Geliş(Recevied) :10.01.2020
Kabul(Accepted) :28.05.2020

Araştırma Makalesi/Research Article
Doi: 10.30708.mantar.673175

Fungal Biodiversity on Slippers and Carpets Dusts in Three Mosques of Edirne City, Turkey

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Abstract: This study was conducted for the purpose of identifying the microfungi types and numbers in carpets, carpet dusts and slippers in three mosques in the Edirne City and surveying of microfungi during perform an ablution. It was isolated 78.937 CFU/g microfungi in total during 12 months from the samples taken between the dates of October 2008 and September 2009 from the stations. Of the microfungi 83 CFU/g were dermatophyte. It was identified only one dermatophyte in the slippers. It was identified 24 fungal species in carpet samples. The genus *Penicilium* was on the first rank with 18.553 CFU/g and 49.03 % in carpets, followed by *Trichoderma* with 13.666 CFU/g and 25 %, and followed *Cladosporium* ranked three with 96.666 CFU/g and 12.34 %. It was found the dermatophyte *Trichophyton rubrum* in the mosques only for once (July 2009). Statistical analysis for identifying whether the fungal types and the total microfungi concentrations are related with various meteorological factors. The highest value in indoor carpets was isolated as 6.084 CFU/g on the October. As a result, it was identified that the carpet dust fungus concentrations in three mosques are within the range of healthy limit values.

Key words: Carpet dust, mosque, microfungus, dermatophyte, fungal biodiversity, Edirne

Türkiye'de Edirne Şehrinin Üç Camisinde Halı Tozları ve Terliklerde Mantar Biyoçeşitliliği

Öz: Bu çalışma, Edirne ilindeki 3 farklı caminin halı, halı tozu ve terliklerde mikrofungus tipleri ve sayılarının belirlenmesi, iç ortam halısında ve abdest alma esnasında kullanılan terliklerde dermatofit varlığının araştırılması amacıyla yapılmıştır. İstasyonlardan Ekim 2008 – Eylül 2009 tarihleri arasında alınan örneklerden, 12 ay süresince, toplam olarak 78937 KOB/g mikrofungus izole edilmiştir. Mikrofunguslardan 83 KOB/g'ı dermatofit fungustur. Terliklerde dermatofit tespit edilmemiştir. Halı örneklerinde 24 fungal cins tespit edilmiştir. Halıda tespit edilen mikrofunguslar arasında ilk sırayı 18533 koloni ve % 49,03 ile *Penicillium* cinsi almıştır. Bunu 13666 koloni ve % 25 ile *Trichoderma* cinsi, 9667 koloni ve % 12,34 ile *Cladosporium* cinsi üçüncü olarak takip etmiştir. Sadece bir camide bir kez (Temmuz 2009) *Trichophyton rubrum* bulunmuştur. Fungal cinslerin ve toplam mikrofungus konsantrasyonlarının çeşitli meteorolojik faktörlerle ilişkili olup olmadığını tespit etmek için istatistik analiz yapılmıştır. İç ortam halısındaki en yüksek değer 2. istasyonda Ekim ayında 6084 KOB/g izole edilmiştir. Sonuç olarak, üç camideki halı tozu fungus konsantrasyonlarının sağlıklı sınır değerleri arasında olduğu tespit edilmiştir.

Anahtar kelimeler: Halı tozu, cami, mikrofungus, dermatofit, fungal biyoçeşitlilik, Edirne.

Introduction

All kinds of decorative purposed covering materials in homes, offices or schools, especially wallpapers and carpet undersides create environments in which the fungi can grow (Ozyaral et al., 1988). It is known that it cumulates too much dust in the carpets in comparison with the flat surfaces such as wooden floors or nylon floors. Thus, the studies conducted have shown that some carpets involve too much allergens and create much more fungus compared to flat surfaces and air (Beguin ve Nolard, 1999).

Environmental fungi are related with many diseases in the humans. These diseases can be listed as atopic allergic dermatitis, allergic rhinitis, asthma, extrinsic allergic alveolitis, hypersensitivity pneumonitis, sick building syndrome (SBS) and liver cancer with its toxins such ad aflatoxin (Abdu-Wahab, 2006; El-Nagerabi et al., 2012).

There are convenient conditions for growing of fungi in historical buildings, museums and libraries (Kasprzyk, 2008). The buildings which involve high fungus concentration are the oldest buildings and their connection with the fungi has not been explained completely yet (Macher, 2001). The age of the buildings is an important factor that affect the indoor fungal spore concentration (Sivasubramani et al., 2004).

Mosques are historical buildings which are visited for praying and for touristic purposes. Researching the fungal concentration in mosques' indoor carpets can play an important role in identifying the possible risk which can be created by fungi and can reveal the necessity to take precautions. Specifying the possible microbiota in the carpets is important for protecting the health of the visitors who come to the mosque. It is also important to research especially the air quality of a place as well as the carpet dust by considering the infecting effects of microfungi. It is expected that the indoor air quality have the most acceptable level in collective areas of usage because of that it plays an important role in triggering allergic reactions especially in atopic persons. The studies on the indoor carpet-sourced microbiota in the mosques are limited.

Muslims go mosques for praying collectively five times in a day. They perform a practice named kotow (touching their forehead and nose, hands, knees and foot fingers to the ground) in a part of the salaat worship. In the study, it was tried to specify the fungal concentration, fungal types, seasonal distribution of fungi which can possibly be faced by the people when they get kotow position, and the dermatophyte factors in the slippers used during performing ablution.

Material and Method

Sampling, fungal isolation and identification

Research materials were collected from 5 m^2 area in total as 1 m^2 areas from the four corners and the exact middle area with a vacuum sweeper between the dates of October 2008-September 2009 from three different mosques in the Edirne City.

It was used a vacuum sweeper (BEKO TT-635, Turkey) in the practice of sampling from carpet dusts. The vacuum sweeper dust bags was transferred to 250 ml sterile containers after sampling from the carpets. Dust samples was weighed as 0.1 gr. and was dissolved in a sterile peptoned water involving Tween 80. The samples were kept in this liquid for 10 minutes, and then vortexed and it was waited for 15 minutes for the subsidence of dust (Macher, 2001).

It was transferred 1 ml for each liquid to 3 petri plates for microfungi by taking with pipette among the material and subsided dust flowing in the tube. Then, it was added potato dextrose agar (PDA) to these three petri plates, it was mixed by shaking 1 ml liquid and PDA petri slightly together, and all petri plates were observed daily. The petri plates was kept waiting in 37^{o}C incubator between 7 and 14 days. They transferred to 5 petri plates by taking 1 ml liquid samples by pipette from the tube in the same manner for dermatophytes. It was cultivated cycloheximide added sabouraud dextrose agar to two of these petri plates and sabouraud dextrose agar to three of them. One petri involving cycloheximide added sabouraud dextrose agar was incubated at 25^{0}C and another petri was incubated at 35^{0}C. Two petri plates involving sabouraud dextrose agar were incubated at 25^{0}C and one petri was incubated at 35^{0}C. All petri plates was kept waiting between 7 and 14 days.

The petri plates with colony forming unit (CFU) were calculated and it was calculated the average of the colonies counted from numerous petri plates in the same dilution. The microfungi concentration in the dust sample was expressed as CFU/g by using the formula below:

[Number of colonies in the petri (CFU) x Overall volume (ml)] **/** [dilution factor (10^{-X}) x cultivated volume (ml) x dust mass (g)] = CFU/g (Macher, 2001).

Also dematiaceous fungi isolated and did not create spores was cultivated as spot-on from the stock cultures in the tubes to PDA and malt extract agar (MEA) media. These plates were left for incubation for

seven days at 25^{0}C by performing spot-on cultivations to czapek agar (CA), czapek yeast autolysate agar (CYA), czapek yeast 20 % sükroz agar ($CY_{20}S$) and malt ekstrat agar (MEA) media of the types belong to *Aspergillus*. It was performed cultivation also to another petri plate which involves CYA and it was left for fertility for seven days (Klich, 2002).

It was used three CYA, 25 % glycerol nitrate agar ($G_{25}N$) and MEA media for identifying the types belong to *Penicillium* (Pitt et al., 2000). The samples cultivated in CYA media was left for incubation at 5°C, 25°C and 37°C, and the samples cultivated in $G_{25}N$ and MEA media was left for incubation at 25°C for seven days. At the end of the incubation process, it was examined the characteristics such as colony diameter, texture, shape, color from above and below, sporulation, zonation, exudation, pigmentation and the existence of various macroscopic structures of the fungal colonies in the petri plates which involve media intrinsic to types microscopically. It was examined the stereo microscope and colony texture, the incidence way and the measurements of various parts with light microscope and the features such as peripheral characteristics and colors. It was made naming by using algorithms defined previously according to the specified characteristics (Klich, 2002; Pitt et al., 2000; Pitt, 1979; Samson et al., 2002; Booth, 1971; Nelson et al., 1983; Gerlach ve Nirenberg, 1982; Barnett ve Hunter, 1999; Ellis, 1971; Ellis ve Ellis, 1997; Hasenekoglu, 1991).

The isolated types belong to dermatophyte was cultivated spot-on and they left for incubation for seven days at 25°C. The samples which are estimated as dermatopyhte fungus macroscopically and microscopically were cultivated in test media for identifying various vitamin requirements, and they were named by using algorithms defined previously (Sutton et al., 1998).

Characteristics of research stations

All stations are situated in the Edirne City Center. The stations have been using for worship and visit purposes between the hours 5:00 AM and 23:00 PM approximately. The first and the second station are historical buildings which have been visiting also for touristic purposes as well as worship, while the third station is a historical building using only for worship.

Moisture and temperature measurement

The temperature and moisture values of all stations were measured by the help of thermometer and hygrometer device (TFA-Dostmann GmbH, Germany) during sampling.

Statistical analyses

In the statistical evaluation, the relations between the microfungi isolated as for seasons and months and fungal concentrations and the various meteorological factors were examined with Spearman Correlation Analysis. It was used Mann Whitney U test in identifying whether there is a significant difference between the indoors environments and the outdoor environment of the mosque. It was used Kruskal Wallis test in identifying whether there is a significant difference between the stations and the overall fungal numbers. $P<0.05$ was accepted as the statistical significance limit value.

Results

It was isolated 78.937 microfungi CFU/g in total in 108 petri plates for fungi in carpet environment samples for the purpose of specifying the fungal intensity in the indoor carpets of the mosques. The distributions of the isolated fungal colony numbers according to months and stations were given in Table 1.

When the distributions of the isolated fungal colony quantities according to months and stations were examined, it was found the maximum fungal colony in the 3rd station with 40.89 % and the minimum fungal colony in the 1st station with 25.52 %. When the distributions of the colony numbers according to months were examined, it was found the maximum fungal colony in the month of October with 19.73 %. It was observed the minimum fungal colony on the month of May with 3.92 % (Table 1).

In the presented study, it was specified 24 fungal genera and 58 species in the samplings from the dusts over the carpets. In the general distribution between microfungi belong to the indoor carpets, the *Penicillium* (23.60 %) was on the first rank. The *Trichoderma* (17.40 %) was identified as second, the *Cladosporium* (12.31 %) as third, and the *Alternaria* (10.08 %) as fourth frequent microfungi. The microfungi in the first four ranks consisted 63.39 % of the overall colony quantity.

When the distributions of the isolated fungal colony quantities according to months were examined, it was found the maximum fungal colony in the month of October all the year around with 19.73 %. The month of September was on the second rank with 10.61 % and the month of June was on the third rank with 9.32 %. It was observed the minimum microfungus colony in the month of May with 3.92 % (Table 2).

Table 1. Distribution of fungal colony numbers isolated from carpet dust of the mosques between the dates of October 2008 and September 2009 according to the months and stations (CFU/g).

Months	1st station	2nd station	3rd station	Total
October	4499	4916	6084	15499
November	1083	1333	2366	4782
December	1665	3416	2333	7414
January	999	2667	750	4416
February	917	1083	2416	4416
March	1666	1500	3666	6832
April	1667	2084	1918	5669
May	416	833	1831	3080
June	2417	2083	2833	7333
July	1667	1500	3166	6333
August	1582	1750	1500	4832
September	2416	2583	3332	8331
Total	20994	25748	32195	
Total		78937		78937

Table 2. Fungal genera list the months in which they were isolated

From curpet dust (CFU/gr)	*Months (CFU/gr)
Acremonium spp. (1833)	9(167), 6(333),10(167), 12(1166)
Alternaria spp. (7914)	2(333), 3(333), 5(83), 6(167), 7(583), 8(1083), 9(1333), 10(3166), 11(83), 12(750)
Apiospora sp. (83)	5 (83)
Arthrinium sp. (83)	5 (83)
Aspergillus spp. (7082)	1(583), 2(584), 3(666), 4(2084), 5(333), 6(583), 7(750), 9(417), 10(333), 11(666), 12(83)
Chaetomium spp. (1416)	1(250), 2(250), 3(250), 5(250), 6(83), 9(167), 11(83), 12(83)
Cladosporium spp. (9667)	2(500), 3(1000), 5(250) 6(1834), 8(333), 9(1000), 10(2667), 11(750), 12(1333)
Drechslera sp. (83)	11 (83)
Fusarium spp. (2083)	6 (250), 7(1000), 9(83), 10 (500), 11(250),
Gliocladium spp. (166)	4(83), 8(83)
Gliomastix spp. (166)	12(83), 5(83)
Hirsutella sp. (83)	6(83)
Mucor spp. (2000)	12(83), 2(167), 4(167), 6(833), 9(750)
Penicillium spp.(18532)	1(2333), 2(2166), 3(3000), 4(1501), 5(1250), 6(500), 8(1000), 9(333), 10(3249), 11(1033), 12(2167)
Pithomyces spp. (333)	9 (333)
Rhizopus spp. (2917)	10(167), 11(250), 12(250), 2(83), 3(1167), 4(167), 5(83), 6(167), 7(167), 9(416)
Scopulariopsis spp. (2168)	1(417), 4(167), 5(83), 6(834), 10(167), 11(417), 12(83)
Sordaria sp. (83)	1(83)
Staphylotrichum sp. (333)	1(250), 2(83)
Trichoderma sp. (13666)	1(417), 2(83), 3(167), 4(750), 5(333), 6(583),

	7(3750), 8(1583), 9(1833), 10(3333), 11(667), 12(167)
Trichothecium sp. (167)	11(167)
Ulocladium spp.(2333)	5(83), 6(250), 8(250), 9(583), 10(167), 12(1000)
Verticillium sp. (83)	11(83)
Sterile (5246)	1(83), 2(167), 3(249), 4(750), 5(83), 6(833), 8(333), 9(916), 10(1583), 11(83), 12(166)
Trichophyton (83)	7(83)
Not identified (334)	8(167), 11(167)

*Months: January (1) is accepted as the beginning.

Trichophyton sp. was isolated from the carpet in the third station in the month of July once as a dermatophyte factor (Table 2). It was not isolated any dermatophyte type in any ablution slippers.

Discussion

The fungal concentrations accepted for carpet environment in literature sources varies between $2x10^4$ and 10^5 CFU/g (Esis, 2004). In its declaration published on the year of 2004, Global Risk Control Service (GRCS) emphasized that there are not any acceptable standards about building and workplace indoor surface contaminations, and that air and dust samples should be evaluated together for evaluating the potential contamination correctly (Esis, 2004). GRCS remarked the limit value in building and workplace indoor dust samples as 100.000 CFU/g. In the report of European Collaborative Action (ECA), <200-500 CFU/m^3 or <20.000 CFU/g concentration in dust samples was classified as low level (Celtik et al., 2011). As it was stated in the study previously published, it was identified that the fungal concentrations in the air in the same environments do not exceed the limit values (Tikvesli et al., 2018). In this study, it was considered that the mosque carpet environments are in accordance with the limit values identified by the Global Risk Control Service.

Niemeier et al. (2006) remarked that the concentration of fungal spores can be measured from the dust covering the floor, that between 20 and 40% of the houses in North Europe and Canada have fungal contamination, and that this value are much higher than the tropical and subtropical countries (Niemeier et al., 2006). They pointed the most widespread spores in the dust samples as *Aspergillus, Penicillium* and *Cladosporium* spores. In their study, Niemeier et al. (2006) identified much more type fungus in dust samples in comparions with the air samples when they compare the dust samples and the air samples belong to carpets or floors, and that the floor dust can be a source of indoor air fungi (Niemeier et al., 2006). When the findings of the study conducted previously in the air of the same environment (Tikvesli et al., 2018) were compared with the findings of this study, it was identified types and kinds in the carpet environment similar with the air environment. Identification of common types and kinds in carpet and air environment can be the evidence of that the microfungi hanged in air environment fall on the floor or they get mixed in the air environment from the floor.

When the distributions of the fungal spore numbers accumulated on the carpet surface in this study, it was seen that while the maximum fungus spore is in autumn season in which almost one third of overall fungal load [with 28614,2 CFU/g (36,44 %)] was identified, they isolated in close values in the following three seasons. Chao et al. (2002) identified the *Cladosporium* type as the most widespread type, and they also identified its maximum frequency in the winter, and then respectively in the seasons of autumn, spring and summer. They remarked that it reaches 12.000 CFU/g the highest concentration in the month of July. It was not seen any significant seasonal influence in *Aspergillus* and *Penicillium* types. They identified a level under 100 CFU/g in *Fusarium* all over the year (Chao et al., 2002). In our study, it was identified the most intense type as *Trichoderma* type in summer and autumn seasons, and *Penicillium* type in spring and winter seasons. *Penicillium* type which had been identified most widespread all over the year was identified as 3249.9 CFU/g the highest in the month of October.

In the study conducted by Ramachandran et al. on the year of 2005, they alleged that heat is the one and only variable for carpet fungal concentrations. They reached the conclusion of that heat causes decrease in carpet fungal levels (Ramachandran et al., 2005). Chao et al. (2002) specified in their study on carpet fungal

concentrations that heat has a positive effect on the fungal concentration (Chao et al., 2002). Buildings with good isolations and covering the floor with carpets provide conditions such as heat and moisture, and that causes a gradual increase of fungi (Ceylan et al., 2006). In the present study, we identified as a result of the correlation analyses made between moisture and heat values that there is not any relation between the fungal numbers on indoor carpet floor and the monthly average indoor moisture and heat.

As a result of the correlation analyses of the types identified as widespread in carpet environment, it was not identified any significant relation of it with moisture and heat in the correlation analyses of *Penicillium*, *Aspergillus* and *Alternaria* genera on the carpet surface. In conclusion, it is thought in this study that only *Trichoderma* and *Cladosporium* genera are affected from indoor conditions. *Trichoderma* genera had displayed an antagonistic situation with *Penicillium* and a synergistic situation with *Cladosporium*. So, it is thought in this study that *Trichoderma* and *Cladosporium* genera display similar seasonal characteristics. In this study, it could be observed the reproduction of *Trichoderma* genera by help of PDA used during the fungal isolation from carpet environment. *Trichoderma* genera was specified on the second rank and in all months following *Penicillium*. As a result, because of that it could be succeeded to isolate *Trichoderma* with the method we used in the study, the role of *Trichoderma* could be presented.

The most important problem of indoor spaces is the increased moisture (Wong et al., 2008). The moisture ratios of indoors over 70 % increase the risk of fungus formation (www.jivs.net/jivs/dosya/2003.pdf). Because of that the fungal concentration is higher in smaller spaces under favorable conditions, in case of inadequate ventilation and due to human activities, the fact that the 3rd station have all of these characteristics can explain the excess of fungal diversity and concentration. The section that has the minimum microfungus concentration is the worship space of the 1st station. The reason of this can be that the indoor of this station was good ventilated in contrast to the 3rd station, and that the 1st station is far from contamination affects because of the mosque floor and other sections have been cleaning and ventilating regularly in spite of that the station accepts many touristic visitor as well as there are individuals who have regularly been coming for worship.

Aspergillus is one of the most frequently isolated types among the dust samples (Stark et al., 2005). It is known that these fungi have allergenic features. In our study, *Penicillium* is on the first rank among the fungi identified in carpet environment, and it was specified in all months except the month of July. Although *Aspergillus* type is on the forth rank, it was not identified in all months except the month of August.

It has been conducted many studies in the indoor and outdoor environments of various buildings hospitals, schools, habitable houses, textile factories, farm houses, piggeries, slaughterhouses and caves. It was remarked that dusts involve too much air-sourced fungal spores which cause hypersensitivity in humans (Awad, 2002). However, people gather together in mosques as crowded groups and in this study, it was tried to specify whether the moisture of the mosques specified have a ratio that support fungal reproduction by conducting moisture control in those mosques. It was concluded that moisture does not have an effect in increasing the fungal concentration because of that it was not identified any relation between the overall indoor fungus quantity on carpet floor and the indoor moisture.

Carpet is an important allergenic reservoir (Tranter et al., 2009). It was showed in the studies that the carpets involve more allergenic (Beguin and Nolard, 1999). Old and damaged carpets may be a large reservoir for microfungi (Roberts et al., 1999). It is quite important to examine the air quality and the fungal concentration in carpet dust in such places in which the people gather together in crowded groups by considering the infecting effects of fungi. There are studies which show that there is strong connections between dust and health symptoms (Niemeier et al., 2006). Stark et al. (2005) alleged that the development of diseases of the 5 years old children with allergenic rhinitis and the fungal concentration (Stark et al., 2005). They especially pointed that they have isolated *Aspergillus* and then *Cladosporium* most widespread from the dust samples. They identified that the fungi with highest concentration are *Aureobasidium*, *Aspergillus*, *Alternaria*, yeast and the fungi which do not form spores. In this study, it is thought that fungi can create a potential risk about allergenic rhinitis due to that *Penicillium*, and then *Trichoderma*, *Cladosporium* ve *Alternaria* genera were isolated respectively of their frequency.

Celtik et al. (2011) have researched the fungal concentration in floor dusts in 10 elementary schools. In

mentioned study, they have isolated most frequently the types of *Cladosporium* (30.8 %), *Penicillium* (25.8 %), *Alternaria* (8.8 %) and *Aspergillus* (6.6 %). Celtik et al. (2011) interpreted their own study as that the fungal contamination is in low level in comparison with the ECA report. In our study, the first four fungal genera which are frequently isolated are *Penicillium* with 23.60 %, *Trichoderma* with 17.40 %, *Cladosporium* with 12.31 % and *Alternaria* with 10.08 %, and they constitute 63.39 % of the overall colony numbers. In this study, the highest value in indoor carpet environment was specified in the 3rd station in the month of October as 6.083 CFU/g. When the limit values of both ECA and GRCS are taken as a basis, it was evaluated that the fungus concentration in the three mosques in this study are between the healthy limit values (Hasenekoglu, 1991).

When the distributions of fungus spore accumulated on the carpet floor according to the stations, the maximum fungi were isolated in the third station. The reason why there are more indoor carpet environment fungal concentration in the third station can be about that it has the maximum fungal concentration in its indoor air, that it is smaller than the others, that the ventilation is not adequate with limited number of windows, and that all the facades of the building is surrounded with a garden area in which there are various plants and trees.

Dermatophytes are pathogenic fungi which cause dermatophytosis which is also defined as tinea infections by infecting the keratinized tissues (skin, hair and nails) of humans and animals (Hryncewicz-Gwozdz et al., 2011). *T. rubrum* is a filamentous fungus which cause 90 % of dermatophytosis in humans by affecting the epidermis (Garcia-Madrid et al., 2011). In our study, it was isolated only *Trichophyton rubrum* (83,3 CFU/g) in the third station once only in the month of July as a dermatophytosis factor. It could be found two literature which research the dermatophytosis factors from the carpet environment in the mosques which are one of the collective life spaces. In these researches, it was applied the single sampling method. In the study presented here, it is thought that the follow-up by months characteristic is also important.

Yenişehirli et al. (2012) researched dermatophytosis factor fungi from the carpet floor environments of 30 mosques in Tokat in worshippers. They took 160 samples from the carpet floor and 40 samples from the people with a cotton swab. As a result of the study, they identified 144 culture positive samples in total 200 samples including 113 from carpet samples and 31 from humans. They have isolated *Epidermophyton floccosum, Trichophyton mentagrophytes, T. rubrum, T. tonsurans* and *T. verricosum* dermatophytes in carpets and humans together. As a result, they remarked that fungus and contaminated carpet environment and humans can be reservoirs in terms of the contamination of these fungi (Yenişehirli et al., 2012).

Raboobee et al. (1998) researched the dermatophytosis factor fungi from the floor of the ablution section and the indoor carpet environment of eight mosques in Durban region. They also took nail and foot skin samples from 77 people who came regularly for worship to those mosques at least one time in a week. As a result of the study, they identified the tinea pedis and unguium prevalence in the people who have infection symptoms through culture positivity or microscopic evaluation as 85 %. They isolated the dermatophytes in all mosque floors. They specified *T. rubrum* and *Candida spp.* from the ablution section and *T. rubrum*, *T. verricosum* and *T. violaceum* from the carpet. In conclusion, they allege that the infected individuals can transfer fungi to the mosque floor and that other people can be infected from here (Raboobee et al, 1998).

In contrast to the studies of Raboobee et al. (1998) and Yenişehirli et al. (2012), the existence of dermatophytosis factors were found as scarcely any when it was followed up for 12 months in the mosque carpets in Edirne. It was also thought that this study is the third study in the literature with its characteristic of conducting on mosque carpets. When it is considered that it could be specified different findings from the first study, it was concluded that it should be conducted more studies on this subject (Raboobee et al. 1998; Yenişehirli et al., 2012).

It was thought in our study that it should be researched the dermatophyte load in the areas which can involve other risk factors such as ablution sections and slippers and even maybe it should be identified the dermatophytosis ratios in individuals who use the mosque regularly as for the society because of it was identified that the mosque carpets do not pose an important risk.

In our study presented here, it was identified only one kind dermatophyte factor (*Trichophyton rubrum*) for only once in the carpet dust of only one mosque station. Identifying dermatophyte factors in the mosque carpets

for only once makes we think that the mosque carpets are not very important in the contamination of infections between the people in the study field.

Acknowledgement

Many thanks to Trakya Universtiy Scientific Research fund (Project Number: TUBAP-2009/64) for their generous financial support.

References

Abdul-Wahab, SA. (2006). Indoor and outdoor relationships of atmospheric particulates in Oman. *Indoor Built Environ*. 15 (3) 247-255.

Awad, A.H. (2002). Environtal study in subway metro stations in Cairo, Egypt. *J Occup Health* 44: 112-118.

Barnett, H.L., Hunter, B.B. (1999). Illustrated Genera of Imperfect Fungi, 4th ed. APS Press, St. Paul, Minnesota, USA. 218.

Beguin, H. and Nolard, N. (1999). Relationship between mycobiota in wall-to-wall carpet dust and age of carpet. *Aerobiologia.* 15: 299–306.

Booth, C. (1971). The Genus *Fusarium*, CAB, Kew, UK, 237.

Celtik, C., Okten, S., Okutan, O., Aydogdu, H., Bostancıoglu, M., Ekuklu, G., Asan, A. and Yazıcıoglu, M. (2011). Investigation of indoor molds and allergic diseases in public primary schools in Edirne city of Turkey. *Asian Pac J Allergy Immunol.* 29, 42-49.

Ceylan, E., Ozkütük, A., Ergör, G., Yücesoy, M., Itil, O., Caymaz, S. and Cimrin A. (2006). Fungi and indoor conditions in asthma patients. *J Asthma*. 43, 789–794.

Chao, H.J., Milton, D.K., Schwartz, J. and Burge, H.A. (2002). Dustborne fungi in large office buildings. *Mycopathologia*. 154, 93-106.

Ellis, M.B. (1971). Dematiaceous Hyphomycetes. London and Reading. Common wealth Mycological Institute. The Eastern Press Ltd. Kew, Surrey, UK. 608.

Ellis, M.B. and Ellis, J.P. (1997). Microfungi on Land Plants. An identification handbook. The Richmond Publishing Co. Ltd. Slough, UK. Enlarged 868.

El-Nagerabi, SAF., Al-Bahry, SA., Elshafie, A.E. and Alhilali, S. (2012). Effect of Hibiscus sabdariffa extract oil on the gowth and aflatoxin B1 production of *Aspergillus flavus* and *Aspergillus parasiticus* strains. *Food Control.* 25, 59-63.

Esis. (2004). Inc- Global Risk Control Services Environtal Health Laboratory Mold Interpretation: Surface Samples.

Garcia-Madrid, L.A., Huziar-Lopez, M.R., Flores-Romo, L. and Islas-Rodrguez, A.E. (2011). *Trichophyton rubrum* manipulates the innate immune functions of human keratinocytes. *Cent Eur J Biol.* 6, 902-910.

Gerlach, W. and Nirenberg, H. (1982). The Genus *Fusarium*-a Pictorial Atlas, Biologische Bundesanstalt für Land- und Forstwirtschaft Institut für Mikrobiologie, Berlin-Dahlem.

Hasenekoglu, I. (1991). Toprak Mikrofungusları. Cilt I-VII. Atatürk Üniv. Yay. No: 689, Erzurum.

Hryncewicz-Gwozdz, A., Jagielski, T., Dobrowolska, A., Szepietowski, J.C. and Baran, E. (2011). Identification and differentiation of *Trichophyton rubrum* clinical isolates using PCR-RFLP and RAPD methods. E*ur J Clin microbiol Infect Dis.* 30, 727-731.

Kasprzyk, I. (2008). Main Research Fıelds of Interest During The Last 25 Years. *Ann Agricult Environ Med.* 15, 1–7.

Klich, M.A. (2002). Identification of Common *Aspergillus* species. First Ed, Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands. 122.

Macher, J.M. (2001). Evaluation of a Procedure to Isolate Culturable Microorganism from Carpet Dust. *Indoor Air.* 11, 134-140.

Nelson, P.E., Toussoun, T.A. and Marasas, W.F.O. (1983). *Fusarium* Species. An Illustrated Manual for Identification. The Pennsylvania State University Press, Pennsylvania, USA.

Niemeier, R.T., Sivasubramani, S.K., Reponen, T. and Grinshpun, S.A. (2006). Assessment of Fungal Contamination in Moldy Homes: Comparision of Different Methods. *J Occup Environ Hyg.* 3 (5) 262-273.

Ozyaral, O., Germeyan, H. and Johannsson, C.B. (1988) İstanbul'da ev tozu küfleri üzerine çalışmalar I. Yatak tozu küf florasının saptanması. *Mikrobiyol Bült*. 22 (1) 51-60.

Pitt, J.I., Samson, R.A. and Frisvad, J.C. (2000). List of accepted species and synonyms in the family *Trichocomaceae*. 9-49. [In: SAMSON RA, PITT JI (Eds.). Integration of Modern taxonomic methods for *Penicillium* and *Aspergillus* classification. Harwood Academic Publishers. Singapore]. 510.

Pitt, J.I., (1979). The genus *Penicillium* and its teleomorphic states *Eupenicillium* and *Talaromyces*. Academic Press. Inc. London. 634.

Raboobee, N., Aboobaker, J. and Peer, A.K. (1998). Tinea pedis et unguium in the muslim community of Durban, South Africa. *Int. Dermatol.* 37, 759–765.

Ramachandran, G., Adgate, J.L., Banerjee, S., Church, T.R., Jones, D., Fredrickson, A. and Sexton, K. (2005). Indoor air quality in two urban elementary schools-measurements of airborne fungi, carpet allergens, CO_2, temperature and relative humidity. *J Occup Environ Hyg.* 2, 553-566.

Roberts, J.W., Clifford, W.S., Glass, G. and Hummer, P.G. (1999). Reducing dust, lead, dust mites, bacteria and fungi in carpets by vacuuming. *Arch Environ Contam Toxicol.* 36, 477–484.

Samson, R.A., Hoekstra, E.S., Frisvad, J.C. and Filtenborg, O. (2002). Introduction to Food and Airborne Fungi. Sixth edition, Centraalbureau voor Schimmelcultures, Utrecht, The Netherlands.

Sivasubramani, S.K., Niemer, R.T., Reponen, T. and Grinshpun, S.A. (2004). Assessment of the aerosolization potential for fungal spores in moldy homes. *Indoor air*. 14, 405-412.

Stark, P.C., Celedon, J.C., Chew, G.L., Ryan, L.M., Burge, H.A., Muilenberg, M.L. and Gold, D.R. (2005). Fungal Levels in the Home and Allergic Rhinitis by 5 Years of Age. *Environ Health Perspect.* 113 (10) 1405-1409.

Sutton, D.A., Fothergill, A.W. and Rinaldi, M.G. (1998). Guide to Clinically Significant Fungi. Williams&Wilkins A Waverly Company.

Tikvesli, M., Asan, A, Gurcan, S. and Sen, B. (2018). Aırborne fungal biodiversity in indoor and outdoor air of three mosques in Edirne city, Turkey. *Fresen Environ Bull.* 27, 5252-5258.

Tranter, D.C., Wobema, A.T., Norlien, K. and Dorschner, D.F. (2009). Indoor allergens in Minnesota schools and child care centers. *J Occup Environ Hyg*. 6, 582-591.

Wong, L.T., Muı Huı, W.Y. and Chan Law, A.K.Y. (2008). Thermal Environtal interference with airborne bacteria and fungi levels in air-conditioned offices. *In Built Environ.* 17 (2) 122-127. www.jivs.net/jivs/dosya/2003.pdf

Yenisehirli, G., Karat, E. and Bulut, Y. (2012). Dermatophytes isolated from the mosques in Tokat, Turkey. *Mycopathologia*. 174 (4) 327-330.