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Original Article
Özgün Araştırma

Investigation of Restaurants in Beyoglu Istanbul, in terms of Hygiene Criterias and Food Safety

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Abstract: This study was carried out in the Beyoğlu region, where the daily food consumer population is high and the most visited by local and foreign tourists in Istanbul. The aim of the study was to determine the hygienic conditions of the personnel and restaurants. 100 Restaurants were checked twice with the pre-prepared check-lists and scored. In each control, 4 surfaces and equipments, 4 personnels and 1 air sample were taken. 5 water sample was taken to determine the microbiological status of the water. Hygienic conditions of the restaurants were determined by microbiological analysis of the samples. As a result of the checks made with the prepared form according to national and international good hygiene practices forms, restaurants were found to be 75% proper in terms of general hygiene conditions, storage hygiene, production hygiene, personnel hygiene and personnel training criterias. The samples taken for the surfaces and equipment hygiene were found improper as 7.5% for *E. coli*, 23.7% for coliform and 10.9% for aerobic mesophilic bacteria. In terms of personnel hygiene, samples were found improper as 9.6% for *E.coli*, 17.7% for coliform and 22.5% for *S.auerus*. Air hygiene samples were found proper as 92.5%. All 5 water samples analyses resulted properly. All total polar compounds measurements made on frying oils have been appropriately concluded.

It was determined that food safety management systems are not used in the restaurants and the basic contamination factor was personnel who has inadequate hygiene knowledge and the restaurants that don't have effective cleaning and disinfection plans.

Keywords: Food Safety, Hygiene, Public Health, Restaurants

İstanbul Beyoğlu ilçesi toplu tüketim yerlerinin gıda güvenliği ve hijyen kriterleri yönünden incelenmesi

Özet: Bu çalışma, İstanbul'da günlük gıda tüketen nüfusun yoğun olduğu ve yerli ve yabancı turistlerin en çok ziyaret ettiği Beyoğlu bölgesinde gerçekleştirildi. Çalışmanın amacı, personel ve restoranların hijyen koşullarının belirlenmesidir. 100 Restoran, önceden hazırlanmış kontrol listeleri ile iki kez kontrol edilerek puanlandı. Her kontrolde 4 yüzey ve ekipman, 4 personel ve 1 hava numunesi alındı. Suyun mikrobiyolojik durumunu belirlemek için 5 adet su numunesi alındı. Örneklerin mikrobiyolojik analizleri yapılarak restoranların hijyenik koşulları belirlendi. Ulusal ve uluslararası iyi hijyen uygulama rehberlerine uygun olarak hazırlanan form ile yapılan kontroller sonucunda restoranların genel hijyen koşulları, depo hijyeni, üretim hijyeni, personel hijyeni ve personel eğitim kriterleri açısından %75 uygun olduğu tespit edildi. Yüzey ve ekipman hijyeni için alınan örnekler *E. coli* için %7,5, koliform için %23,7 ve aerobik mezofilik bakteriler için %10,9 olarak uygunsuz olarak bulundu. Personel hijyeni açısından numuneler *E.coli* için %9,6, koliform için %17,7 ve *S.auerus* için %22,5 olarak uygunsuz bulundu. Hava hijyeni örnekleri %92,5 olarak uygun bulundu. 5 Su numunesinde yapılan analizler ve tüm kızartma yağlarında yapılan polar madde ölçümleri uygun olarak sonuçlandı. Restoranlarda gıda güvenliği yönetim sistemlerinin kullanılmadığı belirlendi. Temel kontaminasyon faktörleri ise yetersiz hijyen bilgisine sahip personel ve restoranların etkin temizlik ve dezenfeksiyon planı olmaması olarak belirlendi.

Anahtar kelimeler: Gıda Güvenliği, Halk Sağlığı, Hijyen, Toplu Tüketim

Introduction

People's food consumption habits are changing due to reasons such as industrialization and taking place more effectively in business life. Especially in countries that have completed industrialization, more than half of the population eat 1 meal a day out of the home. This type of consumption habit creates new risks and threatens public health (Sezgin and Özkaya, 2014). Insufficient hygienic conditions in the food process until consumption and the possible contaminations cause hazards (Fidan and Ağaoğlu 2004).

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The food safety process starts from farms or fields and continues until the ultimate consumer. The selection of raw material, processing, storage and distribution constitute the steps of this process. An unsufficient point can lead to food poisonings and outbreak in this food safety approach, which is also accepted in the EU and in the USA. Food-borne disease rates in industrialized countries are up to 30 %, according to WHO reports (Giray and Soysal, 2007; Lazou et al. 2012). The increasing of the population and the food demand cause the rising of the concerns related to food safety, especially in big cities. Changes on food consumption habits, new technologies in food processing, environmenteal pollution and illegal production lead to consist risks on food safety (McCarthy et al. 2007; Erkmen 2010).

Food-borne diseases are also an important reason for slowing the economic growth of countries and appear in both developed and developing countries, but developing countries deal with rougher circumstances. They impose an economic and social burden on society in developed countries. There are 76 million food-borne disease cases, which 325.000 are inpatient treatment, occur every year in the USA and the annual number of deaths was reported as 5.000. Approximate cost is $ 152 billion per year. Foodborne disease are one of the major reasons of infant mortality all over the world, and considered that approximately 1.9 million children die from diarrhea due to food-borne diseases each year (Mead et al. 1999; WHO 2002, 2015).

There are 1499 restaurants in the Beyoglu district of Istanbul which is frequently visited by local and foreign tourists (FSIS, 2018). The main contamination factors are staff, raw materials, surfaces, equipment, water and especially the cross contaminations that might occur during the pre-service step in such operations (Bas 2004; Ugur et al. 2001).

Restaurants have to complete pre-requisite programs before the implementation of food safety systems, such as HACCP. These programs include; features of operation, processing area and layout, waste management, equipment suitability, cleaning and disinfection, pest control, personnel training and hygiene, reprocessing, recalling, storage and distribution and the traceability of products. (Ariosti 2016)

This study was carried out in the Beyoglu region where one of the most visited districts in Istanbul, to research the hygiene level of restaurants and aimed the protection of consumer and public health through the detection of the possible hazards in the operations.

Materials and Methods

Material: 100 restaurants, that have at least 4 or more employees, were selected in the Beyoglu district. Sampling were completed in 2016. Swabs were taken as 4 employees, 4 contact surfaces and equipment and 1 air sample was taken from each restaurant. Every restaurant was visited twice. The total number of swab samples from employees, surfaces and equipment is 1800. Water hygienic measurement were performed with 5 samples, cause of using city water in any restaurant. The total polar compounds of frying oil is monitored by taking 25 oil samples from restaurants. All samples were stored 4° C, and transported to laboratory within 2 hours to be analyzed on the same day. The restaurants were inspected with pre-prepared checklist.

Microbiological Analysis of Personnel, Surface and Equipment Samples: Samples from personnel, surfaces and equipment (work surfaces, cutting board, knife, clean plate) were taken in accordance with the double swab (wet-dry swab) technique and ISO standards (ISO, 2018). Equipment and surface samples were taken 25 cm^2 of material and employees' samples were taken from hand and fingers. The swabs were broken and put into test tubes (Anon. 1987; ISO 2018). Tubes were mixed and prepared with saline solution to passage of the microorganisms in proper dilution. Total mesophilic aerobic bacteria isolated and counted by using Plate Count Agar (PCA; Oxoid CM0463), incubated at 37º C for 48 hours (ISO 2018, 2013). *E.coli* isolation and counting were performed by using Tryptone Bile X-glucuronide Agar (TBX, Oxoid CM0945), incubated at 30º C for 4 hours, and then at 44º C for 18 hours. The bluish-green colonies were considered positive (ISO 2001, 2018). *S. aureus* isolated and counted by using of Baird Parker Agar (BPA; Oxoid CM1127) with egg yolk and potassium telluride. Typical and atypical colonies were isolated at 37° C after 48 hours. Catalase and coagulase tests were performed on suspicious colonies by using Brain Heart Infusion Agar (BHIB-Oxoid CM225) (ISO 1999, 2018). Coliform bacteria isolated and counted by using Violet Red Bile Lactose Agar (VRB; Oxoid CM0968), after 24 hours incubation at 37° C, colonies were formed reddish zone, have 1-2 mm diameter areas. Suspecious colonies were incubated at 37º C for 24 hours by using Brilliant Green Bile Lactose

Broth (BGLB, Merk 1.05454) and the gas production was commented as positive (ISO 2018, 2006).

The reference values were determined from other similar studies in literature, due to the lack of common international reference for the microbiological criterias.

* Clearly defined surfaces (cfu / cm^2): TMAB <10, coliform: 0, *E. coli*: 0

* Surface and equipment in use (cfu / cm^2): TMAB <1.000, coliform <10, *E.coli*: 0

* Hand of personnel (cfu / cm^2): coliform <10, *E.coli*: 0, *S.aureus*: 0 (Aksu and Kaya 1999; Ayçiçek et al. 2006; Little and Sagoo 2009).

Water Samples: 5 water samples were taken from the kitchens of restaurants, which use the city water. Water samples were collected in 250 ml sterile containers (TSE 2006). Colonies were analyzed by membrane filtration technique using Brilliance *E. coli* / Coliform Selective Medium (BES; Oxoid CM1046) in accordance with standards (ISO 2014). Enterococcus analysis were performed by using Slanetz Bartley Agar (SBA; Oxoid CM0377) by membrane filtration (TSE 2002). 100 ml of filtered water incubated 24 hours for *E. coli* / coliform and 48 hours for enterococcus at 37°C. The results were interpreted in accordance with "Regulation on Water for Human Consumption" (Anon. 2013c).

Air Samples: The petri dish was opened in the area of production and the classical method was used, for the detection of molds and yeasts in the air (Pitt and Hocking 1999, Çöl and Aksu 2007). The petri dish was opened in the kitchen and waited for 15 minutes, the petri was covered and the samples were brought to the laboratory to incubate. Dichloran Rose Bengal Chloramphenicol (DRBC: Oxoid CM0727) agar was used to detect yeast mold in the air and colonies formed in petri dishes after 5 days at 25°C. The colony number was calculated by taking averages of 2 visits. Results were converted to cfu/m^3 unit by Omelinasky Formula. N = 5a × 104 (bt) -1 N = cfu/m^3 (colony forming in 1 m^3), a = number of colonies counted in petri dish, b = petri zone as cm^2, t = waiting time in minutes (Awad and Mawla 2012). As a result of analysis findings, the recommended number of molds and yeasts, isolated from the 65 cm^2 petri dishes, after 15 minutes, was determined as <18 cfu / petri dish.

Detection of Polar Compounds in Frying Oils: Total polar compounds measurement was performed with calibrated Testo-270 Frying Oil Tester (Testo Inc. Germany). The interpreting of the results were carried out within the legal limits (Anon. 2012).

Hygiene Scoring of Restaurants: The hygiene scoring process was carried out using the criterias stated in the control forms. The scoring was calculated by averaging of each the 2 visits to the restaurants. The form was prepared previously and had 5 basic topics (Anon. 2011, Anon. 2013a, Anon. 2013b). These were General Hygiene Status, Storage Hygiene, Production Hygiene, Personnel Hygiene and Personnel Training sections. A control form includes 36 questions and scored out of 100 points. The total scoring was interpreted as table 1.

Table 1. Hygiene Scoring Table

Scoring	Explanation	Point
A	Very Good	90-100
B	Good	70-89
C	Average	50-69
D	Unsufficient	40-49
E	Bad	0-39

Findings

Table 2. General Hygiene Results

	A- General Hygiene Criterias	Number of the Establishments	Number of the Proper Establishments	Rate of Proper Establishments
1	Is there technical staff who is responsible of food safety? Is there external technical support?	100	22	22
2	Is a Food Safety Management System implemented? Which?	100	15	15
3	Fllors, walls, ceilings in production and storage areas; It must be robust, easily cleanable, waterproof and made from suitable materials.	100	77	77
4	Precautions should be taken against the risk of breakage of the windows, dirt accumulation and insect entry should be prevented.	100	80	80
5	Hygienic mats should be used in the area where the toilets are and toilet doors shouldn't be open into the production area.	100	89	89
6	Must have adequate and clean dressing area	100	81	81
7	Regular pest control must be made and recorded	100	94	94
8	The food must be regularly monitored and recorded at the acceptance, storage and processing stages.	100	42	42
	Rate of Total Proper Establishments	100		62,5

Table 3. Storage Hygiene Results

	B- Storage Hygiene Criterias	Number of the Establishments	Number of the Proper Establishments	Rate of Proper Establishments
9	Cleaning materials must be stored in different areas of the kitchen.	100	74	74
10	There should be refrigerators with suitable capacity and temperature records should be monitored	100	69	69
11	Food storages must be done according to proper storage conditions and capacity. Temperatures should be monitored.	100	76	76
12	Stoarge must be higher than floor level and storage material should be easy to clean.	100	81	81
13	The inside of the storage should be checked for moisture	100	18	18
	Rate of Total Proper Establishments	200		63,6

Table 4. Production Hygiene Results

C- Production Hygiene Criterias		Number of the Establishments	Number of the Proper Establishment	Rate of Proper Establishments
14	All surfaces must be easy to clean, robust and hygienic.	100	82	82
15	There must be hot water, soap and drying material in the sinks	100	25	25
16	Equivalent illumination to the daylight must be provided, caution must be taken against breakage.	100	88	88
17	Ensure adequate ventilation.	100	77	77
18	Sufficient dishwashing area or dishwasher must be available.	100	95	95
19	Waste should be removed quickly or stored separately.	100	75	75
20	The garbage bins must be constructed to prevent contamination.	100	76	76
21	Raw and cooked food must be stored in different places.	100	84	84
22	The preparation dates of risky food in storage must be written on them.	100	37	37
23	Self-service products must be protected against external contamination.	100	86	86
24	Vegetables (fruit, vegetables, etc.) must be processed in separate areas.	100	82	82
25	All equipments must be in compliance with regulations, not rusty, broken, or unsuitable.	100	92	92
26	The packaging material must be in compliance with the legislation and avoid contamination during storage.	100	94	94
27	All equipments should be used for food processing and storage.	100	100	100
28	The installation of the equipment and machinery must allow hygienic activities.	100	72	72
29	Cross-contamination cause of equipments should be avoided.	100	98	98
30	Frying oil must be checked.	25	25	100
31	The water must have drinkable properties.	100	100	100
	Rate of Total Proper Establishments	100		80,1

Table 5. Personnel Hygiene Criterias

D- Personnel Hygiene Criterias		Number of the Establishments	Number of the Proper Establishment	Rate of Proper Establishments
32	Clean clothes, gloves, mask, bone for production must be used	100	65	65
33	Personnel must obey the hygiene criterias and the hands should be washed accordingly.	100	65	65
34	There must be no wounds on the hands during production and accessories such as jewelry, watches should not be used	100	67	67
	Rate of Total Proper Establishments	100		65,6

Table 6. Personnel Training Criterias

	E- Personnel Training Criterias	Number of the Establishments	Number of the Proper Establishment	Rate of Proper Establishments
35	All personnels must be trained in basic hygiene and continuous on-the-job training	100	26	26
36	Personnel must have food allergen knowledge, and warn consumers	100	12	12
	Rate of Total Proper Establishments	100		19

Table 7. General Hygiene Scoring Table

Score	Range of Points	Number of Establishments and Rates	Average Point
A	90-100	12 (%12)	93
B	70-89	64 (%64)	76
C	50-69	22 (%22)	65
D	40-49	2 (%2)	48
E	0-39	0	0
Total		100	75

Table 8. Polar Compounds Measurement

Frying Oil	Number of Restaurants	Number of Sample	Range of Polar Compounds Measurement	Average Polar Compounds	Number of Restaurants which has Polar Measurement Device	Suitability with Regulations (%Polar Compounds ≤25)
Total	25	25	7-21	16.0	17	25 (%100)

Table 9. Air Hygiene Samples

Air	Number of Samples (n)	Mold-Yeast Detected Samples and Rates	Average Mold-Yeast (cfu/petri)	Mold-Yeast Detection Range (cfu/petri)	Proper Samples and Rates (< 18 cfu/petri)
Total	200	150 (%75)	12.6	0-101	185 (%92.5)

Table 10. Equipments and Surface Samples

Food Contact Surfaces and Equipments	Number of Samples (n)	Criterias and Eligibility Rates						Proper Samples	
		E.coli		Coliform		TMAB			
		Number	Rate (%)	Number	Rate (%)	Number	Rate (%)	Number	Rate (%)
Cutting Board	200	190	95	142	72	149	74.5	124	62
Work Surfaces	200	176	88	158	79	196	98	141	70.5
Knives	200	185	92.5	134	67	192	96	121	60.5
Plates	200	189	94.5	177	88.5	176	88	168	84
Total	800	740	92.5	611	76.3	713	89.1	554	69.2

Table 11. Water Samples

Water	Number of Samples (n)	Criterias and Eligibility Rates						Proper Samples	
		E. coli		Enterococcus		Coliform			
		Number	Rate (%)	Number	Rate (%)	Number	Rate (%)	Number	Rate (%)
Total	5	5	100	5	100	5	100	5	100

Table 12. Personnel Hand Samples

Personnel	Number of Samples (n)	Criterias and Propriety Rates						Proper Samples	
		E.coli		Coliform		S.aureus			
		Number	Rate (%)	Number	Rate (%)	Number	Rate (%)	Number	Rate (%)
Total	800	723	90.4	658	82.3	620	77.5	570	71.2

Discussion and Conclusion

Inspection with check-list resulted as; 62.5% proper for general hygiene conditions, 63.6% for storage hygiene conditions, 80.1% for production hygiene conditions, 65.6% for personnel hygiene and 19% for personnel training. Restaurants were found good in terms of production hygiene, poor in terms of personnel training, and moderate in terms of other criterias. Only 15% of restaurants use food safety management systems effectively and the technical staff is inadequate. Lack of efficient traceability systems for raw materials and final products cause a significant risk for food safety. Insufficient control of moisture in food storage is considered a negative feature for storage hygiene. The steps of preparing and freezing animal-originated food are considered high risk in restaurants. In terms of personal hygiene, the hand washing procedures were defined not so well in restaurants and cautions weren't taken against using of jewelery and accesories. Personnel dressing procesedures are interpreted poorly. Training of employees were found poor and the allergen knowledge of employees prove that clearly. In a study conducted by Kothe et all. (2016) among street vendors, the conditions and cleanliness of personnel clothes were found as %60 inappropriate, and maintenance of preparared food at temperature above 60° or below 5° was found %50 inappropriate. Ratnasari et al. (2018) revealed the presence of food components and cooked foods under inadequate storage conditions was associated with a high rate of *E.coli* contamination. In the same study, employees in food businesses were found to be inadequate in terms of food processing knowledge by 17.6% and by 66.7% in terms of personal hygiene. Liu et al. (2015) found the employees had food hygiene knowledge at the rate of 54.4%, and the 4.09% of the workers answered "always" the question about mixing of raw and cooked food containers in the Guandong region of China. Lee at al. (2017) revelaed that although it was determined that 61.7% of the food workers had good food hygiene knowledge, the samples taken from their hands were determined high for total aerobic bacterial load at university canteen in Kuala Lumpur. In the study conducted by Yoshimoto and Zapechelnyuk (2019) in the United Kingdom, was found that there is a negative correlation between the food quality and hygiene conditions, the production and processing conditions are insufficient in restaurants with world-renowned quality awards.

The highest microbiological risk was detected on knives and cutting boards. Legnani et al. (2003) determined *E. coli* as 16.7% and TMAB as 6.7% on the working surfaces. Dümen et al. (2009) stated proper surface samples in terms of TMAB as 83.5%, coliform as 91% and *E.coli* as 89%. Rodionava et al. (2018) determined $(6.4\pm1.1)\times10^2$ cfu/cm^2 microorganisms in one hour on washing tables in meat processing enterprises. In the study conducted by 90 restaurants, it was revealed that meat processing benches and knives in kitchens are the most contaminated areas in terms of total coliform bacteria at all hours of the day (Lopašovský et al., 2021).

The 800 samples collected from employees in the kitchen were found proper 77.5% for *S. aureus*, 82.3% for coliform bacteria, 90.4% for *E.coli* and 71.2% for all three (Table 12). Lack of a regular hand washing procedure, hygienic drying materials and continuous hot water supply are interpreted as main reasons. In the study of Civan (1993), personal hand hygiene was founded as 32% proper. Konecka-Matyjec et al. (2012) found that 97.2% proper for the coliform and 98% proper for *S.aureus* on personnel. Fidan and Ağaoğlu (2012) found that *E.coli* positivity rate was 70% in the hands of restaurant employee in Ağrı province. In the study of Akarca et al. (2015) that was conducted in dairies in Afyon, the employee' hand hygine results were concluded as; *E.coli* as 0.67%. Aydin et al. (2007) identified coagulase-positive *S.aureus* in 38.7% of personal hands samples in the production and 34% in the service. Temelli et al. (2005) found that *E.coli* was 37.5% on butchers' hands, 28.5% on dairy farmers, and 40% coagulase-positive staphylococcus on butchers' and dairy farmer's hands. Paul et al. (2021) found between 6.0×10^1 – 1.5×10^2 cfu/cm^2 microorganisms in food handling surfaces of local restaurants in Bangla-

desh. Yentür – Doni et al. (2019) isolated *S. pyogenes* as 22 (35.5%) of 62 throat swabs in their study in university canteen. In the study conducted by 220 food workers, bacteria isolated at a rate of 62.2% in the samples taken from the nails of the workers, and 46% of them were *S. aureus* and 29.2% were *E.coli*. *S.aureus* was detected in 65.4% of nasal swabs and *Shigella boydii* was detected in 0.9% of rectal swabs (Nasrolahei et al., 2017). Yap et al. (2019) found in sushi restaurants, 21.7% positive for *S.aureus* in foods and 30% on the hands of employees, and this rate decreased to 0 by changing gloves and hand washing. Getie et al. (2019) made isolation from samples taken from the hands of food workers as 10.1% *Shigella spp*, 1.9% *E.coli O157:H7* and 1.2% *Salmonella spp*.

200 air samples taken from production areas of the restaurants were resulted in 92.5% proper for mold and yeast isolation. The average number of colonies was found as 12.6 cfu/petri dish and the colony range was found between 0-158 (Table 9). The study of Dülger (2004), detected 1-9.8 cfu/petri dish mold-yeast in meat-processing area of supermarkets. Kang and Frank (1989) suggest that the amount of mold-yeast that should be <430 m^3.

All of the 5 samples taken to specify the microbiological properties of the city water that used in all the restaurants, have been concluded in accordance with the legal regulations (Table 11). Any enterococcus, coliform and *E.coli* have not been isolated (Anon. 2013c). Regular control of the city water reduces the risk of contamination to the minimum level.

25 of the 100 controlled restaurants had actively frying operation. All of the polar compounds measurements made in these restaurants were proper (Table 8). Measures have been assessed within the legal limits (Anon. 2012). Polar compounds measurement range was found between 7-21 and an average of 16 was found. Restaurants have their own device to make measurements and have self-limits that are lower than the legal limits. Hampikyan et al. (2011). found polar compounds between 1,5 and 40 and polar compounds measurement results showed that 68% of the restaurants are under the legal limits.

All the results show the inadequate and need to be improved sections of the restaurants. All restaurants need good hygiene practices and beyond that a food safety system, such as HACCP. Main pre-requisite problems still constitute difficulty to improve restaurant and personal hygiene standards. Internal or external audits play an important role and lack of such private or official controls lead breaking of the food safety chain.

Use of laboratory animals Ethics Committee and other decisions of Ethics Committee and Permissions: Ethical committee permission was not obtained due to lack of study on experimental animals.

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