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Comparative analysis of training delivery methods for new employees cleaning and sanitizing retail deli slicers: An exploratory study

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ABSTRACT

The objectives of this study were to characterize the performance of new employees receiving four types of training delivery methods and determine which training method was most effective in interpretation and execution as measured by temporal performance, ATP bioluminescence and participant survey. Participants with limited food service experience received one of four types of food safety training delivery methods for cleaning and operating a meat slicer. The food safety training delivery methods included; no instruction, written instruction, demonstrations and written instruction with demonstrations. Participants were then instructed to slice four slices of bologna and then clean the slicer based on the training they received. Temporal performance as measured by time was recorded per participant and adenosine triphosphate bioluminescence (ATP-B) was measured to determine the hygienic condition of the slicer post cleaning. Next, participants were given a survey asking them to list the steps for cleaning a deli slicer in proper order and their perceived cleanliness of the slicer based on the training delivery method. When written instruction and demonstrations was used as a delivery method, temporal performance increased, ATP-B readings were lower and participants perceived it as an effective training method.

1. Introduction

Every year foodborne illness devastates the lives of millions and takes a significant toll on the local and national economy. Expenses include costs of medical treatment, lost wages, loss of the business's reputation, lost sales, food items that must be discarded and expenses associated with cleaning the facility. In 2009, a total of 17,468 laboratory-confirmed cases of foodborne disease infection were identified (CDC, no date). The Produce Safety Project at Georgetown University, an initiative of The Pew Charitable Trusts, released the report *Health-Related Costs from Foodborne Illness in the United States* and estimated the cost of acute foodborne illness in the United States to be $152 billion annually, with a single pathogen, *Listeria monocytogenes*, responsible for a significant percentage of these costs (Scharff, 2010). *Listeria* spp., including *L. monocytogenes*, are prevalent in the environment (soil, water, vegetation, wild and domestic animal feces) including farms which then may be transferred into food processing facilities (Sauders & Wiedmann, 2007; Todd & Notermans, 2011). Symptoms for healthy adults may include diarrhea and fever; however, for pregnant women, which account for about 30% of diagnosed cases, symptoms may include fever, diarrhea, miscarriage or still-birth. Newborns may contract sepsis, meningitis or pneumonia (Todd & Notermans, 2011).

Sporadic cases and outbreaks have been associated with delicatessen meats, hot dogs and soft cheeses (Gottlieb et al., 2006; Mead et al., 1999; Olsen et al., 2005; Schuchat et al., 1992; Schwartz et al., 1988).

Several studies have reported that environmental contamination has been the source of *L. monocytogenes* more often than raw materials (Autio et al., 1999; Berrang, Meinersmann, Korthcutt, & Smith, 2002; Miettinen, Björkroth, & Korkeala, 1999; Nesbakken, Kapperud, & Caugant, 1996; Rórvik, Caugant, & Yndestad, 1995). One possible explanation for this is *L. monocytogenes* can adhere and create biofilms on stainless steel and other materials commonly found in processing and retail operations (Beresford, Shama, & Andrew, 2001; Lin et al., 2006). Slicing machines have been implicated in foodborne illnesses including typhoid fever, Hepatitis C and listeriosis (Bocket et al., 2011; Howie, 1968; Vorst, Todd, & Ryser, 2006). Lin et al. (2006) investigated possible routes for cross contamination of *L. monocytogenes* between processing equipment and deli meats and reported that commercial slicers and similar types of equipment could transfer *L. monocytogenes* onto deli meats depending on microbial load found on the slicer blade. Other contributing factors included the types of meat and the design of the meat slicer. Depending on the amount of fat from

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the type of meat (salami for example) parts of the equipment may be covered with fat permitting *L. monocytogenes* to adhere to the slicer blade and blade housing and the design of the slicer may have hard-to-clean areas permitting the bacteria to survive and possibly grow (Lin et al., 2006). Vorst et al. (2006) reported that changes in the surface of a deli slicer blade, caused by continual use and oxidation from cleaning and sanitizing agents over time, created pits and rougher blades which may increase attachment of bacteria.

While environmental contamination and equipment have been implicated as contributing factors for the growth and survival of *L. monocytogenes* in both processing facilities and retail delis, the retail setting has proven to be more challenging. For example, Gombas, Chen, Clavero, and Scott (2003) and Endrikat et al. (2010) concluded that retail-sliced RTE meat and poultry were more likely (one estimate as high as five times) to cause listeriosis than are prepackaged products. While collecting environmental sampling, Sauders et al. (2009) discovered *L. monocytogenes* in 60% of the retail establishments tested. Retail deli operations have several different challenges that packaging plants do not have to contend with including being open to the public, having a wide variety of products, displaying products, and slicing products (Endrikat et al., 2010). The U.S. Food and Drug Administration (FDA) has reported that retail delis are often out of compliance with the Food Code for temperature abuse, employee hygiene issues including glove use and bare hand contact, and safeguards against contamination (FDA, 2010).

While this information may seem discouraging, Lin et al. (2006) stated that proper cleaning and sanitizing can prevent *L. monocytogenes* on previously contaminated deli slicers. Therefore, emphasis must be placed on food safety training for deli workers, and more specifically, proper methods for cleaning and sanitizing deli slicers and similar equipment. Based on the data from environmental sampling studies (Sauders et al., 2009), current training methods may not be efficient and employees may need to change their behavior. However, behavior change is complex and multifaceted approaches are needed (Jenkins-McLean, Skilton, & Sellers, 2004; McKenzie-Mohr & Smith, 1999). One approach is to identify the mutable causes or barriers to desirable behaviors in order for the problem to be addressed in the proper context for changes to be made (Jenkins-McLean et al., 2004). For example, trainers need to understand why deli employees do not clean the slicers properly; what is preventing them from doing their job? Do they have the right tools? Are they afraid of cutting themselves? Howells et al. (2008) identified employees' perception of barriers for cleaning work surfaces which included: time constraints, inadequate training, forgetting, lack of adequate resources, management and employees not caring, competing tasks, and inconvenience. Yapp and Fairman (2006) identified the following factors that affect food safety compliance in small and medium sized-businesses from the owners and managers perspectives: lack of money, time, lack of experience, limited access to information, lack of support, lack of interest and lack of knowledge. Therefore, these barriers must be addressed within the food safety training program.

To complicate matters, supermarket employees are among the youngest people entering the workforce with limited work experience. More specifically, young workers between the ages of 16–29 hold approximately 29 percent of the jobs within supermarkets (Bureau of Labor Statistics, 2012). A comparison of 5 U.S. supermarkets' websites revealed that they do not have any educational or work experience requirements for deli clerk applicants (CareerLeak, 2012). Therefore, more time and effort may be necessary to convey food safety practices for young, inexperienced workers.

Repeatedly, time has been identified as a mutable cause for proper food handling practice and cleaning food contact surfaces (Howells et al., 2008; Yapp & Fairman, 2006). Retail delis are high traffic areas serving many customers in a short amount of time and employees must work constantly with a sense of urgency. Research has demonstrated that temporal performance or the speed of completing a task such as cleaning or preparing menu items and food preparation accuracy are important performance criteria for food service operations (Madera, Dawson, & Neal, 2012). Therefore, in accordance with these expectations, both the deli slicer training and performance of the task (using the slicer) should be completed in a timely manner. Currently, the FDA Food Code states that as a basic requirement, food contact surfaces such as utensils and equipment must be clean "to sight and touch" however, pathogens may still be present (FDA, 2009). Employees may wipe slicers between uses so they appear clean but do not sanitize between uses which may increase the risk of cross contamination.

Several tests and tools have been developed to assist food processors in examining or validating hygienic conditions within their operations. Adenosine triphosphate bioluminescence (ATP-B) is a rapid method used to monitor the hygienic status of food production lines and to verify the effectiveness of cleaning procedures (Chen & Godwin, 2006). The ATP-B method is founded on the naturally occurring reaction found in fireflies, *Photinus pyralis*, in which the enzyme luciferase uses chemical energy contained in an ATP molecule to drive the oxidative decarboxylation of lucerin, thus producing light (Aycicek, Oguz, & Karci, 2006). Much of the research concerning ATP-B compares this technology to traditional plate count methods (Aycicek et al., 2006; Chen & Godwin, 2006; Cunningham, Rajagopal, Lauer, & Allwood, 2011). ATP-B can be effective for determining surface cleaning in retail food settings and should be considered as a tool for food safety training in retail deli operations and as a quantitative method to measure the effectiveness of the training (Cunningham et al., 2011).

This study compares food safety training delivery methods to determine which style is most accurately interpreted and executed by employees with limited or no previous work experience. The objectives of this study were to 1) characterize the performance of new employees receiving four types of training delivery methods, and 2) determine which training method was most effective in interpretation and execution as measured by temporal performance and ATP bioluminescence and participant survey.

2. Material and methods

2.1. Participants

After acquiring the necessary approvals from the committees for the protection of human subjects, participants were recruited from a large urban university. The participants included 115 students majoring in hotel and restaurant management (36% men and 64% women) with 82% being between the ages of 18–24. Participants reported that 29% were currently working in the hospitality industry with less than one year of experience. This demographic was chosen to represent young, inexperienced workers entering the job market as deli clerks. However, while hotel and restaurant management students were chosen, each with at least a high school degree and pursuing higher education within the field, the authors acknowledge this limitation in that they may not have truly reflected the target population.

2.2. Design and procedure

A four-group experimental design was utilized and participants were given one of four types of instructions for cleaning a deli slicer. These included written instructions (Appendix A), demonstrations, both written instruction and demonstration or no instructions (neither written nor demonstrated). Participants were instructed to slice four slices of bologna with a thickness of 0.25 cm using