

## Research Article

# Investigation of Mass Catering Establishments in Shopping Centers of Istanbul Regarding the Food Safety and Critical Hygienic Criteria

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This study, conducted in 100 mass catering establishments in 10 shopping centers in Istanbul in terms of food safety and preservation of public health by using a control form, 200 audits were performed. Establishments were evaluated by the control form over 100 points in 5 categories as A (VERY GOOD), B (GOOD), C (MEDIUM), D (BAD), E (VERY BAD). 29% of the enterprises were evaluated as "A", 52% as "B", 18% as "C", 1% as "D". According to the results of establishments, shopping centers were evaluated as B (GOOD). Total polar compounds (%) of frying oil of 326 samples used in the establishments were measured and 95% found appropriate. In total 2,220 hygiene samples which are 1,000 from food contact surfaces (countertop, cutting board, chopping knife, knife and plate), 800 from the staff, 400 from air and 20 from water have been taken and analyzed. TMAB, *coliform*, *E. coli* were searched on surfaces, *Staphylococcus aureus* (*S. Auerus*), *coliform*, *Escherichia coli* (*E. coli*) in hands of the staff, *enterococcus*, *coliform*, *E. coli* in water and mold-yeast in air. 61% of the food contact surfaces, 44% of the staff, 87% of air samples, 100% of water samples were approved. Bacterial load was mostly found in chopping boards and knives-chopping knives. It has been detected that 72.8% of the staff who are working in the business have been trained in hygiene; however, it has been determined that the management systems of food security are not applied, records are not kept well, traceability is not provided properly and the controls of heat and moisture are not being made sufficiently.

**Keywords:** Shopping centers; Food security; Food control; Food companies; Hygiene**Introduction**

Currently, more than half of the population of the developed counties, and one tenth of the population of our country eats at least one meal in places that supplies mass consumption s [13]. That is why food safety is composed of all measures taken to eliminate the physical, chemical, biological and any other damage that may arise from food, public health problems and food poisoning are increasingly gaining significance in all countries. One of the most important criteria for healthy nutrition is the production of foodstuffs under hygienic conditions and ensuring the consumption without deterioration in the hygiene chain [16]. Even a small negligence during the preparation, cooking, storing and service of food can negatively affect consumers' health which may lead to food poisoning and even deaths [33].

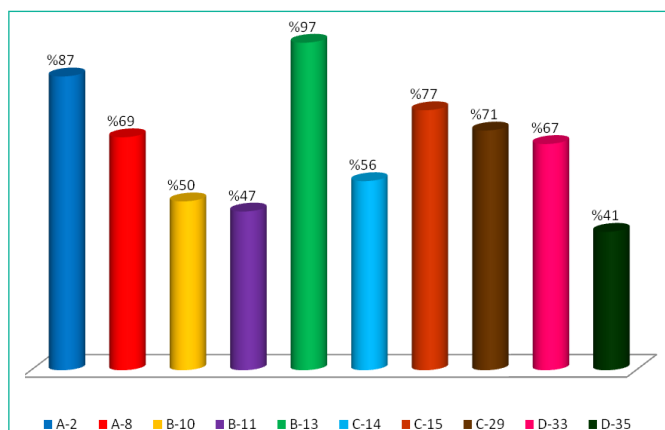
In this case study, samples were taken from the kitchen countertops, tools and equipment contacting with food, hands of personnel, air and water of the mass catering enterprises located in shopping malls in Istanbul province, with the purpose of determining the occupational hygiene and food safety. In Addition, the frying oils used in the operating kitchen are examined by the polar material measuring device and the risks that exist in the enterprises are determined clearly to protect consumer and public health.

**Materials and Methods****Selection and Collection of Samples**

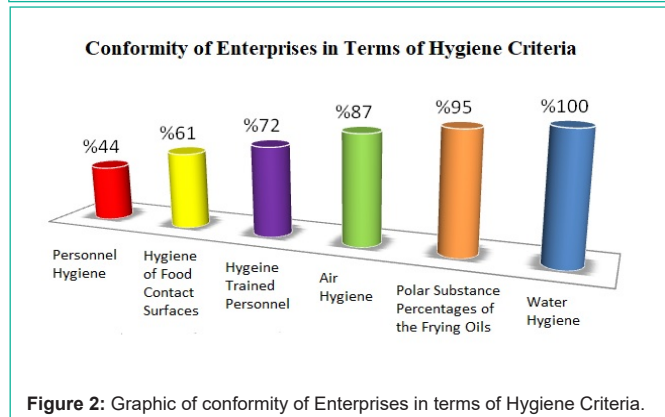
In each enterprise samples were taken from 4 personnel, 5 food contact surfaces and 2 ambient air. The number of total samples received is 2,220 units formed of 800 units (4X100X2) from personnel, 1,000 units (5X100X2) from food contact surfaces, 400 units (2X100X2) from air and 20 units (1X10X2) from water. In Addition, a total of 326 pieces of frying oil samples used in the enterprises were analyzed. All samples received were delivered to the laboratory within 2 hours under cold chain conditions at 4 °C and analyzed on the same day.

**Microbiological Analyses of Personnel Hand and Food Contact Surfaces Samples**

Samples taken from personnel, surface and equipment (countertop surface, cutting board, chopper-knife, and ready-to-serve plate) were collected in compliance with double swap (wet-dry swap) technique and ISO 18593:2004 standards [2,26,31]. Different dilutes were prepared from the test tubes which were delivered to the laboratory and kept in swap. Double-parallel inoculations were conducted in v feeding places and colonies were evaluated at the end



**Figure 1:** The Graphics of Weak Aspects of Mass Consumption Enterprises at Shopping Centers in terms of Food Safety and non-Conformance Rates.



**Figure 2:** Graphic of conformity of Enterprises in terms of Hygiene Criteria.

of the incubation period for the determination of TAMB, coliform, *E. coli* and *S. aureus* [2]. Plate Count Agar was used for TMAB analysis (PCA; Oxoid CM0463) and inoculation was made with the pour plate inoculation technique. The colonies were evaluated 48 hours after media in incubated at 37°C [26,28]. For the purpose of counting *S. aureus* egg yolks and potassium tellurite has been added and Baird Parker Agar (BPA; Oxoid CM1127) spread plate technique method was used. Typical and atypical colonies were evaluated as staphylococcus after the Petri dishes were incubated 48 hours at 37°C. Catalase and coagulase testing were conducted for verification of suspected colonies [Brain Heart infusion Broth (BHIB-Oxoid CM225)] [24,26]. Violet Red Bile Lactose Agar (VRB; Oxoid CM0968) was inoculated to media by spreading plate method and left for 24-hour incubation at 37 °C for coliform analysis. In order to confirm the suspected colonies, it was transferred to Brilliant Green Bile Lactose (BGLB, Merk 1.05454) tubes and those generating gas after incubation at 37°C were considered positive [26,27]. For the detection of *E. coli*, inoculation was conducted to Tryptone Bile X-glucuronide Medium (TBX, Oxoid CM0945) with spreading plate method. The Petri dishes were released to incubation firstly at 30°C for 4 hours and then 18 hours at 44°C. The bluish/green colonies formed after incubation were evaluated as *E. coli* [25,26].

As a result of our research, we have not found any internationally recognized standard with respect to criteria based on which we have conducted analysis, and we have determined some reference values that will shed light on our work according to the reference values recommended by some researchers.

- Cleaned and disinfected surfaces (kob/cm<sup>2</sup>): TMAB<10, coliform: 0, *E. coli*: 0
- Surfaces in use (kob/cm<sup>2</sup>): TMAB<1.000, coliform <10, *E. coli*: 0
- Personnel hands (kob/cm<sup>2</sup>): coliform<10, *E. coli*: 0, *S. aureus*: 0 [1,9,12,21,23,31,32].

### Microbiological Analysis of Air Samples

Mold and yeast detection in air samples was carried out by sedimentation-precipitation method using two Dichloran Rose Bengal Chloramphenicol Agar (DRBC; Oxoid CM0727) petri dishes in the production area of each enterprise [8]. Average of mold-yeast developed in 2 units petri dishes left for incubation for 5 days at 25°C was found in petri dishes. Kang and Frank (1989) have recommended the number of mold-yeast in the air of the food-processed areas as < 430 Kob/m<sup>3</sup>. The results obtained were converted into the Kob/m<sup>3</sup> unit using the Omeliansky Formula.  $N = 5a \times 10^4 (CT)^{-1}$   $N = \text{Kob/m}^3$  (quantity of colony breeding in 1 m<sup>3</sup> area), a = number of colonies counted in petri dishes, B = petri dish area (cm<sup>2</sup>), t = Cooling period (minutes) [11].

### Microbiological Analysis of Water Samples

Water samples were obtained according to ISO 19458 (TSE 2006b). *E. coli* and coliform analyses were conducted according to EN ISO9308-1:2014 (ISO 2014) by using membrane filtration technique and the Brilliance *E. coli/coliform* selective media specified in the standard (BES; Oxoid CM1046). *Enterococcus* analysis was conducted according to TS EN ISO 7899-2 (TSE 2002) by using membrane filtration technique and Slanetz Baertley Agar specified in the standard (SBA; Oxoid CM0377). 100 ml of water was filtered, the filter Agar was transferred to feeding place and left for incubation at 37°C for 24 hours for *E. coli/Coliform* and for 48 hours for *Enterococci*. The assessment of water samples was conducted according to "Regulation amending regulation on Water for Human Consumption". In the Regulation it is indicated that number of *E. Coli*, coliform and *Enterococcus* should be 0 (zero) in 100 ml of water sample [4].

### Regulation of Control Forms (Checklist)

Enterprises were chosen from food establishments such as restaurants, cafes and fast food. These enterprises were audited in terms of food safety two-times between June and August 2015 with the checklist prepared according to; Food Standards Agency [17,19], Department of Public Health of Los Angeles [7].

### Polar Substance Detection in Frying Oils

The frying oils has been measured during inspection with the calibrated Testo 270-Frying Oil Tester (Testo Inc., Germany) [22]. According to Legislation, frying oils with a polar substance of ≤ 25 are considered suitable [3].

### Shopping malls General Hygiene Rating

The scores are given to the enterprises at the range specified in the check list. Shopping malls are rated as A-Very good: 85-100 points, B-Good: 70-84 points, C-Medium-55-69 points, D-Bad: 40-54 points, E-Very bad: 0-39 points based on average of all points received by enterprises.

## Results

### Number of Hygiene Trained Personnel

During the inspections, it was determined that 2,076 (72.8%) of the total 2,852 personnel received hygiene training.

### Polar Substance Measurement Results of Frying Oils

The percentage of the polarity of the 326-frying oil sample was between 4 and 60 and 310 (95%) samples were conforming and 21 of the enterprises used frying oil tester.

### Microbiological Results of Personnel's Hand Hygiene

Out of 800 samples belonging to the personnel: 438 (55%) were found to be conforming in terms of *S. aureus*, 547 in terms of coliform (68%), and 685 (86) in terms of *E. coli* and 348 (44) in terms of all criteria.

### Microbiological Results of Air Samples

Mould-Yeast between 0-158 Petri dishes were detected in 154 (77%) of 200 samples. 174 (87%) of them were found to be conforming.

**Table 1:** Hygiene Results of the General Conditions of Enterprises.

A- Hygiene Criteria for The General Conditions of the Enterprise		Number of inspection (pcs)	*Number of Conforming Enterprises (pcs)	Conformity Rate (%)
1	Is there any technical staff responsible for ensuring food safety in the enterprise or is the enterprise outsourcing professional technical support from outside?	200	154	77
2	Is there any food safety system applied? If yes, which one is implemented?	200	26	13
3	Are the floors, walls and ceilings of the warehouses and the work area robust, easy to clean, waterproof, smooth and non-toxic substances produced?	200	186	93
4	Are windows protected against breakup (glass film, etc.)? Are windows and doors built up to prevent dirt accumulation? Are there any measures taken that will not allow the passing of pests and live organisms? (Mosquito nets, baseboards, etc.)	200	195	97,5
5	Are toilets open directly to the production area? Are hygienic mats placed in appropriate places?	200	196	98
6	Does Enterprise have a dressing area and a sufficiently large clean wardrobe?	200	167	83,5
7	Is regular professional pest control conducted and are records kept regularly?	200	199	99,5
8	Are records of products and monitoring activities held regularly in stages such as food acceptance, storage, processing?	200	62	31
<b>Rating of Enterprises in Terms of Section A</b>		<b>200</b>		<b>74</b>

Number of conforming enterprises: Number of enterprises with full score over specified score.

**Table 2:** Results of the Enterprises Regarding Preservation and Storage Hygiene Criteria.

B-Storage and Preservation Hygiene Criteria for Enterprises		Number of inspection (pcs)	*Number of Conforming Enterprises (pcs)	Conformity Rate (%)
9	Are Cleaning and disinfecting agents stored separately from food?	200	158	79
10	Are there a refrigerator and freezer in adequate capacity? Are temperature values of these items controlled?	200	101	50,5
11	Are there different warehouses suitable for food in adequate capacity? Are temperature values of these items controlled?	200	106	53
12	Are all food ingredients stored high on the floor using easy-to-clean equipment? (Plastic pallet etc.)	200	174	87
13	Is there moisture control in the warehouse? Does Water condensation occur?	200	6	3
<b>Rating of Enterprises in Terms of Section B</b>		<b>200</b>		<b>54,5</b>

Number of conforming enterprises: Number of enterprises with full score over specified score

**Table 3:** Results of Enterprises Regarding the Kitchen Hygiene Criteria.

C-Hygiene Criteria for the Kitchens of Enterprises		Number of inspection (pcs)	*Number of Conforming Enterprises (pcs)	Conformity Rate (%)
14	Are all surfaces that contact with food is easy to clean, robust, chromium-resistant, and smooth and are designed to be attentive of the hygiene of these surfaces?	200	88	44
15	Is there hot water, liquid soap, disinfectant and hygienic hand drying material in the washbasin sinks?	200	46	23
16	Is there adequate lighting? Are measures taken against the risk of breaking artificial lighting?	200	196	98
17	Is adequate ventilation provided by considering air hygiene?	200	168	84
18	Is there enough space to wash dishes? Is hot water or dishwashers used?	200	193	96,5
19	Are wastes quickly removed from the area where food is processed and stored or stored in a separate section?	200	195	97,5
20	Do garbage cans prevent contamination?	200	168	84
21	Is raw food stored in separate cabinets with ready-to-consume food?	200	171	85,5
22	Are the preparation dates for high-risk foods printed?	200	156	78
23	Is the presentation of self-service or exposed products protected from contamination?	200	145	72,5
24	Are Fruits and vegetables washed and processed in a separate section?	200	143	71,5
25	Are all the equipments used in accordance with the Turkish Food Codex? Is it suitable for disinfection? Is there any broken, cracked, rusty equipment?	200	185	92,5
26	Are packaging materials in contact with food suitable for the Turkish Foods Codex? Is storage and packaging done to prevent contamination?	200	156	78
27	Are equipments used for different purposes besides food work?	200	199	99,5
28	Are all the equipments have been settled to prevent contamination and clean?	200	169	84,5
29	Are the chopping boards and cutting materials (knives, chopper, etc.) used in food processing separately designed to prevent cross-contamination? Is the cleaning done often enough?	200	58	29
30	Are the frying oils used in the enterprise often checked and replaced with a new one when they expire?	200	186	93
31	Is potable and clean water used for drinking?	200	200	100
<b>Rating of Enterprises in Terms of Section C</b>		<b>200</b>		<b>78,4</b>

Number of conforming enterprises: Number of enterprises with full score over specified score

**Table 4:** Results of Personnel Hygiene Criteria in Enterprises.

D-Personnel Hygiene Criteria		Number of inspections (pcs)	* Number of Conforming Enterprises (pcs)	Conformity Rate (%)
32	Are clean and light-colored clothing and gloves, masks and caps in contact with food used?	200	140	70
33	Are rules of personal hygiene applied? Are hands washed regularly?	200	21	10,5
34	Are there signs of open wounds and disease in the hands? Are jewelers and cosmetic materials used?	200	190	95
35	Does the staff have training in hygiene? Are these training courses renewed periodically?	200	118	59
36	Does staff have information on food allergies? Are consumers being warned against allergic substances?	200	18	9
<b>Rating of Enterprises in Terms of Section C</b>		<b>200</b>		<b>48,7</b>

Number of conforming enterprises: Number of enterprises with full score over specified score.

**Table 5:** Microbiological Detection Ranges for Surfaces and Personnel in Contact with Food in Enterprises.

Sample type	Number of samples (n)	Name of bacteria	Microbiological Detection Range (kob/cm <sup>2</sup> )					
			Not detected (n - %)	<10 <sup>1</sup> (n - %)	<10 <sup>2</sup> (n - %)	<10 <sup>3</sup> (n - %)	<10 <sup>4</sup> (n - %)	n>10 <sup>4</sup> (n - %)
Countertops	400	TMAB	81 (%20,3)	43 (%10,8)	159 (%39,8)	71 (%17,8)	37 (%9,3)	9 (%2,3)
		Coliform	209 (%52,3)	50 (%12,5)	101 (%25,3)	30 (%7,5)	10 (%2,5)	0 (%0)
		<i>E. coli</i>	379 (%94,8)	18 (%4,5)	3 (%0,8)	0 (%0)	0 (%0)	0 (%0)
Cutting boards	200	TMAB	18 (%9)	6 (%3)	64 (%32)	55 (%27,5)	41 (%20,5)	16 (%8)
		Coliform	58 (%29)	17 (%8,5)	75 (%37,5)	31 (%15,5)	18 (%9)	1 (%0,5)
		<i>E. coli</i>	183 (%91,5)	12 (%6)	3 (%1,5)	1 (%0,5)	1 (%0,5)	0 (%0)
Chopper and knives	200	TMAB	40 (%20)	21 (%10,5)	78 (%39)	33 (%16,5)	25 (%12,5)	3 (%1,5)
		Coliform	105 (%52,5)	30 (%15)	38 (%19)	18 (%9)	9 (%4,5)	0 (%0)
		<i>E. coli</i>	184 (%92)	13 (%6,5)	2 (%1)	1 (%0,5)	0 (%0)	0 (%0)
Plates	200	TMAB	142 (%71)	29 (%14,5)	25 (%12,5)	3 (%1,5)	1 (%0,5)	0 (%0)
		Coliform	191 (%95,5)	5 (%2,5)	3 (%1,5)	1 (%0,5)	0 (%0)	0 (%0)
		<i>E. coli</i>	199 (%99,5)	1 (%0,5)	0 (%0)	0 (%0)	0 (%0)	0 (%0)
Personnel	800	<i>S. aureus</i>	438 (%54,8)	256 (%32)	91 (%11,4)	9 (%1,1)	6 (%0,8)	0 (%0)
		Coliform	453 (%56,6)	94 (%11,8)	196 (%24,5)	40 (%5)	12 (%1,5)	5 (%0,6)
		<i>E. coli</i>	685 (%85,6)	99 (%12,4)	12 (%1,5)	2 (%0,3)	2 (%0,3)	0 (%0)

**Table 6:**

Surfaces That come into Contact with Food	Number of enterprises	Number of samples (n)	Number of Conforming Samples Appropriate for the Data Examined						*Conforming samples	
			TMAB		Coliform		<i>E. coli</i>		Number (piece)	Rate (%)
			Number (piece)	Rate (%)	Number (piece)	Rate (%)	Number (piece)	Rate (%)		
Countertops	100	400	354	89	259	65	379	95	244	61
Cutting board	100	200	143	72	75	38	183	92	70	35
Chopper-knives	100	200	172	86	135	68	184	92	128	64
Plate	100	200	171	86	191	96	199	100	171	86
<b>Total</b>	<b>100</b>	<b>1.000</b>	<b>840</b>	<b>84</b>	<b>660</b>	<b>66</b>	<b>945</b>	<b>95</b>	<b>613</b>	<b>61</b>

\*Conforming sample: is the one in conformity in terms of total Mesophilic Aerophilic Bacteria, Coliform Bacteria and *E. coli* numbers.

**Table 7:** Classification of Shopping Centers and Mass Food Enterprises in Terms of Food Safety Rating.

Shopping mall title	Number of enterprises (n)	Rating score					Average score	Average note
		A (n)-(%)	B (n)-(%)	C (n)-(%)	D (n)-(%)	E (n)-(%)		
A	10	3 (%30)	5 (%50)	2 (%20)	0 (%0)	0 (%0)	81	B
B	10	3 (%30)	3 (%30)	3 (%30)	1 (%10)	0 (%0)	74	B
C	10	3 (%30)	6 (%60)	1 (%10)	0 (%0)	0 (%0)	79	B
D	10	2 (%20)	6 (%60)	2 (%20)	0 (%0)	0 (%0)	77	B
E	10	3 (%30)	6 (%60)	1 (%10)	0 (%0)	0 (%0)	79	B
F	10	3 (%30)	6 (%60)	1 (%10)	0 (%0)	0 (%0)	80	B
G	10	4 (%40)	4 (%40)	2 (%20)	0 (%0)	0 (%0)	80	B
H	10	2 (%20)	7 (%70)	1 (%10)	0 (%0)	0 (%0)	78	B
I	10	2 (%20)	4 (%40)	4 (%40)	0 (%0)	0 (%0)	72	B
J	10	4 (%40)	5 (%50)	1 (%10)	0 (%0)	0 (%0)	79	B
<b>TOTAL</b>	<b>100</b>	<b>29 (%29)</b>	<b>52 (%52)</b>	<b>18 (%18)</b>	<b>1 (%1)</b>	<b>0 (%0)</b>	<b>78</b>	<b>B</b>

**Microbiological Results of Water Samples**

Enterococci, Coliform and *E. coli* were not detected in any of the 20 samples and the waters were found to comply with the regulation.

\*A-2, A-8, B-10, B-11, B-13, C-14, C-15, C-29, D-33, D35 are codes of hygiene criteria given in Table: 1, Table: 2, Table: 3, Table: 4.

**Discussion**

When enterprises are evaluated in terms of all criteria covered by the check list: conformity of enterprises in terms of hygiene criteria is 74%, conformity of enterprises in terms of preservation and storage hygiene criteria is 54.5%, conformity of enterprises in terms of

hygiene criteria for kitchens is 78.4%, and conformity of enterprises in terms of personnel hygiene criteria is 48.7%. From here it is observed that the general conditions of enterprises (section A) and enterprise kitchens (Section C) are in good condition, but enterprises are not good at preservation and storage issues (Section B) and personnel hygiene (Section D). The main reason for the general situation of enterprises and their kitchens is the fact that enterprises operating in the shopping centers are operated economically by strong chain companies, thereby maintaining a certain standard as a substructure. That's why conformity of enterprises with regards to floors, walls, ceilings, windows, doors, use water, lighting, ventilation, dressing cabinets, toilets and hand wash sinks, fruit and vegetable washing

sinks, dishwashing section, kitchen counterparts, instrument-equipment in contact with food and waste bins. It is found that enterprises have adequate infrastructure in terms of storage and preservation conditions, but conformity rates are low due to lack of temperature and humidity follow-up and because records are not kept regularly. Low conformity of enterprises in terms of personnel hygiene criteria (Section D) arises from insufficient supply of hot water, paper towels, liquid soap and disinfectant in the washbasin sinks (Table 3), negligence of staff to fully comply with the rules of personal hygiene and missing knowledge of staff on the food allergy.

Out of 1,000 units material samples in contact with foodstuffs (kitchen counters, cutting boards, chopper-knives, plates) 84% were found conforming in terms of TMAB, 66% in terms of coliform bacteria, 95% in terms of *E. coli*, and 61% in terms of all three criteria (Table 6). The maximum bacterial load was found on cutting boards followed by countertop (Table 5). Rudder et al. (2009), identified 16.5% of samples for TMAB as unacceptable, 8.5% for coliform bacteria and 11% for *E. coli* as unacceptable. In the analysis of instruments and equipment, 15.7% of samples in terms of TMAB were evaluated as unacceptable and 7.3% in terms of total number of coliform bacteria as unacceptable and 9.9% was considered unacceptable in terms of *E. coli*. Balzaretto and Marzano (2013) stated that the standard for coliform bacteria in contact with food was  $< 1.0 \log_{10} \text{ kob/cm}^2$ , and the conformity rate was 92.1%.

Out of 800 samples received from personnel working in the enterprises, 55% was found conforming in terms of *S. aureus*, 68% in terms of coliform bacteria, 86% in terms of *E. coli* and 44% in terms of all three items. In other words, the personnel hygiene was very low both on the basis of enterprise (10.5%) and personnel (44%). The fact that enterprises are identified as 23% (Table 3) for the availability of hot water, liquid soap, disinfectant and hygienic hand drying materials in the washbasin sinks explains the causes of these results.

As a matter of fact, when enterprises where these cleaning materials are fully available are examined, the rate of hygiene of the personnel hands is determined as 67.4%. Konecka-Matyjec et al. (2012), found conformity of the personnel's hands in terms of coliform bacteria as 97.2%, in terms of coagulase positive *S. aureus* as 98% and the conformity of all personnel as 71%. In the study of Saplings and Agaoglu (2004), the positivity rate of coagulase positive *staphylococcus* in the hands of cooks and waiters was 90% and 85%, the ratio of coliform bacteria to as 100%, and *E. coli* bacteria as 75% and 70%. Aydin et al. (2007) determined coagulase positive *S. aureus* in personnel working in the production area as 38.7%, and in the hands of the service personnel as 34%. Balzaretto and Marzano (2013) have identified the  $< 1.0 \log_{10} \text{ CFU/cm}^2$  as standard for the coagulase positive *S. aureus* in personnel hands and stated the availability rate as 96.5%. Temelli et al., (2005) has reported that the high rate of detection of *E. coli* is due to the lack of habit of using toilets and disinfectant use of the personnel. The high number of Coagulase positive *S. Aureus* has been explained as an indication of the presence of the personnel touching the mouth and nose or working in the kitchens despite having wounds, abscesses, and cuts etc. in their hands. The conformity of the enterprise with regards to personnel having hygiene training and renewing these trainings periodically has been identified as 59%. This training rate is 72.8% when we are on a personnel basis.

Hygiene training has become mandatory according to the "Regulation on Hygiene Training" that entered into force on 05.07.2013 [5].

As a result of the 200 air samples obtained from the enterprises, the mold-yeast was examined, and the mold-yeast was found in 77% of the samples. The range of mold-yeast detection is between 0-158 petri dishes and 87% of samples were found to be conforming. In their study in animal food enterprises, Civan and Ergun (1994) found that in the air of enterprises, the number of mold-yeast was between 3-141 Petri dishes and they reported that 50% of enterprises were not conforming with respect to air samples. They explained the cause of this negativity as unplanned buildings, technological inconsistencies and ignorance. In our study, the conformity of enterprises in terms of ventilation conditions is in good condition with a ratio of 84% (Table 3). It is the biggest factor for enterprises to have ventilation systems available. Probable causes of air samples not being conforming may be that ventilation system maintenance are not fulfilled in a timely manner and the air fittings are not changed sufficiently frequently.

20 samples [4] taken from the water were examined in terms of Enterococci, coliform bacteria, *E. coli* according to the legislation. Because none of these bacteria have been found, water samples are found in conformity with legislation. Shopping malls and all enterprises operating here are using city mains water, and these waters are regularly disinfected by competent administration, so that the risk of contamination caused by water is very low.

The 326 samples obtained from frying oils were examined in terms of percentage of polar substances, and the percentages of polar material were determined between 4 and 60 and 95% of the frying oils were found to be suitable according to regulation [3]. In addition, 21 (21%) of enterprises have been determined to control the frying oils daily by having a frying oil measuring device for auto-control purposes. In the study of the restaurant, cafeteria and school Canteen Hampikyan et al. (2001), determined that the polar substance percentages of the frying oils were between 1.5 and 40 and that 68% of the samples were in accordance with the legislation of the polar substances  $\leq 25$ . As a percentage of conformity, it is understood that our work result is better than the result of Hampikyan et al. (2001). The establishment of an oil measuring device as an auto-controller by enterprises, controlling the frying oils continuously with these devices in controls performed during Ministry of Food, Agriculture and Livestock controls created an awareness about changing frying oils in appropriate periods.

After all inspections and analyses, general hygienic conditions of the shopping centers have been tried to be determined. As shown in Table 7, according to the general hygiene status, the highest score is 81 in the shopping centers based on 100 points system and the lowest rating is 72. On Average, all shopping centers were assessed with a "B" (70-84 points) note. That all shopping centers have a "B" i.e. "GOOD" score, which is an indication that a standard for food safety practices has been ensured. On the basis of the particular enterprise, 29% of 100 enterprises in the 10 shopping centers in Istanbul received "A", 52% "B", 18% "C" and 1% "D" average rating. No enterprise has received an "E" note (0-39 points). So, the companies ranked in the class between "MEDIUM" and "VERY GOOD" when rated. Only one enterprise is classified with a "BAD" rating.

- CONSEQUENTLY, following factors that create risk for food safety in enterprises are disclosed. Although the rate of obtaining technical support for enterprises to contribute to food safety is good, in practice food safety management systems are not implemented, records are not adequately maintained and traceability is not fully provided

- Temperature records of storage tanks and refrigerator cabinets are not fully maintained, and humidity controls are almost never made

- Hot water, liquid soap, disinfectant and hygienic hand drying material in hand washing sinks is very low and the use of hand sanitizer is not widespread enough,

- The most bacterial rate on the surfaces that come into contact with food is in the cutting boards, knife-choppers and kitchen countertop, respectively, and the cleaning and disinfection of these items are not performed with regular intervals. Personnel doesn't pay attention to the hand hygiene, especially the rates of detection of *S. aureus* and *E. coli* are high,

- Due to the necessity of obtaining hygiene training per Legislation, although the number of personnel receiving training is in good condition, there are concerns in practice or given training is insufficient,

The knowledge of personnel about allergens is found to be nearly none.

## References

- Aksu H, ve Kaya İ. Gıda sanayiinde personel hijyeni. Gıda Mühendisleri Dergisi. 1999; 15-19.
- Anonim. Commission of The European Communities (CEC). Code of good hygienic practices. EC-Documen VI/5938/87 (PVET/2140). 1987.
- Anonim. Kızartmada Kullanılmakta Olan Katı ve Sıvı Yağlar İçin Özel Hijyen Kuralları Yönetmeliği. 12.05.2012 tarih ve 28290 sayılı Resmi Gazete. 2012.
- Anonim. İnsani Tüketim Amaçlı Sular Hakkında Yönetmelikte Değişiklik Yapılmasına Dair Yönetmelik. 07.03.2013 tarih ve 28580 sayılı Resmi Gazete. 2013a.
- Anonim. Hijyen Eğitimi Yönetmeliği. 05.07.2013 tarih ve 28698 sayılı Resmi Gazete. 2013b.
- Anonim. Toplu Tüketim Yerleri İçin Hijyen Esasları ve İyi Uygulama Kılavuzu. Gıda, Tarım ve Hayvancılık Bakanlığı. Ankara. 2014a.
- Anonim. Retail Food Inspection Guide. County of Los Angeles Department of Public Health Environmental Health. Erişim. 2014b.
- Arda Ş, ve Aydın A. Hammadde kalitesi ile bazı hijyen parametrelerinin yufkanın mikrobiyolojik kalitesi arasındaki ilişki üzerine bir araştırma. İstanbul Üniv. Vet. Fak. Derg. 2011; 37: 135-147.
- Ayçiçek H, Oğuz U, ve Karci K. Comparison of results of ATP bioluminescence and traditional hygiene swabbing methods for the determination of surface cleanliness at a hospital kitchen. International Journal Hygiene Environment Health. 2006; 209: 203-206.
- Aydın A, Aksu H, ve Arun ÖÖ. Hygienic properties of food handlers and equipment in food production and sales units. Medycyna Wet. 2007; 63: 1067-1070.
- Awad AH, ve Mawla HA. Sedimentation with the Omeliansky Formula as an accepted technique for quantifying airborne fungi. Polish Journal of Environmental Studies. 2012; 21: 1539-1541.
- Balzaretti CM, ve Marzano MA. Prevention of travel-related foodborne diseases: Microbiological risk assessment of food handlers and ready-to-eat foods in northern Italy airport restaurants. Food Control. 2013; 29: 202-207.
- Bilici S. Toplu Beslenme Sistemleri Çalışanları İçin Hijyen El Kitabı. Ankara. 2008.
- Civan E, ve Ergün Ö. İstanbul bölgesi hayvansal gıda işletmelerinde hijyen uygulamaları ve mevsimler arası farklılıklar. Gıda. 1994; 19: 265-269.
- Dümen E, Çetin Ö, ve Sezgin FH. Unlu mamul işletmelerinde temas yüzeyleri ve aletlerin mikrobiyolojik kirliliğinin araştırılması. Türk Mikrobiyoloji Cemiyeti Dergisi. 2009; 39: 108-114.
- Fidan F, ve Ağaoğlu S. Ağrı bölgesinde bulunan lokantaların hijyenik durumu üzerine araştırmalar. YYU Veteriner Fakültesi Dergisi. 2004; 15: 104-114.
- FSA. SC5 Hygiene Inspection Checklist. Food Standards Agency. 2013a.
- Erişim 02.06.2014, <http://www.food.gov.uk/sites/default/files/multimedia/pdfs/pdf-ni/safe-catering-hygiene.pdf>.
- FSA. Food Hygiene A Guide For Businesses. Food Standards Agency. Erişim 02.06.2014. 2013b.
- Gloria H, ve Aguilera JM. Assessment of the quality of heated oils by differential scanning calorimetry. Journal of Agricultural Food Chemistry. 1998; 46: 1363-1368.
- Gork FP. Personel hygiene and basic requirement for hygienic food production. International Symposium on Safe Food in Airline Catering, Frankfurt, Germany. 1985.
- Hampikyan H, Çolak H, Akhan M, ve Turgay İ. Determination of total polar compound (TPC) levels in frying oils. Journal of Food, Agriculture & Environment. 2011; 9: 142-144.
- Henroid DH, AF Mendonca, ve J Sneed. Microbiological evaluation of food contact surfaces in Iowa schools. Food Prot. Trends. 2004; 24: 682-685.
- ISO. Microbiology of food and animal feeding stuff. Horizontal method for the enumeration of coagulase-positive staphylococci (*Staphylococcus aureus* and other species). Part 1: Technique using Baird-Parker agar medium. ISO 6888-1: 1999. International Organization for Standardization, Geneva, Switzerland. 1999.
- ISO. Microbiology of food and animal feeding stuff. Horizontal method for the enumeration of beta-glucuronidase-positive *Escherichia coli*. Part 1: Colony-count technique at 44 degrees C using membranes and 5-bromo-4-chloro-3-indolyl beta-D-glucuronide. ISO 16649-1: 2001 International Organization for Standardization, Geneva, Switzerland. 2001.
- ISO. Microbiology of food and animal feeding stuffs-Horizontal methods for sampling techniques from surfaces using contact plates and swabs, ISO 18593. International Organization for Standardization, Geneva, Switzerland. 2004.
- ISO. Microbiology of food and animal feeding stuff. Horizontal method for the enumeration of coliforms Colony-count technique. ISO 4832: 2006. International Organization for Standardization, Geneva, Switzerland. 2006.
- ISO. Microbiology of the food chain. Horizontal method for the enumeration of microorganisms. Part 1: Colony count at 30 degrees C by the pour plate technique. ISO 4833-1: 2013. International Organization for Standardization, Geneva, Switzerland. 2013.
- ISO. Water quality-Enumeration of *Escherichia coli* and coliform bacteria. Part 1: Membrane filtration method for waters with low bacterial background flora. EN ISO 9308-1. 2014.
- Kang YJ, ve Frank JF. Biological Aerosols: A review of airborne contamination and its measurement in dairy processing plants. Journal of Food Protection. 1989; 52: 512-524.
- Konecka-Matyjek E, Mackiw E, Krygier B, Tomczuk K, Stos K, ve Jarosz M. National monitoring study on microbial contamination of food-contact surfaces in hospital kitchens in Poland. Annals of Agricultural and Environment Medicine. 2012; 19: 457-463.

32. Little C, ve Sagoo S. Evaluation of the hygiene of ready-to-eat food preparation areas and practices in mobile food vendors in the UK. *International Journal of Environmental Health Research*. 2009; 19: 431–443.
33. Örer N. Turistlerde Görülen Besin Zehirlenme Sıklığı İle Otellerin Sanitasyon Şartlarının Etkileşimi ve Türk Mutfağının Turistlerin Ülkemize Tekrar Gelişlerinde Etkisi. H.Ü. Sağlık Bilimleri Enstitüsü, Beslenme ve Diyetetik Programı. Doktora Tezi, Ankara. 1995.
34. Tayar M. Sağlıklı Mutfak İlkeleri. Uluslararası 2. Sağlıklı Gıda Kongresi, 7-10 Kasım 2013, Konya. Erişim 25.02.2016. 2013.
35. Temelli S, Şen MKC, ve Anar Ş. Et Parçalama Ünitelerinde ve Beyaz Peynir Üretiminde Çalışan Personel Ellerin Hijyenik Durumunun Değerlendirilmesi. *Uludag Univ. J. Fac. Vet. Med.* 2005; 24: 75-80.
36. TSE. Su kalitesi-Bağırsak Enterokoklarının tespiti ve sayımı. Bölüm 2: Membran Süzme Yöntemi. TS EN ISO 7899-2: 2002. Türk Standartları Enstitüsü. Ankara. 2002.
37. TSE. Su kalitesi - Mikrobiyolojik analizler için numune alma. TS EN ISO 19458:2006. Türk Standartları Enstitüsü Kurumu, Ankara. 2006b.
38. Uğur M, Nazlı B, ve Bostan K. Gıda Hijyeni. İstanbul, Teknik Yayınları. 1999.