



Review

Assessment of the methodological strategies adopted by food safety training programmes for food service workers: A systematic review

Caroline Opolski Medeiros^{a,*}, Suzi Barletto Cavalli^a, Elisabete Salay^b, Rossana Pacheco C. Proença^a

^a Nutrition Department and Nutrition in Foodservice Research Nucleus (NUPPRE) of Federal University at Santa Catarina, Florianópolis, Brazil

^b Department of Food and Nutrition, School of Food Engineering, University of Campinas, São Paulo, Brazil

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ABSTRACT

This is a systematic review conducted to identify and assess the methodological strategies used in training programmes designed to enhance food safety in food services. Fourteen original articles were selected from the Scopus, Scielo and Medline digital databases. The topics most dealt with in the educational programmes were personal hygiene, food safety and best practices. The resources most widely used during the training courses were interactive media, audiovisual materials, videos, lectures and recreational activities. In addition to being low cost, hand washing activities yield positive results in food safety. Employee training assessment is carried out by using questionnaires, analytical monitoring, a check list and the Likert scale. Hand washing is the most assessed item. The activities most widely accepted by the employees during training courses are interactive media and hands-on activities. These activities contribute toward the enhancement of employees' skills and knowledge, and encourage changes in attitude and behaviour.

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1. Introduction

Food-borne diseases (FBDs) significantly affect people's health and their harmful consequences are reflected on the national economy, development, and on foreign trade (WHO, 2006). In 2000

the World Health Organisation declared FBD prevention and control a public health priority (WHO, 2007). The number of reported and researched FBD outbreaks has increased, revealing that most of them are caused by food mishandling, often due to inappropriate pre-preparation, preparation and distribution of meals by food handlers (Adams & Mortarjemi, 1999; WHO, 2000). Studies have shown that FBD prevention requires favourable hygienic conditions during food preparation, a phase in which the handler plays an important role, since he or she may carry

* Corresponding author.

E-mail address: caroline.opolski@gmail.com (C.O. Medeiros).

pathogens. Inadequate practices can taint foods and cause FBDs. Therefore, appropriate handling practices are crucial for preventing FBDs during food production and distribution (Campos et al., 2009; Lues & Van Tonder, 2007; Sousa, 2008; WHO, 2000, 2006).

Greater food safety requires enhancing local scientific and technical skills and the development of efficient tools and training programmes (WHO, 2002). Such programs are considered a primary intervention for promoting food safety in food services (Mitchell, Fraser, & Bearon, 2007). As stated by the World Health Organization (2000), food safety education is an essential tool to assure that workers do not contaminate food; it is also vital in eliminating or reducing food contaminants and preventing micro-organism growth at levels causing disease.

Regular training is thus considered the most important way to prevent or mitigate food contamination risks by adjusting the practices of handlers and improving their skills. Such training should be accompanied by regular inspection of the activities of the workers involved (Acikel et al., 2008; Campos et al., 2009; Capunzo et al., 2005; Sousa, 2008).

Employee training is considered an important component of a corporation's image and of both its internal and external competitiveness (DiPietro, 2006). However, according to Nieto-Montenegro, Brown and LaBorde (2008), for a training programme to be successful, planning checks are required; and the methodology and approach adopted are equally important.

Studies of food service worker training methodologies can help improve the food safety learning of these professionals (Pontello, Dal Vecchio, Doria, & Bertini, 2005; Salazar, Ashraf, Tchong, & Antun, 2006). For this reason we conducted a systematic review to identify and assess methodological strategies used in training programmes, to enhance food safety in food services.

2. Methodology

2.1. Review outline

A systematic review was conducted of the strategies used in food service worker training programmes. These programmes are designed to increase workers' knowledge of the importance of food safety and hygiene procedures in order to provide safe foods to consumers.

The research was carried out in April 2009. Studies published in the Scopus, Scielo and Medline digital databases (Jan. 2004–Apr. 2009) were screened for eligibility. The search was made with the following descriptors: [{training} or {course} or {education} or {teach}] and [{food security} or {food safety} or {quality control} or {food hygiene} or {food quality}] and [{food employee} or {food handlers} or {food manipulation} or {food-handling}] and/or [{restaurant} or {foodservice unit}], totalling 236 combinations. Titles and abstracts were analysed to select the articles and verify their inclusion, and when necessary, the full-text article.

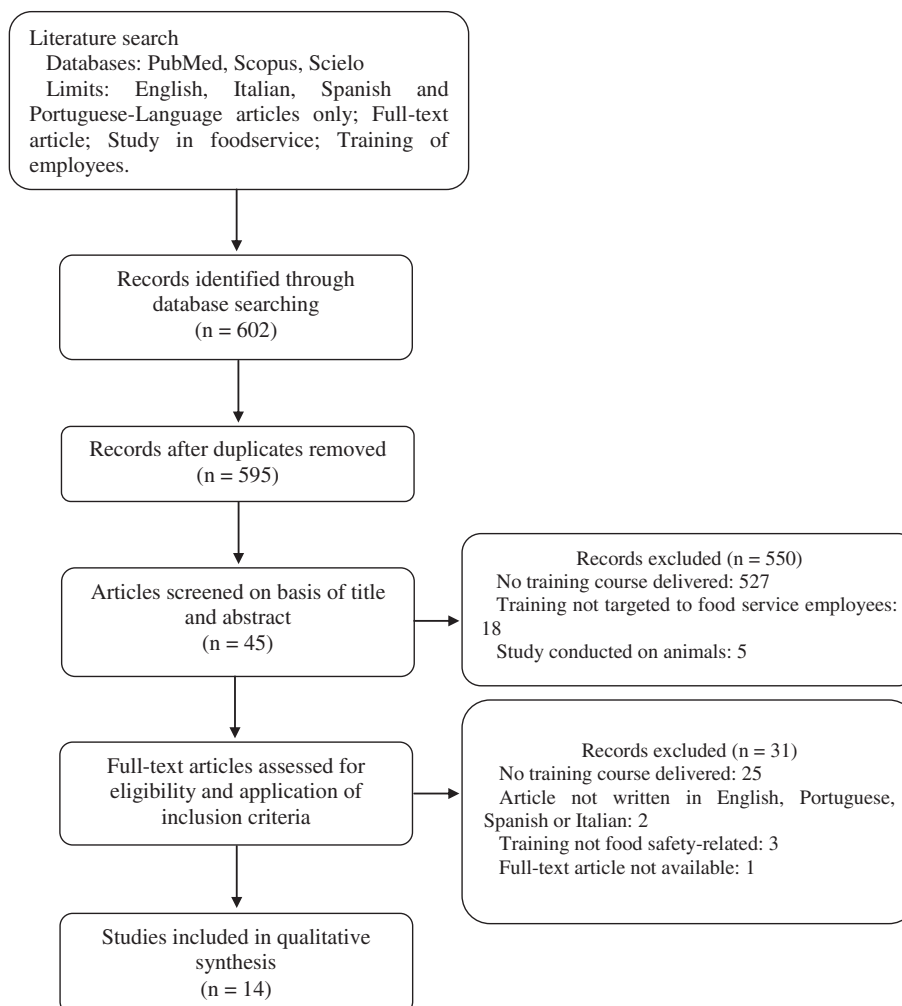


Fig. 1. Flow diagram of study selection. *Figure adapted from Liberati et al., 2009.

In terms of language, the articles reviewed were chosen if they met the following criteria: (a) the study was carried out in a food service unit, (b) the study provided a training course to the food service unit employees, (c) the full-text article was available, (d) the article was published in English, Portuguese, Spanish or Italian.

The articles found were characterised as shown in Fig. 1. The database search provided a total of 595 citations. After screening titles and abstracts, 550 studies were excluded, because they did not meet the inclusion criteria or did not pertain to the topic in question. Thus, 45 articles were selected. A search was then made for the full-text article and, if not found; it was requested from the author or through the Comut system. In this phase, another article was ruled out because it was not available in full-text. Forty-five articles were examined in further detail and 31 of them did not meet the inclusion criteria. At the end of the process, 14 original articles were selected that complied with the goal of this study and the inclusion criteria.

2.2. Investigated results

The studies were analysed based on the hypothesis that the effect of food service worker training may vary depending on the methodology employed. The data was compiled in tables and schematics for further analysis. A double data extraction was performed. Tables were prepared to chart year of publication, location of study, study outline, type of food service unit, population studied, methods and approaches used in the training, duration of training, as well as an assessment of the effectiveness of the training programmes.

Three criteria were used to compare the training courses: topic, method and duration. The criteria used to evaluate the training were: worker knowledge, behaviour and practices.¹

3. Results

3.1. Overall characteristics of the studies included in the sample

Fourteen original studies in which intervention training was provided to food service workers were identified and reviewed. Details of the reviewed studies are shown on Tables 1 and 2. Most of them were published in 2008 (36%) and in 2005 (29%). Five studies (29%) were conducted in the USA, three (22%) in Italy, two each (14%) in India and in the United Kingdom, and one each (7%) in Egypt, Turkey and Thailand.

The studies were carried out in a variety of sectors including hospital food services (29%) (Acikel et al., 2008; Danchaivijitr et al., 2005; El Derea, Salem, Fawzi, & Abdel Azeem, 2008; Singh, 2004), catering companies (21%) (Howells et al., 2008; Malhotra, Lal, Krishna Prakash, Daga, & Kishore, 2008; Pollitt, 2008), fast-food (14%) (DiPietro, 2006; Pollitt, 2007), university cafeterias (14%) (Cenci-Goga et al., 2005; Salazar et al., 2006), public catering services (7%) (Quaranta, Laurenti, Cairo, & Ricciardi, 2007), corporate restaurants/cafeterias (7%) (Lillquist, McCabe, & Church, 2005), and ships (7%) (Capunzo et al., 2005).

In terms of the target population of the studies, thirteen (93%) analysed food handlers and one (7%) food service managers. Most studies provided courses on food and personal hygiene, and held discussions on FBDs. All of them conducted some type of assessment of the training delivered and of the results achieved. Some measured the knowledge acquired by the participants (64%), while

others investigated specific aspects of their attitudes, behaviours and food safety and food hygiene practices (79%).

Regarding the assessment outline, the mode of intervention of eight studies was characterised as pre- or post-intervention, since the assessors compared a group of participants before and after the training was delivered (Acikel et al., 2008; Capunzo et al., 2005; Cenci-Goga et al., 2005; Danchaivijitr et al., 2005; Malhotra et al., 2008; Salazar et al., 2006; Singh, 2004; Quaranta et al., 2007). Two other studies, however, were characterised as descriptive, since the assessors observed food handlers after the intervention, describing the behaviours that were discussed (Pollitt, 2007, 2008). One study was characterised as experimental and comparative, because the assessors compared the results of two groups submitted to different training programs (Lillquist et al., 2005), and another as an experimental, random and controlled study because the assessors compared one group that received training with another that did not (Howells et al., 2008). Finally, the study carried out by DiPietro (2006) was characterised as experimental, random, controlled and comparative, because the researcher compared the results among groups submitted to different training programs with a group that did not receive any training.

3.2. Training topics

The topics dealt with in the training courses were presented in 13 studies, as shown in Table 3. Singh's (2004) study was the only one that did not specify the topics. He mentioned, however, that the training programme was based on the "IOWA model" of research that seeks the best results by combining knowledge with hands-on activities.

The compilation of topics showed that hygiene was the most common employee training topic.

3.3. Training methods

The methods employed by the studies that we analysed are depicted on Table 1. Audiovisual resources designed to explain the topics were present in 10 studies (71%) (Capunzo et al., 2005; DiPietro, 2006; El Derea et al., 2008; Lillquist et al., 2005; Malhotra et al., 2008; Pollitt, 2007, 2008; Quaranta et al., 2007; Salazar et al., 2006; Singh, 2004). Among these resources were: videos (36%) (Lillquist et al., 2005; Pollitt, 2008; Quaranta et al., 2007; Salazar et al., 2006), slides (14%) (Capunzo et al., 2005; Quaranta et al., 2007), posters (29%) (Capunzo et al., 2005; El Derea et al., 2008; Malhotra et al., 2008; Salazar et al., 2006), illustrations and cartoons (7%) (Capunzo et al., 2005), flip chart (7%) (Malhotra et al., 2008), and music (7%) (Pollitt, 2007). DiPietro's (2006) (7%) study indicated that interactive media was used without, however, specifying the type.

Lectures or presentations were made in half of the training courses (50%) (Capunzo et al., 2005; Danchaivijitr et al., 2005; DiPietro, 2006; Lillquist et al., 2005; Malhotra et al., 2008; Pollitt, 2008; Quaranta et al., 2007). Reading materials ($n = 2$, 14%) (Lillquist et al., 2005; Salazar et al., 2006), booklets ($n = 2$, 14%) (Danchaivijitr et al., 2005; Pollitt, 2007) and leaflets ($n = 1$, 7%) (El Derea et al., 2008) were also used in these courses. Some studies conducted recreational activities such as games (Pollitt, 2007) or animations (Pollitt, 2008). Hands-on activities were reported in four studies (29%) (Acikel et al., 2008; Lillquist et al., 2005; Salazar et al., 2006; Singh, 2004). All of the programs involved hand washing; Salazar et al. (2006) also reported the use of gloves and thermometers.

Specific theoretical models for training were used in five studies (36%). Singh (2004) trained employees based on the "IOWA model". In their hands-on activities Lillquist et al. (2005) used the hand

¹ Although the meanings of behaviour and practice are similar, we decided to use both terms, respecting the terminology used by each of the reviewed articles.

Table 1
Methodology of studies that delivered food service training.

Author, year	Place	Participants	Training		Duration
			Topics dealt with	Teaching method	
Singh, 2004	India	23 hospital food handlers	Training programme based on the "IOWA model"	Audiovisual resources and practical hand washing techniques	NI
Lillquist et al., 2005	USA	66 corporate food handlers	Personal hygiene, hand washing	Videos, lectures, writing, reading, and practical hand washing techniques	1–1.5 h
Cenci-Goga et al., 2005	Italy	Food handlers at university cafeteria	HACCP, personal hygiene, best manufacturing practices, cleaning/washing and sanitisation in procedures and food safety	NI	NI
Capunzo et al., 2005	Italy	Food handlers on board ships	Basics of microbiology, personal behaviour and hygiene, hand washing, workplace and utensils hygiene, hygiene of operations, wearing goggles, best food-handling practices, and HACCP	Lectures, audiovisual resources, slides, illustrations, cartoons, and posters.	1.5 h
Danchaivijitr et al., 2005	Thailand	200 hospital food handlers	Gastroenteritis, food and water contamination, and food-handling practices	Lectures and booklet	NI
DiPietro, 2006	USA	20 fast-food establishment managers	Customer satisfaction and complaints, service quality assessment by customer, interaction with customer	Lecture in classroom, interactive media, and in-service training	2.5 h
Salazar et al., 2006	USA	85 cooks and university cafeteria workers	Food safety and HACCP	Videos, books, colour posters, and hands-on activities with magnets, thermometers and gloves	5 h
Quaranta et al., 2007	Italy	25 food handlers at public catering services	Food quality and safety, nutritional quality, microbiological contamination, quality control tools (checklist, HACCP, self-control)	Lecture, slides and DVD	11 h
Pollitt, 2007	UK	>2700 fast-food workers	Personal hygiene and behaviour, customer service, workplace hygiene, best practices, menu, company policies	Recreational activities, games, music, balloons, and booklets	NI
Pollitt, 2008	UK	Company employees	Basics of safety and health, food safety, wine cellar management, and allergy and food intolerance	Multimedia, video, lecture and animation	Sessions delivered in 3 days
Malhotra et al., 2008	India	143 food handlers at food service units, except hospitals	Food-borne and water-borne diseases, basics of microbiology, microbiological contamination, personal hygiene, food hygiene and workplace hygiene. The training program was based on WHO, and on India's National Institute of Nutrition (NIN) and Health Education Centre.	Lecture based, flip chart, and posters	1 h
El Derea et al., 2008	Egypt	23 hospital food handlers	Food-handling practices, personal hygiene, and hand washing	Leaflets, posters and visual resources	NI
Acikel et al., 2008	Turkey	83 hospital kitchen workers	Personal hygiene, food hygiene, and hand washing	Practical hand washing techniques. Material from "Gulhane Military Medical Academy Department of Public Health"	NI
Howells et al., 2008	USA	Food establishment workers	Food safety, personal hygiene, reception and storage, cooking and food preservation, washing and sanitisation of work surfaces	Material from "ServSafe Employee Guide Workbooks" and videos	4 h

NI = Not informed.

Table 2
Methodology for the assessment of training delivered to food services.

Author/year	Place	Participants	Method and training topics assessed	Attitudes, behaviour and practices at the workplace
Singh, 2004	India	23 hospital food handlers	Knowledge Questionnaire with 16 multiple-choice questions on hand washing	Checklist for observing hand washing practices
Lillquist et al., 2005	USA	66 corporate food handlers	Questionnaire with 5 questions on hand washing	15 multiple-choice questions to find out hand washing
Cenci-Goga et al., 2005	Italy	Food handlers at university cafeteria	Not checked	Microbiological analysis
Capunzo et al., 2005	Italy	Food handlers on board 22 ships	Not checked	Analytical monitoring of work surfaces and of handlers' hands.
Danchaijitr et al., 2005	Thailand	200 hospital food handlers	Questionnaire on microorganisms, Food contamination prevention	Questionnaire and bacteriological analysis of some pathogens.
DiPietro, 2006	USA	20 fast-food establishment managers	NI	NI
Quaranta et al., 2007	Italy	25 food handlers at public catering services	Questionnaire with 32 multiple-choice questions on: microbiological hazard, preservation temperature, chemical and physical hazards, nutrition, legislation, labelling, infrastructure, control, HACCP.	Not checked
Pollitt, 2007	UK	>2700 fast-food workers	Not checked	Questionnaire to assess hospitality and customer service
Malhotra et al., 2008	India	143 food handlers at food service units, except hospitals	Questionnaire with open-ended questions on: food-borne and water-borne diseases, mode of transmission and prevention	Likert's 3-point scale to assess personal and food hygiene, and attitudes at the kitchen. Hand washing practices were questioned.
El Derea et al., 2008	Egypt	23 hospital food handlers	Questionnaire on food safety	Checklist and bacteriological analysis of patients' meals and of food preparation surfaces
Acikel et al., 2008	Turkey	83 hospital kitchen workers	Questionnaire with 39 questions on: level of information, food hygiene habits	Bacteriological analysis and questionnaire with 39 questions on: level of information, food hygiene habits.
Howells et al., 2008	USA	Food establishment workers	Questionnaire for focus group on: obstacles to hand washing, washing and sanitisation of workplace and use of thermometer	Questionnaire for focus group on: obstacles to hand washing, washing and sanitisation of workplace and use of thermometer

NI = Not informed.

washing protocol issued by the *Food and Drug Administration* (FDA). Malhotra et al. (2008) prepared their material based on WHO's recommendations, as well as on India's National Institute of Nutrition (NIN) and Health Education Centre. Acikel et al. (2008) used the material developed by the "Gulhane Military Medical Academy, Department of Public Health", and Howells et al. (2008) on the "ServSafe Employee Guide workbooks".

Only one study did not report on the activities carried out in its employee training (Cenci-Goga et al., 2005).

Although all of the studies used more than one method for training professionals, only two of them (DiPietro, 2006; Lillquist et al., 2005) compared the different methods to evaluate the knowledge acquired in and acceptance of each course. DiPietro (2006) did not find a significant difference between training methods. This author believes that this was probably due to: the small sample size; the fact that the training was provided to people from different levels and interests; and the lack of support from the organisation for their employees' training and education.

In terms of the duration of training, 56% of the studies provided this information. The minimum duration was 1 h (Malhotra et al., 2008), and the maximum 11 h (Quaranta et al., 2007) and/or 3 days of training sessions (Pollitt, 2008).

3.4. Training assessment

Training assessment was conducted in all of the studies reviewed, but in different ways. In terms of content, most studies assessed employee knowledge acquisition by analysing pre- and post-training methods (Acikel et al., 2008; Capunzo et al., 2005; Danchaijitr et al., 2005; El Derea et al., 2008; Howells et al., 2008; Lillquist et al., 2005; Malhotra et al., 2008; Quaranta et al., 2007; Singh, 2004), and by observing changes in attitude, behaviour and practices at the workplace (Acikel et al., 2008; Capunzo et al., 2005; Cenci-Goga et al., 2005; Danchaijitr et al., 2005; El Derea et al., 2008; Howells et al., 2008; Lillquist et al., 2005; Malhotra et al., 2008; Pollitt, 2007; Singh, 2004).

Salazar et al. (2006) assessed employee motivation created by the training provided by using a questionnaire with 14 questions. Worker satisfaction was evaluated with 3 questions. The authors found that employees were generally pleased with the training sessions that used videos, books, colour posters and practical techniques involving magnets, thermometers and gloves.

Cenci-Goga et al. (2005) focused on the training and motivation of employees. These authors affirm that it is essential for management to provide on-going training of food service professionals, encourage them to conduct self-inspection and provide suggestions for the implementation of good hygienic practices and for assessing work goals.

Nine (64%) of the studies reviewed assessed the knowledge of the participants who took the training course (Table 2). The assessment tools were questionnaires that ranged from five (Lillquist et al., 2005) to thirty-nine questions (Acikel et al., 2008). There were two multiple-choice questionnaires (Singh, 2004; Quaranta et al., 2007) and one with open-ended questions (Malhotra et al., 2008); the others did not specify the assessment format used with the participants. The assessment conducted by Singh (2004) used interview techniques for data collection whereas none of the other researchers specified their techniques. We believe, however, that their interviewees completed questionnaires on their own. Although the study carried out by DiPietro (2006) did not clearly mention the use of a questionnaire to assess the knowledge of employees, the characteristics described seem to suggest that a questionnaire was used. Eight (80%) of the studies that conducted employee knowledge assessment listed specific

Table 3

Topics dealt with in the training courses delivered to food services, broken down per study.

Training topic	Singh, 2004	Lillquist et al., 2005	Cenci-Goga et al., 2005	Capunzo et al., 2005	Danchaivijitr et al., 2005	DiPietro, 2006	Salazar et al., 2006	Quaranta et al., 2007	Pollitt, 2007	Pollitt, 2008	Malhotra et al., 2008	El Derea et al., 2008	Acikel et al., 2008	Howells et al., 2008
Personal hygiene	x	x	x						x		x	x	x	x
Food safety			x				x	x		x				x
Best practices			x	x	x				x			x		
Workplace hygiene				x					x					x
Hazard analysis and critical control point (HACCP)			x	x			x	x						
Hand washing	x											x	x	
Microbiology basics				x				x			x			
Food- and water-borne diseases					x						x			
Personal behaviour				x					x					
Food hygiene											x		x	
Utensils hygiene				x										x
Wine cellar/Menu management									x	x				
Workplace, Customer service, Focus on customer						x			x					
Cleaning/Washing and sanitisation procedures			x											
Reception and storage														x
Cooking and food preservation														x
Checklist								x						
Food quality								x						
Nutritional quality								x						
Self-control								x						
Company policies									x					
Allergy and food intolerance										x				

topics with hand washing being the most frequent (Howells et al., 2008; Lillquist et al., 2005; Singh, 2004).

The assessment of workplace attitudes, behaviours and practices was conducted in eleven (79%) of the studies (Table 2). The types of assessment varied greatly but the predominant focus was on food safety. Observations were made by using a checklist in two studies (El Derea et al., 2008; Singh, 2004), and questionnaires were the assessment tool in five studies (Acikel et al., 2008; Danchaivijitr et al., 2005; Howells et al., 2008; Lillquist et al., 2005; Pollitt, 2007). These assessment tools were usually applied to the trainees, however, Pollitt (2007, 2008) assessed the attitudes, behaviours and practices of employees at the workplace based on the opinions of managers. The study conducted in India was the only one to use the Likert scale for assessing these actions (Malhotra et al., 2008). Analytic monitoring, through the microbiological analysis of the final product, food preparation surfaces or handlers' hands, was conducted in five studies (Acikel et al., 2008; Capunzo et al., 2005; Cenci-Goga et al., 2005; Danchaivijitr et al., 2005; El Derea et al., 2008). But Cenci-Goga et al. (2005) and Capunzo et al. (2005), did not associate the analytic monitoring with other assessments by using questionnaires or checklists.

Hygiene-related practices and attitudes, particularly hand washing, were those most assessed. Some studies used bacteriological analyses to verify the results. Only Pollitt's (2007) study did not assess issues directly related to food safety, because this author analysed the employees' hospitality and customer service.

Some studies specify the time elapsed between employee training and reassessment. The interval ranged from approximately 48 h (Singh, 2004) to two weeks (Lillquist et al., 2005), 7 months (Cenci-Goga et al., 2005) and 3 months (Malhotra et al., 2008).

4. Discussion

The topics presented in the training courses were in accord with Sousa's (2008) recommendations, which state that to reduce the incidence of FBDs, public health interventions must focus on general hygiene measures, appropriate hygiene and food-handling procedures, hand washing with soap, and the frequent sanitation of utensils. According to the World Health Organization (2000), food service employees should be trained in two subjects regarding knowledge of food safety: 1. Good hygienic practices, and 2. The HACCP system. It is also noted that training should identify unfit employee behaviour and clarify how to correct these issues.

In terms of quality control tools, studies in Italy trained employees in Hazard Analysis and Critical Control Point (HACCP) procedures. Baş, Ersun, and Kivanç (2007) affirm this is the correct training method because they consider such training programmes essential for maintaining food safety and implementing HACCP. They found the absence of food handler training to impede the implementation of quality control systems.

According to DiPietro (2006), the training of professionals is crucial for the success of organisations. Two of the studies reviewed identified the importance of building administrative capacity to support the concern for food safety (DiPietro, 2006; Pollitt, 2007). Both authors refer to transnational corporations with branch offices in many countries. They presented initiatives that combine training in corporate management with that about food safety in food services, highlighting the economic significance of this action, which emphasizes concern for the corporation, its employees and consumers.

Mitchell et al. (2007) argue that food service training usually conveys basic knowledge about the factors causing food-borne diseases, and, in some cases, specific contents emphasising individual behaviour. Howells et al. (2008) emphasize that training

courses should not focus solely on the theoretical elements of food safety. In this light, DiPietro (2006) and Howells et al. (2008) mention the importance of considering problems in the company's production system and other issues when determining the contents of the training. They also highlight the importance of identifying impediments to the execution of important activities and to meeting employees information needs.

In the study conducted by Howells et al. (2008), a group of food handlers that participated in a training course detected the following obstacles to cleaning and sanitisation of their workplace: time constraints, lack of encouragement or willingness to adopt practices, and carelessness of managers and employees. According to Singh (2004) and Nieto-Montenegro et al. (2008), for company management to contribute to the execution of the activities that were taught, a person must be assigned to supervise the activities after the training course. This person should also be committed to providing the appropriate equipment and materials for the proper execution of the work.

The type of training method may interfere with its acceptance by participants and impact their level of satisfaction. Singh (2004) believes that the structure used in food service training can be significantly effective in enhancing the appropriate professional practices and skills. Egan et al. (2007) and Mortimore (2001) argue that food handler training methods should be developed in order for them to be able to contribute toward behavioural change and knowledge dissemination. However, according to the World Health Organization (2000), the education, as well as the training program strategy choice, should take into account population characteristics and available infrastructure.

For Malhotra et al. (2008), in addition to lectures and posters, more training techniques are required to solve food safety issues. A study by DiPietro (2006) showed that training with the aid of interactive media was better accepted by participants than other methods. This training method led to more positive changes in performance.

DiPietro (2006) argues that training with interactive media is relatively cheap in the long run. The initial cost may be high because of the need to develop the materials, but these materials can be used more than once. This author and Pollitt (2008) maintain that another benefit is that when interactive media is employed, the training components can be used in variable configurations (e.g. in the home or workplace), and participants can train at their own convenience (DiPietro, 2006).

In a study by Lillquist et al. (2005), when participants were asked about their preferred mode of learning, those who did not have hands-on activities answered that they preferred reading (52%), followed by video (38%) and writing (10%). The participants of the other group preferred hands-on activities (47%), followed by reading (33%) and video (19%). Approximately 50% of the participants in the training thought that hand washing practices were the most informative method. For Sousa (2008), hands-on activities focussing on personal hygiene and food-handling are recommended for training that introduces concepts of microbiology.

By analysing the cost of training, Lillquist et al. (2005) realised that limited time and money is invested for employees to adopt and assimilate hand washing practices. These authors point out that in approximately 7 min it is possible to demonstrate and practice hand washing. They also mention that the financial cost of this practice is minimal, because the materials used (nail brush, paper towel, soap and water) are relatively cheap and should already be available at the units.

According to DiPietro (2006), in-class training is advantageous because it brings many people together at the same place, thus reducing costs, in addition to increasing interaction. In-service training allows people to see what is being taught while they work,

and elicits relevant comments. However, the cost of training per person may be higher.

The resources used in the studies reviewed are highlighted by visual resources such as interactive animations, videos, slideshows, posters, flip charts, cartoons and illustrations. For Singh (2004), posters and leaflets can be used to remind workers of the practices that must be performed. These materials, after being used in the training sessions, can be posted on walls in appropriate places at the workplace.

Most of the studies that obtained distinguished results used lectures to support presentations involving multimedia, video and illustrations such as posters, as well as reading, writing and hands-on exercises. These resources were also associated with positive attitudinal and behavioural changes. The same was true of in-service training and the use of recreational activities. Training must be assessed to ensure that it is contributing toward the company's positive performance. Even though training is important, the benefits it brings must be greater than the costs it entails (DiPietro, 2006). As with any other assessment process, the evaluation of training can be complex, since numerous factors may contribute toward lesser or greater learning, such as the type and level of training provided, employee motivation and cultural dimensions (Egan et al., 2007).

Many studies have shown that training courses are able to enhance skills and personal hygiene, including hand washing (Acikel et al., 2008; Capunzo et al., 2005; Cenci-Goga et al., 2005; DiPietro, 2006; El Derea et al., 2008; Howells et al., 2008; Lillquist et al., 2005; Malhotra et al., 2008; Pollito, 2007, 2008; Quaranta et al., 2007; Salazar et al., 2006; Singh, 2004).

In the studies reviewed, microbiological analyses conducted after training indicated an improvement in food hygiene (Acikel et al., 2008; Capunzo et al., 2005; Cenci-Goga et al., 2005; El Derea et al., 2008). For Singh (2004), bacteriological analysis can be used to check hand washing practices as well as other tasks performed by these professionals.

Hedberg et al. (2006) report that establishments that provide food safety training to their employees have less risk of causing food-borne diseases. Green et al. (2007) observed that the employees in establishments with training programs tend to wash their hands correctly.

Food service worker training influences correct hand washing. The four studies that carried out hand washing practices obtained positive differences after training was provided in this particular behaviour (Acikel et al., 2008; Lillquist et al., 2005; Salazar et al., 2006; Singh, 2004). However, this difference was significant only in the study by Lillquist et al. (2005). Wearing gloves was one of the practices found to be carried out by Salazar et al. (2006). This is an important issue because some studies have shown that food handlers wear disposable gloves for an excessively long time, because they believe that gloves alone reduce the risk of bacterial contamination (Lynch, Phillips, Elledge, Hanumanthiah, & Boatright, 2005).

After training, studies showed significant differences in the reduction of microorganisms (Cenci-Goga et al., 2005; El Derea et al., 2008) in food preparation and handling (Capunzo et al., 2005), employee skills/knowledge (El Derea et al., 2008; Malhotra et al., 2008; Quaranta et al., 2007; Salazar et al., 2006), and use of personal ornaments (Acikel et al., 2008). Other studies also found differences, although not significant ones.

According to Acikel et al. (2008), training contributes significantly toward reductions in the use of personal ornaments, and, consequently, microorganisms. A study by Wongworawat and Jones (2007) showed that food handlers who wear jewellery may contaminate their hands more often. This contamination can be decreased with correct hand washing and sanitisation practices.

The importance of training employees on this specific topic is thus emphasized.

Only one of the studies reviewed found an educational programme that did not contribute toward the enhancement of the participants' skills, knowledge, and hygienic and other practices to prevent the dissemination of pathogens. According to this study, other training approaches are required, in addition to the ones they used, such as lectures and the distribution of reading materials (Danchaiwijitr et al., 2005). Although all of the other studies reported positive general changes in the participants' level of knowledge, skills and attitudes, Acikel et al. (2008) found that the knowledge acquired was not reflected in all behaviour.

Among the benefits found after training, the articles reviewed emphasized: increased customer satisfaction with the service provided (Pollitt, 2007); employee satisfaction with the additional benefits received and with the supervision (Salazar et al., 2006); enhancement of employees' skills/knowledge (Acikel et al., 2008; El Derea et al., 2008; Lillquist et al., 2005; Malhotra et al., 2008; Pollitt, 2007; Quaranta et al., 2007; Salazar et al., 2006; Singh, 2004); improved hand washing practices (Lillquist et al., 2005; Malhotra et al., 2008; Singh, 2004); reduction of microorganisms on food handlers' hands, food preparations and on the utensils and equipment used in food preparation (Acikel et al., 2008; Capunzo et al., 2005; Cenci-Goga et al., 2005; El Derea et al., 2008); improved food safety practices (Acikel et al., 2008; Capunzo et al., 2005; El Derea et al., 2008; Malhotra et al., 2008); improved teamwork, employee and company activities (Pollitt, 2008) and better customer service (Pollitt, 2007).

Employee satisfaction after training can be associated to increased awareness among these professionals about the importance of safe food-handling (Tokuç, Ekuklu, Berberoglu, Bilge, & Dedeler, 2009). Salazar et al. (2006) maintain that employee satisfaction and satisfaction with training contributed toward food safety.

As for the duration of training, the studies of the programs with the longest duration – 11 h (Quaranta et al., 2007) and 5 h (Salazar et al., 2006) –, obtained a significantly positive difference in the level of knowledge of employees after the intervention. Training courses that were 4 h or less showed an improvement in the level of knowledge and attitudes of the participants. However, not all improvements were significantly different in these courses.

According to Veiros, Proença, Santos, Kent-Smith and Rocha (2009), a lack of periodic food handler training may contribute to or induce unsafe food-handling procedures, such as not wearing disposable gloves. However, in the studies reviewed assessment was conducted just once after training. Malhotra et al. (2008) suggest revisiting the employees' workplaces to reassess their actions and, if necessary, providing them new guidance, since the process must be on-going and periodic to ensure food safety in food services.

The World Health Organization (2000) highlights the importance of identifying available resources to implement an education and training program. The necessity of program monitoring, as well as evaluation to identify desirable and necessary correctives actions, are also suggested.

Finally, it is important to cite that the public health sector has a relevant role in food safety education. The health sector, in cooperation with other governmental and non-governmental sectors, should develop and implement a food safety education program for food service employees (WHO, 2000).

5. Conclusion

Food handler, training must include contents dealing with both food quality and personal hygiene, according to standards and

guidelines for food establishments issued by international institutions.

The topics that are most often presented to food service employees during training are personal hygiene, food safety, best practices, Hazard Analysis and Critical Control Point (HACCP), workplace hygiene, hand washing and basic microbiology.

Interactive media seems to be the most widely accepted resource, particularly audiovisuals, videos and lectures, in addition to recreational activities involving hands-on courses, all of which bring more benefits to the trainees. The presentation of training-specific theoretical concepts was also observed.

Hands-on activities during training are usually related to hand washing practices and associated with other educational methods. In addition to being low cost, hand washing is well accepted by employees, yielding positive results in food safety.

Training assessments analysed the knowledge acquired by employees through pre- and post-training evaluation methods. Attitudinal and behavioural changes at the workplace were also observed. In order to assess employee knowledge, questionnaires containing multiple-choice and open questions were used. The number of questions varied from one study to another. Attitudes and behaviours at the workplace were assessed by using questionnaires, analytical monitoring, a check list and the Likert scale. Hand washing was the most assessed item related to employee knowledge, attitudes and behaviours.

After training was provided, the studies found that there was a considerable enhancement in knowledge acquisition by employees, as well as positive attitudinal and behavioural changes. Some studies indicated that there were significant differences in the level of microorganisms found in food preparation and handling, in employee knowledge levels and in their use of body ornaments.

The development and provision of training courses are crucial to achieve behavioural changes and improve skills and knowledge. Nevertheless, there are few studies exploring their methodologies. This highlights the need to conduct detailed analysis of methodological strategies adopted by food service training. Additional experimental, random, controlled and comparative studies are recommended. They can help us understand the methods used in food service worker training, and their impact on the learning of food safety.

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