were to also act as role models by practicing the behavior themselves, thereby increasing the expectancy) and increasing instrumentality (supervisors were to praise workers when they perform the desired behavior); and (3) item 1 and 2 plus altering the employee motivational valence by examining the effect of a economic incentive on the dependent variables (Actions), three different handwashing opportunities, jewelry and hairnet usage. For comparison, a control group received no treatment. The tracks and variables are shown in table 4.2.

4.2.4.2 Steps in Pilot Test

A time line for the needs assessment, program development and steps in pilot test is shown in figure 4.2.

Step 1 – Measuring Baseline Behaviors and Practices

One observer collected the baseline data by conducting a direct observation procedure at each participating company examining food safety practices (hairnets and personal adornment usage) and employee handwashing practices. The procedure for conducting the observations is described in section 4.2.6.1.

Step 2 – Obtaining Informed Consent and Administering the Knowledge Pre-Test

Each participant signed an informed consent form before completing a pre-test. The knowledge test was administered orally in Spanish through a face-to-face interview to each employee and participating supervisor who then returned to his/her workstation. The interviewer read each question to the respondent, and then recorded their answer on an answer sheet. No tape recording took place.
Step 3 – Delivering the Lessons

The instructor visited each facility before starting the project to ensure that the conditions would be adequate for program delivery. The revised educational intervention included four lessons lasting from 22 to 45 minutes each. All lessons were administered in sequence and a minimum of a week apart to workers in tracks A-C. For packing companies in tracks A and B where supervisors were involved, the instructor held special lesson sessions with the supervisors as a separate group (s), with no other workers present. The supervisors received the exact same lessons as their co-workers but the last session included an extra section described below in step 5. The control group in track D received the lessons after the post-evaluation was completed (delayed). The same instructor delivered all the lessons orally in Spanish, using the slides as props in small groups of workers in the companies’ conference room and/or lunchroom. The lesson content was consistent across tracks for all participants. The presence of common physical contaminants in mushrooms (hairs, foreign objects), personal hygiene, and handwashing were given extra emphasis in the food safety lessons based on deficiencies noted in the baseline observations.

Since this project took place in an actual food industry setting, mushroom production needs always prevailed over the research project needs. Despite cancellations encountered at all steps of the project, lesson delivery was kept similar across all the participating companies. A four-week delay occurred between lesson 2 and 3 because of mushroom production demands during the Thanksgiving-Christmas holiday season. Since all the lessons were conducted
during working hours, the group size per lesson varied considerably, due to production constraints. Each session had a somewhat different group dynamic due to personalities and participation patterns. Appendix D demonstrates the number of lessons held at each workplace and the average number of participants at each session. Also, during the final lesson, an economic incentive was presented to packing company workers in track A. To encourage desired handwashing practices, twenty-five grocery store cards with a face value of $20 each were offered in a raffle at this company. The authors felt that this approach was the fairest method to award an incentive without making this activity a simple give away. A graphic depicting the baseline level of handwashing compliance was shown to the workers who were then asked to help increase the overall level of handwashing compliance. The workers were told that a drawing for the cards would take place 12 weeks after the post-test was administered. The number of cards drawn depended on the increase that was shown in handwashing compliance at the eight-week check compared to baseline (pre lesson administration) The higher the rate of handwashing, the higher the number of cards included in the drawing (i.e., 90% of handwashing compliance = 21 cards in the draw; 80% of handwashing compliance = 18 cards in the draw; so on and so forth until reaching 20% of handwashing compliance = 6 cards in the draw). If there was no increase in handwashing frequency from baseline, no cards were to be raffled. The same economic incentive also was offered to pickers for wearing their hairnets properly. It was not possible to monitor handwashing with pickers
but it was necessary to offer something to them since both pickers and packers worked for the same company.

**Step 4 – Assessing Immediate Post- Knowledge and Skill**

The same knowledge test used as a pre-test was administered to the participating workers and supervisors at least one week after the last lesson, using the same methodology as in step 2. In addition, a skill (appropriate hairnet usage), was measured in the post-test; something that was not done in the pre-test. At the end of this step, each company received a Penn State Certificate of Participation and each participating employee was presented with a certificate of completion endorsed by the Penn State University Department of Food Science and the American Mushroom Institute (Appendix E).

**Step 5 – Training the Supervisors and Implementation Period**

The implementation period for participant behaviors was eight weeks. During their final lesson (lesson 4), the supervisors at companies in tracks A and B received instructions on how to: a) encourage compliance with desired food safety behaviors among the workers; b) appropriately ask workers to follow a food safety rule; and c) be a food safety role model. This additional activity with the supervisors took place in a discussion-lesson format. The slide show used during this lesson is presented in Appendix F. First, a summary of the content of the lessons received by all workers was presented to review the four lessons content. Among other things, the lessons focused on the importance of three food safety behaviors: hairnet usage, jewelry usage, and handwashing practices at three different occasions: (1) before starting work; (2) after each break; and (3)
after using the restroom. The instructor went over the importance of compliance with these food safety behaviors. The role that supervisors play in having workers following the rules also was stressed. Then, using examples, the supervisors were given ways to approach workers to suggest they follow the rules. Supervisors were asked to be blunt, but courteous when they asked a worker to wash their hands. Supervisors needed to listen to the complaints of the workers and to make suggestions accordingly. Supervisors were told to focus on one behavior per week. A discussion was generated as to how this process could take place. During this lesson, supervisors agreed to make sure that workers always had the necessary food safety items to perform the noted behaviors (soap, paper towels, hairnets, gloves, etc.). Finally, some suggestions that would facilitate interactions with workers were presented (“please”, “thanks”, “refer to elders with respect”, “I would like you to go back and wash your hands”).

Upper management was aware of the activities that were taking place and of the information that was being shared with the supervisors. No policy changes in plant protocols were suggested by the researchers.

An eight-week waiting period followed for all companies in tracks C and D, with no further contact by the researcher. During this eight-week period, the researcher met with supervisors bi-weekly for 10-15 minutes for the first six weeks in companies from tracks A and B. In these meetings, the supervisors were instructed to monitor and encourage worker compliance with program goals, especially around handwashing, jewelry and hairnet usage. Their role in
the success of the program and the importance of serving as role models was also reviewed.

After the initial 2 meetings, several supervisors requested handwashing posters to place on walls. The researcher then designed 12” X 18” posters using artwork from the lesson materials to remind the workers the importance of washing their hands at work – before starting work, after breaks and after using the restroom. The posters are included in the Appendix G. Each company received 10 posters that were displayed as handwashing reminders on the walls in the hallways, outside the restrooms, near the time clock at each of the packing plants for the remaining 5 weeks of the study.

To ensure supervisor attention to motivation activities, upper management was asked to attend the last two meetings with the supervisors at all worksites involved in track A and B. At that point, upper management directed the supervisors to promote handwashing and to enforce the hairnet and jewelry policy. However, it is not known for how long this enforcement occurred since the activities of supervisors and upper management were not monitored or observed during this 8-week period. Therefore, it is unclear if any motivational activities were taking place or if supervisors self-reports of activities were truthful.

**Step 6 – Collecting 8 Week Delayed Observations**

Using the step 1 methodology, observations were conducted to collect 8-week follow-up data on food safety practices (hairnets and personal adornment usage) for each participating company and handwashing practices from those companies with observable handwashing stations. Observations were begun
after a minimum of 8 weeks had passed from the last post-test at the worksite and were carried out by the same researcher that conducted the initial observations. The procedure used for conducting the observations is described in section 4.2.6.1.

**Step 7 – Retrospective Interviews with a Sample of Workers and Supervisors at 5 Months Post-Lessons.**

Three months after the end of the waiting period, retrospective scripted interviews were conducted with a sample of 5 workers and at least one supervisor at each participating packing site, including the control company (packing sites in tracks A-D). After signing an informed consent form, workers and supervisors were interviewed individually and asked 5 open-ended questions. The interviews were conducted in Spanish and tape recorded. The interviews were transcribed and translated into English for analysis. The objective was to determine: a) worker and supervisor impressions of the food safety program (except in track D), b) practices by supervisors and management using food safety rules, c) worker recall of motivational activities conducted by supervisors or upper management during the 8 week waiting period; and d) current food safety practices versus past food safety practices. These data were collected to confirm any motivational activity and explore the effect of the pilot program ± motivational factors on the company’s food safety norms. The instrument used in this step is included in Appendix H.
4.2.5 Participant Sample

Each participating worksite provided a list of workers who were eligible for the food safety training. The researcher, who did not know the workers, walked into the facilities, gathered groups of workers, invited them to participate in the pilot study, explained the project, and finally explained the informed consent document to them. After hearing the purpose of the pilot (including the evaluation interviews), the informed employee could then decide whether or not to participate in the program as a volunteer who would complete the lessons and the evaluation instruments. The researcher reviewed again the consent form with each volunteer employee and obtained his/her signature before proceeding to the next step of the project. The companies required the workers to attend the food safety training, but did not require participation in the evaluation (pre- and post-testing).

4.2.6 Pilot Program Instruments and Scoring

4.2.6.1 Observation Forms and Procedures

The same observer, experienced in observational procedures (Nieto-Montenegro et al., 2004; Nieto-Montenegro et al., 2006), conducted the direct observations at all companies. In using this method, individuals do not know they are being observed. Due to the setting of this research work, this observation method was the most feasible. However, this method may lead to a Hawthorne effect (an experimental effect in the direction expected but not for the reason predicted), which could lead to overestimating the effect of the intervention. It is
thought that when individuals are aware that they are being observed they will change their behaviors. To avoid a single observer bias and to obtain more reliable data around handwashing, hairnet and jewelry usage, the researcher developed a way to approach the workers and explain his presence at their workstations or lunch breaks. The observer used the identical approach and explanations to avoid employee behavior modification. In addition, the researcher performed several tasks while observing (i.e. counting mushroom boxes, looking at production details, sorting chemicals, writing reports in his laptop in the lunch room, etc). Furthermore, to minimize changes in employee behavior, someone unfamiliar to the workers accompanied the observer and pretended that he/she was having a tour of the company during the observation period. Meanwhile the observer continued to collect data.

a) Hairnets and jewelry

Using an audit type protocol, the observer acted as an inspector who checked the workers for hairnet and jewelry compliance. Using a clipboard and a checklist, which is included in appendix I, the observer walked through the production lines checking and taking notes of the workers’ food safety compliance behaviors. The observer was free to move anywhere within the mushroom packing facilities or the growing farms to collect data. The observer walked through the packing lines and/or farms until he observed all the workers at that worksite at that specific company. This observation procedure was repeated four times, each at a different time on one of four different days for each
worksite (i.e. track A packers and pickers are considered two separate sites). For hairnets and jewelry compliance, the researchers reported a non-compliance rate that was calculated as following:

1) Hairnet usage: Number of workers not wearing a hairnet appropriately/Total number of workers observed

2) Jewelry usage: Number of workers wearing any kind of jewelry besides a wedding band/Total number of workers observed

Before starting the study, the researchers defined a properly worn hairnet as one that covered all the head’s hair, regardless if wearing a hat. If the company allows the use of hats along with the hairnet, the hairnet should be worn under the hat. Regardless of gender, jewelry was defined as earrings, neck chains, bracelets or watches. Jewelry, with the exception of the wedding band was not allowed in the areas where mushrooms are picked or packed.

b) Handwashing

The observer also collected handwashing frequency data from the companies in each track that had a visible handwashing station outside the restrooms. Due to the number of workers in each company, Track B included two worksites with handwashing stations. The observer collected frequency data when a pre-defined handwashing opportunity occurred. A handwashing opportunity was defined as a specific occasion where workers should wash their hands at the work site. In this case, three different occasions were defined: (1) before starting work; (2) after each break (morning or afternoon and lunch breaks); and (3) after using the restroom.
Each of these handwashing opportunities was analyzed independently from each other. In any given day, work started around 6 or 7AM, with a mid-morning break (around 9:30 AM), a mid-afternoon break (around 2:30PM) plus a lunch break (around noon). Exact times varied by company. In addition to their scheduled breaks, workers have the freedom to use the restrooms while they are working. Due to space limitations of the break facilities at all the worksites, workers did not go on break at the same time. In general, breaks were taken in groups, depending on the total number of workers in the company (generally two or three groups were formed). However all workers got the same time of break described above. Hence, there could be two or three morning breaks, two lunch breaks, and two or three afternoon breaks, depending on the company.

Figure 4.3 demonstrates the typical handwashing observation time slots. To conduct the handwashing observations, the observer spent time observing at the worksites using two different approaches. (1) the observer arrived at the worksite before the operations started, observed handwashing before start of work and stayed until everyone had taken the morning and lunch breaks; and (2) the observer arrived at the worksite in the morning, observed handwashing before start of work, then left, came back right before lunch, and stayed at the worksite to observe everyone taking lunch and afternoon breaks. All worksites were observed equally as illustrated in Figure 4.3. The observer also looked at handwashing compliance rates of workers after using the restroom through the course of the day. The observer only checked if the employee did indeed wash his/her hands. He did not evaluate the procedure used for handwashing.
However, it was necessary that the worker used soap and scrubbed their hands in order to record that action as a valid handwashing count. The observation procedure was conducted on three different days at each different company. All workers present in the company at the day of the visit were observed, whether or not they had participated in the educational program. Therefore, not everyone was evaluated since a small percentage of workers were on vacation or had a day off. Some who were evaluated had not participate in the educational program. In addition, the observation time slots were even across tracks. Therefore, the amount of time spent at all companies and the patterns of the observations were the same in all tracks.

The rate of handwashing compliance was calculated as followed:

Before starting work:
Number of workers washing their hands/Total number of workers arriving at work that morning

After breaks:
Number of workers washing their hands/Total number of workers taking a break at that time

After using the bathroom:
Number of workers washing their hands/Number of workers using the restroom

The rate was reported as compliance percentages. Only the observed workers, not the total number of workers working in that company, were included in the handwashing compliance results. None of the participating companies had
access to the observation data collected, and workers involved in the
observations were anonymous.

4.2.6.2 Knowledge Instrument

A survey instrument (Appendix J) addressing knowledge of issues and
concepts discussed in the lessons was developed for use in individual face-to-
face interviews. The interviews were conducted according to the timeline
presented in figure 4.2. Because the needs assessment (Nieto-Montenegro et
al., 2006) indicated that the majority of workers at these sites had only a sixth
grade education or less and oral interviews had proved effective in that step, it
was decided to collect the data orally.

The interviewer read each question and the possible answers to the
respondent, and then recorded his or her responses on an answer sheet.
Culturally compatible analogies also were used to explain the mechanics of the
interview and the scale used. The instrument included 10 knowledge questions,
each with five multiple-choice options, where one option – to avoid guessing -
was ‘do not know’. The answers from each participant were compiled in a
database and added to obtain a final score. A point was awarded for each
question answered correctly; therefore the minimum possible score was 0 for no
correct answers, and the maximum possible score was 10 for all correct
answers. The instrument also included demographic questions. The same
researcher gave all the pre- and post-tests.

To assure content validity, four individuals with expertise in food safety, program
evaluation, and food microbiology reviewed a draft of the instrument. Their
comments were incorporated into a revised survey instrument, which was translated into Spanish. To assure its clarity and accuracy, and to practice the interview methodology, the instrument was pilot tested with Spanish speaking volunteers (N=5). Comments and experiences were recorded and then used to modify the instrument.

Skill Check – During the post-test, each participant was required to put on a hairnet. They were scored (correct =1, incorrect = 0) as to ability to use the correct procedure that was taught during one of the lessons.

Note: The knowledge test was used as a marker for attention to the lesson content. Handwashing skills were observed in the last lesson and hairnet skills checked in the immediate post-test.

4.2.7 Data Management and Analysis

When the pre-test was given, each participant was assigned a code with two letters and a number. To enable pre- and post-test data matching, a master list was generated with the participant names and their assigned code. Only one of the researchers had access to these names and codes. The participant’s demographic information, along with the tests scores, were entered into a database, recoded, and transferred into SPSS 10 for Macintosh (SPSS Inc., Chicago, Ill.) for statistical analysis. For quality control purposes, the researcher, assisted by someone not connected with the study, triple checked the information in the databases.

The quantitative data collected were organized using descriptive statistics (i.e., frequencies, percentages, means and standard deviations). T-tests, one-way ANOVA, and ANCOVA tests were used to determine if there were significant differences.
between different companies. The selected post-hoc tests were the Scheffe test when equal variances were present and the Games-Howell test when variances were not equal. SPSS 10 (SPSS Inc., Chicago, Ill.) was used for conducting the statistical analysis. The qualitative data yielded from the retrospective interviews with workers and supervisors was used to develop thematic summaries for each company.

4.3 RESULTS

4.3.1 Overall Knowledge Pre-Post-Test

A total of 454 workers, including 23 supervisors, from nine different worksite locations completed the knowledge pre-test. After the intervention, the experimental mortality mean was 17.84% across all the participating locations. A total of 373 workers completed both the pre- and then the post-knowledge tests and data from these tests were used for analysis. Demographic characteristics of participants with matched data are shown in Table 4.3. Most of participants in this sample were packers (77.21%). The mean age of participants was 37.07±12.84 years and the sample was evenly split between 50.9% males and 49.1% females. Educational attainment was low since most participants (68.36%) had 0 to 6 years of formal education. Three quarters of the sample (75.33%), came from the same area in Mexico (Moroleon, Guanajuato State). The approximate total number of workers that were in the lists provided by each company at the time of the study (workers eligible to participate) were as follows: Brown 1, 91 workers; White 2, 29 workers; Red 5, 54 workers; Green 6, 73 workers; Purple 3, 90 workers; Black 4, 38 workers; Pink 8, 25 workers; Yellow 7, 64 workers and Blue 9, 44 workers.
Tables 4.4 and 4.5 display knowledge pre- and post-test scores for packers and pickers respectively. Overall, participants’ mean scores on the ten pre-test knowledge questions indicated deficiencies in food safety knowledge (mean 5.91±1.68), even though women attained a significantly higher mean pre-knowledge score than men (6.30±1.71 vs. 5.53±1.55, p = 0.000). One-way ANOVA tests demonstrated that there were no significant differences in mean pre-test knowledge scores when controlling for educational level, previous food safety education, or income.

The mean pre-test knowledge scores were significantly different when the workers were categorized by their job location (packers vs. pickers). Overall, workers working in the mushroom packing houses (packers) scored significantly higher in the knowledge pre-test than workers who worked picking mushrooms in the farms (pickers) (6.13±1.63 vs. 5.14±1.60; p=0.000). This observation suggested that packers and pickers should be separated in the analysis, since the packing houses were the worksites where all the handwashing observations were conducted.

**4.3.1.1 Packers**

One-way ANOVA tests indicated significant differences in knowledge pre-test scores for the packing worksites in the four tracks (F=4.791, p=.001). Table 4.4 includes the mushroom packers knowledge scores. The post-hoc test found differences in knowledge scores between the control worksite (yellow 7) and the worksites in tracks A and C (brown 1 and purple 3). The other individual comparisons were not significantly different. The one-way ANOVA for post-test
scores was significant for mean post-test scores. The pair-wise comparisons
demonstrated individual significant differences between the company in the
control group (yellow 7) and all the other companies (brown 1, red 5, green 6,
purple 3, and yellow 7). As expected, the knowledge mean score for the control
group was lower than the scores of the companies that received the intervention.

4.3.1.2 Pickers

One-way ANOVA indicated a statistically significant difference in mean pre-
test scores among the mushroom farms in the four tracks (F=2.833, p=.043).
Table 4.5 includes the mushroom *pickers* knowledge scores. According to the
post-hoc test, the pre-test scores of the control worksite (Blue 9) differed from
that in Track B (Pink 8). The other pair-wise comparisons were not significantly
different. The one-way ANOVA for post-test scores was significant for mean
post-test scores. The pair-wise comparisons demonstrated individual significant
differences between the company in the control group (blue 9) and all the other
companies (white 2, pink 8 and black 4). As was observed with the *packers*, the
knowledge mean score for the control group was lower than the scores of the
companies that received the intervention.

4.3.1.3 ANCOVA

Analysis of covariance (ANCOVA) using the pre-test score of each individual
as the covariate for their post-test score was used to compare mean post-test
knowledge scores for all experimental and the control companies (fixed factor).
Use of ANCOVA reduced effects of initial worksite differences so that the
worksite differences on the post-test scores may be due to the intervention,
rather than to differences that previously existed among worksites. ANCOVA revealed a significant difference among worksite post-knowledge scores (Table 4.6 and Figures 4.4 and 4.5). Subsequent pair-wise comparisons indicated a significantly greater score for each of the experimental worksites, as compared to the control worksite for both pickers and packers. Among packers, red 5 scored significantly but slightly higher than green 6 and yellow 7. Scores for brown 1, green 6 and purple 3 were not significantly different. Pair-wise comparison from the post-hoc analysis revealed no significant difference between any of the experimental picking worksites.

4.3.2 Handwashing Compliance Rates

Pre and 8-week post-handwashing compliance for the three handwashing opportunities that were evaluated are presented in tables 4.7, 4.8, and 4.9 respectively. Only mushroom packing worksites had visible (outside the restrooms) handwashing stations.

4.3.2.1 Handwashing “Before Start Working”

The one-way ANOVA indicated a significant difference in handwashing compliance among the target worksites before the intervention. Table 4.7 and Figure 4.6 include the mean values and comparison for handwashing compliance rates “Before Start Working.” The post-hoc analysis revealed that there was a significant difference in handwashing compliance between the control worksite (yellow 7) and each of experimental worksites. The control worksite had a significantly higher compliance rate (81.21 %), as compared to the experimental
worksites (5.86%, 10.96%, 10.42%, and 4.47%) in brown 1, red 5, green 6, and purple 3, respectively.

One-way ANOVA also indicated a significant difference in handwashing compliance rates after the intervention. Pair-wise comparisons found no significant differences between green 6 and purple 3 worksites and between yellow 7 and red 5. These companies had the lowest and the highest handwashing compliance rates, respectively. Paired t-tests indicated a significant increase in handwashing compliance rates after the intervention for worksites brown 1 and red 5. Red 5 demonstrated the greatest increase in handwashing compliance. Experimental worksites green 6, purple 3 and the control worksite, yellow 7, demonstrated no significant change.

4.3.2.2 Handwashing “After each Break”

One-way ANOVA indicated a significant difference in handwashing compliance among the participating worksites before the food safety intervention. Table 4.8 and Figure 4.7 include the mean values and comparison for handwashing compliance rates “after each break.” The post-hoc analysis revealed that the compliance rate in the control worksite was significantly higher than in the other worksites (78.48% in the control group vs 15.78 %, 29.01%, 12.5%, and 11.20% in brown 1, red 5, green 6, and purple 3 respectively).

One-way ANOVA of post-intervention compliance rates also demonstrated a significant difference. The post-hoc analysis found that worksite purple 3 had significantly lower handwashing compliance than worksites brown 1, red 5 and yellow 7, which had the highest post-intervention handwashing compliance rate.
“after each break.” No significant difference was found in the post-hoc analysis among the companies with highest compliance rates (Brown 1, red 5, and yellow 7).

Paired t-tests indicated a significant increase in handwashing compliance post-intervention in worksites brown 1, red 5 and green 6. Red 5 demonstrated again the largest increase in handwashing compliance. Worksite purple 3 and the control worksite did not exhibit any change in compliance rate after the intervention.

4.3.2.3 Handwashing “After Using the Restroom”

One-way ANOVA indicated a significant difference in handwashing compliance among the different worksites before the intervention. Table 4.9 and Figure 4.8 include the mean values and comparison for handwashing compliance rates “after using the restroom.” The post-hoc analysis revealed a significant difference between the control worksite, yellow 7, and the experimental worksite, purple 3. Purple 3 also was significantly different from worksite brown 1.

One-way ANOVA demonstrated no significant differences among worksite compliance rates after the intervention. All worksites had very high handwashing compliance after the intervention. Paired t-test analysis indicated a significant difference in handwashing compliance post-intervention in worksites brown 1, purple 3, and green 6. Experimental worksite red 5 and control group yellow 7 demonstrated no change in compliance rate after the intervention. However these two companies were the ones with the highest handwashing compliance rates, both before and after the intervention (company red 5 scored perfect).
4.3.3 Hairnets Usage Non-Compliance Rate

Observations conducted at the beginning of the study found that not all workers were properly wearing their hairnets. Therefore, a skill test was included during the post-test interview. Every participating worker was asked to show how a hairnet should be worn. At the end of the skill test, every participant was able to demonstrate appropriate hairnet usage.

Table 4.10 and Figures 4.9 and 4.10 include the mean values for non-compliance rates of hairnet usage before and after the educational intervention. The one-way ANOVA test demonstrated significant differences for the hairnet non-compliance rates before the intervention in both packers and pickers. For packers, the pair-wise comparisons demonstrated individual significant differences on the non-compliance rates between the worksite purple 3 and the worksites red 5 and yellow 7. No other individual differences were found between packing worksites in the pair-wise comparisons for the pre-intervention data. For pickers, the pair-wise comparison before the intervention revealed that the non-compliance rates were significantly different between the worksite blue 9 (control group) and each of the other picking worksites (white 2, pink 8 and black 4). The company blue 9 had a significantly lower non-compliance rate than the other companies.

For post-intervention, the one-way ANOVA revealed significant differences between worksites in both packers and pickers. For packers, the post-hoc analysis revealed that worksite purple 3 had the highest non-compliance rate of hairnet usage and it was significantly different from that of the other worksites. In
addition, worksite green 6 was significantly different than worksites brown 1 and yellow 7. For *pickers*, the only significant difference in the post-hoc analysis was between worksites pink 8 and blue 9.

Paired t-tests revealed significant decreases in post-intervention non-compliance rates for the *packers* in worksites brown 1, green 6 and yellow 7. There was no difference in the worksite red 5 where a ceiling effect (when the effect of a treatment is underestimated because the dependent measure cannot distinguish between participants who have somewhat high and those who have very high levels of the dependent variable that is being studied) might have contributed to finding no differences. For the *pickers*, significant decreases were also found in non-compliance rates in worksites white 2, pink 8 and blue 9.

### 4.3.4 Jewelry Usage Non-Compliance Rate

Table 4.11 and Figures 4.11 and 4.12 include the mean values for non-compliance rates of jewelry usage before and after the educational intervention. One-way ANOVA indicated significant differences for the non-compliance rates before the intervention in both *packers* and *pickers*. For *packers*, pair-wise comparisons demonstrated no significant differences in the pre-intervention between worksite purple 3 and green 6 which had higher non-compliance rates. There were significant differences between these two worksites and the worksites brown 1, red 5 and yellow 7, when compared individually. For *pickers*, the pair-wise comparison indicated a significant difference between worksite black 4 and each of the other worksites. Company black 4 had the highest non-compliance rate score among the *pickers* before the intervention occurred. For
post-intervention findings, one-way ANOVA revealed significant differences among packer and picker worksites. For packers, the pair-wise comparison revealed significant differences between worksite purple 3, which had the highest non-compliance rate and each of the other worksites. For pickers, worksite black 4 and the other worksites were significantly different when compared individually. Again, worksite black 4 had a highest non-compliance rate. For packers, t-tests revealed a significant decrease in non-compliance after the intervention for worksite brown 1 and green 6. The decrease in green 6 was greater than in brown 1. In contrast, t-tests revealed no significant change in any of the pickers’ non-compliance rates after the intervention.

4.3.5 Retrospective Interviews

The summary of results of the retrospective interviews with a sample of workers and supervisors from each worksite at 5 months post-lessons are presented in Tables 4.12 and 4.13 respectively.

4.3.6 Summary of Results

For the controls (packer-yellow 7 and picker-blue 9), no lessons were given and no work with supervisors was done.

• Pre-knowledge for yellow 7 and blue 9 was comparable to that in other tracks and did not change significantly by two months post-lessons. Other findings include:
  • Handwashing compliance was high initially and did not change significantly over the period of observation for any of the three handwashing opportunities.
• However, yellow 7 and blue 9 hairnet usage compliance did improve significantly. Compliance with jewelry usage rules was high at pre-measurement and did not improve significantly by post-measurement.

• The retrospective interviews revealed that this company had a personal hygiene enforcement program implemented before the research began. This observation explains why the levels of handwashing compliance were high in yellow 7. Management had appointed quality control (QC) workers to do checks and enforcement so supervisors were free to work on orders.

For companies in track C (packer-purple 3 and picker-black 4) the lessons were delivered but no other form of intervention took place.

• Pre-knowledge for purple 3 was comparable to the other two experimental tracks but was significantly less than pre knowledge of controls. Pre-lesson knowledge for black 4 pickers was comparable to all other picking sites. Both purple 3 and black 4 demonstrated a significant knowledge gain after the intervention.

• Handwashing compliance was low initially and did not change significantly at post-observation for “after each break” and “before starting work.” Handwashing compliance did increase significantly “after using the restroom.”

• Hairnet and jewelry non-compliance rates did not change significantly after the program. These non-compliance rates were among the highest across tracks for both purple 3 and black 4.

• The retrospective interviews revealed lack of management commitment, and little enforcement. One supervisor was in charge of food safety enforcement plus
the mushroom orders. According to employees, mushroom orders took priority. Despite a significant improvement in handwashing “after using the restroom” in purple 3 and an improvement, but not significant, hairnet compliance among workers in black 4, the lessons had no effect on other food safety practices.

For companies in track B (packers-red 5 and green 6 and picker-pink 8) the lessons were given, plus the supervisors were trained to encourage food safety rule compliance.

- Pre knowledge for packers and pickers was comparable to that in other tracks except for workers in pink 8 and blue 9 the control group. Knowledge did increase significantly after the intervention at all sites.
- Handwashing compliance was initially low for handwashing “after each break” and “before starting work.” After receiving the program, red 5 demonstrated significant increases in these handwashing compliance rates. Green 6 demonstrated significant but low improvement only for handwashing after each break. At red 5, initial handwashing compliance “after using the restroom” was very high and no significant increase was observed after the intervention. Green 6 demonstrated a significant increase in handwashing “after using the restroom.”
- Red 5 hairnet and jewelry non-compliance rates were initially low and did not change significantly after the program. Green 6 demonstrated a significant decrease in initial non-compliance rates for both hairnet and jewelry usage. Finally, pink 8 demonstrated a significant decrease in non-compliance rates for hairnets but not for jewelry. Pre-jewelry usage was low prior to the start of the educational intervention.
The retrospective interviews revealed that, in *red 5*, one key person in upper management was committed to making the food safety program a success. She was aided by her quality control (QC) team to whom she delegated enforcement. The QC team had completed the lessons and supervisory training and also had the knowledge and skills to motivate workers to follow rules. The QC staff enforced the rules and made workers aware of infractions. This approach significantly altered the worker’s behavior after the food safety training such that workers realized the risks and reasons for doing things. Commitment to food safety grew during the training, reached a peak over the subsequent eight weeks and remained at high levels five months post-training. In *Green 6*, management implemented changes immediately after training by assigning a supervisor to enforce food safety rules. However, based on the interviews it was determined that the commitment of the supervisor diminished after the eight-week period and at five months post-lessons. Although some food safety rules were enforced periodically, there was less commitment to enforcement than immediately after the lessons.

For companies in *track A* (packer- *brown 1* and picker- *white 2*) the lessons were delivered plus the supervisors were trained to encourage food safety rule compliance and an economic incentive was offered to workers.

- Pre-knowledge for *brown 1* was significantly lower than that of controls while that of *white 2* was comparable to other tracks. Knowledge did increase significantly after the intervention.
• At brown 1, initial handwashing compliance was low “after each break” and “before starting work” while rates “after using the restroom” were high. After the 4 lessons were completed, brown 1 demonstrated significant increases in handwashing compliance in all three opportunities.

• At brown 1, hairnet and jewelry non-compliance rates decreased significantly after the program. A high hairnet non-compliance rate was reduced to low levels. Jewelry usage was initially low and lowered after the program. The workers at white 2 also demonstrated a significant decrease in hairnet and jewelry usage non-compliance rates.

• The retrospective interviews revealed brown 1 management had delegated responsibility to supervisors who had increased worker compliance after the lessons. However, management commitment became stronger after the eight-week observation period, as compared to immediately after the lessons. Supervisors did implement worker actions immediately after the lessons but found that the actions were not working as well as desired. Five months post-lessons, compliance and enforcement improved. However, handwashing was not checked as much as other behaviors. Prior to training, brown 1 placed low emphasis on personal hygiene, but improved immediately after the lessons. This emphasis on following the rules appeared to improve after the 8 week observation period so that at the time of the retrospective interviews the emphasis on rules was quite different than prior to the lessons.
4.4 DISCUSSION

To assess the impact of the HAM-based educational program, this study focused on changing baseline food safety knowledge through the lessons and five behaviors through skills taught in the lessons as well as alteration of the motivational system.

The educational intervention appeared to be well received by workers across all the companies. Employees seemed to like hands-on training, discussions and activities. It was expected that the provision of knowledge and skills may have affected the belief system and influenced the behavioral intent, although beliefs were not measured. The motivational system was altered by working with supervisors from companies in tracks A and B to influence expectancy (extra effort will lead to better performance) and instrumentality (insuring that good performance by workers will be noticed and rewarded). An economic incentive (chance at winning a raffle) was provided for the track A employees as an attempt to influence valence (perceived value) of the rewards for good behavior.

4.4.1 Lesson Impact

To determine if employees understood the lessons, knowledge gain was evaluated. The employees being trained had low educational attainment (majority at or below 6th grade level) and had low literacy skills. The ANCOVA revealed that pickers and packers who participated in the food safety program demonstrated a significant improvement in their knowledge scores while workers in the control groups demonstrated no significant improvement in knowledge. It
appears that pickers and packers could be trained in food safety principles, regardless of their job assignment.

In addition, employees with low educational attainment demonstrated significant knowledge gain. Other cross sectional consumer surveys, regardless of ethnic mix, indicate that low level of education is related to low food safety knowledge scores (Altekruse, et al., 1999; Meer and Misner, 2000; Williamson, et al., 1992; Woodburn and Raab, 1997). The current study indicates that a well-designed (inclusion of adult education concepts and skill based program) and structured educational program (series of interconnected sessions) can be effective with a low literacy audience. It is hypothesized that the discussions, activities and hands-on training included in this food safety program may have played a key role in knowledge gain.

Pink 8 demonstrated the highest adjusted post-knowledge score among the pickers. This observation may be attributed to the fact that most workers in pink 8 were women. Other food safety surveys have demonstrated higher knowledge scores for women than for men (Altekruse et al., 1996 and 1999; Nieto-Montenegro et al., 2000; Patil et al., 2005).

Delivered without any changes in the motivational system, the lessons appeared to have had some impact on handwashing “after using the restroom” and hairnet usage, suggested by the significant improvement in handwashing behavior in track C, purple 3, and a nearly significant improvement in hairnet usage in black 4, track C. In addition, handwashing behavior also improved significantly in green 6, track B, where supervisor support was poor.
Handwashing and hairnet usage were emphasized in the lessons with hands-on activities and practice. The emphasis of the lessons on handwashing may have connected to the continuous public health messages in Mexico to wash one’s hands after using the restroom and made it easier for workers to move from intent to action (Curtis, Scott, & Cardosi, 2005). However, it is clear that the lessons by themselves cannot lead to alterations in behaviors that are less ingrained and familiar to workers, such as handwashing after breaks.

It is hypothesized that the alteration in handwashing behavior observed in track C was not due to a Hawthorne effect at the time of observation, since similar changes did not occur “before starting work” or “after taking a break” when the observer was visible to workers. The extent of Hawthorne effect is most likely shown by the slight shift upward in handwashing compliance “after using the rest room” in track D-yellow 7. The extent of change in track C-purple 3 is 5 times that of track C-yellow 7. The latter helped to highlight the importance of supervisory work (track B as compared to track C where no supervisory activities took place), during the food safety program implementation.

The training also incorporated information about the risks of foodborne outbreaks traced to food production facilities. Although it is not clear that this approach influenced behavior, the retrospective interviews indicated that workers remembered the example used and that the fall-out of this foodborne outbreak had meaning to them. In track B, red 5, workers and supervisors reported that this example was used very effectively by the QC team monitoring and enforcing
behavior to provide instant reminders of the unpleasant consequences of laxity in food safety behaviors.

Clayton et al. (2002) had concluded that training by itself will not lead to behavioral change and that food safety training needs to incorporate a risk-based approach to symbolize the level of risk associated with their food business. The current educational program highlighted the consequences of a foodborne outbreak, particularly loss of jobs, as well as increased risk perception. The needs assessment (Nieto-Montenegro et al., 2006) indicated that workers in the mushroom industry value the job security provided by this industry.

4.4.2 General Supervisory Commitment

The importance of supervisory support and enforcement is clearly illustrated in Track B. Several authors have indicated that management commitment and support are both key in the implementation of any food safety program (Hennum, Lawrence and Snyder, 1983; Kirby and Gardiner, 1997; Seaman and Eves, 2005). For instance, Coleman and Roberts (2005) concluded that success of a food training program will depend on the food safety management system in place and the availability of resources. Clayton et al. (2002) mentioned that food safety must be an organizational issue within the company and management must allocate resources to food safety. The improvements in the two, less familiar handwashing behaviors in red 5 contrasts with the poor improvement in green 6 and reflects the difference in supervisory commitment. In addition, the supervisory load was handled in a more equitable manner in red 5 than in green 6. One explanation for the success in red 5 may be that responsibilities for
mushroom orders were separated from enforcement responsibility in red 5. Results from track B demonstrated that the success of a food safety program requires hard work, continuous discipline, and follow-up activities. And finally, additional responsibilities of the supervisory staff should be separated from food safety and/or enforcement.

### 4.4.2.1 Expectancy – Supervisory Enforcement and Role Modeling

Track B – red 5 illustrated how supervisor commitment and QC follow-through on enforcement are necessary elements in maintaining high rates of compliance. In red 5, handwashing rates ‘before starting work” and “after taking a break” post program were the second highest compared to the control and, on average, the non-compliance rates for hairnets and jewelry were the second lowest, as compared to the controls. A ceiling effect occurred in this track for jewelry since these non-compliance rates were low before the intervention and remained low after the intervention. These rate changes appear to reflect at least partially how the QC team served as re-enforcers of the behaviors. Behavioral theory states that if a re-enforcer follows a desired behavior, that behavior is more likely to happen again and if there is no re-enforcer, the desired behavior is less likely to recur (Stanton, 1992). It also states that environmental cues are a discriminative stimulus (i.e., provides information about what to do) and indicates to a person when a behavior must be followed (Stanton, 1992). In the retrospective interviews, employees reported enforcement reminders and warnings that seemed to inspire compliance. While not proven, appearance of the QC members served as a stimulus. The QC team at red 5 enforced a specific act
(handwashing) and then the workers performed the desired behavior. Apparently the enforcement made such an impression that after awhile, handwashing and other food safety practices at red 5 became a habit. These findings are consistent with Ehiri (1997) who suggested that a food safety educational program would more effective if it is followed by “strong management controls”.

The necessity of continuous enforcement was evident in track B, green 6, wherein upper management and supervisors were enthusiastic immediately after training. These individuals implemented changes and assigned the QC-supervisor to enforce and to correct. This approach led to jewelry and hairnet usage rules that were enforced immediately after the lessons with an increase in hairnet usage compliance for both packers and pickers. Altering handwashing behavior ‘before starting work’ was unsuccessful while that ‘after each break’ improved marginally. In the retrospective interviews, workers reported there was no enforcement or plan in place to encourage behavior change, so workers compliance appeared to decrease.

Role modeling was not reported in track A –brown 1. Conversely, supervisors in track B- red 5 reported they served as role models demonstrating correct behaviors and workers verified this observation in retrospective interviews. One employee said “they do worry about handwashing, the hairnets and the smocks. You have to wear it properly. No jewelry is allowed.” In track B, green 5, even though the supervisors took part in their lesson sessions, it is suspected that supervisors performed no role modeling as this was not mentioned in the retrospective interviews. The exception was one supervisor assigned to
enforcement. This situation may have contributed to the lack of improvement in handwashing at less obvious times (after the break and before work). Although hairnet usage and jewelry usage improved, it was not clear if this observation was due to role modeling or enforcement.

4.4.2.2 Instrumentality – Recognition of Good Behavior

Retrospective interviews indicated that in track D, most of the emphasis appeared to be on enforcement rather than instrumentality (the idea that good behavior would be noted). In track B – red 5, and track A – brown 1, where supervisor training was provided and appeared to be adopted, workers reported that supervisors (brown 1) and QC staff (red 5) reminded workers of the rules. In track A, brown 1, workers indicated the management offered ‘polite reminders’ and ‘advice’ right after the lessons but found that this was ineffective in ensuring compliance. Since both red 5 and brown 1 were focusing on enforcement rather than recognition of good behavior 5 months after the lessons, it appeared the companies did not successfully adopt workers recognition for appropriate behavior (i.e., instrumentality).

4.4.2.3 Valence – Use of an Economic Incentive

The economic incentive had no effect on worker behavior. Any effect was overshadowed by similar or bigger changes in other tracks that did not offer an economic incentive. It is possible that a more immediate economic incentive (i.e. gift cards awarded weekly) was needed. The incentive was not awarded until 10 weeks after the program ended. Indeed, no mention was made of this event in the retrospective interviews, indicating that the incentive made little impression
on the workers. Other studies where monetary incentives were used found an increase in the use of preventive health care services when an economic incentive or direct payment was given to households (Morris et al., 2004). Monetary incentives to complete a multi-dose vaccine treatment were effective among drug users (Seal et al., 2003). Another study demonstrated that incentives did not have an impact on program participation among people who were being rehabilitated from drug usage. The authors suggest a need for a stronger intervention which might have better success (Jones et al., 1998). However, these studies used different methods for allocation of the incentive. Therefore, it is not clear how an economic incentive may affect a person’s behaviors.

4.4.3 Overall Patterns

Summarizing, Track D, highlighted the importance of management commitment to enforcement. The management was concerned about the food safety rules but their approach was to delegate rule enforcement to the QC person who was able by constant enforcing to have people generally following the food safety rules. However workers knowledge of food safety principles was not outstanding.

Track C indicated that while the lessons might inspire some changes in behavior, more is need to ensure consistent change in all targeted behaviors. Food safety programs should take into account the environmental factors surrounding the workers (Ehiri et al., 1997, Rennie, 1995, Seaman and Eves, 2005) as well as the provision of skills and knowledge. Track B, with the
contrasting results in red 5 and green 6 demonstrated the importance of combining expectancy, wherein supervisors enforce the rules, with the skills and knowledge provided by the lessons. Track A reaffirmed the importance of combining expectancy with the lessons and indicated that the economic incentive had no visible impact compared to the other activities by the management and the supervisors in this and in other tracks. In all tracks, the management was to some extent involved. Considering all tracks together highlights the importance of management commitment in food safety program implementation.

The retrospective interviews also highlighted the different trajectories of adoption of lesson principles and management buy-in. In track B, red 5 bought into the lessons and enforcement immediately after the lessons and commitment remained high at 5 months after the lessons. In track A, commitment to food safety behaviors was higher 5 months after the lessons than at two months later. The reasons for this change are not clear. However, the changes in this track could be attributed to: a) the lessons and follow up period gave the management the opportunity to reflect on food safety importance and react; b) the lessons raised the worker’s consciousness and clarified reasons for food safety behaviors; and c) the risk based approach of using “the green onions outbreak” may have made compliance more relevant to management and workers. Ultimately, other unreported trends or activities across the mushroom industry might have influenced adoption of stronger enforcement methods and the commitment seen at 5 months post program.
Handwashing compliance is the most important single practice to avoid foodborne outbreaks. However hairnets and jewelry usage are important practices to avoid physical contamination in food products that could become aesthetic adulterants or possible hazards to consumers. (Olsen, 1998; Valdes-Biles and Ziobro, 2000). These practices also are some of the easiest behaviors to monitor and can work as indirect indicators of management commitment to implement a food safety program. Having workers with no jewelry and wearing hairnets properly are simple and straightforward concepts to enforce (brown 1, red 5, and yellow 7 are examples). Therefore, if supervisors and managers were not able to control this practice at their worksites, handwashing could have been something more difficult to deal with. Even though the participating companies appeared willing to allocate all the necessary resources to support the food safety rules, this study made clear that management involvement should go further than just providing resources. Management does play a key role in food safety compliance.

Finally the worksites, where almost all of the supervisory staff in charge of enforcement among packers were women (Red 5 and Yellow 7), had significantly higher handwashing rates and significantly lower non-compliance rates for jewelry and hairnet usage than other worksites with males in a supervisory position. Research has demonstrated that women possess higher food safety knowledge and have better food safety practices than men (Altekruse et al., 1996 and 1999; Nieto-Montenegro et al., 2000; Patil et al., 2005). Perhaps, women
were better role models than men or women took the food safety program more seriously than men. These concepts could be explored in further research.

4.5 CONCLUSIONS

Incorporating adult education principles, hands on activities and skill building resulted in both knowledge gain and some improvement in more familiar hand washing activity at the worksite where only instruction took place.

Training must be followed by the involvement of the supervisory personnel in enforcement of behavioral rules. Management support of the supervisory role will increase the success in any food safety program within the industry. Training will only work if it is conducted in conjunction with other activities that enforce and promote the use of the skills that have been taught. The monetary incentive had no effect. However this might be due to the way the incentive was offered, more research work is needed.

Expectancy (as enforcement and role modeling) seems to be more effective in the mushroom industry. Instrumentality was not evident in supervisory actions as reported by both supervisors and workers. This may reflect the cultural expectations of the Hispanic workers when employed in a hierarchical unit.

It was impossible to control the supervisors’ activities. Although efforts were made to provide consistent training and follow-up visits to encourage uniform efforts with the workers, many other businesses related concerns and prejudices about worker supervision overshadowed efforts to follow up with supervisors.

It was clear that food safety training requires resources including time availability for training, planning, follow-up activities, availability of day-to-day
supplies (hairnets, soap, paper towels, adequate toilets etc). Lack of resources will impede food safety compliance.

The HAM was useful to identify the different factors affecting food safety behaviors within this food industry setting and to expose connections between the various players in the worksite. This model therefore can be used in different food industry scenarios to develop food safety training programs for other production and processing situations. The research design focusing on the knowledge and motivational systems was inadequate to predict outcomes. A more controlled study of the different factors in the model affecting food safety behaviors is needed. Further work should examine the normative system and learn more about the environmental system at each work place. An alteration of the normative system by the management and supervisory staff might be the most important step towards proper workers’ food safety behaviors within an industry.

The solution to behavioral change in food safety may be constant enforcing of the rules until the desired behavior becomes a habit. This enforcement should include a designated person within a company who is only responsible for this and other quality control duties. This person would act as an enforcer and a role model and must have a fair method of enforcing rules using courteous communication to the other workers.

This work has some limitations:
The same observer, who also delivered the program, conducted all the observations, which might have affected worker behavior. However to minimize this, a helper accompanied the observer during the observations.

There was no formative evaluation involved. Further work with HAM should include formative evaluation to determine the effect on the normative system and the supervisory activities at each worksite. No rigorous data collection methodology for use with the supervisors was included in the design. Therefore, it is not known what the exact activities of the supervisors were. Nevertheless, the set of retrospective short interviews helped to clarify some of the activities that were happening at the different worksites.

Although they served as a reference, the use of controls with already high levels of the desired behaviors is another limitation. This approach limited the ability to fully compare the workers' food safety behaviors in the experimental tracks with the control group.

The lack of visible handwashing stations at picker sites prevented evaluation of handwashing practices of mushroom pickers. Future research should include pickers in the evaluation.
4.6 REFERENCES


<table>
<thead>
<tr>
<th>LESSON TITLE</th>
<th>LEARNING OBJECTIVES</th>
<th>LESSON ACTIVITIES</th>
</tr>
</thead>
</table>
| **Lesson 1.** FOODBORNE OUTBREAKS TRACED TO PRODUCE | The worker/supervisor will be able to:  
- Describe a foodborne illness  
- Describe a recent foodborne outbreak originating in fresh produce and its impact on patrons, the restaurant, and the produce growers  
- State the impact a foodborne outbreak could have on their work time, job security and family income.  
- List the symptoms of this foodborne illness  
- Identify the likely source of the pathogen causing the illness  
- Identify places in the food system where food can be contaminated with pathogens  
- Describe how mushrooms could contribute to a foodborne outbreak | Discussion of experiences with foodborne illness (ice breaker) using placemats showing food to create a feeling of reality in the classroom  
- Presentation of a case study of a Hepatitis outbreak attributed to green onions  
- Discussion of the similarities between mushroom and green onion production practices  
- Inoculation of Petri film plates with body secretions and surfaces |
| **Lesson 2. MUSHROOM CONTAMINATION** | The worker/supervisor will be able to:  
- Identify contaminants at their mushroom worksite  
- Identify the three types of food contamination  
- Identify actions to prevent mushroom contamination from these contaminants  
- Identify the three types of microbes (good, bad and ugly)  
- Demonstrate how microbes can spread at work  
- Express willingness to keep physical and chemical contaminants away from mushrooms | Presentation of the inoculated Petri film plates followed by discussion about microbes  
- Display and distribution among participants of physical contaminants that have been found in mushrooms followed by discussion about physical and chemical contamination prevention  
- Demonstration with Glo-germ to show students how hands could transfer contaminants to the mushroom surfaces |
| **Lesson 3. PERSONAL HYGIENE** | The worker/supervisor will be able to  
- State how poor personal hygiene directly affects mushrooms safety  
- Demonstrate correct usage of the smocks, hairnets, and gloves.  
- Volunteer to properly use smocks, hairnets, and gloves when handling mushrooms  
- Tell another worker what personal practices must be avoided while handling with mushrooms  
**After this lesson, worker/supervisor will be**  
- More likely to wear clean smocks or jumpsuits, hairnets, and gloves correctly (Behaviors)  
- Avoid wearing personal adornments in the working areas (Behavior)  
- Follow the ‘dress policy’ (Behavior)  
- Put personal needs on hold when working with mushrooms (Behavior) | Discussion using placemats with pictures of actual correct/incorrect personal hygiene practices  
- Demonstration by the instructor of incorrect eating and drinking behaviors while handling mushrooms example. Discussion about appropriate personal hygiene followed  
- The instructor demonstrated improper food safety practices (spitting and picking one’s nose) to show workers that no one would eat a food that have been mishandled (role playing activity) followed by discussion  
- Demonstration and discussion of proper hairnet usage |
<table>
<thead>
<tr>
<th><strong>Lesson 4.</strong> PERSONAL HYGIENE II &amp; HANDWASHING AT WORK</th>
<th><strong>The worker/supervisor will be able to</strong></th>
<th><strong>After completing the lesson, the worker/supervisor will be more likely to</strong></th>
</tr>
</thead>
</table>
|  | - List the four areas of personal hygiene covered in lesson 3-4  
- Describe how wounds can contaminate mushrooms  
- Describe how hands can become contaminated with microbes and transmit them to mushrooms  
- State the importance of hand washing to avoid mushroom contamination  
- Demonstrate how hands can spread germs  
- Explain why gloves are not enough to prevent mushroom contamination  
- List the situations when hand washing is required  
- Demonstrate appropriate glove usage  
- Demonstrate appropriate hand washing techniques  
- Commit to increasing frequency of hand washing at one of three key points during the day (by voting) | - Increase the frequency of hand washing at each of three key points during a workday |
|  | - Glo-germ demonstration to illustrate the importance of handwashing (Good handwashing vs washing using no soap vs quick handwashing with soap) by student volunteers.  
- Demonstration of handwashing efficacy using Petri film plates (Washed hands vs Unwashed hands)  
- Glo germ demonstration to show why it is important to wash hands before wearing gloves  
- Demonstration of correct handwashing procedure by each worker |
Table 4.2. Penn State-Mushroom Industry Food Safety Project Tracks and Variables

<table>
<thead>
<tr>
<th>Track</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Track A</strong></td>
<td></td>
</tr>
<tr>
<td>Mushroom Packinghouse Company Brown1*</td>
<td>1. The food safety educational lessons (knowledge system)</td>
</tr>
<tr>
<td>Mushroom Farm  Company White2</td>
<td>2. The supervisors acting as role models and food safety rules encouragers (motivational system – expectancy &amp; instrumentality)</td>
</tr>
<tr>
<td></td>
<td>3. A monetary incentive (motivational system - valence)</td>
</tr>
<tr>
<td><strong>Track B</strong></td>
<td></td>
</tr>
<tr>
<td>Mushroom Packinghouse Company Red5* Company Green6*</td>
<td>1. The food safety educational lessons (knowledge system)</td>
</tr>
<tr>
<td>Mushroom Farm  Company Pink8</td>
<td>2. The supervisors acting as role models and food safety rules encouragers (motivational system – expectancy &amp; instrumentality)</td>
</tr>
<tr>
<td><strong>Track C</strong></td>
<td></td>
</tr>
<tr>
<td>Mushroom Packinghouse Company Purple3*</td>
<td>1. The food safety educational lessons (knowledge system)</td>
</tr>
<tr>
<td>Mushroom Farm  Company Black4</td>
<td></td>
</tr>
<tr>
<td><strong>Track D</strong></td>
<td></td>
</tr>
<tr>
<td>Mushroom Packinghouse Company Yellow7*</td>
<td>Control Group - No Control</td>
</tr>
<tr>
<td>Mushroom Farm  Company Blue9</td>
<td></td>
</tr>
</tbody>
</table>

* Visible handwashing stations available
Table 4.3. Demographic information of matched data (pre-post test).

<table>
<thead>
<tr>
<th>Variable</th>
<th># of Participants (Percentage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPANY</strong></td>
<td></td>
</tr>
<tr>
<td>TRACK A</td>
<td></td>
</tr>
<tr>
<td>Brown 1</td>
<td>73 (19.57 %)</td>
</tr>
<tr>
<td>White 2</td>
<td>18 (4.82 %)</td>
</tr>
<tr>
<td>TRACK B</td>
<td></td>
</tr>
<tr>
<td>Red 5</td>
<td>39 (10.45 %)</td>
</tr>
<tr>
<td>Green 6</td>
<td>63 (16.89 %)</td>
</tr>
<tr>
<td>Pink 8</td>
<td>12 (3.21 %)</td>
</tr>
<tr>
<td>TRACK C</td>
<td></td>
</tr>
<tr>
<td>Purple 3</td>
<td>61 (16.35 %)</td>
</tr>
<tr>
<td>Black 4</td>
<td>24 (6.43 %)</td>
</tr>
<tr>
<td>TRACK D</td>
<td></td>
</tr>
<tr>
<td>Yellow 7</td>
<td>52 (13.94 %)</td>
</tr>
<tr>
<td>Blue 9</td>
<td>31 (8.30 %)</td>
</tr>
<tr>
<td><strong>JOB POSITION</strong></td>
<td></td>
</tr>
<tr>
<td>Packers</td>
<td>288 (77.21 %)</td>
</tr>
<tr>
<td>Pickers</td>
<td>85 (22.79 %)</td>
</tr>
<tr>
<td><strong>YEARS WORKING for the COMPANY</strong></td>
<td>5.66 ± 5.61 (n=370)</td>
</tr>
<tr>
<td><strong>AGE</strong></td>
<td>37.07 ± 12.84 (n=361)</td>
</tr>
<tr>
<td><strong>SEX</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>190 (50.9 %)</td>
</tr>
<tr>
<td>Female</td>
<td>183 (49.1 %)</td>
</tr>
<tr>
<td><strong>PREVIOUS FOOD SAFETY EDUCATION</strong></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>218 (58.44 %)</td>
</tr>
<tr>
<td>No</td>
<td>152 (40.75 %)</td>
</tr>
<tr>
<td>Missing Data</td>
<td>3 (8.04 %)</td>
</tr>
<tr>
<td><strong>ORIGIN</strong></td>
<td></td>
</tr>
<tr>
<td>Guanajuato State</td>
<td>281 (75.33 %)</td>
</tr>
<tr>
<td>Mexico State</td>
<td>21 (5.63 %)</td>
</tr>
<tr>
<td>Other Mexico’s States</td>
<td>38 (10.19 %)</td>
</tr>
<tr>
<td>USA</td>
<td>4 (1.07 %)</td>
</tr>
<tr>
<td>Other Countries (PR and DR)</td>
<td>20 (5.36 %)</td>
</tr>
<tr>
<td>Missing Data</td>
<td>9 (2.41 %)</td>
</tr>
<tr>
<td><strong>EDUCATION</strong></td>
<td></td>
</tr>
<tr>
<td>0 to 6 years</td>
<td>255 (68.36 %)</td>
</tr>
<tr>
<td>6.1 to 9 years</td>
<td>63 (16.89 %)</td>
</tr>
<tr>
<td>9.1 to 12 years</td>
<td>46 (12.33 %)</td>
</tr>
<tr>
<td>Some College or Bachelor Degree</td>
<td>5 (1.34 %)</td>
</tr>
<tr>
<td>Missing Data</td>
<td>4 (1.07 %)</td>
</tr>
<tr>
<td>Total</td>
<td>373</td>
</tr>
<tr>
<td><strong>INCOME PER WEEK – AFTER TAXES</strong></td>
<td></td>
</tr>
<tr>
<td>$300 or lower</td>
<td>152 (40.75%)</td>
</tr>
<tr>
<td>$301 - $400</td>
<td>123 (32.98%)</td>
</tr>
<tr>
<td>$401 or higher</td>
<td>56 (15.01%)</td>
</tr>
<tr>
<td>Missing Data</td>
<td>42 (11.26%)</td>
</tr>
<tr>
<td>Total</td>
<td>373</td>
</tr>
</tbody>
</table>
Table 4.4. Mushroom packers knowledge scores.

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>N</th>
<th>Pre-Test Score Observed</th>
<th>Post-Test Score Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track A Brown 1</td>
<td>73</td>
<td>5.70±1.63&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.79±0.44&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track B Red 5</td>
<td>39</td>
<td>6.56±1.76</td>
<td>9.95±0.22&lt;sup&gt;d,f,g&lt;/sup&gt;</td>
</tr>
<tr>
<td>Green 6</td>
<td>63</td>
<td>6.11±1.64</td>
<td>9.65±0.65&lt;sup&gt;f,h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track C Purple 3</td>
<td>61</td>
<td>5.84±1.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9.61±0.76&lt;sup&gt;d,e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track D Yellow 7</td>
<td>52</td>
<td>6.79±1.55&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>6.50±1.55&lt;sup&gt;c,e,g,h&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

One-way ANOVA F-value

| F-value | F = 4.791; Significant p = 0.001 | F = 159.041; Significant p = 0.000 |

<sup>a,b,…n</sup> Same letter superscript denotes significant difference on pretest scores (pair-wise comparisons) among companies at the 0.05 level.

Knowledge test scale: 0 = lowest score and 10 = highest score.
Table 4.5. Mushroom *pickers* knowledge scores - No handwashing observations were done.

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>N</th>
<th>Pre-Test Score Observed</th>
<th>Post-Test Score Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Track A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White 2</td>
<td>18</td>
<td>5.17±1.86</td>
<td>9.39±0.70 c</td>
</tr>
<tr>
<td><strong>Track B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink 8</td>
<td>12</td>
<td>6.25±1.71 a</td>
<td>9.75±0.87 d</td>
</tr>
<tr>
<td><strong>Track C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black 4</td>
<td>24</td>
<td>5.13±1.36</td>
<td>9.25±1.22 e</td>
</tr>
<tr>
<td><strong>Track D</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue 9</td>
<td>31</td>
<td>4.71±1.44 a</td>
<td>4.32±1.66 c, d, e</td>
</tr>
<tr>
<td><strong>One-way ANOVA F-value</strong></td>
<td></td>
<td>F= 2.833; Significant p=.043</td>
<td>F= 103.16 Significant p= 0.000</td>
</tr>
</tbody>
</table>

\[a,b,...,n\] Same letter superscript denotes significant difference on pretest scores (pair-wise comparisons) among companies at the 0.05 level. Knowledge test scale: 0 = lowest score and 10 = highest score.
### Table 4.6: ANCOVA knowledge scores for mushroom packers and pickers.

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>N</th>
<th>Pre-Test Score Observed</th>
<th>Post-Test Score Adjusted for Pre-Test (Std Error)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PACKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track A Brown 1</td>
<td>73</td>
<td>5.70 ±1.63</td>
<td>9.863 (0.158)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track B Red 5</td>
<td>39</td>
<td>6.56±1.76</td>
<td>9.957 (0.150)&lt;sup&gt;b,d,e&lt;/sup&gt;</td>
</tr>
<tr>
<td>Green 6</td>
<td>63</td>
<td>6.11±1.64</td>
<td>9.585 (0.108)&lt;sup&gt;d,f&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track C Purple 3</td>
<td>61</td>
<td>5.84±1.43</td>
<td>9.286 (0.163)&lt;sup&gt;b,c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track D Yellow 7</td>
<td>52</td>
<td>6.79±1.55</td>
<td>6.155 (0.166)&lt;sup&gt;a,c,e,f&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>ANCOVA - adjusting for pre-test score)</strong></td>
<td></td>
<td></td>
<td>F = 51.545 Significant p = 0.000</td>
</tr>
<tr>
<td><strong>PICKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track A White 2</td>
<td>18</td>
<td>5.17±1.86</td>
<td>9.310 (0.331)&lt;sup&gt;x&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track B Pink 8</td>
<td>12</td>
<td>6.25±1.71</td>
<td>9.750 (0.362)&lt;sup&gt;y&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track C Black 4</td>
<td>24</td>
<td>5.13±1.36</td>
<td>9.294 (0.319)&lt;sup&gt;z&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track D Blue 9</td>
<td>31</td>
<td>4.71±1.44</td>
<td>5.100 (0.286)&lt;sup&gt;x,y,z&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>ANCOVA - adjusting for pre-test score)</strong></td>
<td></td>
<td></td>
<td>F = 30.192 Significant p = 0.000</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup> Same letter superscript denotes significant difference on posttest scores (pair-wise comparisons) among companies at the 0.05 level.

Knowledge test scale: 0 = lowest score and 10 = highest score.
Table 4.7. Mean values for hand washing compliance rates “BEFORE START WORKING”

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>Mean values for % of compliance Pre-Intervention</th>
<th>Mean values for % of compliance Post-Intervention</th>
<th>Paired t-test t value (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Track A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown 1</td>
<td>5.866 ± 0.75&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>66.15 ± 6.30&lt;sup&gt;a,d,e,f&lt;/sup&gt;</td>
<td>-16.434* (0.004)</td>
</tr>
<tr>
<td><strong>Track B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red 5</td>
<td>10.96 ± 3.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>90.32 ± 6.27&lt;sup&gt;d,g,h&lt;/sup&gt;</td>
<td>-15.193* (0.004)</td>
</tr>
<tr>
<td>Green 6</td>
<td>10.42 ± 7.18&lt;sup&gt;c&lt;/sup&gt;</td>
<td>18.40 ± 3.81&lt;sup&gt;b,e,g&lt;/sup&gt;</td>
<td>-1.280 (0.329)</td>
</tr>
<tr>
<td><strong>Track C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple 3</td>
<td>4.47 ± 2.50&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.74 ± 3.32&lt;sup&gt;c,f,h&lt;/sup&gt;</td>
<td>-0.400 (0.728)</td>
</tr>
<tr>
<td><strong>Track D</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow 7</td>
<td>81.21 ± 6.75&lt;sup&gt;a,b,c,d&lt;/sup&gt;</td>
<td>90.52 ± 2.58&lt;sup&gt;a,b,c&lt;/sup&gt;</td>
<td>-1.870 (0.202)</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 137.130 Significant p=0.000</td>
<td>F= 215.46 Significant p=0.000</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b…n</sup> Same letter superscript denotes significant difference on handwashing scores “before starting work” (pair-wise comparisons) among companies at the 0.05 level.

* Pre and Post handwashing compliance rates were significantly different at the 0.01 level when compared through a paired t-test.
**Table 4.8. Mean values for hand washing compliance rates “AFTER EACH BREAK”**

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>Mean values for % of compliance</th>
<th>Mean values for % of compliance</th>
<th>Paired t-test t value (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Track A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown 1</td>
<td>Pre-Intervention: 15.78 ± 0.48 (^{a,e})</td>
<td>Post-Intervention: 77.29 ± 10.55 (^{a,b})</td>
<td>-9.799* (0.010)</td>
</tr>
<tr>
<td><strong>Track B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red 5</td>
<td>Pre-Intervention: 29.01 ± 14.11 (^{b})</td>
<td>Post-Intervention: 80.00 ± 5.64 (^{c,e})</td>
<td>-4.498* (0.046)</td>
</tr>
<tr>
<td>Green 6</td>
<td>Pre-Intervention: 12.5 ± 0 (^{c,e \oplus})</td>
<td>Post-Intervention: 25.11 ± 3.99 (^{b,e,f})</td>
<td>-5.460* (0.032)</td>
</tr>
<tr>
<td><strong>Track C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple 3</td>
<td>Pre-Intervention: 11.20 ± 3.56 (^{d})</td>
<td>Post-Intervention: 12.70 ± 7.20 (^{a,c,d})</td>
<td>-0.312 (0.785)</td>
</tr>
<tr>
<td><strong>Track D</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow 7</td>
<td>Pre-Intervention: 78.48 ± 7.08 (^{a,b,c,d})</td>
<td>Post-Intervention: 87.37 ± 5.20 (^{d,f})</td>
<td>-1.493 (0.274)</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 45.94 Significant p=0.000</td>
<td>F= 76.25 Significant p=0.000</td>
<td></td>
</tr>
</tbody>
</table>

\(^{a,b,...n}\) Same letter superscript denotes significant difference on handwashing scores “after each break” (pair-wise comparisons) among companies at the 0.05 level.

* Pre and Post handwashing compliance rates were significantly different at the 0.05 level when compared through a paired t-test.

\(^{\oplus}\) The three observations that were carried out at this company yielded exactly the same handwashing compliance rates of 12.5%.
Table 4.9. Mean values for hand washing compliance rates “AFTER USING THE RESTROOM”

<table>
<thead>
<tr>
<th>Track &amp; Worksite</th>
<th>Mean values for % of compliance Pre-Intervention</th>
<th>Mean values for % of compliance Post-Intervention</th>
<th>Paired t-test t value (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Track A</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown 1</td>
<td>77.91 ± 2.69&lt;sup&gt;a&lt;/sup&gt;</td>
<td>98.57 ± 1.24</td>
<td>-9.190* (0.012)</td>
</tr>
<tr>
<td><strong>Track B</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red 5</td>
<td>88.09 ± 10.91</td>
<td>100.0 ± 0</td>
<td>-1.890 (0.199)</td>
</tr>
<tr>
<td>Green 6</td>
<td>58.42 ± 11.42</td>
<td>97.88 ± 1.91</td>
<td>-7.015* (0.020)</td>
</tr>
<tr>
<td><strong>Track C</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple 3</td>
<td>41.31 ± 19.78&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>94.5 ± 6.38</td>
<td>-6.871* (0.021)</td>
</tr>
<tr>
<td><strong>Track D</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow 7</td>
<td>87.08 ± 6.34&lt;sup&gt;b&lt;/sup&gt;</td>
<td>97.42 ± 2.25</td>
<td>-2.168 (0.162)</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 8.920 Significant p=0.002</td>
<td>F= 1.206 Not Significant p=0.367</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b,…n</sup> Same letter superscript denotes significant difference on handwashing scores “after using the restroom” (pair-wise comparisons) among companies at the 0.05 level.
* Pre and Post handwashing compliance rates were significantly different at the 0.05 level when compared through a paired t-test.
Table 4.10. Mean values for NON-compliance rates of HAIRNET usage before and after the intervention

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>Mean values for % of NON-compliance Pre-Intervention</th>
<th>Mean values for % of NON-compliance Post-Intervention</th>
<th>Paired t-test t value (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PACKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown 1</td>
<td>30.945 ± 12.93</td>
<td>5.30 ± 2.027&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>3.966*&lt;sup&gt;(0.029)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red 5</td>
<td>13.13 ± 6.38&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.94 ± 2.46&lt;sup&gt;c&lt;/sup&gt;</td>
<td>1.181&lt;sup&gt;(0.323)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Green 6</td>
<td>27.09 ± 8.30</td>
<td>11.94 ± 2.59&lt;sup&gt;b,d,f&lt;/sup&gt;</td>
<td>3.522*&lt;sup&gt;(0.039)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple 3</td>
<td>41.63 ± 8.94&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>34.17 ± 2.07&lt;sup&gt;a,c,d,e&lt;/sup&gt;</td>
<td>1.361&lt;sup&gt;(0.267)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow 7</td>
<td>17.895 ± 6.55&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.18 ± 2.15&lt;sup&gt;e,f&lt;/sup&gt;</td>
<td>3.958*&lt;sup&gt;(0.029)&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 6.271 Significant p= 0.004</td>
<td>F= 109.305 Significant p=0.000</td>
<td></td>
</tr>
<tr>
<td><strong>PICKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White 2</td>
<td>37.55 ± 3.665&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.517 ±3.04</td>
<td>11.916*&lt;sup&gt;(0.001)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink 8</td>
<td>40.40 ± 9.84&lt;sup&gt;d&lt;/sup&gt;</td>
<td>18.72 ± 5.21&lt;sup&gt;g&lt;/sup&gt;</td>
<td>8.634*&lt;sup&gt;(0.003)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black 4</td>
<td>35.09 ± 7.99&lt;sup&gt;e&lt;/sup&gt;</td>
<td>13.62 ± 6.80</td>
<td>2.927&lt;sup&gt;(0.061)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Track D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue 9</td>
<td>14.12 ± 3.096&lt;sup&gt;c,d,e&lt;/sup&gt;</td>
<td>5.817 ± 3.45&lt;sup&gt;g&lt;/sup&gt;</td>
<td>3.175*&lt;sup&gt;(0.050)&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 12.503 Significant p= 0.001</td>
<td>F= 5.196 Significant p=0.016</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b,...</sup> Same letter superscript denotes significant difference on “hairnet usage NON-compliance rates” (pair-wise comparisons) among companies at the 0.05.

<sup>*</sup> Pre and Post hairnet usage NON-compliance rates were significantly different at the 0.05 level when compared through a paired t-test.
Table 4.11. Mean values for NON-compliance rates of JEWELRY usage before and after the intervention

<table>
<thead>
<tr>
<th>Track Worksite</th>
<th>Mean values for % of NON-compliance Pre-Intervention</th>
<th>Mean values for % of NON-compliance Post-Intervention</th>
<th>Paired t-test t value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PACKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brown 1</td>
<td>4.25 ± 1.25&lt;sup&gt;a,b,c,d&lt;/sup&gt;</td>
<td>1.83 ± 1.35&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>3.951* (0.029)</td>
</tr>
<tr>
<td>Track B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red 5</td>
<td>0.00 ± 0.00&lt;sup&gt;b,e,g&lt;/sup&gt;</td>
<td>0.66 ± 1.32&lt;sup&gt;c,f&lt;/sup&gt;</td>
<td>-1.000 (0.391)</td>
</tr>
<tr>
<td>Green 6</td>
<td>34.13 ± 2.71&lt;sup&gt;c,g,h&lt;/sup&gt;</td>
<td>14.395 ± 2.77&lt;sup&gt;b,d,f,g&lt;/sup&gt;</td>
<td>12.155* (0.001)</td>
</tr>
<tr>
<td>Track C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purple 3</td>
<td>36.96 ± 9.37&lt;sup&gt;a,e,f&lt;/sup&gt;</td>
<td>29.41 ± 4.28&lt;sup&gt;a,c,d,e&lt;/sup&gt;</td>
<td>1.284 (0.289)</td>
</tr>
<tr>
<td>Track D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow 7</td>
<td>0.675 ± 1.35&lt;sup&gt;d,f,h&lt;/sup&gt;</td>
<td>0.00 ± 0.00&lt;sup&gt;e,g&lt;/sup&gt;</td>
<td>1.000 (0.391)</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 70.753 Significant p= 0.000</td>
<td>F= 109.352 Significant p= 0.000</td>
<td></td>
</tr>
<tr>
<td><strong>PICKERS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White 2</td>
<td>11.507 ± 3.394&lt;sup&gt;i&lt;/sup&gt;</td>
<td>3.03 ± 3.50&lt;sup&gt;h&lt;/sup&gt;</td>
<td>2.623 (0.079)</td>
</tr>
<tr>
<td>Track B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink 8</td>
<td>11.77 ± 5.27&lt;sup&gt;j&lt;/sup&gt;</td>
<td>5.147 ± 4.16&lt;sup&gt;i&lt;/sup&gt;</td>
<td>2.428 (0.093)</td>
</tr>
<tr>
<td>Track C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black 4</td>
<td>33.9813 ± 7.84&lt;sup&gt;i,j,k&lt;/sup&gt;</td>
<td>32.85 ± 4.04&lt;sup&gt;h,i,j&lt;/sup&gt;</td>
<td>0.253 (0.816)</td>
</tr>
<tr>
<td>Track D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue 9</td>
<td>5.55 ± 6.167&lt;sup&gt;k&lt;/sup&gt;</td>
<td>0.000 ± 0.000&lt;sup&gt;i,j&lt;/sup&gt;</td>
<td>1.801 (0.169)</td>
</tr>
<tr>
<td><strong>ONE-WAY ANOVA</strong></td>
<td>F= 18.074 Significant p= 0.000</td>
<td>F= 80.493 Significant p= 0.000</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a,b,…n</sup> Same letter superscript denotes significant difference on “hairnet usage NON-compliance rates” (pair-wise comparisons) among companies at the 0.05.

* Pre and Post jewelry usage NON-compliance rates were significantly different at the 0.05 level when compared through a paired t-test.
Table 4.12. Summary of results of the workers’ retrospective interviews.

<table>
<thead>
<tr>
<th>Worksite</th>
<th>Prior to Lessons</th>
<th>Immediate Post-Lessons</th>
<th>Five Months After the Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown 1</td>
<td>In the beginning, they [management and supervisors] did not care about cleaning during the day and rules about hairnets, candies, gloves, jewelry and handwashing were not enforced. Supplies needed like paper towels and soap were not always available. Many workers did not follow personal hygiene rules.</td>
<td>The majority of workers felt that right after the lessons, people followed the rules, management’s interest was evident and the supervisors were checking more often. One worker indicated that supervisors mainly gave advice, but after a while some people forgot. Others indicated management did not worry until the lessons occurred and then things were checked. Some felt there was more emphasis on rules right after the lessons but it was back to pre-lesson interest. Others felt that interest in enforcing the rules was higher after the lessons and has grown stricter since then.</td>
<td>Management supplies the workers with everything needed to follow the rules. Workers report they are checked and asked to follow the rules and sometimes suspended if they do not. However, emphasis is on hairnets, gloves and chewing gum now. Handwashing is checked less rigorously perhaps because workers are thought to know to do this. Supervisors vary in attention to checking workers, depending on their workload and other responsibilities. If the supervisor is lax, some people [workers] get relaxed about the rules. However, several workers thought the management was stricter and better now about food safety. This shift to stricter and better became more evident when workers thought about conditions prior to the lessons.</td>
</tr>
<tr>
<td>Red 5</td>
<td>Handwashing through the day was casual and only became important when an inspector would show up. Smocks were optional and proper use of hairnets and gloves was not enforced. People did not see poor personal hygiene as a risk and were not conscious of the rules, including the QC staff. Even upper management was not as vested since they could not give reasons for enforcing hygiene rules.</td>
<td>Upper management, through one woman, expressed support for following the rules and delegated the enforcement to the QC staff, who were more aware, looked for things and issued warnings about the rules. For a while, handwashing was checked and enforced by one person. Upper management would visit the plant to see if the program was working and if they (the QC staff) did serve as role models.</td>
<td>Immediate supervisors check and remind workers of what needs to be done and tell workers to wash their hands, use hairnets, no jewelry and may give a warning. However, supervisors are more worried about the mushroom orders, although they do serve as role models. Management supports the idea of wearing hairnets and gloves but real enforcement is delegated to the Quality Control (QC) staff who are women and who remind people to wash their hands, etc. Workers report that ‘regular workers’ know what to do, but new workers have to be trained.</td>
</tr>
<tr>
<td>Green 6</td>
<td>Rules were not enforced. There were times when there was no soap and paper towels were not replaced. There was very little checking of jewelry, hairnets were not worn properly or at all, and handwashing was not considered very important.</td>
<td>After the lessons, the rules changed and the supervisor checked everything, including jewelry and chewing gum. Things became stricter but handwashing was not checked as much as other activities. One worker reported threats of suspension for three days if a rule was broken. Workers did not attribute this change in concern about personal hygiene to upper management’s interest.</td>
<td>Majority of workers feel that upper management does not worry about personal hygiene rules. In fact they have announced they are not going to give reminders any more as they think we know what to do. Supervisors are inconsistent about checking for infractions. Sometimes paper towels and soap are missing. Personal hygiene, including handwashing, is seen as a personal responsibility. There is little enforcement so compliance is limited. Infractions can be noted in reports passed to upper management but the degree of concern among workers about these varies greatly.</td>
</tr>
</tbody>
</table>
Table 4.12 (cont.). Summary of results of the workers’ retrospective interviews.

<table>
<thead>
<tr>
<th>Worksite</th>
<th>Prior to Lessons</th>
<th>Immediate Post-Lessons</th>
<th>Five Months After the Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple 3</td>
<td>People have been using jewelry and hairnets not properly secured for a long time. Rules are not really enforced. People did not pay attention to rules unless an inspector was coming to the company.</td>
<td>People were somewhat worried after the lessons but with no management or supervisory commitment, not much happened at this worksite. Supervisor and management are busy with the mushroom orders and some other duties in the production floor, leaving food safety rules out of the priorities. There was a feeling that the lessons provided by the instructor flew over the heads of this company.</td>
<td>Not much has changed since before the lessons. Rules are not strictly enforced. Management does not worry as much as it should. The program did not work here because people did not do as the instructor asked them to do. People do not follow the rules. Many people still wear jewelry and rings and do not wear their hairnets properly. This worksite does not demonstrate the importance of management and supervisory commitment.</td>
</tr>
<tr>
<td>Yellow 7</td>
<td>A food safety program was already in place before the current intervention. Most people were following the rules with the exception of new employees and few people. There was a QC person in charge of food safety related activities.</td>
<td>People are aware of the rules and the appointed QC person enforced the rules. All food safety and quality issues responsibilities are delegated to this person. Therefore, supervisors are free to work on the mushroom orders. No changes were reported on the way things work at this worksite. New hires were reported for not following the rules.</td>
<td>Most people always follow the rules here although there is always someone who does not follow the rules. The upper management asks the workers to follow the rules. There is a true management commitment to food safety but all the work is delegated to a QC team.</td>
</tr>
</tbody>
</table>
Table 4.13. Summary of results of the supervisors’ retrospective interviews.

<table>
<thead>
<tr>
<th>Worksite</th>
<th>Immediate Post-Lessons</th>
<th>Five Months After-Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown 1</td>
<td>The management took a stance on this topic and had a meeting with the workers to tell them they were serious about the rules. The management comes through every day checking for hairnets and gloves, asking those out of compliance politely to fix it. Supervisors are not sure if management pays attention to hand washing.</td>
<td>The management keeps coming in to check for hairnets. Food safety commitment has increased over the time. Other food safety changes have occurred. Supplies are always available and workers have unlimited access to them.</td>
</tr>
<tr>
<td>Red 5</td>
<td>Supervisors reported that giving reminders of the lessons content was enough to have people remembering the importance of handwashing. They watched and reminded people until they did not have to do it anymore. Supervisors reported they washed their hands often to be role models for workers.</td>
<td>The QC team tells people to wash hands, use hairnets, no jewelry. People have gotten used to following the rules. Even the contract workers know to follow the rules now. New workers might be a problem. There is a strong management commitment.</td>
</tr>
<tr>
<td>Green 6</td>
<td>Management told workers they had the responsibility to follow through. A person is responsible for providing all the necessary supplies for complying with the rules. Management did come to the packing site several times and talk to workers but the efforts faded as time passed. Changes were implemented after the lessons.</td>
<td>The management goes inside the plant. They do sometimes check people and tell them what to do but this is not a specific assignment. It occurs as they do other jobs. The responsibility for doing this is passed to one person in charge of enforcing the rules and to other supervisors. But supervisors are busy processing the orders.</td>
</tr>
<tr>
<td>Purple 3</td>
<td>Same commitment – no different than now. The supervisor did talk to the workers and tell them to follow the rules and some people did get the point and some did follow the rules. Supervisor pointed out that to have the program working there is a need for enforcement, but this is not possible because the mushroom orders are a priority to him.</td>
<td>Supervisors claim the program is working and compliance is better than before. Supervisor claims that it is very difficult to keep program working. You do have to keep telling people to comply. Upper management does not worry about this at all. The management comes and tells the supervisor to get things in line when the inspector is coming. They give the supervisor all the responsibility and he can’t do it all since he is the only one on the production floor. There is no management commitment.</td>
</tr>
<tr>
<td>Yellow 7</td>
<td>The management is concerned about the food safety rules but they do delegate this task to the QC person. People generally followed the rules and most people washed their hands.</td>
<td>The management approves whatever supply is needed. They provide the QC person with the supplies they need to do their job and to enforce the rules. It is difficult for supervisors to be aware of the rules because they do have the order priorities. Food Safety is very important but as in other places the production remains a priority. The QC person takes care of the food safety rules while supervisors are in charge of the mushroom orders. Around 90% of people wash their hands and most workers are concerned about following the rules. There is strong management commitment.</td>
</tr>
</tbody>
</table>
Figure 4.1 The Health Action Model proposed by Rennie (1995) for use in food safety and modified for the Hispanic Mushroom Worker Food Safety Program.

*Indicates that the system was addressed in the intervention.
Figure 4.2 Time line for the needs assessment, program development and steps in pilot test.
Figure 4.3 An example of the typical handwashing observation time slots used by the researcher at each mushroom worksite.
Pre and Adjusted-Post Knowledge Mean Scores for "Packers"

Figure 4.4 Comparison of mushroom packers knowledge scores before and after the intervention (knowledge test scale: 0 = lowest score and 10 = highest score).
Figure 4.5 Comparison of mushroom pickers knowledge scores before and after the intervention (knowledge test scale: 0 = lowest score and 10 = highest score).
Figure 4.6 Comparison of mean values for hand washing compliance rates Handwashing “Before Start Working”. Bolded italics denote significant difference (0.05 level) between that pair of values.
Handwashing Compliance "AFTER EACH BREAK"

Figure 4.7 Comparison of mean values for hand washing compliance rates Handwashing “After Each Break”. Bolded italics denote significant difference (0.05 level) between that pair of values.
Handwashing Compliance "AFTER USING THE RESTROOM"

Figure 4.8 Comparison of mean values for hand washing compliance rates Handwashing “After Using the Restroom”. Bolded italics denote significant difference (0.05 level) between that pair of values.
Hairnet Usage Non-Compliance "Packers"

Figure 4.9 Comparison of packers mean values for non-compliance rates of HAIRNET usage before and after the intervention. Bolded italics denote significant difference (0.05 level) between that pair of values.
Figure 4.10 Comparison of *pickers* mean values for non-compliance rates of HAIRNET usage before and after the intervention. Bolded italics denote significant difference (0.05 level) between that pair of values.
Jewelry Usage Non-Compliance "Packers"

Figure 4.11 Comparison of packers mean values for non-compliance rates of JEWELRY usage before and after the intervention. Bolded italics denote significant difference (0.05 level) between that pair of values.
Figure 4.12 Comparison of *pickers* mean values for non-compliance rates of JEWELRY usage before and after the intervention. Bolded italics denote significant difference (0.05 level) between that pair of values.
CHAPTER 5

GENERAL CONCLUSIONS

5.1 THE NEEDS ASSESSMENT

This research study utilized a modified version of the Health Action Model (HAM) proposed by Rennie (1995) for using in food safety research. To increase the specificity of the HAM construct of motivational system, expectancy theory (ET) by Vroom (Campbell and Pritchard, 1983; Tubbs, et al., 1993) was added.

This modified version of HAM (HAM plus ET) was used to design and conduct a needs assessment in the PA mushroom industry to provide data upon which a food safety education program would be based. By using this framework, factors were identified that should be taken into account in designing an educational intervention for Hispanic workers in the mushroom industry. The breadth of information gathered using the HAM, led the authors to believe that the level of knowledge, worker attitudes, and beliefs that influenced the practices observed in this part of the study are likely to be similar to those present in many other food production and processing facilities. The information gathering process included an observation exercise and a focus group at each worksite (N = 7 total) and 10-12 interviews/worksite (N = 100 total). Each method explored one or more systems of the model. The information was triangulated across the model and used to develop the educational materials by answering five research questions, one for each of the HAM systems.

1. Knowledge system.

• What do the workers know about food safety?
Workers did not achieve high scores on the knowledge test, indicating poor understanding of the reasons why food safety rules must be followed.

2. Normative system.

- What are the norms and rules followed in the mushroom growing and packing facilities?

Scores on normative interview questions indicated socially acceptable agreement with good food safety practices. However, focus groups indicated food safety rules were not necessarily followed and there was little social support among the workers or from management to actively follow the rules. Few role models were evident among management or supervisors. In addition, supervisors generally were not even-handed in enforcing the rules and their lack of courtesy contributed to poor worker morale. Direct on-site observations generally confirmed that food safety practices were not consistently followed and that enforcement was haphazard.

3. Motivational system.

- What factors motivate the workers to follow the food safety rules?

Focus groups revealed extra effort by workers did not lead to team building or support of correct practices (expectancy low), that many workers felt ‘following the rules’ was not recognized or rewarded (instrumentality low), and that, if rewards were offered, these had little value to workers (valence low). Most companies did not have an active incentive program to increase motivation to follow the food safety rules. Mushroom workers wanted ‘more recognition for hard work, good performance and good behavior from management,’ more use
of good manners in enforcement, and rewards to be meaningful (i.e. a jacket instead of a keychain or a money certificate instead of a pen).

4. Food safety belief system.
   • What are their beliefs and attitudes about food safety and foodborne illness?
   Socially acceptable responses on the interview belief questions did not agree with the findings from focus groups. Resentment of restrictions on personal behavior surfaced and misconceptions about cleaning and sanitizing, food spoilage and foodborne illness emerged. Their beliefs did not support connections between their personal actions and possible bad food safety outcomes.

5. The worksite environmental system.
   • What is the worker’s working environment like?
   Observations indicated that infractions of food safety rules and behaviors were common. Physical resources were available to support sanitation but degree of cleanliness of worksite, restrooms and personnel varied across companies. Workers were aware of these resources and were receptive to following rules but training and communication about rules and their enforcement was generally poor. Most companies needed to create a more supportive environment for food safety practices.

These findings illustrate the specific advantages of using HAM to design a needs assessment which include a) broadening an investigation to the social and physical environment in addition to just examining worker characteristics, b) allowing data triangulation which can explain why something is or is not
happening, and c) exposing connections between the various players in the worksite. It was felt that the HAM model has wide applicability to a variety of industry settings and thus can be used as a guide to develop customized food safety educational materials at a variety of different settings and target audiences in food production facilities.

5.2 THE WORKER EXPERIENCE-PROTOCOL

No reports of an ‘observation method’ applicable to conducting a needs assessment for food safety training in a food production setting were found. To address this gap in methodology, a ‘Worker-Experience Protocol’ (WEP) was developed, in which a person unconnected to either the regulatory system or the food company, served as a ‘worker’ as a way to make direct observations of company operations and worker behaviors. In this part of the thesis work, it was postulated that this protocol would provide valuable and unique information that would be useful in designing a food safety program. This work concluded that WEP does offer some unique advantages for monitoring and evaluating the implementation of a food safety program within an industry setting. These advantages include:

- WEP offers a fast, inexpensive method to gain a well rounded impression of worker and management actions and interactions around food safety at one time point or repeated time points.
- WEP permits an outsider with ‘new’ eyes to evaluate an operation and provide a fresh perspective on operations.
• WEP allows periodic examination of company operations so that emerging food safety problems can be addressed.
• WEP allows periodic examination of behavioral outcomes of any food safety training so that problems that persist can be corrected.

It was concluded that others would find the WEP useful and could extend its usefulness through further testing.

### 5.3 DEVELOPMENT AND PILOT TESTING OF THE FOOD SAFETY EDUCATIONAL MATERIALS AND TRAINING STRATEGIES.

In the final part of this work a pilot food safety educational program was developed and evaluated. In testing this program, the following research hypotheses were examined:

**Hypothesis 1:** Workers completing the pilot food safety program will achieve significantly higher scores on a knowledge/skill test than workers with no exposure to the program immediately post program.

This hypothesis was accepted as workers in all three experimental tracks (A-C) completing the program did achieve significantly higher knowledge scores than workers with no exposure (the control track D) in immediate post program assessment. In addition all people who completed the program demonstrated proper hairnet usage during a skill test. Incorporating adult education principles, hands on activities and skill building resulted in both knowledge gain and some improvement in skills featured.

**Hypothesis 2:** Handwashing frequency at critical points in the workday [(1)-before starting work in the morning, (2) after using the restroom, and (3) at
the end of breaks] will not differ significantly between companies in which most workers participate in the pilot food safety program and those with no exposure to the program at 8 weeks post program.

It was believed that the pilot program may increase compliance with desired handwashing behaviors since these were emphasized in the lessons with a variety of hands-on activities. When comparing tracks C and D, evidence suggested that the program alone significantly increase frequency of washing hands after using the restroom. But no other handwashing behaviors were significantly affected in track C. Thus H2 is accepted. Incorporating adult education principles, hands on activities and skill building resulted in some improvements in a more familiar handwashing situation but not in its frequency in less familiar situations.

**Hypothesis 3:** Companies in which most workers participate in the pilot food safety program and where supervisory motivation occurs will demonstrate greater handwashing frequency at critical time points in the workday [(1)-before starting work in the morning, (2) after using the restroom, and (3) at the end of breaks] than those companies exposed to the program where supervisory motivation does not occur at 8 weeks post program compared to pre program.

This study demonstrated that the provision of knowledge/skills was not enough to alter less familiar handwashing behaviors. Workers who received supervisory motivation’ (acting as a role model, enforcing and reinforcing correct behavior) showed higher compliance with all handwashing behaviors than
workers who just received knowledge/skills. Comparison of track B and C and comparison of red 5 with green 5 within track B support this. Therefore, H3 is accepted.

These findings led us to conclude that training must be followed by the involvement of the supervisory personnel in enforcement of behavioral rules. Management support of the supervisory role will increase the success in any food safety program within the industry. Training will only work if it is conducted in conjunction with other activities that enforce and promote the use of the skills that have been taught. Expectancy (as enforcement and role modeling) seems to be more effective in the mushroom industry. Instrumentality was not evident in supervisory actions as reported by both supervisors and workers. This may reflect the cultural expectations of the Hispanic workers when employed in a hierarchical unit.

**Hypothesis 4:** Among companies in which most workers participate in the pilot food safety program and supervisory support occurs, those in which an economic incentive is offered will demonstrate greater handwashing frequency at critical points in the workday [(1)-before starting work in the morning, (2) after using the restroom, and (3) at the end of breaks] than those companies receiving no economic incentive at 8 weeks post program compared to pre-program.

Comparing tracks A and B, it was demonstrated that offering a monetary incentive to workers did not have an effect on the tested food safety behaviors [(1)-before starting work in the morning, (2) after using the restroom, and (3) at
the end of breaks] perhaps due to the way the incentive was offered. Therefore H4 is rejected.

5.3.1 The Health Action Model
The HAM was useful to identify the different factors affecting food safety behaviors within this food industry setting and to expose connections between the various players in the worksite. This model therefore can be used in different food industry scenarios to develop food safety training programs for other production and processing situations.

5.4 LIMITATIONS AND FUTURE RESEARCH DIRECTIONS
Results from this research work have limitations.

5.4.1 Needs Assessment
The sample involved in the interviews and focus groups may not have represented the knowledge and views of all workers in participating companies. The number of focus groups was determined by funding and not by saturation of the data. Future work should consider conducting more focus groups discussions until saturation is reached.

Since one person performed all the needs assessment tasks in a company within a couple of days, the observation period might not have been long enough to detect subtle patterns in workers behaviors. Therefore if a similar project is conducted a bigger sample of workers should be included in the needs assessment and a longer period of observation at each company should be also considered.
Nevertheless, the authors believe that a HAM-based needs assessment provides a sound basis for designing a food safety training program for Hispanic mushroom workers.

5.4.2 Pilot Program Evaluation

All the observations (handwashing, hairnets and jewelry usage) were made by the same researcher who delivered the program, although a helper accompanied the observer during the observations. This could have led workers to modify behaviors when noting the researcher’s presence. If this project were to be conducted again a person non-related to the research team could conduct the observations of the food safety behaviors.

No rigorous data collection methodology for use with the supervisors was included in the design. As mentioned above supervisors play a key role on program implementation. It is not known what the exact activities of the supervisors were when the researcher was not at the worksite. Therefore some ongoing formative evaluation would have been helpful. Further research should monitor supervisory activities more closely to make sure they get involved in the activities related to the food safety program. A daily activity checklist, written records and more accurate checking procedures could have helped to monitor their activities during the waiting period.

A set of retrospective short interviews helped to clarify some of the activities that were happening at the different worksites. However these interviews were conducted with a small sample of workers who might not have been aware of the supervisory activities and/or the changes at the worksite. The
interviews could have been done with a broader sample of workers at each worksite and continued until reaching data saturation.

Although they served as a reference, the use of controls with already high levels of the desired behaviors is another limitation. This limited the ability to truly compare the change in workers’ food safety behaviors between the experimental tracks and the control group. Further research must use a true control site with low levels of food safety compliance.

5.4.3 Recommendations for Improving the Protocol

The needs assessment focused on the workers and gathered limited data on management, mainly through observations and the informal introductory meetings that were held at each participating company to explain the project. Since management plays a key role in program implementation, future work should include interviews with supervisors and other members of the management team to obtain their opinions about how they cope with food safety issues within the company.

Future work should consider using a third party observer in both the needs assessment and as program evaluators.

The Health Action Model was useful to identify the different factors affecting food safety behaviors within this food industry setting and to expose connections between the various players in the worksite. This model therefore can be used in different food industry scenarios to develop food safety training programs for other production and processing situations. However, our focus on the knowledge and motivational system was inadequate to predict outcomes.
Some systems of HAM were left out of the program evaluation. Further work should examine the normative system and learn more about the environmental system at each work place. An alteration of the normative system by the management and supervisory staff might be the most important step towards proper workers’ food safety behaviors within an industry. A more controlled study of the different factors in the model affecting food safety behaviors is needed.

5.4.4 Recommendations for Program Delivery Improvement

Due to mushroom production constraints, the time between lessons varied across worksites. A four-week delay occurred between lesson 2 and 3 because of mushroom production demands during the Thanksgiving-Christmas holiday season and program continuity might have been lost. However lesson 3 started with a review of the first two lessons. In addition, because all the lessons were conducted during working hours, the group size for each lesson varied considerably due to production constraints and each session had a somewhat different group dynamic due to personalities and participation patterns.

Finally, workers days off and vacation prevented all workers from completing each of the 4 lessons. However, most workers at most worksites received the entire program. It is not known how this could have affected program outcomes. Future work should keep lessons as close as possible to the original plan to get all employees through the entire program. It might be possible to reduce the number of lessons to three from four without diminishing the quality and content of the program. Case studies would be useful to determine if these suggestions would have a positive outcome effect.
5.4.5 Recommendations for Mushroom Industry

Food safety training of employees is something that should be taken seriously within the mushroom industry. The program developed in this work might be used to standardize training across the industry. Another option for further work within the industry can be the use of the train-the-trainer model. The QC personnel and supervisors could be trained and then they would train the other workers. Case studies could help to evaluate the effectiveness of the train-the-trainer model. However any positive effect that training may have on worker knowledge and attitudes may not translate into behavioral changes if environmental conditions are such that workers cannot comply with food safety rules. Therefore, it would be necessary to assure that worksites that start training have the appropriate environmental conditions such as adequate restrooms, handwashing facilities, provision of gloves and hairnets.

After completing this research, this author believes that the mushroom industry as a whole should adopt a single food safety management system that encompasses elements that would ensure the production of safe mushrooms and that meets regulatory and customer food safety requirements.

Currently, the mushroom industry must comply with several different standards and requirements; therefore the adoption of a common food management system industry wide would save money in the long run. The big mushroom producers should not only encourage but help the small mushroom farms that supply product to them to adopt a food safety management system. To achieve this, it would be necessary to start by evaluating small farms to make
sure they are equipped according to basic food safety principles (i.e. the provision of adequate handwashing facilities). The lack of visible handwashing stations at picker sites prevented evaluation of handwashing practices of mushroom pickers. Pickers can be a serious source of contamination to mushrooms. Therefore, future research should include pickers in program evaluation to provide a clearer picture of the workers' food safety behaviors in the entire mushroom production chain. Food safety programs at the farm level are something that big mushroom customers will be looking for in the very near future.

5.5 IMPLEMENTATION AND EVALUATION OF A FOOD SAFETY TRAINING PROGRAM IN THE MUSHROOM INDUSTRY - A PROPOSED CASE STUDY

The case study below is a suggestion for further research work on food safety training with the mushroom industry. More specifically, a hypothetical case for working with mushroom companies will be presented.

The case study will be based on HAM. However some assumptions, such as the training needs will be made since this research demonstrated that food safety needs are similar across the mushroom industry.

The case study will be focused in two systems, the environmental and the normative systems identified in the HAM. Management and supervisors will play a key role for this case study since it will evaluate the influence of managers and supervisors during the implementation of a food safety program at one worksite. The supervisors will also be essential in this case study since they will be in charge of food safety issues plus enforcing and encouraging workers to follow
the rules. The first step will be to work with the top management to make sure they understand the scope of the project.

After consulting with the top management, the environmental system of the company will be evaluated and no training will be conducted until the worksite has all the appropriate environmental conditions for food safety compliance. Special attention will be given to handwashing facilities. Other worksite physical conditions include but are not limited to water supply and facility lay out to avoid cross-contamination between raw compost and mushrooms. The researchers, a member of the top management, and a supervisor will conduct the evaluation of the worksite.

An open-ended interview with the top management, foreman, supervisors, and some workers will help to elucidate the normative system within that worksite. The top management and supervisors will be also asked questions about the food safety challenges that are encountered in their daily operations.

That data obtained from the worksite environment and the normative system will be analyzed and results will be included in the program.

The Penn State food safety educational program will be used for training the workers, but it will use a three-lesson format. The lessons will be given to workers weekly. A knowledge evaluation, before and after the program, will be included as a marker for attention to the lesson content.

After all the workers and supervisors complete the lessons, the researcher will train the supervisors in food safety self-inspection practices, food safety paperwork completion, and how to enforce and motivate workers to follow the
food safety rules. The researcher will be at the worksite on a daily basis for two-
four weeks to help with program implementation. After the researcher has 
completed the supervisory training a waiting period will be given. The program 
will also include record keeping activities for supervisory activities. It is important 
that supervisors understand that they will take control and be held accountable 
for food safety activities.

After the implementation-waiting period ends a third party observer will 
evaluate handwashing compliance and other food safety key points at that 
facility. The data will be compared to the worksite environment evaluation that 
was completed at the beginning of the case study and conclusions and 
recommendations will be drawn. A variable that could be incorporated in this 
study is to offer a weekly based economic incentive to the workers. However this 
might confound the outcome and would avoid observing the work of the 
supervisors though the course of the program.

5.6 CONCLUDING REMARKS ABOUT FOOD SAFETY TRAINING

This research clearly demonstrated that food safety training requires many 
resources including time available for training, planning, follow-up activities and 
adequate day-to-day supplies (hairnets, soap, paper towels, adequate toilets 
etc). Lack of resources will impede food safety compliance. Therefore, in order 
to succeed on implementing a food safety program, upper management should 
be fully committed to these efforts. Monitoring simple food safety behaviors by 
upper management can be seen as indirect indicators of management 
commitment to fully implement a food safety program.
The lessons were necessary to ensure the workers had the skills and reasons that the skills were needed. Skill provision is key when teaching food safety. Changing this skill into a habit may require constant enforcing of the rules until the behavior becomes automatic.

This approach is likely to be more successful if a designated person within a company becomes responsible only for this and other quality control duties. This person would act as an enforcer and a role model and must have a fair method of enforcing rules using courteous communication to the other workers.
GLOSSARY

Adult education. It is the delivery of information and skills to an adult audience in a manner that encourages learning and self-confidence. Such education can take place in campus, community and worksite settings. The practice is also often referred to as andragogy (to distinguish it from pedagogy).

Education. It is a social science that encompasses teaching and learning specific knowledge, beliefs, and skills.

Teaching. In education, teachers are those who teach students or pupils, often a course of study or a practical skill, including learning and thinking skills.

Anecdotal Record Procedure. This semi-structured procedure is a good way to collect research data. It has the advantage that it can be used when it is not possible to define the precise behaviors or information that one is looking for.

Behavior. The manner in which one conducts oneself.

Behavioral intent. How our attitudes and norms would lead us to behave.

Ceiling Effect. When the effect of a treatment is underestimated because the dependent measure cannot distinguish between participants who have somewhat high and those who have very high levels of the dependent variable that is being studied.
Cognition. The term cognition (Latin: *cogito*, "to think") is used in several loosely-related ways to refer to a facility for the intelligent processing of information. In psychology, it is used to refer to the mental processes of an individual, with a particular focus toward the study and understanding of mental states (i.e. beliefs, desires and intentions) in terms of information processing especially in the area of context awareness (i.e. abstraction or concretization), or where processes involving knowledge, expertise, or learning are at work.

Construct. Constructs are concepts developed or adopted for use in a particular theory. The key concepts of a given theory are its constructs.

Delivery Method. This term refers to the way an educational program is presented to students. Examples are lectures, discussions, videos, computer programs, etc.

Education. It is a social science that encompasses the teaching and learning of specific knowledge, beliefs, and skills.

Expectancy. One of three concepts of the expectancy theory, it is the belief that extra effort will lead to improved performance.

Expectancy Theory. This theory is basically an attempt to come up with a model of how people would rationally decide whether or not to be motivated to pursue a particular course of action.

Evaluation. Program evaluation is the use of social research procedures to systematically investigate the effectiveness of social intervention programs.
**Foodborne Illness.** Infection or intoxication caused by the transfer of microbial or chemical contaminants (substances that spoil or infect) from food or drinking water to a human. In most cases, the contaminants are bacteria, parasites, or viruses.

**Food Handler.** Any person who manipulates food at any point of the food system.

**Food Safety Plan.** A documented plan to ensure that illness or harm will not result from eating food. Everyone along the farm-to-table continuum - farm (production), processing, transportation, retail, and table (home) - plays a role in keeping our nation’s food supply safe.

**Food Safety Education.** Delivery of the necessary knowledge and skills to any person who manipulates food at any step of the food system. Its ultimate goal is to prevent foodborne illnesses.

**Hawthorne Effect.** The Hawthorne effect is a phenomenon in group-based observational research. It is an effect on an outcome variable caused by the fact that the participants of the study know they are participating in the study.

**Health Action Model.** Developed by Tones, it provides a framework where the variables that influence health choices and actions and their interrelationships are categorized and described. It has five constructs or systems, all of which influence behavior: the knowledge system, the normative system, the motivational system, the belief system, and the environmental system.
**Health Belief Model.** This model addresses the individual’s perceptions of the threat posed by a health problem (susceptibility, severity), the benefits of avoiding the threat, and factors influencing the decision to act (barriers, cues to action, and self-efficacy).

**Instrument.** A tool used to collect and organize information. For example, scales, tests, questionnaires, etc.

**Instrumentality.** One of three concepts of the expectancy theory, it is the belief that good performance will be noticed or rewarded.

**Model.** A representation of a set of components of a process, system, or subject area, it is generally developed for understanding, analysis, improvement, and/or replacement of the process. Models may draw on a number of theories to help understand a particular problem in a certain setting or context and are not always as specific as theory.

**Modified Health Action Model.** The Expectancy Theory (ET) added to the Health Action Model to define the motivational system (HAM plus ET).

**Motivation.** In psychology, motivation is the driving force behind all actions of human beings, animals, and lower organisms. It is an internal state that activates guides and maintains behavior over time and gives it direction.

**Pilot Test.** Preliminary test or study of the program and/or evaluation activities to try out procedures and make any needed changes or adjustments.
**Program.** A plan of activities and procedures designed to accomplish a predetermined objective or set of allied objectives.

**Purposeful Sampling.** The researcher selects research subjects from a population according to preset criteria. For example, sex, geographic location, age, place of residence, etc.

**Skill.** The ability to use one's knowledge effectively and readily in execution or performance. Abilities that have been acquired by training.

**Social Learning Theory.** The social learning theory focuses on the learning that occurs within a social context. It considers that people learn from one another, including such concepts as observational learning, imitation, and modeling.

**Teaching.** In education, teachers are those who teach students or pupils, often a course of study or a practical skill, including learning and thinking skills.

**The Stages of Change (Transtheoretical) Model.** A model that describes individuals' motivation and readiness to change a behavior, it focuses on individual's predisposition to change or attempt to change toward healthy behaviors.

**Training Program.** A program designed for training in specific skills and to provide knowledge.

**Theory.** A theory is a set of interrelated concepts, definitions, and propositions that present a systematic view of events or situations by specifying relations among variables, in order to explain and predict events or situations.
**Theory of Reasoned Action/Theory of Planned Behavior.** This model examines the relations between an individual’s beliefs, attitudes, intentions, behavior, and perceived control over that behavior. The individual's intention to perform a behavior is a combination of attitude toward performing the behavior and subjective norm. The individual's attitude toward the behavior includes; behavioral belief, evaluations of behavioral outcome, subjective norm, normative beliefs, and the motivation to comply. The major difference between TRA and TPB is the addition of a third determinant of behavioral intention, perceived behavioral control.

**Valence.** One of three concepts of the expectancy theory, it is the value placed on the rewards offered.

**Variables.** Variables are the operational forms of constructs. They define the way a construct is to be measured in a specific situation. One matches variables to constructs when identifying what needs to be assessed during evaluation of a theory-driven program.
APPENDIX A

Penn State University Internal Review Board IRB Approval Letters

The proposal for the IRB project #14108 "Food Safety Education for Hispanic Mushroom Workers", the amendments, and the approval letters for this project are on file at the Pennsylvania State University Office for Research Protections at 212 Kern Building and are available upon request.
APPENDIX B

Survey Instrument used in the Needs Assessment
Face-to-Face Interviews (English)

Company_________________ Date _____________
Interviewer _________ Interviewee code number __________
___ ___/ ___ ___ - ___ ___ - ___ ___/ ___/ ___ ___ ___
1 12

We are conducting this survey of workers to learn the food practices used by them. We will use the results to develop educational materials for others like yourself. Your answers to all the questions that follow are very important to us. They will help us to make very important decisions about the material contents to address your needs. Completing this questionnaire will take about 60 minutes (50 minutes). Your identity will be kept confidential since we are using a coding system and even more the data gathered will be summarized for all participants. You will remain anonymous to the management of the mushroom company. No names will be attached to the final data report.

In return for completing the entire interview you will receive a $10 telephone card. Now before we begin I would like you to sign this form for me. This is a consent form that is required by Penn State regulations. Would you like me to read this to you or would you prefer to read it yourself?

[Review the form with participant]

As it says in the form your participation is voluntary. You may refuse to answer any particular questions. Your name as I said before would not be connected to any answers you give. Do you have any questions or comments?

[Have them sign two informed consent forms. Store one signed copy. Give them the other copy you have signed for their records.]

[Read to interviewee] You may have not been in an interview before. Let me tell you a little about it. During the interview I will be reading the questions to you, so everyone completing this survey can answer the same questions. Sometimes you will just tell me the answer. Sometimes I will be reading you a list of possible answers and you will choose one that is the best fit. We will have this visual book to help you see better the answers that you are giving me. {Sometimes I will be tape recording your answers so we do not miss any of your comments. Here you will be able to freely express your thoughts and comments}. It is very important that you understand the questions. So feel free to tell me if you don’t understand something. Then I can read you the question again and clarify it to you.
Icebreaker: Comments about workers' work and/or how long have they been here, etc.

SECTION CLOSED END QUESTIONS

Subsection 1. Norms

Now we need to know what others around you might expect of you in some situations. I am going to read you a statement and I would like you to choose one of five possible answers. [Please show the interviewee the visual book]

The possible answer for the following questions are as following

1 = Strongly agree   2 = Agree   3 = Neutral
4 = Disagree   5 = Strongly disagree

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<tr>
<td>1.</td>
<td>Cleaning our stations during the work day is considered inconvenient by most workers</td>
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<tr>
<td>2.</td>
<td>My supervisor demonstrates the hygiene rules of our plant by following them</td>
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<tr>
<td>3.</td>
<td>Clean restrooms in our plant can prevent workers from contaminating mushrooms</td>
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<td>4.</td>
<td>Most people who work here will come to work even if they feel sick</td>
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<tr>
<td>5.</td>
<td>Most people at work feel wearing hairnets does little to insure food safety</td>
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<tr>
<td>6.</td>
<td>Cleaning our working site is only a task to keep us busy</td>
</tr>
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<td>7.</td>
<td>Wearing gloves makes it difficult to do my job</td>
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<td>8.</td>
<td>Most workers in our plant feel if a fellow worker has diarrhea there is a good chance he or she could contaminate the mushrooms they work with</td>
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<td>9.</td>
<td>A worker with more experience is more likely to follow the rules for cleanliness than a new worker</td>
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<td>10.</td>
<td>Wearing jewelry in the plant has no impact on the safety of mushrooms we pick and pack</td>
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<td>11.</td>
<td>My fellow workers would tease me if I covered up cuts or sores on my hands at work</td>
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<tr>
<td>12.</td>
<td>Most people ignore the posters about personal hygiene posted in the plant</td>
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<td>13.</td>
<td>Most people who work here consider eating snacks or candy as they work to be acceptable</td>
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<td>14.</td>
<td>Line workers feel the cleaning crew should only work when the lines are stopped</td>
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<td>15.</td>
<td>My co-workers would consider me a nag for suggesting they wash their hands more often</td>
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16. Setting up rules about frequent hand washing is an unnecessary bother

17. It is a sign of weakness to stay home if you become ill.

18. Most workers would ignore a requirement for more frequent hand washing.

19. Cleaning tasks are done to make the company look good in case an inspector walks into the company.

20. Most people feel wearing hairnets is a nuisance.

21. The cleanliness of our restrooms reflects our company's attitude toward cleanliness.

22. Our plant rules require keeping floors clean of mushrooms to avoid an accident.

23. Our bosses demonstrate their commitment to cleanliness by keeping their workstations clean.

24. Most people at work feel that washing their hands after using the bathroom is not important.

Subsection 2. Attitudes /Beliefs

Now I need to learn what you think about the following statements. [Provide germ definition and an illustration form the visual book to the interviewee for better understanding] [Please show the interviewee the visual book]

The possible answer for the following questions are as following:

1 = Strongly agree  2 = Agree  3 = Neutral  4 = Disagree  5 = Strongly disagree

1. Bacteria are everywhere on and in our bodies.

2. Cleaning is the same as sanitizing.

3. Mixing mushrooms that fall on the floor with ones that do not is likely to increase the risk of contaminating the mushrooms we pack.

4. Food that is contaminated with pathogens that make you sick will always smell or taste bad.

5. Washing my hands can remove bacteria from my hands.

6. Standing water on the plant floor can lead to contamination of the mushrooms we pack.

7. Bacteria can get on my hands from my feces.

8. Sweeping the packing room floors while mushrooms are being packed will not cause food safety problems.
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<tr>
<td>9.</td>
<td>Cleaning chemicals that get on mushrooms might make people who eat them sick</td>
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<tr>
<td>10.</td>
<td>It is everyone’s responsibility to report possible sources of contamination of mushrooms to our supervisors</td>
</tr>
<tr>
<td>11.</td>
<td>Spitting is an unsanitary practice that should not be allowed in our plant</td>
</tr>
<tr>
<td>12.</td>
<td>If a sick person in the plant touches mushrooms, this can cause the consumer who buys them to get sick</td>
</tr>
<tr>
<td>13.</td>
<td>Bacteria can grow on mushrooms</td>
</tr>
<tr>
<td>14.</td>
<td>Most bacteria do not cause illness.</td>
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<tr>
<td>15.</td>
<td>A quick hand wash is just as effective as more thorough washing to remove bacteria</td>
</tr>
<tr>
<td>16.</td>
<td>Surfaces that look clean can still be contaminated</td>
</tr>
<tr>
<td>17.</td>
<td>Mushrooms can be a source of food borne illness if not handled correctly in our facility</td>
</tr>
<tr>
<td>18.</td>
<td>Fresh mushrooms have no bacteria on them</td>
</tr>
<tr>
<td>19.</td>
<td>Sores or open wounds on a worker’s hands increase the risk of getting bad bacteria (pathogens) on mushrooms</td>
</tr>
<tr>
<td>20.</td>
<td>Bacteria in my feces could cause illness if they get on the mushrooms that the consumer eats</td>
</tr>
<tr>
<td>21.</td>
<td>I can transfer bacteria to food that I handle</td>
</tr>
<tr>
<td>22.</td>
<td>Trash bins that are not emptied increase our rodent problem</td>
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<tr>
<td>23.</td>
<td>Wearing gloves can prevent contamination of our mushrooms by bacteria that cause sickness</td>
</tr>
<tr>
<td>24.</td>
<td>Slicing mushrooms does not increase the chance of transmitting bad bacteria (pathogens) to the consumer</td>
</tr>
<tr>
<td>25.</td>
<td>Eating snacks or candy while we work does not affect the sanitation of the mushrooms</td>
</tr>
<tr>
<td>26.</td>
<td>Most people in the plant feel the person buying the mushrooms from our plant or at the grocery store has all the responsibility to keep them safe from bad bacteria (pathogens)</td>
</tr>
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</table>
If you would have to rate on 0-100 scale the cleanliness of the restrooms, workstation, lunchrooms, etc.

How would you rate the cleanliness of your company restrooms?

0  100
Extremely Dirty  Extremely Clean

How would you rate the cleanliness of your company lunchroom?

0  100
Extremely Dirty  Extremely Clean

How would you rate the cleanliness of your company workstations?

0  100
Extremely Dirty  Extremely Clean

How would you rate the cleanliness of your favorite restaurant?

0  100
Extremely Dirty  Extremely Clean
Subsection 3. Knowledge

[First, I would like to know if you have heard about the following terms "bacteria, microbe, germ or bug"]...
[Simplest definition in Spanish]
Finally for each of the following questions please choose one that fits the best answer.

A. Pathogens are bacteria that
   Cause spoilage  
   Cause disease  
   Make cheese  
   Produce medicines  
   Make yogurt

B. A chemical used to reduce the number of bacteria to safe levels of work surfaces is
   Soap  
   Salt  
   Sanitizer  
   Degreaser  
   Alcohol

C. The most likely place people can carry pathogens is
   In cuts and wounds on hands  
   On their jewelry  
   On their shoes  
   On their clothes  
   On their make up

D. What action could most likely contaminate mushrooms in your plant?
   Spitting on the plant floor as we work  
   Not wearing uniforms over our clothes  
   Using hairnets  
   Smoking right before coming to work  
   Sharing food with others

E. A foodborne illness is most likely caused by
   Spoilage bacteria in foods  
   Preservatives in foods  
   Pathogens in foods
Insects in foods
Hot pepper in food

F. A chemical used to reduce dirt and dust in the plant is
Disinfectant
Salt
Detergent
Sulfites
Bactericides

G. The most likely cause of contamination that leads to foodborne illness is
Pesticides
Insects
Household pets
People
Preservatives in foods

H. What is the biggest source of bacterial contamination?
Hands not washed after using the restrooms
Hands wearing clean gloves
Jewelry worn in the plant
Hat on our heads
Our work Clothes

I. Food that contains harmful bacteria that can make us sick usually
Smells bad
Has an unusual color
Tastes bad
Looks no different from safe food
Comes from the grocery store that way

J. Why do we clean and sanitize?
To make the plant look nicer
To make working conditions more comfortable
To avoid mushrooms contamination
To make the mushrooms look nice and clean
To satisfy the management

K. What is the most effective way to kill bacteria in food?
Freezing it
Keeping food cold as in a refrigerator
Heating food to boiling or very high temperatures
Washing the food
Storing in a covered container
SECTION 2. DEMOGRAPHIC INFORMATION
Subsection 4. Demographic Questions

Finally we need to know something about you.

1. How long have you been working for the company? ______

2. Where do you come from in Mexico? _________

3. What is the highest level of formal education you have completed?
   
   1 = Some elementary school   2 = Elementary School
   
   3 = Some Secondary   4 = Secondary School
   
   5 = Some Preparatory School   6 = Preparatory School
   
   7 = Some College   8 = College or higher
   
   9 = Other (practical training, apprenticeship) ________________

4. Sex of the Respondent:
   
   1 = Male   2 = Female

5. What is your marital status:
   
   1 = Single   2 = Married   3 = Other ________________

6. What is your living situation here in Pennsylvania?

   Who do you live with? ______________________________

   Ask if they live in
   
   ___ Company’s barracks
   
   ___ Company’s house or apartment
   
   ___ Apartment or house with wife and other first generation relatives (mother,
   mother in law, children)
___ Apartment or house with more distant relatives – like aunts, uncles, cousins,

___ Apartment or house with friends (this is different than company’s barracks)

___ Other (Explain)

In this location:

6a. How many adults live with you here (18 yrs and older)? _____

6b. How many children live with you here (18 years and younger? _____

7. Into which category does your yearly income fall?

1 = 0-$7,500US  2 = $7,500-$10,000  3 = $10,001 – $15,000

4 = 15,001 – 20,000  5 = $20,001 – $25,000  6 = 25,001 or higher.

In case the worker does not know its yearly income use the following monthly scale

1 = 0- <$500US  2 = $501-$750  3 = $751 – $1,000

4 = $1001 – $1250  5 = $1251 – $1500  6 = $1501 – $1,750

7 = $1,750 - $2000  8 = $2001 - $2500  9 = $2001 - $2500

10 = $2500 - $3000  11 = $3001 - $3500  12 = $3501 or higher
SECTION 3. OPEN ENDED QUESTIONS

Now I would like to ask you a few questions to which you can respond freely. There is no right or wrong answer. There are also no categories to answers. I will be tape recording your answers. May I turn on the tape recorder?

Management policy on cleanliness

Please tell me about the management policy on cleanliness. What are the company’s rules about cleanliness in regards to:

- Workers
- The workstations
- The lunch room
- The restrooms

[For helping the worker you use the following probes: Why you say that? What leads to say that? What have you observed that leads you to think that?]

Previous food safety training

Now, Tell me about any previous food safety education you have received.

- What have you been told about keeping workstations clean?
- What have you been told about handwashing?
- What have you been told about using gloves, hairnets?
- Who provided this training? How was it done? (Who, how, etc)

Attitudes of workers toward cleanliness and sanitizing practices

Now how do your fellow workers feel about the rules for cleanliness in the plant?

Who does these jobs?
What is the worker’s reaction when they are asked to doing this?

How important do you think the regulations really are at the company?

What might you consider futile or silly about these practices?

**Barrier to follow the rules at the workplace**

What barriers do you see to following regulations about cleanliness?

How serious do you feel the management is about enforcing these rules? (Do they really enforce them?)

How seriously do your fellow workers take regulations about the following topics:

- Handwashing
- Gloves
- Hairnets
- Personal Hygiene

Is there anyone in the plant that is considered a role model for cleanliness?

Finally, how often do people wash their hand while working?

- After using the bathroom?
- Before handling mushrooms?

[Thank the participant for their time. Answer any questions he could have about the interview. Have the participant complete the signature form to receive the telephone card]
APPENDIX C

Focus Groups Interview Script (English)

FOCUS GROUP LOCATION: DATE:

LOCATION:

PARTICIPANTS (NAME, COMPANY, STATE OF ORIGIN):

<table>
<thead>
<tr>
<th>NAME</th>
<th>STATE OF ORIGIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
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</tr>
<tr>
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<tr>
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<td>8.</td>
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</tr>
</tbody>
</table>
WELCOME:

Good evening and welcome everyone. Thank you for taking sometime and being here. My name is Sergio Nieto from Penn State University and as many of you know I’m from Chihuahua Mexico. I don’t work for this or any of the mushroom companies I’m a student and will design educational materials to help mushroom companies and today was your company turn to hold a focus group. We are trying to get information about your work environment to develop these educational materials. You were selected because you have certain things in common that can help us to run the discussion. Your opinion is very important for us, therefore we will be tape-recording your opinions and code them to protect your confidentiality. This is going to allow us do not miss any of your opinions. My assistant will be taking paper and pencil notes of what is said. This is just a precaution to insure we obtain the data from the focus group in case the tape recorder should malfunction. You have a marker and a piece of paper with you. Would you please write down your name in the sheet of paper and place it front of you.

ICE BREAKER:

Let’s go around the table and introduce ourselves. Please tell us Where do you come from? What do you like doing in your free time? Where do you live here? I will start, again my name is Sergio Nieto Montenegro and I’m from Chihuahua, Mexico. I’m studying here at Penn State which is the state’s university. I would like to go back when I finish. I live in State College, which is in central PA and is about 4 hours drive from here. Also I like soccer a lot and I’m a Monterrey team fan please don’t laugh I know they are so bad.
FOCUS GROUP GROUND RULES AND OVERVIEW OF THE TOPIC

First than nothing I am going to explain what is this. A focus group is nothing more than a group of people discussing a topic, there are no right or wrong answers, here all your comments are points of view and they are going to be taken into account for the improvement of your workplace and us. We are interested in both your positive and negative comments, so bring both type of comments up. Remember, none of this is going to be shared to the management. You should feel free and comfortable with all the viewpoints that you express here. We will be using our first names but later all the information will be coded and no names will be contained in the reports. Because we are doing focus groups in several companies, the collected information will be pooled with the opinions of workers from the other mushroom companies. Since we are tape recording this session I'm going to ask that you speak up and speak one at a time. If several of you speak at once, it is impossible to have a record of your opinions later. I'll be moderating the discussion tonight and moving us from topic to topic. The session will last about 75 minutes including a five minutes break but if you feel like stretching, need to go to the bathroom or just want to grab a drink just stand up and do so.
OBJECTIVE: WARM-UP QUESTIONS.

Topic: Short Term Illness

How healthy have you been over the last years?

What do you do when you get sick? What about a foodborne illness (symptoms: nausea, diarrhea, fever, vomits, etc)?

What sort of health insurance or in-house attention do you have?

What things have made people around your family sick?

What does the management do when you are sick? Do you have to take the day off?

TRANSITION QUESTIONS

Now, I would like to hear first how is the working environment at your workplace and how you feel working there? What is the best part of your job? What is the worst part of your job?

CORE FOCUS GROUP (Objective: To evaluate if the workers know the Management Rules and Norms) (Construct: Appropriate working environment and Conditions)

All of us are subject to rules that we have to follow. Lets talk now about the rules that we have at work. What set rules are imposed by the management that is necessary to follow at the job? I will direct the rules toward food safety issues and direct the discussion towards this topic

Probes:

Would you explain further that rule? How does it work? Who enforces it?

What rules are written down in a handbook? How difficult are those rules to follow?

What rule reminders are around (signs, pamphlets, etc)?
CORE FOCUS GROUP (Objective: To evaluate the Pros and Cons within the Company and Transforming it) (Construct: Appropriate working environment and Conditions)

Now let’s talk about the good and bad things in your company. What would be the things that you classify as good and bad within this company? (Uncued questions before cued questions)

Probes:
I will take the discussion to food safety issues
Why did you say that? Why do you feel that's good or bad?
Is there any other comment? So, let's move on.
There is always room for improvement; I believe that applies in this company too.

How do you think we would have a better company?
What about cleaning and sanitizing issues?
What ideas do you have of something we could do?

CORE FOCUS GROUP (Objective: To discover incentives that might lead the workers to follow the rules and change practices) (Construct: Motivational system)

Now we will talk about why we do or do not follow the rules. Do you remember the X rule (a food safety rule) that XXXXXX brought up earlier in this discussion? Do all the people follow the rule? So, what must we do to always follow that rule? How would an incentive such the ones you were talking about work?

Probes: Why’s? How's?

What kind of motivational issues that can help all of us to do this? What about strict surveillance or a role model among you? How do you think that would work?
CORE FOCUS GROUP (Objective: To discover incentives that might lead the workers to follow the rules and change practices) (Construct: Motivational system)

A lot of times in real life situations, there are prizes and incentives given to reward behaviors as punctuality bonus, lunch bonus, etc. A lot of times these are not necessarily money. What sorts of incentives are offered here at your company?

Probes:
How real are they?
Who gets them and how?
Please tell me more about it?
Why should think you must receive an incentive?
What would you like as an incentive?
What would be an ideal incentive?

ADJOURNMENT

I want to thank you for participating in this discussion tonight. Do you have any additional thoughts? Do you think we have missed something tonight? Thanks again and do not forget to pick up your award.
APPENDIX D. Number of Lessons Held at Each Workplace and the Average Number of Participants at Each Session.

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<th>Lesson 1 # sessions</th>
<th>Lesson 2 # sessions</th>
<th>Lesson 3 # sessions</th>
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<th># People</th>
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<td>171 lessons</td>
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</table>

The total number of lessons given during the whole duration of the program was 218. Forty seven lessons were delivered during pilot testing and to the control groups.
APPENDIX E

Penn State University Certificates of Participation for Companies and Each Worker who Completed the Food Safety Program
Certificate of Participation

Presented to

ABC Mushroom Farms

for participating in the

Food Safety Training Program

Department of Food Science
The Pennsylvania State University
University Park, Pennsylvania

This company participated in an educational training program on the principles of food safety. The curriculum presented the fundamentals of foodborne illness, sources of food contamination, personal hygiene, and handwashing practices to mushroom farm employees.

2005

J. Lynne Brown PhD
Associate Professor
Department of Food Science
Penn State University

Sergio Nieto-Montenegro
Instructor
Department of Food Science
Penn State University

Luke F. LaBorde PhD
Associate Professor
Department of Food Science
Penn State University
Reconocimiento

Por su asistencia y participación en el curso “MANEJO HIGIENICO DE LOS HONGOS”

Laura Phelps
Presidente
American Mushroom Institute

Sergio Nieto-Montenegro
Instructor – Food Science
Penn State University

XXXXX X. XXXXX
Presidente
XXXXX Mushroom Farms

Kennett Square, PA. 25 de Mayo del 2005.
APPENDIX F

Slide Show Used in Supervisors Lessons (English)
SUPERVISORS-SUMMARY

HANDWASHING

›ANTES DE:
BEFORE:

›DESPUES DE:
AFTER:

HAIRNETS

JEWELRY
SUPERVISORS

- Courtesy
- Politely
- Be blunt when giving indications…but do not forget the manners
- Listen to complaints and advice
- Indicate when someone does something wrong
- Suggest ways to correct things
- Let's see if all of this works
SUPERVISORS

- We Need your Help
- Week 1 - Hairnets
- Week 2 – Handwashing - Mornings
- Week 3 – Jewelry
- Week 4 – Handwashing - After Breaks
- What is easier for you?
SUPERVISORS

KEY WORDS

- Please
- Gracias….Madam
- You are Welcome
- I would like you to..
- Let’s all go to do X.
APPENDIX G

Handwashing Reminders (English)

STOP
DO YOU REMEMBER?

WASH YOUR HANDS

BEFORE:
STARTING WORK
EATING

AFTER:
USING THE RESTROOM
AFTER EACH BREAK
DO YOU REMEMBER?
WASH YOUR HANDS

BEFORE:
STARTING WORK
EATING

AFTER:
USING THE RESTROOM
EACH BREAK
APPENDIX H

Retrospective Interviews Script (English)

Worker Follow-up Interview

Company _____________________________ Date: __________

Interview No ____; Sex __ M, ___ F; Position: _________________

Thanks for agreeing to help me today. I will read each question to you. Please tell me what you think in response. Please be very frank (brutally honest) in your answer. The ‘truth’ as you see it will help us improve our program. Your supervisor and the management will not have access to your answers and your name will not be linked to your answers.

A. Thinking of the last several weeks –(NOW)

1. Tell me how the upper management are dealing with personal hygiene rules like hand washing and use of hairnets right now
   - Probe --
   - Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing

   If they are doing something ask
   - Describe what they are doing ---

   How would you rate their concern about personal hygiene rules right now?  
   1(no interest) ------10 (very concerned) (have them chose one number)

2. Tell me how your immediate supervisor is dealing with personal hygiene rules right now
   - Probes
   - Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing

   If he/she is doing something ask
   - Describe what they are doing ---

   How would you rate his/her concern about personal hygiene rules right now?  
   1(no interest) ------10 (very concerned) (have them chose one number)

3. Tell me how the quality control people are dealing with personal hygiene rules right now
   - Probes
   - Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing

   If he/she is doing something ask
   - Describe what they are doing ---
How would you rate their concern about personal hygiene rules right now?
1 (no interest) ------ 10 (very concerned) (have them chose one number)

B. Think back to the two months right after my food safety lesson sessions ended. This would be (give the two months relevant to them)

Thinking of X and Y – (Two Months)
1. Tell me how the upper management was dealing with personal hygiene rules like hand washing and use of hairnets then
   Probe
   Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing
   If they were doing something ask
   Describe what they were doing ---

   How would you rate their concern about personal hygiene rules then?
   1 (no interest) ------ 10 (very concerned) (have them chose one number)

2. Tell me how your immediate supervisor was dealing with personal hygiene rules then
   Probes
   Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing
   If they were doing something ask
   Describe what they were doing ---

   How would you rate his/her concern about personal hygiene rules then?
   1 (no interest) ------ 10 (very concerned)

3. Tell me how the quality control people were dealing with personal hygiene rules then
   Probes
   Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing
   If they were doing something ask
   Describe what they were doing ---

   How would you rate their concern about personal hygiene rules then?
   1 (no interest) ------ 10 (very concerned)
C. Think back to last fall of 2004 and compare what you observe now.

1. What changes, if any, have you observed in overall company attitudes about personal hygiene rules? Chose a number on the following scale

1 (no change at all) ----------------- 10 (a lot of change) (have them chose one number)

If they report a change, ask
What sort of change have you seen? Specific examples.
What do you think caused this change?

If they report no change, ask why this might be

2. Please share any other comments you have about personal hygiene rules in this company.

Thank you
Supervisor Follow-up Interview

Company _____________________________ Date: __________

Interview No ___; Sex ___ M, ___ F; Position: _________________

Thanks for agreeing to help me today. I will read each question to you. Please tell me what you think in response. Please be very frank (brutally honest) in your answer. The ‘truth’ as you see it will help us improve our program. The company management and workers will not have access to your answers.

A. Thinking of the last several weeks –(NOW)
1. Tell me how the upper management are dealing with personal hygiene rules like hand washing and use of hairnets right now
   Probe
   Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing
If they are doing something ask
   Describe what they are doing ---

How would you rate their concern about personal hygiene rules right now?
1(no interest) -------10 (very concerned)

2. Tell me how the workers you supervise are dealing with personal hygiene rules now
   Probes
   Dealing can be – supporting, accepting, ignoring, practicing, breaking
If they are doing something ask
   Describe what they are doing ---

How would you rate worker concern about personal hygiene rules right now?
1(no interest) -------10 (very concerned)

3. Tell me how the quality control people are dealing with personal hygiene rules now
   Probes
   Dealing can be – supporting, accepting, ignoring, practicing, breaking
If they are doing something ask
   Describe what they are doing ---

How would you rate the quality control people concern about personal hygiene rules right now?
1(no interest) -------10 (very concerned)
B. Think back to the two months right after my food safety lesson sessions ended. This would be (give the two months relevant to them)

Thinking of X and Y – (Two Months)
1. Tell me how the upper management was dealing with personal hygiene rules like hand washing and use of hairnets then
   Probe
   Dealing can be – supporting, enforcing, ignoring, delegating, doing nothing
   If they were doing something ask
   Describe what they were doing ---

How would you rate their concern about personal hygiene rules then?  
1 (no interest) ------10 (very concerned)  (have them chose one number)

2. Tell me how the workers you supervise were dealing with personal hygiene rules then
   Probes
   Dealing can be – supporting, accepting, ignoring, practicing, breaking
   If they were doing something ask
   Describe what they were doing ---

How would you rate worker concern about personal hygiene rules then?  
1 (no interest) ------10 (very concerned) (have them chose one number)

3. Tell me how the quality control people were dealing with personal hygiene rules then
   Probes
   Dealing can be – supporting, accepting, ignoring, practicing, breaking
   If they were doing something ask
   Describe what they were doing ---

How would you rate the quality control people concern about personal hygiene rules then?  
1 (no interest) ------10 (very concerned) (have them chose one number)
C. Think back to last fall of 2004 and compare what you observe now.

1. What changes if any have you observed in overall company attitudes about personal hygiene rules? Chose a number on the following scale

1 (no change at all) ---------10 (a lot of change) (have them chose one number)

If they report a change, ask
What sort of change have you seen?
What do you think caused this change?

If they report no change, ask why this might be.

2. Please share any other comments you have about personal hygiene rules in this company.

Thank you.
### APPENDIX I.
Food Safety Behaviors Observation Checklist

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<th>Day/Hour:</th>
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#### Behavior/Practice

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Please mark the appropriate case with an X when a participant is not wearing any of the included items while handling mushrooms.
### Handwashing Opportunity Rates

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Rate of Handwashing/Notes</th>
<th>Restroom Users</th>
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<tbody>
<tr>
<td><strong>Before Start Working</strong></td>
<td><strong>Rate 1 =</strong> # of people washing their hands/Total # of people coming in to work</td>
<td><strong>Rate 3 =</strong> # of people washing their hands/Total # of people using the restroom</td>
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<tr>
<td>Handwashing Opportunity A</td>
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<tr>
<td><strong>Break 1</strong></td>
<td><strong>Rate 2 =</strong> # of people washing their hands/Total # of people taking a break</td>
<td><strong>Rate 3 =</strong> # of people washing their hands/Total # of people using the restroom</td>
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<td>Handwashing Opportunity B</td>
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<tr>
<td><strong>Break 2</strong></td>
<td><strong>Rate 2 =</strong> # of people washing their hands/Total # of people taking a break</td>
<td><strong>Rate 3 =</strong> # of people washing their hands/Total # of people using the restroom</td>
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<td>Handwashing Opportunity B</td>
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<tr>
<td><strong>Break 3</strong></td>
<td><strong>Rate 2 =</strong> # of people washing their hands/Total # of people taking a break</td>
<td><strong>Rate 3 =</strong> # of people washing their hands/Total # of people using the restroom</td>
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<td>Handwashing Opportunity B</td>
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<tr>
<td><strong>Break 4</strong></td>
<td><strong>Rate 2 =</strong> # of people washing their hands/Total # of people taking a break</td>
<td><strong>Rate 3 =</strong> # of people washing their hands/Total # of people using the restroom</td>
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<td><strong>Break 5</strong></td>
<td><strong>Rate 2 =</strong> # of people washing their hands/Total # of people taking a break</td>
<td><strong>Rate 3 =</strong> # of people washing their hands/Total # of people using the restroom</td>
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APPENDIX J

Pre and Post Knowledge Test
Instructions: Read each of the questions and its answers to the participants and ask them to mark the correct answer in their answer sheet

1. As you might know there was a big foodborne outbreak in Pennsylvania due to contaminated green onions. How did the Mexican Food Restaurant outbreak affect the company producing the contaminated green onions?
   a) The company continued to provide green onions to other restaurants
   b) The company was shut down (and workers laid off)
   c) The company provided mandatory food safety lessons to its workers
   d) The company switched to producing another food
   e) Don’t know

2. What was the identified source of the virus that caused the Mexican Food Restaurant outbreak?
   a) Infected worker in the production facility
   b) Infected restaurant patron,
   c) Infected rodents,
   d) Infected restaurant workers,
   e) Don’t know.

3. Which of the following is an example of mushroom contamination?
   a) Small stones in a package of mushrooms
   b) Moisture in a package of mushrooms
   c) Friendly microbes on unwashed mushrooms
   d) A mushroom slice in a package of button mushrooms
   e) Don’t know

4. Which is the most common way that (bad microbes) pathogens can be spread to mushrooms at work?
   a) A failure in the cooling room
   b) Visitors in the mushroom company premises
   c) Workers touching mushrooms with their hands
   d) Workers touching the packing tills or transport boxes in which mushrooms are placed.
   e) Don’t know

5. Wearing hairnets help do which of the following for mushroom safety
   a) Guarantee the company passes an inspection
   b) Meet your supervisor’s expectations
   c) Reduce the risk of contaminating the company product
   d) Reduce the risk of a mushroom buyer rejecting an order
   e) Don’t know
6. A properly worn hairnet allows
   a) Exposed sideburns
   b) Exposed bangs
   c) Guarantee the company passes an inspection
   d) Fewer hairs to escape
   e) Don’t know

7. Which of the following is most likely to increase the chance of contaminating mushrooms?
   a) Covering a sore on your hand with a bandage
   b) Putting your fingers in your ears as you work
   c) A failure in the cooling room
   d) Do not listen to my supervisors instructions
   e) Don’t know

8. You have just finished your lunch in the lunchroom. What critical action should you complete just before you return to your work position?
   a) Use the restroom
   b) Make sure your smock is buttoned
   c) Adjust your hairnet
   d) Wash your hands
   e) Don’t know

9. Which of the following actions is most important to avoid microbial contamination of mushrooms?
   a) Wear hairnets
   b) Wear smocks
   c) Wash hands
   d) Do not wear jewelry
   e) Don’t know

10. Which of the lists below covers times that handwashing is required at work?
    a) Before punching the time clock
    b) After finishing up an order
    c) After dumping mushrooms into the slicing machine
    d) After a break
    e) Don’t know
**DEMOGRAPHIC INFORMATION**

*Code Number: ___________

We need some information about you, so please answer the following questions. Remember that this information will be kept confidential.

**Sex (recorded from observation)**

1 = Male  
2 = Female

Read and record the answers to the following:

1. How long have you been working for this company? ______

2. Have you received any form of food safety education before? _____

If yes, ask which of these methods was used? (Check all that apply)

Lecture ___  Video ___  Booklets ____  Handout (sheet of paper) __  Poster ___

3. Where do you come from (country, state, city)? ___________

4. What is the highest level of formal education you have completed?

1 = Some elementary school  
2 = Elementary School  
3 = Some Secondary School  
4 = Secondary School  
5 = Some Preparatory School  
6 = Preparatory School  
7 = Some College  
8 = College or higher  
9 = Other (practical training, apprenticeship) ________________

6. When were you born? ______

7. Into which category does your weekly income fall?

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<tr>
<th>1</th>
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<th>$101-$150</th>
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<td>$551 - $600</td>
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<td>$600 or higher</td>
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VITA
SERGIO NIETO-MONTENEGRO

Education
• Ph.D. in Food Science
  The Pennsylvania State University, University Park, PA 2006
• M.Sc. Food Science and Technology. Graduated with Honors
  University of Chihuahua, Chihuahua, Mexico. 2000
• B.Sc. Chemical Engineering Food Technology option.
  University of Chihuahua, Chihuahua, Mexico. 1997

Publications

Selected Presentations

Honors and Other Activities
• Recipient – 1997-1999. CONACYT (Mexico’s National Council for Science and Technology) scholarship to pursue a M.Sc. degree in Food Science and Technology at the University of Chihuahua.
• Recipient – 2000-2003. CONACYT (Mexico’s National Council for Science and Technology) scholarship to pursue a Ph.D. degree in Food Science at the Pennsylvania State University.
• Runner-up at 2004 Mark A. Bieber Nutrition Division Poster Competition at the 2004 Institute of Food Technologists Annual Meeting. Las Vegas, NV.
• Guest Speaker at several forums on Food Safety Education and Hispanic Workforce Management.
• Top ranked player of The Pennsylvania State University Racquetball Team (2001-2004).

Grants

Professional Affiliations
• The Institute of Food Technologists (IFT).
• The Society for Nutrition Education (SNE).
• The American Dietetic Association (ADA).
• The Produce Marketing Association (PMA).