

Enhancing the Amelioration of Hygienepactices after Monitoring Food Caterings during Preparation of Non-Commercial Meals for A School Food Aid Program

Panagiotis Georgakopoulos¹, Christina Maria Kastorini¹, Matina Kouvari¹, Anastasia Pantazopoulou¹, Dina Zota¹, Amanda Garrison^{1,2}, Meera K Nagarajan^{1,3}, Afroditi Veloudaki¹, Alexandros Gryparis^{1,4} and Athena Linos^{1*}

¹Department of Environmental and Occupational Health, Institute of Preventive Medicine, Greece

²Department of School of Public Health, France

³Department of Hygiene, Ohio State University, USA

⁴Department of Hygiene, Epidemiology and Medical Statistics, National and Kapodistrian University of Athens, Greece

Article Information

Received date: Aug 03, 2017

Accepted date: Sep 11, 2017

Published date: Sep 18, 2017

*Corresponding author

Athena Linos, Environmental and Occupational Health, Institute of Preventive Medicine, 7 Fragoklisias str., Maroussi, 15125, Greece,
Tel: +30 210 6255700;
Fax: 30 210 6106810;
Email: a.linos@prolepsis.gr

Distributed under Creative Commons
CC-BY 4.0

Keywords Food aid program; Meal hygiene; HACCP; Food catering; Hygiene/quality control checking

Abstract

Background: The safety of meals distributed in the context of food aid programs remains a strong priority. The improvements of hygiene practices after monitoring food-catering suppliers applied for a school food aid program were evaluated.

Methods: 31 unannounced inspections were conducted during the 2013-14 school year. Through inspections, HACCP principles and its prerequisite programs along with additional specifications were evaluated.

Results: Despite overall compliance with HACCP, some infringements were detected; staff's incomplete implementation of hygiene rules and inappropriate protective clothing (violations of 10.5% and 15.8%, respectively), possible "cross-contamination" during meal preparation (violations of 28.9%), presence of insects/mites (violations of 13.2%), trash and stagnant waters on floors/wells (violations of 13.2% and 10.5%, respectively). Important improvements were highlighted mainly in terms of staff education regarding clothing and "cross-contamination" prevention, disinfection/deworming facilities and foreign material detection.

Conclusions: Food caterings would benefit from a well-organized food aid program through the provision of appropriate corrective actions which enhance the reduction, or even, the elimination of the vast majority of violations.

Introduction

Since the beginning of the economic crisis in 2009, the Greek population has been living under the constraints of economic insecurity, unemployment and income reduction. According to the UNICEF report, over 20% of Greek households live below the poverty line, while the rates of child poverty and malnutrition are alarming [1]. Thus, many Greek households shifted their meal choices based on cost efficiency rather than meal hygiene/safety and nutritional quality.

To confront these adverse socioeconomic conditions, a school-based nutritional program, the "DIATROFI" Program (<http://diatrofi.prolepsis.gr/en/>) was implemented [2-5]. The Program was developed by the Institute of Preventive Medicine, Environmental and Occupational Health, Prolepsis, with main funding from the Stavros Niarchos Foundation, with a dual purpose: to provide all students of participating schools with daily free meals and to promote healthy nutrition for the students and their families. The meals were particularly designed for the "DIATROFI" Program based on healthy nutrition guidance and principles, including e.g., the exclusive utilization of extra virgin/virgin oil as the only fat (excluding butter or seed oils), the avoidance of preservatives (since all meals are distributed to the schools within 24 hours after their production/packaging) and all artificial additives, and specific nutritional requirements (i.e. salt and sugar level of less than 0.5 g/100 g and 10 g/100 g, respectively).

At the same time, a major issue of "DIATROFI" Program was to strongly ensure on a daily basis the hygiene and quality of the meals, setting the following priorities: a) absolute compliance with the available Food Safety/Hygiene System [6-8] performed in the selected food suppliers to nullify any possibility of food borne illness or outbreaks e.g., salmonellosis caused by the meal consumption [9] and b) statement and adherence to even stricter recommendations through partial modification of

the applied ones. All the above were performed in order to guarantee healthy and qualitative meals for every student in the participating schools. Thus, frequent unannounced hygiene/quality control inspections were performed by Institute's authorized members.

The aim was to present the most valuable improvements performed in catering facilities supplying the "DIATROFI" Program, being carried out through out various stages of the flow diagrams. The findings of the present work are expected to serve a useful tool for the evaluation and mainly improvement of the hygiene conditions in food production chains across Europe and worldwide.

Materials and Methods

Food catering selection

In July 2013, Prolepsis Institute issued an open call for applications of food-supplier position for the "DIATROFI" Program throughout caterings in Greece. According to the Institute's protocol, the first stage of the selection process involved verification of all paperwork (i.e., documents and certificates analytically described in the call) submitted with the proposal. The second stage involved inspections of each food catering facility, performed by authorized Institute's members, so as to verify the validity of the submitted application and Hazard Analysis and Critical Control Points (HACCP) compliance. The final decision for the food catering selection was made in the last stage of the evaluation process. The selection took into account only the food catering companies that met all technical requirements based on their hygiene and quality parameters (including sensory-based characteristics of the proposed meals) ratings, along with their respective economic offers.

Control parameters for catering facilities during the school year

The selected food caterings agreed to adhere to certain control parameters and to high hygiene/quality standards. The control parameters that were set forth by the "DIATROFI" Program, consisted of a) guidelines related to the HACCP principles and its prerequisite programs [10,11] and b) additional terms and specifications of "DIATROFI" Program, as specified by Prolepsis Institute (e.g., dealing with physical disinfection of cutting surfaces with edible vinegar solutions, increased frequency of disinfection/deworming, no use of preservatives and artificial additives, natural disinfection of vegetables with vinegar solutions).

During all Institute member visits, staff members were observed regarding personal hygiene practices (Table 1). Moreover, the use of different cutting surfaces according to the product and the absence of insects/bugs from the facilities were assessed. Table 1 summarizes the parameters assessed for each facility. After inspection of the production flow chart, facilities issued relevant records of the Hygiene/Quality System to further confirm absolute adherence to the legislative requirements.

Moreover, random, representative samples of raw materials and ready-to-eat meals were selected and weighted, to ensure adherence to the weight standards, described in the signed contracts. Approximately five products from the standardized meals, such as toast slices, baguettes, and bakery products (i.e., plum cakes, breadsticks) were weighted and macroscopic controls were performed by Institute

members, with the presence of associated personnel by each food supplier. In terms of raw materials such as fruits (i.e., apples, oranges, bananas) and cut vegetables (i.e., sliced tomatoes, carrot/cucumber slices) approximately twenty products from each food supplier were weighed and macroscopically examined.

Finally, the condition of the transport vehicles was examined through checking the temperatures of the cooling chambers and whether their owners kept a detailed daily log of temperature recordings.

Unannounced inspection procedure at the food suppliers' facilities

Once the school meal distribution for the 2013-14 school-year began, to further evaluate the food caterings, regular unannounced inspections were performed. Such visits were provisioned in the initial signed contracts, and each food supplier was approximately visited at least once in a period of 30-45 days.

During inspections, at least two authorized Institute members performed hygiene/quality control checks; the entire flow chart was inspected and detailed observations were conducted. In addition, random samples of raw materials and ready-to-eat meals were collected, stored in isothermal packs, along with ice packs and were labeled accordingly (i.e., name of product, name of manufacturer, dates of production/distribution). These samples were subsequently analyzed in Accredited ISO/IEC 17025:2005 Standard Laboratories with the purpose to verify compliance with both the applied Food Hygiene System and the Program's requirements.

Furthermore, representative HACCP records (i.e., storage cooling chambers temperature records, files with internal temperatures of roasted fillet chicken, disinfection/deworming files, etc.) were requested. All findings implied potential hazards at any stage of the flow chart were communicated to the relevant supplier staff. In case those corrective actions were demanded, a specific report including the major findings was timely delivered to the Hygiene/Quality Manager.

Statistical analyses

To examine whether the number of violations/per visit was associated with company characteristics Spearman's correlation coefficient was applied. Mann-Whitney test was used to examine potential differences among the suppliers located in the Attica Prefecture/Thessaloniki (highly populated urban areas) and the ones in province regarding various company characteristics. Statistical significance level was set to 0.05 and all reported p-values were two-tailed. Statistical analysis was performed in IBM SPSS v. 23 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.).

Results and Discussion

During the 2013-14 school year, 11 applications were received from food caterings, for the position of the food-supplier for the "DIATROFI" Program; Attica Prefecture ($n=5$), Thessaloniki ($n=2$) and province regional food caterings ($n=4$). The one that did not meet hygiene standards was excluded from the final selection. After the evaluation process, 7 food caterings were selected as suppliers.

31 unannounced inspections of the selected food suppliers were performed. The number and frequency of the inspections depended, among others, on the results of previous inspections, laboratory analyses, and reports from school headmasters regarding inadequate hygiene/quality of the distributed meals. Table 1 summarizes the total number of aberrations found in these unannounced inspections.

Out of the 6,484,249 meals distributed, there were only 27 incidences of school reports delineating the detection of foreign materials (i.e., presence of insects, hair/fibers, plastic pieces), representing a rate lower than 0.001%. Among them, only 10 incidences referred to the sealed packaging. To nullify such phenomena all hygiene conditions during meal preparations were re-examined by authorized Institute members. Furthermore, the entire flow chart line of food production was thoroughly examined, even if the reported existence of foreign material was the sole among several thousand meals produced per day. The dates and major audit findings of the inspections of each food supplier are presented in table 2.

The observed violations resulted from incomplete implementation of hygiene rules during meal preparation. Infringements included working without proper gloves, improper covering of the raw materials/ready-to-eat meals, and possible “cross-contamination” by the simultaneous storage of them in the same containers (Table 2). These might be attributed to inadequate staff’s knowledge and education on hygiene practices [12-19]. Uncovered or improperly covered raw materials and ready-to-eat meals, trash and waste left on the floor and the presence of insects in food preparation areas were the most common violations (Tables 1 and 2), in accordance with previous studies [16,19,20-22].

Various studies have examined the increased possibility of “cross-contamination” due to the storage of raw materials and/or non-thermal products with ready-to-eat products in the same container. Ko [21] and Haileselassie et al. [17] stated that incidences of storage of uncooked products (i.e., raw eggs, raw chicken fillet) within the same cooling chambers as fruits and bakery products or placing raw meat on the same workbench as cooked products are erroneous practices potentially leading to “cross-contamination” [17,21]. Similar issues were observed in the Institute’s unannounced visits;

e.g., at a catering site, pears without protective plastic covering were placed in uncovered crates opposite a bench containing raw slices of meat (Table 2). Multiple visits to other facilities showed insufficient coverage of raw materials remained in the production line. For instance, there were uncovered raw materials and meals such as peas/apples after the appropriate disinfection, incomplete coverage of bread and uncovered cooked pieces of chicken. All these undoubtedly raised the risk of “cross-contamination” [17,20]. However, none of the respective microbiological analyses performed ($n=67$), revealed pathogens, apart from some spoilage microbes (i.e., *Enterobacter* species or *Listeria* strains, not of pathogenic *Listeria monocytogenes* strain) in few samples ($n=11$) (mainly uncooked raw materials or cucumber-carrot sticks) indicative of poor or inadequate hygiene. According to the laboratory report statement, the spoilages’ detection along with the aforementioned possible “cross contamination” incidences were possibly attributed to the inadequate raw material hygiene and/or improper maintenance of good manufacturing practices (e.g., improper sanitation), as addressed in similar studies [23].

The necessity for the implementation of corrective actions was more indicative in food caterings in province, where insects (flies/ flour parasites) and small populations of vermin were detected (Table 2). On the contrary, inspections of Attica Prefecture suppliers revealed no insects, with the exception of some small parasites found on the non-disinfected oranges of one company (Table 2).

The most difficult parameter to control was the fruit weight and quality standardization, since school complaints were mainly for defective fruits. Moreover, during inspections, Institute members found fruits with substandard weight/quality. Such incidences included the presence of dust or dirt residues in ready-to-distribute fruits (i.e., oranges with white posts and stains on the peel or bruised and abraded apples). Furthermore, the majority of school complaints dealt with internal fruit irregularities, such as mold, sepsis or internal parasites within the flesh, being invisible during distribution process [24]. Even so, the number of defective fruits distributed was extremely low, since there were only 61 school reports referring to defective fruits among the total distributed number of 7,055,448 fruits with daily meals.

Table 1: Basic control checking parameters and frequency of findings during the 31 unannounced visits to suppliers.

Parameter	Total number of aberrations	% on the total number of aberrations observed for all food suppliers
Trash on floor and wells	5	13.20%
Stagnant water (in floors and wells)	4	10.50%
Cleaning/Disinfection	0	0.00%
Prevention of “cross contamination” (from uncovered product pieces) – Institute recommendations led to satisfactory results in terms of adequate coverage	11	28.90%
Personal hygiene rules from the staff (e.g., change gloves after each interruption, use gloves to handle fruits etc.)	4	10.50%
Protective clothing for staff	6	15.80%
Placement of meals in the appropriate cooling temperatures	0	0.00%
Baking at the appropriate temperatures	0	0.00%
Raw materials of high hygiene	2	5.30%
Presence of insects/mites on walls, floor, food etc.	5	13.20%
Presence of foreign materials (glass, wood, metal, plastic) in the food production chain	0	0.00%
Keeping the appropriate records/forms of the respective Food Hygiene/Quality System (baking temperatures records, cooling chambers’ temperatures records, disinfection files etc.)	1	2.60%

Table 2: Basic findings from the unannounced visits to facilities suppliers from 14/10/2013 until 13/06/2014.

Supplier	# of unannounced visits	Control Dates	Findings/ Comments	Number of violations	Number of violations/ Number of visits	Establishment year of the company	Personnel number (2012)	Number of certifications other than HACCP	Foreign materials Monitoring system	2012 turnover (in 1,000 euros)
Food catering in Attica (A)	5	23/10/2013	No findings	5	1	2001	34	2	Yes	2.902
		13/11/2013	<i>Uncovered pears (without plastic film) near worktop with cutting meat</i>							
		25/11/2014	No findings							
		30/01/2014	a) Many oranges with white spots and stains on their bark b) Enough food wastes in the production area, c) Legume burgers on open trays							
		28/04/2014	Some apples with small scratches and imperfections							
Food catering in Attica (B)	5	29/10/2013	No findings	5	1	1992	54	2	Yes	10.626
		4/12/2013	Insufficient coverage of apples and bread pieces in adjacent frames							
		3/2/2014	No findings							
		28/04/2014	a) Dust and dirt residues in ready-to-distribute apples b) Inadequate filling of the baking temperatures form (for chicken fillets)							
		28/05/2014 (Branch in Crete)	a) <i>Lack of space for non-compliant products</i> b) Non-electronic recording temperatures in the cooling chambers (would be completed in the end of June)							
Food catering in Attica (C)	4	5/12/2013	a) Weighing of roasted chicken pieces in impure surface b) <i>Some parasites (bugs) on non-already disinfected orange peels</i>	3	0.8	1970	56	3	Yes	60.061
		30/01/2014	No findings							
		4/3/2014	No gloves wearing of staff handling disinfected oranges							
		26/03/2014	No findings							
Food catering in Thessaloniki	3	18/12/2013	No findings	2	0.7	1986	13	3	Yes	26.588
		24/02/2014	<i>Floater nearby wells</i>							
		19/03/2014	Uncovered roast chicken pieces storage in a cooling chamber							

Food catering in province (1)	5	29/11/2013	Incomplete coverage of bread and veggie-burger pieces	12	2.4	1997	5	1	No	1.18
		13/01/2014	a) <i>Fly in the uncovered pieces of bread</i>							
			b) Uncovered tomato slices							
			c) <i>Disinfection of workbench with the spray liquid transferred to the ready for primary packaging sandwiches</i> (batch marking as "non-compliant")							
		5/3/2014	a) Weighing of decontaminated apples in an impure scale							
			b) <i>Inadequate hygiene compliance by two staff members</i>							
			c) <i>Secretary entrance in the meal production area without the proper protective clothing</i>							
		26/03/2014	a) <i>Inadequate protective equipment of three staff members</i>							
			b) Uncovered pieces of cooked chicken fillets							
		21/05/2014	a) Two workers with otherwise than the appropriate shoes							
b) Uncovered bread pieces										
c) <i>Open door that communicates the waiting room with the food production area</i>										
Food catering in province	3	9/10/2013	<i>Dirty floors and dirty premises wells</i>	8	2.7	1997	12	0	No	6.243
		22/01/2014	a) Dirty floors							
			b) <i>Uncovered bread pieces while a worker was sweeping the floor</i> (possible powder transfer etc.)							
			c) Inadequate coverage of roasted chicken fillets							
			d) <i>Some insects in the production areas</i>							
		19/02/2014	e) "Beaten, bruised, abraded" apples							
a) <i>Dirty floors and dirty premises wells</i>										
b) <i>Inadequate protective equipment of two staff members</i>										

Food catering in province	6	18/12/2013	No findings	19	3.2	1983	16	1	No	9.246
		5/2/2014	a) <i>Inhibition and difficulties to the implementation of the unannounced visit</i>							
			b) <i>Inadequate protective equipment of all staff members</i>							
			c) <i>Non-compliance records with baking temperatures</i>							
			d) <i>Delay of filling temperatures in cooling chambers the day of visit</i>							
		12/2/2014	<i>Dirty floors and dirty premises wells/</i> generally more improved hygiene conditions compared with the previous unannounced visit							
		10/3/2014	a) <i>Inadequate protective equipment of two staff members</i>							
b) <i>Some food wastes and residues in the workbench</i>										
c) <i>Incomplete coverage of frozen chicken pieces</i>										
d) <i>Staff member with no gloves wearing during the weighing of decontaminated apples</i>										
19/03/2014	a) <i>Inadequate protective equipment of two staff members</i>									
	b) <i>Failure to comply with hygiene rules by a staff member</i>									
	c) <i>Incomplete coverage of roasted chicken fillets</i>									
	d) <i>Non-compliance records with baking temperatures</i>									
12/5/2014	a) <i>Inadequate protective equipment of the most staff members</i>									
	b) <i>raw eggs without cover in the same cooling chamber and next to sweets and raw fruits</i>									
	c) <i>Incomplete compliance with baking temperatures record</i>									
	d) <i>raw meat cut pieces on the same bench and next to baked vegetable pies without cover</i>									
	e) <i>Not use the cut surfaces of different color</i>									
	f) <i>Incomplete coverage of apples</i>									

The major infringements are presented underlined in italics.

The larger catering sites (Attica Prefecture) showed better compliance than the smaller in size facilities located in province (Thessalia, Korinthos and Thrace) (Table 2). In line with this, other studies have confirmed that the larger the company facility and the greater the staff number, the better the implementation of hygiene requirements [7,18,25-26]. Similarly, thanks to the better compliance of larger catering sites with “DIATROFI” recommendations, fewer unannounced visits compared with their smaller facilities counterparts in province, were performed (Table 2).

The number of violations per visit was significantly different between the facilities located in Attica Prefecture/Thessaloniki vs the ones in province (median number of violations per visit= 0.9 vs 2.7, respectively) (p-value=0.029). Furthermore, the rate of observed violations per visit was negatively correlated with the number of certificates apart from HACCP (p-value=0.003, ρ =-0.926). Towards this end, the facilities located in Attica Prefecture/Thessaloniki had a significantly larger number of certificates apart from HACCP (median number=2.5) compared to the facilities in the province (median number=1.0) (p-value=0.029) (Table 2).

Thanks to Institute’s recommendations, many suppliers of the “DIATROFI” Program adhered to better hygiene conditions. For instance, two suppliers increased the disinfection/deworming frequency, especially during the summer months when insects and mites have greater rates of activity and reproduction [27]. Staff training tabs at a majority of suppliers were also updated, through the application of either internal seminars or external seminars [28]. What is more, to overcome the possible transport of dust and germs into the facilities, employees were initially asked to replace their sports shoes, which they were used to wearing during work, with special, personal use socks and specific working clogs. Cooked chicken fillets that were originally left uncovered to cool were subsequently placed in “cold ovens” to avoid the physical risks of dust, suspended particles, insects, etc. Similar practices were followed for all thermally-processed products as well. One food supplier even purchased an X-ray detector, in addition to the metal detector that already existed in the facility, to maximize the detection of foreign materials [29] and thus to minimize their potential presence in ready-to-distribute meals.

Conclusions

Apart from the value of the large-scale initiative of “DIATROFI” Program to cover the nutritional needs of school children vulnerable populations, an equally major public health aspect was highlighted; referring to the undeniable contribution to enhance both further knowledge and skills on hygiene/quality conditions to the staff members and compliance with necessary Food Hygiene/Quality Systems, in the selected food suppliers. Thus,

the hope is that similar initiatives will lead to a general improvement of hygiene/quality conditions in food catering facilities for all citizens.

Acknowledgements

The DIATROFI Program research team (in alphabetical order): Belogianni Katerina, MSc; Critselis Elena MPH PhD; Dalma Archontoula, MSc; Georgakopoulos Panagiotis PhD; Haviaris Anna Maria, MSc; Karagas R Margaret, PhD; Karnaki Pania, MA;

Kastorini Christina Maria, PhD; Kouvari Matina BSc; Linos Athena, MD, MPH, PhD; LinosConstantinos, BSc; Lykou Anastasia, PhD; MarkakiIoanna, PhD; Mitraka Kallis, MA; Pantazopoulou Anastasia, MD, PhD; Papadimitriou Eleni, MD, PhD; Peppas Manolis, BSc; Petralias Athanassios, PhD; Riza Elena, PhD; Saranti Papasaranti Eirini, MSc; Spyridis Ioannis, MSc; Veloudaki Afroditi, MA; Yannakoulia Mary, PhD; Zota Dina, MSc.

The Food-Aid and Promotion of Healthy Nutrition Program - DIATROFI (<http://diatrofi.prolepsis.gr/>) is implemented by the Institute of Preventive Medicine, Environmental and Occupational Health, Prolepsis. The program has been approved and runs under the auspices of the Ministry of Education, Research and Religious Affairs. The DIATROFI Program is implemented with founding donor the Stavros Niarchos Foundation. Over 100 volunteers participate in the DIATROFI Program and deserve our sincere thanks.

References

1. UNICEF, The state of the children in Greece report 2012. Hellenic National Committee for UNICEF. Athens. 2012.
2. Kastorini CM, Lykou A, Yannakoulia M, Petralias A, Riza E, Linos A, et al. The influence of a school-based intervention programme regarding adherence to a healthy diet in children and adolescents from disadvantaged areas in Greece: the DIATROFI study. *J Epidemiol Community Health*. 2016; 70: 671-677.
3. Petralias A, Papadimitriou E, Riza E, Karagas MR, Zagouras AB, Linos A, et al. The impact of a school food aid program on household food insecurity. *Eur J Public Health*. 2016; 26: 290-296.
4. Yannakoulia M, Lykou A, Kastorini CM, Saranti Papasaranti E, Petralias A, Veloudaki A, et al. Socio-economic and lifestyle parameters associated with diet quality of children and adolescents using classification and regression tree analysis: the DIATROFI study. *Public Health Nutr*. 2016; 19: 339-347.
5. Zota D, Dalma A, Petralias A, Lykou A, Kastorini CM, Yannakoulia M, et al. Promotion of healthy nutrition among students participating in a school food aid program: a randomized trial. *Int J Public Health*. 2016; 61: 583-592.
6. Kokkinakis EM, Fragkiadakis GA. HACCP effect on microbiological quality of minimally processed vegetables: a survey in six mass-catering establishments. *Int J Food Sci Technol*. 2007; 42: 18-23.
7. Dalgıç AC, Belibağlı KB. Hazard analysis critical control points implementation in traditional foods: a case study of Tarhana processing. *Int J Food Sci Technol*. 2010; 43: 1352-1360.
8. Chan M. Food safety must accompany food and nutrition security. *Lancet*. 2010; 384: 1910-1911.
9. Williams S, Market P, Harlock M, Binns P, Gaggin J, Patel M. Individual and household-level risk factors for sporadic salmonellosis in children. *J Infect*. 2016; 72: 36-44.
10. Wallace C, Williams T. Pre-requisites: a help or a hindrance to HACCP? *Food Control*. 2001; 22: 235-240.
11. de Oliveira CAF, da Cruz AG, Tavolaro P, Corassin CH. Chapter 10 - Food Safety: Good Manufacturing Practices (GMP), Sanitation Standard Operating Procedures (SSOP), Hazard Analysis and Critical Control Point (HACCP). In: *Antimicrobial Food Packaging* (edited by J Barros-Velazquez). 2016; 129-139.
12. Green LR, Selman C. Factors impacting food workers' and managers' safe food preparation practices: A qualitative study. *Food Prot Trends*. 2005; 25: 981-990.
13. Hertzman J, Barrash D. An assessment of food safety knowledge and practices of catering employees. *Brit Food J*. 2007; 109: 562-576.
14. Jevšnik M, Hlebek V, Raspor P. Food safety knowledge and practices among food handlers in Slovenia. *Food Control*. 2008; 19: 1107-1118.

15. Grujić R, Grujić S, Durasinovic P, Pavlovic P. Workers responsibility in food businesses during implementation of food safety system. *Applied Technologies & Innovations*. 2010; 1: 43-48.
16. Bánáti D, Zoltán L. Managerial attitudes, acceptance and efficiency of HACCP system in Hungarian catering. *Food Control*. 2010; 25: 484-492.
17. Haileselassie M, Taddelle H, Adhana K. Source(s) of contamination of 'raw' and 'ready-to-eat' foods and their public health risks in Mekelle City, Ethiopia. *J Sci Food Agric*. 2012; 2: 20-29.
18. Grujić R, Antičić B, Brenjo D, Pavlović P. Attitudes of workers employed in restaurants toward importance of food safety system management implementation. *Quality of Life*. 2013; 4: 5-11.
19. Liz Martins M, Rocha A. Evaluation of prerequisite programs implementation at school foodservice. *Food Control*. 2014; 39: 30-33.
20. Allwood PB, Jenkins T, Paulus C, Johnson L, Hedberg CW. Hand washing compliance among retail food establishment workers in Minnesota. *J Food Prot*. 2004; 67: 2825-2828.
21. Ko W-H. Food sanitation knowledge, attitude, and behavior for the university restaurant employees. *Food Nutr Sci*. 2011; 2: 744-750.
22. Tan SL, Cheng PL, Soon HK, Ghazali H, Mahyudin NA. A qualitative study on personal hygiene knowledge and practices among food handlers at selected primary schools in Klang valley area, Selangor, Malaysia. *Int Food Res J*. 2013; 20: 71-76.
23. Zilelidou EA, Tsourou V, Poimenidou S, Loukou A, Skandamis PN. Modeling transfer of *Escherichia coli* O157:H7 and *Listeria monocytogenes* during preparation of fresh-cut salads: impacts of cutting and shredding practices. *Food Microbiol*. 2015; 45: 254-265.
24. Barth M, Hankinson TR, Zhuang H, Breidt F. Microbiological spoilage of fruits and vegetables. In: *Compendium of the microbiological spoilage of food and beverages* (edited by WH Sperber & MP Doyle). 2010; 135-183.
25. Yapp C, Fairman R. Factors affecting food safety compliance within small and medium-sized enterprises: implications for regulatory and enforcement strategies. *Food Control*. 2006; 17: 42-51.
26. Kussaga JB, Jacxsens L, Tiisekwa BPM, Luning PA. Food safety management systems performance in African food processing companies: a review of deficiencies and possible improvement strategies. *J Sci Food Agric*. 2014; 94: 2154-2169.
27. Phillips TW, Throne JE. Biorational approaches to managing stored-product insects. *Annu Rev Entomol*. 2010; 55: 375-397.
28. Egan MB, Raats MM, Grubb SM, Eves A, Lumbers ML, Dean MS, et al. A review of food safety and food hygiene training studies in the commercial sector. *Food Control*. 2007; 18: 1180-1190.
29. Haff RP, Toyofuku N. X-ray detection of defects and contaminants in the food industry. *Sens Instrum Food Qual Saf*. 2008; 2: 262-273.