GIDA
THE JOURNAL OF FOOD
E-ISSN 1309-6273, ISSN 1300-3070

Research /Araştırma
GIDA (2019) 44 (6): 1020-1029
doi: 10.15237/gida.GD19070

THE RELATIONSHIPS BETWEEN SERVING TEMPERATURES AND MICROBIOLOGICAL QUALITY OF NORMAL AND DIETARY MEALS PRODUCED IN A UNIVERSITY HOSPITAL KITCHEN*

Mevhibe Terkuran[1], Zerrin Erginkaya[2]**
[1]Department of Gastronomy and Culinary Arts, Kadirli School of Applied Sciences, Osmaniye Korkut Ata University, Osmaniye, Turkey.
[2]Department of Food Engineering, Faculty of Agriculture, Cukurova University, Adana, Turkey

Received /Geliş: 13.04.2019; *Accepted* /Kabul: 17.08.2019; *Published online* /Online baskı: 25.10.2019

Terkuran, M., Erginkaya, Z.. (2019). The relationships between serving temperatures and microbiological quality of normal and dietary meals produced in a university hospital kitchen. GIDA (2019) 44 (6): 1020-1029 doi: 10.15237/gida.GD19070

Terkuran, M., Erginkaya, Z.. (2019). Üniversite hastane mutfağında üretilen normal ve diyet öğünlerinin servis sıcaklıkları ile mikrobiyolojik kalitesi arasındaki ilişkiler. GIDA (2019) 44 (6): 1020-1029 doi: 10.15237/gida.GD19070

ABSTRACT
In this research, temperature levels and microbiological quality of served meals produced in Balcalı Hospital Kitchen from 2015 to 2017 years were evaluated. The temperatures of 7316 dishes (1812 normal and 5504 diet menus) were analyzed statistical. The recorded temperatures of hot served-normal menu dishes showed riskier holding temperatures (<55 °C) than dietary dishes (P <0.001). However, cold served dishes showed more safety holding temperatures (≤8 °C) than hot-served meals except for salads which were served immediately after preparation (P <0.001). Sauced and one-pot dishes were served at safer temperatures (≥63 °C) than pastries and pasta dishes due to their production methods (P <0.001). Microbiological analyses of the meals were found suitable for the legislation. *E. coli, S. aureus* and *Salmonella* spp. were not found in any samples. Finally, the temperature evaluation of prepared meals was considered a significant part of the HACCP system and a mandatory factor for guaranteeing food safety.
Keywords: HACCP, microbiological quality, temperature, evaluation

ÜNİVERSİTE HASTANE MUTFAĞINDA ÜRETİLEN NORMAL VE DİYET ÖĞÜNLERİNİN SERVİS SICAKLIKLARI İLE MİKROBİYOLOJİK KALİTESİ ARASINDAKİ İLİŞKİLER

ÖZ
Bu araştırmada, Balcalı Hastane Mutfağında 2015-2017 yılları arasında üretilen ve sunulan yemeklerin sıcaklık dereceleri ve mikrobiyolojik kaliteleri değerlendirildi. 7316 çeşit yemeğin (1812 normal ve 5504 diyet menüleri) sıcaklıkları istatistiksel olarak analiz edildi. Sıcak servis edilen-normal menü yemeklerinin kaydedilen sıcaklıklarının, diyet yemeklerinden daha riskli servis sıcaklığında (<55 °C) sunulduğubelirlendi (P <0.001). Bununla birlikte, soğuk servis edilen yemeklerin, hazırlandıktan hemen sonra servis edilen salatalar hariç, sıcak servis edilen öğünlerden daha güvenli servis sıcaklığında (≤8 °C) sunulduğusaptandı (P <0.001). Soslu ve tencere yemeklerinin, üretim yöntemlerinden dolayı, hamur işleri ve makarna yemeklerinden daha güvenli sıcaklıklarda (≥63 °C) servis edildiği belirlendi (P <0.001). Yemeklerin mikrobiyolojik analiz sonuçları mevzuata uygun bulundu. Örneklerin hiçbirinde *E. coli, S. aureus* ve *Salmonella* spp. tespit edilmedi. Sonuç olarak, hazırlanan yemeklerin sıcaklık değerlendirmesi, HACCP sisteminin önemli bir parçası ve gıda güvenliğini garanti altına almak için zorunlu bir faktör olarak değerlendirildi.
Anahtar kelimeler: HACCP, mikrobiyolojik kalite, sıcaklık, değerlendirme

* *Some part of this study has been presented as a poster at IMSEC Congress, Adana, October 24-26, 2018*/ Bu çalışmanın bir bölümü 24-26 Ekim 2018 tarihinde Adanada gerçekleştirilen IMSEC kongresinde poster poster bildiri olarak sunulmuştur.

** *Corresponding author* / Yazışmalardan sorumlu yazar/
✉mevhibeterkuran@osmaniye.edu.tr, ✆ (+90) 328 888 0090 🖷 (+90) 328 888 0091

INTRODUCTION

Hospital catering should be guarantee foods that are suitable and covering the nutritional needs of the patients, recipients and hospital staff. Additionally, different types of foods served in healthcare settings should be prepared to reduce the risk of foodborne disease in patients and other hospitalized consumers including the most susceptible and specific advice should be given to vulnerable people such as immunocompromised, organ-transplant and cancer patients (go through chemotherapy or radiotherapy) (Wall et al., 2008).

Some epidemiological studies reported that improper practices in food processing plants, food service establishments, as well as home play an important role in the causal chain of foodborne diseases. In some nosocomial foodborne outbreaks have also been proved by this issue (Maguire et al., 2000; Spearing et al., 2000; Hassan and ElBagoury, 2018). So, the main purpose of the hospital is to supply safe food to patients who frequently are at higher risk of acquiring infections and their complications (Lund, 2018).

In hospitals catering services, the meals are prepared and cooked in the hospital kitchen and distributed directly to the clinics. This procedure is based on a daily preparation of meals that are distributed and served with a minimum holding period in order to maintain suitable holding temperatures of them (Petruzzelli et al., 2018). In order to provide microbial food safety in the hospital kitchen; food processing by heat requires the center of the product to reach 70 °C or higher for at least 2 minutes, or equivalent heat treatment, in order to destroy vegetative microorganisms (UK, 1989; FSA, 2004; FAO/WHO, 2006). Cooked foods should be consumed immediately, or kept for a short time at a temperature higher than 63 °C, or they should be cooled fastly and kept below 7-8 °C (ideally below 4°C) to control Clostridia and other bacteria. Besides, reheating should be made at least 72 °C before consumption (EFSA, 2005). International legislations recommended that keeping procedures for cooked prepared meals: ≥ 63 °C (thermal retention, for meals consumed within a few hours). In addition, ≤ 8 °C (refrigerated storage for meals consumed within 24 hours); ≤ 4 °C (refrigerated storage for meals with a shelf life more than 24 hours) and ≤ -18 °C (frozen storage for longer shelf life) (EC 2004; EFSAandECDC, 2013; EFSA and ECDC, 2015).

Catering services have to apply a food safety management system depend on the principles of Hazard Analysis and Critical Control Points (HACCP) for providing safe food (CAC, 2003). However, in small and medium catering establishments have some difficulties in implementing this system are reported before (Garayoa et al., 2011; Chaoniruthisai et al., 2018). So, the necessity of a flexible application of HACCP has been suggested by some authors previously (Al Yousuf et al., 2015; Garayoaet al., 2016).

The HACCP system required some important procedures. Those are briefly; applying the Good Manufacturing Practices (GMP), established in prerequisite programs such as cleaning and disinfection procedures for surfaces and equipment, and controlling decisive critical limits such as temperature/time during and after food processing. Implementation of an effective HACCP system and regarding food safety, training of all food workers is an essential part of self-control systems in order to improve food handlers' knowledge (Garayoa et al., 2016; Salazar et al., 2006). Therefore, European and Turkish Legislations have been recognized for training catering personnel (CAC, 2003; Anonymous, 2011).

The objectives of the present study were to determine relationships between holding temperatures and types of the dishes produced in a university hospital kitchen during three years in terms of microbiological quality of normal and dietary meals.

MATERIALS and METHODS

Characterization of the hospital kitchen catering service

The hospital catering service which was established in Adana, Southern part of Turkey. This business did not apply the HACCP system

and was supplying an average of 6500 to 8000 meals (including normal and dietary dishes which were produced in a separate room of the kitchen) per day, and served to different clinics in the same hospital. All kinds of meals were prepared, distributed and consumed on the same day in lunch and dinner time and they were prepared twice in a day in the morning and afternoon period. Isothermal containers and special vehicles were used for transporting the prepared-meals to maintain suitable temperatures. The time that passed between preparation, deploy and consumption ranged between 1 and 3 hours. Prepared meals stayed in airtight sealed containers during distribution time.

Training of hospital food workers about HACCP system

A total of 150 food workers were trained about HACCP system. For these purposes, some critical information was given to all staff members (cooks, waitresses, chef cooks, cleaning personnel etc.) These pieces of information were included number/various of meals and workers, application of prerequisites necessities (i.e. maintenance of facilities and equipment, cleaning and disinfection, pest control, proper selection of suppliers, requirements of staff training, traceability, water control and waste management), food hygiene practices (standard staff uniforms, hand washing practices, chilling, defrosting, reheating of the foods including disinfection of vegetables and fruits, cleaning and disinfection of equipments and kitchen parts (normal and dietary meals preparation rooms, storage rooms, raw foods preparation and cooking areas..etc), the details of temperature control, appropriate maintenance of raw materials and warm and cold dishes, etc.) and documentation (HACCP manual, control recording system, etc.). Therefore, at least four hours of training in a year were presented by Food Engineer of the catering service and Hospital Infection Control Team (handwashing practices and general hospital infection controls training), including slides presentations and practical examples to understand the main notions. Some of the topics of these training were: Supplying Safe Foods in Hospitals, Foodborne Disease and Hospital Kitchen, Perishable Food Products, Heating, Cooling and Cleaning procedures of the foods, Safe Work Practices, Good Hygiene Practices, and The Main Principles of HACCP System.

Sample collection

Ready-to-eat normal and dietary meals

Prepared meals (with hot or cold served) were taken every day from each of the meals (normal and diet menu dishes) (n = 604 normal menu, n = 1835 dietary dishes; a total of n = 2439 meals in each year). In lunch and dinner time before serving; a total of 30 samples (including 250 Gram of each meal) were collected under aseptic conditions using jars (sterilized in hospital sterilization unit) and utensils according to Turkish legislation (EC, 2004; Anonymous, 2011).

Food temperatures were measured at the time of filling into isothermal containers which were used for transporting dishes to the eight small kitchens and three restaurants which were on different floors in the hospital. The temperatures of the meals were measured in the center of the dishes, using a calibrated thermometer (Figures 1 and 2) with a certainty of 0.1 °C (TESTO Instruments). Then all measurements were recorded on daily food temperature report forms. Samples were obtained by aseptic conditions to the sterilized jars and transported to the laboratory under refrigerated conditions. Food samples were kept in refrigeration (3 °C ± 2 °C) until the send to the microbiological analyses (about 72 hours) according to Turkish Legislation (Anonymous, 2011).

Microbiological analysis of the meals

Microbiological tests were carried out on food samples according to the legislation in each year. Conforming to Turkish and international legislation, following pathogenic microorganisms were investigated; *Staphylococcus aureus*, *Escherichia coli* and *Salmonella* spp. (EC, 2004; Anonymous, 2011). All samples were analyzed according to standard official methods (ISO) following the standard ISO/IEC 17025:2005 in the Turkish

Ministry of Food and Agriculture Laboratories in Adana routinely (According to HACCP plan).

Statistical analysis

Statistical analyses were performed using SPSS 17 (SPSS Inc., Chicago, Illinois, USA) version. The chi-square test was used to compare differences for proportions between groups. The significance level was set at $P < 0.001$ (Özdamar, 1999).

Figure 1. The measuring of cold served salad with a calibrated-food thermometer before serving.

Figure 2. The measuring of a hot-served meal with a calibrated-food thermometer before serving.

RESULTS AND DISCUSSION

According to an investigation of that training program certification of the personnel in the catering service was found very high because 98% of the checked workers had undergone specialized training given by the company (Anonymous 2011; Anonymous 2013). Considering of HACCP system, temperature control and temperature recording was found lacking during the first year including the storage of raw food materials, food processing, and preservation of the prepared foods, primarily due to temperatures not being recorded routinely. This situation has been reported by some authors before (Garayoa et al., 2016; Zanin et al., 2017). If this is ignored, it may cause a crucial problem in providing food safety in hospital catering. Moreover, implementing cleaning and disinfection procedures were found to be insufficient. The same results were pointed out in previous studies (Fielding et al., 2011; Adikari et al., 2016). According to a training plan (which was prepared at the beginning of each year), the importance of temperature control of the meals and recording of all recording sheets related to the HACCP system was explained clearly to all food workers worked in each step of food production processes. So, there existed a significant increase of recorded activities and compliance with criteria for food temperature holding.

Considering the temperatures of hot served dishes; Table 1 was presented with the recorded holding temperatures of 1426 cooked food products which hot- served meals measured at the time before serving. For hot served meals; the temperatures were grouped into ranges ≥63 °C, 62-55 °C and <55 °C, being considered as safe, tolerable and unacceptable, respectively, following the criteria of some international legislation and some previous studies (EC, 2004; EFSA and ECDC, 2015; Garayoa et al., 2016). For cold served meals; the temperatures were grouped into ranges ≤8 °C, and >8 °C, being considered as safe and unacceptable, respectively, according to the criteria of international legislation (EC, 2004; EFSA and ECDC, 2015). The percentage of the meals served at lunch and dinner times with risky holding temperatures (<55 °C) was found from 11% to 19% respectively (P <0.001). It was found that 84.9% of the recorded temperatures in both serving times (n =1211) conformed to international legislation (≥63 °C) (EC, 2004; EFSA, 2005; EFSA and EDCD, 2015). While 12% (n =170) of them had temperatures in the range 62-55 °C, which is considered to be inadequate from the legislation levels. However, according to the WHO temperature limit was set at ≥60 °C (FAO/WHO, 2006). Besides, various international regulations and some authors regarded a barrier of 55 °C for safety food (ICMSF, 2002; Garayoaet al., 2011). Therefore, the temperatures of our results could not show a health risk to consumers due to the meals still protected against the growth of pathogenic or spoilage microorganisms. So, 84.9% of our results could be considered correct. Our results were lower than Garayoa and his colleagues'(2016) results, in their study (for hot served meals; 55-65 °C the temperature was considered tolerable level according to Spanish Legislation); 90.5% of their analyzed samples were found correct. Besides, there existed same significant differences in temperature retention, depending on the type of food and the type of cooking in our study. While one-pot dishes or sauces (soups/creams, vegetables/legumes, and meals with sauce) recorded higher temperatures than meals without sauces or used to short heat treatments (pastries, grilled and roast) had the lowest temperatures (P <0.001) in accordance with other previously reported studies (Irigoyen et al., 1992; Garayoa et al., 2016). Therefore, hospital catering services should create suitable procedures for meals that are not stayed at <55 °C until serving, particularly if the transport of the meals too far clinics/restaurants is necessary.

It should be considered that temperatures of the meals can be lost during the transfer and serving time with isothermal containers (Garayoa et al., 2016). Similarly, in our study, grilled and roasted dishes and pastries served at lunch and dinner times have more risky temperatures than other food groups (Table 1). According to the food groups including normal and diet menu dishes, the ratio of food served at risky temperatures was

higher in the normal food menus than dietary menus (P <0.001). For example; while normal menu dishes were served at lunchtime showed that 11% of them were found a risky holding temperature (<55 °C); this rate was found to be 10% in diet menu dishes. Besides, normal menu meals were served in the evening time with a rate of 19% at risky temperatures (<55 °C); this rate was found to be 10% in the diet menu dishes (P <0.001). A total of 614 grilled and roasted meals were served in both normal and diet menus. Comparing of their serving temperatures; 68.5% (average rate; lunch and dinner time) of roasted, 94% (average rate) of grilled meals which were in normal menü and 99.6% of roasted and 100% of grilled meals (in the oven) were in diet menu dishes were presented at safe temperature. In general, 0.4% (average rate) of dietary meals were presented at risky temperatures (P <0.021). However, dietary meals showed less risky temperatures due to their fewer volumes preparation (average; 450 meals per day), our results showed that grilling and or roasting are not the suitable techniques in terms of keeping the temperatures of the meals during distribution or serving time. These results are supported by previous studies (Irigoyen et al., 1992; Garayoaet al., 2011; Garoyoa et al., 2016).

Table 1. Temperature levels of hot-served normal and diet menu dishes in hospital kitchen

Dishes		No of Samples		No of Samples (%)				No of Samples (%)				No of Samples (%)			
				≥63°C				62 °C-55 °C				<55°C			
Normal Menu		Lunch	Din.	Lunch	%	Din.	%	Lunch	%	Din.	%	Lunch	%	Din.	%
Starters	Soups/Creams	157	157	150	(95.5)	150	(96)	2	(1.3)	2	(1.3)	5	(3.2)	5	(3.2)
	Vegetable/Legumes	10	10	10	(100)	10	(100)	0	0	0	0	0	0	0	0
	Pasta/Rice	213	244	108	(50.7)	100	(41)	80	(38)	59	(24)	25	(12)	85	(35)
Main Courses	With Sauce	139	138	137	(98.6)	137	(99)	1	(0.7)	0	0	1	(0.7)	1	(0.7)
	One-pot dishes	84	83	74	(99.3)	78	(99.3)	5	(5.9)	0	0	5	(0.6)	5	(0.6)
	Pastries	34	35	5	(14.7)	5	(14)	5	(15)	4	(11)	24	(71)	26	(74)
	Roasted	11	11	5	(45.5)	6	(54.5)	2	(18)	2	(18)	4	(36)	3	(27)
	Grilled	56	44	50	(89.3)	36	(82)	3	(5.4)	5	(11)	3	(5.4)	3	(6.8)
	Total	704	722	530	(75.2)	512	(71)	98	(14)	72	(10)	77	(11)	138	(19)
Diet Menu															
Starters	Soups/Creams	433	433	430	(99.3)	430	(99)	0	0	0	0	3	(0.7)	3	(0.7)
	Vegetable/Legumes	50	50	50	(100)	50	(100)	0	0	0	0	0	0	0	0
	Pasta/Rice/Bulgur	390	392	213	(54.6)	212	(54)	58	(15)	60	(15)	119	(31)	120	(31)
Main Courses	With Sauce	81	81	81	(100)	81	(100)	0	0	0	0	0	0	0	0
	Roasted	241	241	230	(95.4)	240	(99.6)	10	(4.1)	0	0	1	(0.4)	1	(0.4)
	Grilled(in the oven)	5	5	5	(100)	5	(100)	0	0	0	0	0	0	0	0
	Total	1200	1202	1009	(84.1)	1018	(85)	68	(5.7)	60	(5)	123	(10)	124	(10)

Din.: Dinner.

Bacterial proliferation in cooked foods may be affected by a_w capacity or free water (which is not connected to any other compounds) content of the food. So, if the food has more free water capacity (higher a_w capacity), it can be more suitable for bacterial surviving. Because pathogenic or spoilage bacteria of the food can easily use this water for their growth. Thus, sodium salts contributing to the overall sodium consumption are also very important in the prevention of spoilage and/or growth of microorganisms in foods (Taormina, 2010). Normal menu dishes in our study were contained salt while dietary meals should be prepared without salt. Moreover, dietary meals have more free water capacity (higher a_w capacity) that may

be allowed to bacterial surviving. However, the results of our study showed that dietary meals served at safer temperatures than normal menu meals that contained salt (lower a_w capacity) (P <0.001). This result is good for patients) health that may affect unsafe food easily.

Pasta dishes/rice/bulgur (a traditional Turkish meal) and pastries were found higher risky holding temperatures than other meals in our study. A total of 3828 normal and diet menu hot dishes were served at lunch and dinner times. In the normal menu with a rate of varieties of pasta dishes were found 12% in lunch and 35% in evening serving times were presented at risky holding temperatures (<55 °C). Besides, 71% of pastries at lunch and 74% of them at dinner times were presented at risky holding temperatures (<55 °C) respectively (P <0.001). In diet menus, riskier serving temperatures were found 31% of pasta dishes in both serving times -pastries did not prepare in dietary menus- (P <0.001). However, some of the hot meals such as vegetable legumes, soups/creams, and souced dishes were served at more safer temperatures (≥63 °C) than other food groups. Besides this, 100% of grilled diet meals (meat/chicken meatballs grilled in the oven) was also served at safe temperatures (P <0.001). It was found that an average of 10% of the dietary hot-meals were served at risky temperatures while an average of 15% of the normal hot-meals were served at risky temperatures (P <0.001). The possible reason for this result might be; pasta dishes were found lower temperatures (<55 °C) because of their cold serving (not achieved properly in cold temperatures), and pastries showed temperature losing after cooking due to their cooking procedures. This condition is so important for providing safe foods, because this problem might be a cause of foodborne illness. Schaffner et al. (2005) pointed out that refrigeration and freezing were in the realm of heat transfer. They reported that these processes had been so important in safe and quality cooking since improper cooling practices were responsible for more than 500 foodborne illness outbreaks in U.S. restaurants between 1998 and 2008 years. In addition, there existed some differences between lunch and dinner times serving temperatures of hot served normal menu dishes. For example; only 10% of the hot meals were served at risky temperatures (<55 °C) at lunchtime while 19% of them were served at risky temperatures at evening time (P <0.001). The possible reason for these results might be; fewer food workers worked in the evening shift than lunchtime. Therefore, staff rotation might show a crucial negative-effect on holding temperatures of normal meals in our study.

Considering the holding temperatures of cold served meals (Table 2); a total of 3102 cold-dietary menu meals were served at lunch and dinner times. It was found that 3.9% of yoghurt/buttermilk/tzatziki and 2.05% of stewed were presented at risky holding temperatures (>8 °C) respectively. On the other hand, the average rate of 93.6% of jellos - puddings and ashuras were found at safe holding temperatures (≤8 °C), (P <0.001). The possible causes of these results could be; puddings-jellos and ashuras were prepared the day before serving and stored in a refrigerator at 5±3 °C and waited until serving time. Besides this, a total of 386 normal menu-cold meals were served at lunch and dinner times. It was found that the avarage rate of 86.5% of salad and 33.3% of puddings/ashuras/desserts with syrup were served at risky holding temperatures (>8 °C). In general, the average rate of 69.4% of cold served normal meals were found to be at risky holding temperatures (>8 °C), (P <0.001). In addition, a total of 3102 dietary menu-cold meals were served at lunch and dinner times and the average rate of 53.5% of varieties of salads was found at risky holding temperatures (>8 °C). In general, an average rate of 16.9% of cold served dietary meals were found to be at risky holding temperatures (>8 °C), (P <0.001). The possible causes of these situations might be; salads were served immediately after preparation and they were not chilled before serving. Therefore, room temperatures could be an effective role in their serving temperatures. In addition, desserts with a syrup such as baklawa, semolina dessert etc. were served immediately after hot syrup adding that could be effected their serving temperatures.

Table 2. Temperature levels of cold-served normal and diet menu dishes in hospital kitchen

Dishes		No of Samples		No of Samples (%)				No of Samples (%)			
				> 8 °C				≤ 8 °C			
		Lunch	Dinner	Lunch	%	Din.	%	Lunch	%	Din.	%
Cold Dishes	Yoghurt/Buttermilk/Tzatziki	98	98	7	(7.2)	7	(7.2)	91	(92.9)	91	(92.9)
(Normal Menu)	Deserts/Puddings/Ashuras	24	24	8	(33.3)	8	(33.3)	16	(66.7)	16	(66.7)
	Salads	72	70	71	(98.6)	52	(74.3)	1	(1.4)	18	(25.7)
	Total	194	192	86	(73.4)	67	(65.3)	108	(26.6)	125	(34.7)
Cold Dishes	Yoghurt/Buttermilk/Tzatziki	425	426	16	(3.8)	17	(3.9)	409	(96.2)	409	(96)
(Dietary Menu)	Jellos/Pudings/Ashuras	447	437	50	(11.2)	7	(1.6)	397	(88.8)	430	(98.4)
	Stewed	364	363	8	(2.2)	7	(1.9)	356	(97.8)	356	(98.1)
	Salads	242	398	187	(77.3)	118	(29.6)	55	(22.7)	280	(70.4)
	Total	1478	1624	253	(22.7)	142	(11.2)	861	(77.3)	1119	(88.7)

Din.: Dinner.

In the present study, microbiological analyses of the evaluated samples; in each food production time (lunch and dinner) 250 Gram samples were collected from each meal by aseptic conditions in a sterilized container and stored at 5±3 °C in a calibrated refrigerator during 72 hours. These samples were analyzed periodically by the Ministry of Agriculture laboratory, according to Turkish Legislation (Anonymous, 2011). The results of the microbiological analysis of all (100%) of tested samples as; pathogenic bacteria such as *Salmonella* spp., *E. coli*, and *S. aureus* could not be detected in any of the samples. In our study, the short retention time for transferring of the meals and twice food preparing in a day and strict controls of temperatures of storage areas might be the reasons for these results. On the other hand, some studies demonstrated different from our results such as; Garayoa et al. (2016) were reported that 99.9% of their analyzed meals were suitable to the legislation and one positive *Salmonella* spp. was detected in roast chicken with recorded 35 °C holding temperature. Besides, *E. coli* was also detected in the same sample including coliform count was found higher than the standard allowed level ($1.7x10^3$ CFU/g). Rodriez et al.(2011)were reported that neither *Listeria* spp. nor *Salmonella* spp. were detected in any food samples and prevalence of *E. coli* was found low (3%) in their study which was evaluated microbiological quality of Chilled Ready-To-Eat (RTE) foods (lettuce, salads and cooked hum) in different five hospital catering services established Southern Spain.

The limitation of our study is that microbiological analyzing of utensils-equipments used for preparation or serving of the dishes and microbiological analyses of the hands of catering staff as well as the food processing environment could be in suffier. However, our results were evidence of the performance of a primitive HACCP system.

Finally, HACCP system implementation has beneficial effects on catering establishment such as control mechanisms of prepared/cooked foods, recording practices and importance on the microbial quality of the foods, regular education, and awareness about food safety required for catering personnel as well as the hygienic quality of prepared foods. Besides, analyzing more parameters related to food safety can provide proactive implications for guaranteeing the hygienic quality of prepared foods in healthcare settings.

ACKNOWLEDGMENTS

We would like to acknowledge the food businesses and employees who agreed to participate in this study.

REFERENCES

Adikari, A.M.N.T., Rizana, M. F., Amarasekara, T.P. (2016). Food safety practices in a teaching hospital in Sri Lanka. *Procedia food sci, 6*: 65-67.

Al Yousuf, M., Taylor, E., Taylor, J. (2015). Developing a government strategy to meet international standards of food safety across the hospitality industry. *Worldwide Hosp Tour Them*, 7(1):4-16.

Anonymous (2011): Türk Gıda Kodeksi Mikrobiyolojik Kriterler Yönetmeliği: Resmi Gazete, Sayı: 28157(3 mükerrer), 29/12/2011, Ankara.

Anonymous (2013): Hijyen Eğitimi Yönetmeliği: Resmi Gazete, Sayı: 28698, Tarih; 5 Temmuz, Ankara.

CAC (2003). Recommended International Code of Practice, General Principles of Food Hygiene, CAC/RCP 1-1969, Rev. 4-2003 in Codex Alimentarius Commission Food Hygiene Basic Texts, Food and Agriculture Organization of the United Nations, World Health Organization, Rome.

Chaoniruthisai, P., Punnakitikashem, P., Rajchamaha, K. (2018). Challenges and difficulties in the implementation of a food safety management system in Thailand: A survey of BRC certified food productions. *Food Control*, 93:274-282.

EC (2004): Regulation (EC) No.852/2004 of the European Parliament and of the Council of 29 April 2004 on the hygiene offoodstuffs. Official Journal of the European Union, L226/3, 25 June.

EFSA (2005). Commission Regulation (EC) No. 2073/2005 of 15 November 2005 on microbiological criteria for foodstuffs, Official Journal of the European Union, L 338.

EFSA and ECDC (2013): The European Union Summary Report on Trends and Sources of Zoonoses, Zoonotic Agents and Food-borne Outbreaks in 2011. *EFSA J*, 11(4): 3129- 250.

EFSA and ECDC. (2015): The European Union Summary report on trends and sources of zoonoses, zoonotic agents and Food-borne outbreaks in 2013, European Food Safety Authority and European Centre for Disease Prevention and Control, *EFSA J*, 13(1):1-162.

FAO/WHO (2006). FAO/WHO guidance to governments on the application of HACCP in small and/or less-developed food businesses. *FAO Food and Nutrition Paper*, 86. Rome.

Fielding, L., Ellis, L., Clayton, D., Peters, A. (2011). An evaluation of process-specific information resources, aimed at hazard analysis, in Small and Medium Enterprises in food manufacturing. *Food Control*, 22(8):1171-1177.

FSA (2004). Cook Safe. Aberdeen: *FSA Scotland*: p. 1-107.

Garayoa, R., Vitas, A.I., Díez-Leturia, M., García-Jalón, I. (2011). Food safety and the contract catering companies: Food handlers, facilities and HACCP evaluation. *Food Control*, 22(12):2006-2012.

Garayoa, A.I.R., Y´anez, N., D´ıez-Leturia, M., Bes-Rastrollo, M., Vitas A.I. (2016). Evaluation of Prerequisite Programs Implementation and Hygiene Practices at Social Food Services through Audits and Microbiological Surveillance. *J Food Sci*,Vol. (81): Nr. 4.

Hassan, K.and ElBagoury, M. (2018).The Domestic Kitchen-The'Front Line in the Battle Against Foodborne Disease'. *J Pure Appl Microbiol*, 12(1):181-188.

ICMSF (2002). Microorganisms in foods 7. Microbiological testing in food safety management. New York: *Kluwer Academic/Plenum Publishers*: p.167-169.

Irigoyen, A. and Garcia-Jalon, I. (1992). Hygienic study and critical control points determination in collective dining halls. *Alimentaria* (Spain).

Lund, B.M. (2018). Provision of microbiologically safe food for vulnerable people. *Food Control*, 96(2):535-547.

Maguire, H., Pharoah, P., Walsh, B., Davison, C., Barrie, D., Threlfall, E.J., Chambers, S. (2000). Hospital outbreak of *Salmonella virchow* possibly associated with a food handler. *J Hosp Infect*, 44(4): 261-266.

Özdamar, K. (1999). Paket Programlar ile İstatistiksel Veri Analizi. *Kaan Kitabevi*, Eskişehir, Türkiye, 535s.

Petruzzelli, A., Osimani, A., Tavoletti, S., Clementi, F., Vetrano, V., Di Lullo, S., Luchetti, T. (2018). Microbiological quality assessment of meals and work surfaces in a school-deferred catering system. *Int J Hosp Manag*, 68:105-114.

Rodriguez, M., Valero, A., Carrasco, E., Pérez-Rodríguez, F., Posada, G.D., Zurera, G. (2011). Hygienic conditions and microbiological status of chilled Ready-To-Eat products served in Southern Spanish hospitals. *Food Control,* 22(6): 874-882.

Salazar, J., Ashraf, H.R., Tcheng, M., Antun, J. (2006). Foodservice employee satisfaction and motivation and the relationship with learning food safety. *J Culinary Sci Technol*, 4(2-3):93-108.

Schaffner, D.W., Green Brown, L., Ripley, D., Reimann, D., Koktavy, N., Blade, H., Nicholas, D. (2005). Quantitative data analysis to determine best food cooling practices in U.S. restaurants. *J Food Prot*, 78:778–783.

Spearing, N.M., Jensen, A., McCall, B.J., Neill, A.S., & McCormack, J.G. (2000). Direct costs associated with a nosocomial outbreak of Salmonella infection: an ounce of prevention is worth a pound of cure. *Am J Infect Control*, 28(1): 54-57.

Taormina, P.J. (2010). Implications of salt and sodium reduction on microbial food safety. *Crit Rev Food Sci Nutr*, 50(3):209-227.

UK (1989). Chilled and Frozen. Guidelines on cook-chill and cook-freeze catering systems. London*, HMSO*.

Wall, P.G., Overview In: Lund, B.M, Hunter, P.R., (2008). The microbiological safety of food in healthcare settings. Oxford: Blackwell, p. 1-11,

Zanin, L.M., da Cunha, D.T., de Rosso, V.V., Capriles, V.D., Stedefeldt, E. (2017). Knowledge, attitudes and practices of food handlers in food safety: An integrative review. *Food Res Int*, 100:53-62.