İst Tıp Fak Derg 2013;76:4 **RESEARCH ARTICLES/ARAŞTIRMALAR**
J Ist Faculty Med 2013;76:4
http://dergipark.ulakbim.gov.tr/iuitfd

MICROBIOLOGIC EXAMINATION OF AIR, WATER AND FECES OF WORKERS FROM HOSPITAL KITCHENS

HASTANE MUTFAKLARINDA HAVA, SU ve ÇALIŞANLARIN DIŞKILARININ MİKROBİYOLOJİK İNCELENMESİ

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ABSTRACT

Objective: Food production in hygienic conditions is important for a healthy diet at all levels of food production. We aimed to perform some microbiologic analysis of air and water samples taken from the kitchens of Istanbul University, Istanbul Faculty of Medicine, and perform parasitologic analysis of feces from the kitchen personnel.

Material and Method: In this descriptive study, air and water analyses were conducted between January 24th, and March 25th, 2011. Air samples were obtained using AES air sampler (AESAP1075/1078), 100 m^3 of air per minute was taken by impact method. Sample collection, and evaluation was made according to the ISO 14644 and ISO 14698. The prepared media for bacteria was incubated at 37° C for 2 days. The media prepared for molds was incubated at room temperature for at least five days. To obtain mold Sabouraud dextrose agar (SDA) and for total bacteria Standard Plate Count Agar (APHA) was used. Bacteria and mold colony counts were performed, and results were determined as CFU/m^3. Water samples were taken to the (TS) 266 and were filtered using the Sartorius Stedim Membrane Filtration Mechanism. After filter papers incubated in Fluorocult LMX-Buyyon media at 37 ^{0}C, colonies were counted in Chromocult Coliform Agar (Merk). Feces samples were taken four times between March, 2010, and March, 2011, and these samples were checked using the intensive method with formol-ether.

Results: Air samples were taken from 45 areas, none of them were more than 99 CFU/m^3 for the total bacteria. In the 11 areas measured in the kitchens, in 7, total number of mold were more than 500 CFU/m^3 and in the meal service kitchens of the clinics 34 areas were measured, 7 was also more than 500 CFU/m^3. No coliform bacterial growth was detected in any of the water samples. In parasitologic research, one staff was positive for *Blastocystis hominis* and one for *Entamoeba histolytica/Entamoeba dispar*.

Conclusion: To avoid the proliferation of colonizing species of mold, precautions were taken against high temperature and humidity. Regular hygiene practices and suitable air circulation for these areas were applied.

Key Words: Air, water, microbiologic examination, feces, hospital kitchen.

ÖZET

Amaç: Sağlıklı bir besin için, gıda üretim zincirinin tüm düzeylerinde hijyenik şartların sağlanması önemlidir. Bu çalışmada İstanbul Üniversitesi, İstanbul Tıp Fakültesi hastane mutfağından ve kliniklerdeki yemek ofislerinden hava ve su örnekleri alınarak mikrobiyolojik analizlerinin yapılması, buralarda çalışan personelin dışkı örneklerinin alınarak parazitolojik incelemesinin yapılmasını amaçladık.

Gereç ve Yöntem: Tanımlayıcı bu çalışmada, hava ve su analizleri 24 Ocak-25 Mart 2011 tarihleri arasında yapıldı. Hava örnekleri AES marka Hava Örnekleme Cihazı (AESAP1075/1078) ile dakikada 100 m^3 hava çekecek şekilde impact yöntem ile alındı. Örneklerin alınması ve değerlendirilmesi ISO 14644 ve ISO 14698'e göre yapıldı. Bakteri için hazırlanan besiyerleri, 37°C'de 2 gün inkübe edildi. Küfler için hazırlanan besiyerleri oda ısısında en az beş gün inkübe edildi. Küf mantarı saptamak için Sabouraud Dextrose Agar (SDA), toplam bakteri için Standart Platecount Agar

Date received/Dergiye geldiği tarih: 20.06.2013 - Dergiye kabul edildiği tarih: 30.12.2013

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(APHA) besiyerleri kullanıldı. Bakteri ve küf koloni sayımları yapıldı, sonuçlar CFU/m^3 olarak belirlendi. Su örnekleri (TS)266 ya göre alınarak, Sartorius Stedim Membran Filtrasyon Düzeneği ile filtre edildi, filtre kağıtları Fluorocult LMX-Buyyon besiyeri içinde etüvde bekletildikten sonra, Chromocult Coliform Agar (Merck) besiyerinde koloni sayımı yapıldı. Dışkı örnekleri Mart 2010-Mart 2011 tarihleri arasında dört kez alınarak, formol-eter ile yoğunlaştırma yöntemi uygulanarak incelendi. ***Bulgular:*** Hava örneği alınan 45 alandan, toplam bakteri sayıları 99 CFU/m^3 ü geçen bir alan saptanmadı. Mutfakta ölçüm yapılan 11 alandan yedisinde, 34 klinik dağıtım mutfağından yedisinde toplam küf mantarı sayısı 500 CFU/m^3 ün üzerindeydi. Alınan su örneklerinin hiçbirinde koliform bakteri üremesi olmadı. Parazitolojik incelemede bir çalışanda *Blastocystis hominis*, bir kişide *Entamoeba histolytica/Entamoeba dispar* saptandı.
Sonuç: Küf mantarı koloni üremesinden kaçınmak için yüksek ısı ve neme karşı önlemler alındı. Düzenli hijyen uygulamaları ve bu alanlar için uygun havalandırma sağlandı.
Anahtar Kelimeler: Hava, su, mikrobiyolojik inceleme, dışkı, hastane mutfağı.

INTRODUCTION

Food production in hygienic conditions is important for a healthy diet at all levels of food production. If insufficient attention is paid to food sanitation and hygiene rules in this period, toxic substances may develop in food structures or chemical and biological agents can be transmitted from the environment, which may adversely affect human health (9,15,31,32).

Major infectious diseases such as typhoid fever, paratyphoid, dysentery, cholera, and hepatitis A and B are caused by inadequate cleaning habits of employees who work in food production services and by environmental factors (6,10). Because the working place is a hospital, hygiene and sanitation conditions gain more importance in mass food production and consumption. (14,25,27).

For hygienic production of food, the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) recommend that the indoor air and water in food production places are tested regularly (19,46). The importance for health of clean indoor air and water has been known for a long time (43,45). The kitchen is one of the most important indoor areas in this respect (5,10,30). Kitchen personnel must provide and maintain the terms of hygiene (18). Because intestinal parasites infect the human body through ingestion of fecal matter, staff feces must be investigated regularly by parasitologic analysis (2,34,40).

MATERIALS and METHODS

Food service is provided by a private company for the Istanbul Faculty of Medicine. Approximately 3300 people have their meals each day in the hospital, 1550 patients and 1750 staff. Nearly ¼ of the company personnel works in food production and ¾ of them work in the kitchens.

We aimed to peform microbiologic analyses of air and water samples from the hospital kitchen and service areas of Istanbul University, Istanbul Faculty of Medicine (Dervis Kartal Central Kitchen). We also aimed to analyse staff feces for parasites.

In this way, microbiologic analyses of air and water samples were planned for all the food serving areas in clinics (34 office kitchens) and in all working areas in Dervis Kartal Central Kitchen (11 areas in the central kitchen). Feces samples were taken from each of the staff (n=83) who work in kitchens during the study period between March, 2010, and March, 2011. Air samples were taken from 11 places identified in the Dervis Kartal Central Kitchen and from 34 meal distributiion kitchens in clinics. For air samples, locations up to 50 m^2 area were considered as a unit. Sample collection and evaluation was performed accordance with ISO 14644 and ISO 14698 (3, 35).

Two consecutive samples were taken from each unit for bacteriologic analysis and two samples taken for the analysis of mold. In total, 180 samples were taken for microbiologic analyses of air. The sample that had the highest number of colonies from both samples was evaluated. Air samples were obtained using an AES Air Sampler (AESAP1075/1078) at one hundred liters per minute. For each sample, a total of 100 L. of air was aspirated in 1 min. Samples were taken between 09:00 - 11:00. Heat and humidity measures were taken using a TM956HI room thermometer (ThermoMETER) from each of the areas where samples were taken. Standard Platecount Agar (APHA) and Sabouraud Dextrose Agar (SDA) were used for culture. To avoid contamination after the air sample collection, the Petri dishes were wrapped in paraffin film and taken to Department of Public Health, Division of Environmental Health for analysis. For total mold, air samples were stored for a minimum of five days at 25° C (room temperature) in SDA culture, and for total bacteria, air samples were stored for two days in APHA cultures in an incubator (37° C). Bacteria and mold colonies were counted, then by using a Correspondence Table of AES air sampler, corresponding N (probable number of viable impacted microorganisms, either estimated or adjusted) was determined (39). Results were determined as Colony Forming Units (CFU/m^3) (11,13,21,41). Air and water samples from the kitchens were obtained between January 24th, 2011, and March 25th, 2011, over 9 weeks and only on Mondays. Assessments were conducted on consecutive days. In accordance with WHO and American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), a professional organization standards, count levels of total mold and bacteria were determined as 500 CFU/m^3 for acceptible indoor air quality (5,30,4,33,37).

Two water samples were taken from the taps of 34 kitchens in the clinics, 5 were taken from the taps of the Dervis Kartal Central Kitchen, and the remaining samples were taken from 6 stores in the hospital (Deanery, Department of Emergency Surgery, Department of Internal Medicine - 2 stores, Department

of Eye Diseases - 2 stores). In total, 90 water samples were obtained. Samples were taken following the standard conditions specified in the "Republic of Turkey Water Pollution Control Regulations" and "Turkish Standards (TS) 266" (44,45). They were then filtered using a Sartorius Stedim (Biotech 16692/16695) Membrane Filtration Mechanism. Filter papers were stored in Fluorocult LMX–Buyyon (Merck) media at $37C^0$ for 48 hours in an incubator. Some of the blurred tubes were inoculated to Chromocult Coliform Agar (Merck) culture and were stored in the incubator for 24 hours at 37˚C, the colonies were then counted (23,40,44,45).

Feces samples were taken four times a year between April, 2010, and April, 2011 from 83 staff (from the Dervis Kartal Central Kitchen, Istanbul Faculty of Medicine and food distribution services). The samples were analyzed on the day of sampling. These samples were analyzed using the intensive method with formol – ether at the Istanbul Faculty of Medicine, Division of Parasitology (Midi Parasep SF Dia Sys) (20). Statistical analyses were performed using SPSS software, version 17. Descriptive analyses were presented using means and standard deviations. Qualitative data were assessed by frequencies, percentages.

RESULTS

There was no coliform bacterium proliferation in any of the water samples. Table 1 shows the results of air samples taken from 11 areas of the kitchen, the total numbers of bacteria and mold of 34 clinic areas, and the heat and humidity results. There were no areas more than 99 CFU/m^3 for the total bacteria numbers taken from 45 sample areas. These bacteria colonies were under 500 CFU/m^3. Total mold was more than 500 CFU/m^3 in 7 of 11 areas measured in the kitchen, and 7 of 34 clinic areas. These were *Mucor spp*. in 11stations, *Aspergillus spp*. in 4 stations, *Cladosporium spp*. in 2 stations, *Fusarium spp*. in 1 station, and *Alternaria spp*. in 1 station, respectively. The distribution of detected mold per species are shown in Table 2.

Blastocystis hominis was detected in one staff member's stool sample,and *Entamoeba histolytica / Entamoeba dispar* was detected in one person. One of these persons worked in food production, the other one worked in the food service area.

DISCUSSION

Mold in kitchens may provide a source of infection, toxicity in food, or allergy for staff. Therefore, intoxication may occur in people who eat foods prepared in contaminated kitchens. The physical properties of the local environment play an important role in the proliferation of colonizing species of mold. In this study, mold proliferation was excessive in some areas: 3rd and 4th kitchen areas; meat processing area; stock room; vegetable preparation area; dry food area 2; general surgery 7th floor; urology department; internal medicine B block 1st and 2nd floors; pediatrics milk kitchen; pediatrics gastroenterology division; emergency; and physical therapy and rehabilitation departments. There were two windows and two paddle boxes on stoves in the Central Kitchen. There were windows in all other study areas but no additional ventilation systems. Therefore, all of the study areas were most frequently ventilated using windows, so precautions were taken to avoid high temperatures and humidity, to have regular hygiene practices and to provide air circulation for areas of food storage. Cardboard boxes in kitchens may cause contamination and mold proliferation; therefore, cardboard boxes were not taken into the stock room.

In this study, the most frequently found proliferative mold species were *Aspergillus spp., Cladosporium spp., Penicillium spp., Fusarium spp., Alternaria spp., Mucor spp., Rhizopus spp*. respectively. In a study by Ergin C. et al., the most found mold were *Cladosporium spp. (57.7%), Aspergillus spp. (15.8%) and Penicillium spp. (3.4%)* in indoor air; *Cladosporium spp. (60.4%), Alternaria spp. (16.8%), Aspergillus spp. (11.8%) and Penicillium spp. (3.0%)* in outdoor air of Laodikeia Recreation Zone. *Mucor spp., Cunnighamella spp., Ulacladium spp. and Cladophilaphora spp*. were isolated only in indoor air (16).

Imalı A. et al performed research in another city of Turkey, Corum. The most frequently reported mold species in their study in indoor and outdoor air were *Aspergillus (23.15%), Cladosporium (21.30%), Penicillium (11.11%), Ulocladium (10.18%), Alternaria (5.55%) and Mycelia(5.55%)* (26).

Güllü G. et al took some samples from sitting rooms, kitchens, bathrooms of houses, from nursery and primary schools, cafes, restaurants, sports centres, libraries, offices and dining halls in Ankara, Turkey. The most found bacterium species were *Micrococcacea (31.2%), Bacillacea (22.4%), Staphylococcus auricularis (20.4%)* and *Staphylococcus hominis (10.0%);* the most found mold and fungi species were *Penicillium spp.(44.8%), Aspergillus spp.(23.3%), Cladosporium spp.(7.0%), Rhizopus spp.(7.0%)*. The highest total bacterium levels were obtained from nursery and primary schools; the highest total mold and fungi levels were obtained from bathrooms and kitchens of houses (22). In moist buildings, Gram-negative bacterium, endotoxin and mycobacteria were found with mold (38). Microorganism concentration in indoor air depends on some activities as coughing, speaking, sneezing, breathing. In this study, bacterium colony numbers were below 500 CFU/m^3 for the air samples of the areas studied, therefore we did not make a distinction between types.

In the study of Nunea at al., 94.3- to 99.4% of the air samples from offices, hospitals, shopping centers, and factories were within the limits of Brazil for microbial contamination of air (750 CFU/m^3). 0-100 CFU/m^3 fungi and bacteria were detected in the factories; an average of 300 CFU/m^3 fungi and bacteria were detected in offices; and an average of 200 CFU/m^3 fungi and bacteria were detected in hospitals. An average of 300 CFU/m^3 fungi and 1000 CFU/m^3 bacteria were detected in shopping centers (36).

In a study conducted in a university library in Poland, the mold and fungi of air samples were found to be 10-1000 CFU/m^3 (1).

In our study, at the time of sampling 6 water tanks of Istanbul Faculty of Medicine had recently been maintained; therefore, there was no coliform bacterium proliferation in any of the water samples.

Table 1. Heat and humidity measurements and total bacteria, mold numbers in air samples taken from Istanbul Faculty of Medicine, Dervis Kartal Central Kitchen and clinics.

	Heat (◦C)	Humidity (%)	Total Bacteria Colony Numbers (CFU/m^3)	Total Mold Colony Numbers (CFU/m^3)
Kitchen Samples				
Kitchen 1	21	51	5	41
Kitchen 2	22.2	52	8	114
Kitchen 3	22.3	54	29	1259
Kitchen 4	22.9	58	30	1259
Breakfast distribution	12.2	57	10	97
Meat Processing	20.2	63	7	1259
Preparation- Meat Processing	15	42	11	1259
Preparation- Storage	7.6	62	4	1259
Vegetable Preparation	20.5	65	13	1259
Dry Food 1	16	49	12	6
Dry Food 2	17.8	52	7	1259
Meal distribution kitchens in clinics				
Obstetrics and Gynecology	19.9	26	48	30
Gynecology	21.9	47	71	14
General Surgery 8th.floor	24.6	25	59	19
General Surgery 7th.floor	26	49	39	1259
General Surgery 6th.floor	26	47	67	18
General Surgery (Private)	29.2	48	0	22
Urology	27	44	47	1259
Plastic Surgery	27.4	41	32	2
Ear-Nose-Throat Dept.	25	24	94	33
Transplantation	28.8	47	41	19
Thoracic Surgery	30	52	52	26
Chest Diseases	23.5	26	32	10
Hyperbaric O2 Unit	27.2	48	34	8
Cardiovascular surgery	25.5	45	99	22
Pediatric Surgery	27.7	49	39	7
Internal Medicine B (1-2)	22	31	21	1259
Internal Medicine B (3-4-5)	23.1	24	18	15
Internal Medicine A (1-2)	23.9	24	74	11
Internal Medicine A (3-4)	23.2	24	39	10
Psychiatry (Male)	23.7	25	23	19
Psychiatry (Female)	23.3	25	43	18
Orthopedics (2nd. floor)	21.1	25	49	17
Pediatric Hematology	22	25	29	20
Pediatric Milk Kitchen	22	25	91	1259
Pediatric Cardiology	25	37	51	27
Pediatric Allergy	23	41	42	9
Pediatric Gastroenterology	24	36	38	1259
Emergency	21	37	7	1259
Oncology	23.3	47	3	8
Ophtalmology	17.2	26	2	10
Physical Therapy	23.4	40	4	1259
Dermatology	26	44	2	8
Neurosurgery	25	49	4	21
Neurology	24.1	49	2	17

Table 2. The average colony numbers of total mold proliferated in all stations (CFU/m^3)

Mold species	The average colony numbers of total mold proliferated in all stations (CFU/m^3)				
	n	**Mean**	**Standard Deviation**	**Median**	**Min-Max**
Mucor spp.	3	2.33	2.31	1	1-5
Aspergillus spp.	25	17.64	24.54	7	2-114
Cladosporium spp.	11	9.36	8.65	7	1-30
Fusarium spp.	11	5.45	7.15	3	1-25
Alternaria spp.	16	3.44	2.31	2.5	1-9
Penicillium spp.	13	6.15	7.02	2	1-19
Rhizopus spp.	2	1.50	0.71	1.5	1-2
Unidentified species	5	1.00	0.71	1.5	1-2
Total mold	31	22.55	23.87	18	2-114

In respect of some results from different research between 1991 and 2010, regarding feces parasites of kitchen personnel, rates were found to range between 7.74 and 66.6%. Kurtoğlu investigated food administration in Van, Turkey, and 17.7% of personnel were found to have parasites (29). In another city, Aydın, Turkey, 29.3% of kitchen personnel who worked at city center hospitals were found to have intestine parasites. The parasites that were identified (in order of prevalence) were *B. hominis, E. vermicularis, G. intestinalis, E. histolytica/dispar, E. Coli* (47). In Malatya, Turkey, a research was undertaken in a state hospital and the frequency of parasites in feces for the kitchen personnel was 13.2% (18). Another study was performed in Inönü University Medical Faculty, the frequency of parasites in feces of the kitchen personnel was 15.0% (12). In a food company in Malatya, Turkey, the frequency of parasites for the kitchen personnel was 23.0% (6); whereas in our study it was 2.4%.

CONCLUSION

There was no coliform bacterium proliferation in any of the water samples taken from hospital kitchens and meal offices in clinics of Istanbul Faculty of Medicine. Total bacterium numbers were considered acceptable for the standards of air samples. Total mold numbers were found to be over the upper limit of the standards in 7 clinic areas and in 7 areas from the kitchens.

To avoid the proliferation of colonizing species of mold, precautions were taken for high temperature and humidity. Regular hygiene practices and suitable air circulation for these areas were applied.

Acknowledgements: This study was supported by Istanbul University, Scientific Research Projects (BAP), Project Number: 3538.

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ERRATUM/DÜZELTME

İstanbul Tıp Fakültesi Dergisi 2013;76:2 sayısında yayımlanan "**Nutrition Habits and Food Consumption Frequencies of Medical Faculty Students"** başlıklı makaleye yazarları tarafından aşağıdaki bilgilerin eklenmesi istenmiştir:

Acknowledgements: This study was supported by Istanbul University, Scientific Research Projects (BAP), UDP Project Number: 18865.
We thank also the dietitians Beyza Eliuz, Cemile İdiz, Betül Sanrı and Hanife Başaran who are working at Istanbul Faculty of Medicine, for their contributions during data collection.