This article is cited as: *Hancı, H., Igan, H. (2025). Fungal Diversity of Hairdressers and Turkish Baths in Erzurum (Türkiye), Mantar Dergisi, 16(1)55-60*

Geliş(Recevied) :18.02.2025 ***Research Article***
Kabul(Accepted) :24.03.2025 **Doi: 10.30708/mantar.1642204**

Fungal Diversity of Hairdressers and Turkish Baths in Erzurum (Türkiye)

Hayrunisa HANCI[1*], Hakan IGAN[2]

** Corresponding Author: hayrunisa.hanci@hotmail.com*

[1]Ataturk University, Faculty of Pharmacy, Department of Pharmaceutical Microbiology, Erzurum, TÜRKİYE hayrunisa.hanci@hotmail.comcom
[2] Health Sciences University, Erzurum City Hospital, Department of Medical Microbiology, Erzurum, TÜRKİYE /hakan_igan@hotmail.com

Abstract: The purpose of this study is to investigate fungal contamination in some hairdressers and Turkish baths in Erzurum/Türkiye. For the study, swab samples were collected from various materials used in hairdressers (n:407) and multiple areas of Turkish baths (n:435). The specimens were inoculated into suitable media for the fungus, and then the isolated fungi were identified. Fungal growth was detected in 107 (26.28%) hairdresser samples and 238 (54.71%) of the Turkish bath samples. Hairbrushes used in hairdressers and nail files were the materials with which fungi were most isolated. It was determined that the most fungal growth in the samples taken from Turkish baths was on the floor of the dressing rooms and slippers. While *Aspergillus* sp was the most isolated fungus genus in the hairdresser samples, *Candida* sp. was the most isolated fungus genus in the Turkish bath samples. The results of our study demonstrate that although these environments are generally risky in terms of fungal infections, the contamination rates were lower compared to previous studies.

Keywords: Fungal colonization, Fungal contamination, Hairdressers, Turkish baths

Erzurum (Türkiye)'daki Kuaför ve Hamamlarda Fungal Çeşitlilik

Öz: Bu çalışmanın amacı Erzurum ilindeki bazı kuaför ve hamamlarda fungal kontaminasyonu araştırmaktır. Çalışma için kuaförlerde kullanılan çeşitli materyallerden (n:407) ve hamamların çeşitli alanlarından (n:435) sürüntü örnekleri toplandı. Örnekler mantar için uygun besiyerlerine ekildi ve daha sonra izole edilen mantarlar identifikasyona tabi tutuldu. Kuaför örneklerinin 107 (%26.28)'sinde, hamam örneklerinin ise 238 (%54.71)'inde fungal üreme tespit edildi. En fazla fungal üreme kuaförlerde kullanılan saç fırçaları ve tırnak törpülerinde saptandı. Hamamlardan alınan örneklerde fungal üreme en fazla soyunma odası zemininde ve terliklerde tespit edildi. Kuaför örneklerinde en fazla izole edilen fungal cins *Aspergillus* sp. iken, hamam örneklerinde en fazla izole edilen fungal cins *Candida* sp. oldu. Çalışmamızın sonuçları, bu ortamların genel olarak fungal enfeksiyonlar açısından riskli olmasına rağmen kontaminasyon oranlarının önceki çalışmalara göre daha düşük olduğunu göstermektedir.

Anahtar kelimeler: Fungal kolonizasyon, Fungal kontaminasyon, Kuaförler, Hamamlar,

Introduction

The worldwide incidence of fungal infections is increasing and posing a serious threat to global public health. While most of these infections are superficial infections affecting the hair, skin, and nails, some some types can cause life-threatening illness (Lockhart and Guarner, 2019; Strickland and Shi, 2021). Dermatophytosis, one of the most common infectious diseases worldwide, is an infection of the superficial epidermal layers caused by dermatophyte fungi, as well as keratinised tissues such as hairs and nails (Hayette and Sacheli, 2015; Ramaraj et al., 2016; Faway et al., 2018). An increase in the incidence of dermatophytosis has been noted, especially in developing countries. Factors such as geographical location, climatic characteristics, hygiene habits, socioeconomic status, health services, and age of the person are significant factors affecting the epidemiology of dermatophyte infections, and children are more prone to dermatophyte infections (Araya et al., 2020). The dissemination of dermatophytes between humans can occur contact with infected patients or animals, or through contact with contaminated materials, thanks to the long-term survival of fungal arthroconidia. For example, insufficient disinfection of the tools used for haircuts in hairdressers contributes to the spread of dermatophytes (Faway et al., 2018; Coulibaly et al., 2015). Since hairdressers and beauty salons are one of the sectors where many materials are used jointly, the possibility of infectious diseases occuring in these environments is high (Vurucuoglu et al., 2018). If the hairdressers and beauty salons do not comply with the hygiene rules, many diseases, including fungal infections, can be transmitted to customers and employees (Ozaras et al., 2013).

Turkish baths (in other words, Turkish hammams) are environments temperature with high humidity at 35–45 °C. Traditional Turkish baths have an important place in social and cultural life as in cleaning and health in Turkish society and many other societies (Erdogan and Arslan, 2015; Tanıs, 2021). However, many studies report that Turkish baths can be a source for fungal and bacterial infection agents (Erdogan and Arslan, 2015; Tanıs, 2021; Benammar et al., 2017; El Ouardi et al., 2013; Savci and Sahin, 2019).

This study aims to investigate fungal contamination in some hairdressers and Turkish baths in Erzurum/Türkiye.

Material and Metod

Fungal Isolation from hairdressers

For the study, swab samples were taken from the materials used in 28 different hairdressers. Swab samples were collected from the from combs, hairbrushes, clippers, nail files, tweezers, nail clippers and towels by using sterile cotton swabs moistened with sterile saline suspension. While taking the samples, special attention was paid to contact at least 5 cm^2-10 cm^2 in diameter areas of the materials that come into contact with hair, skin or nails.

Fungal Isolation from hammams

Samples from 10 different Turkish baths were collected for this study. Swab samples were collected from the walls of the bath, the navel stone used in many of the bath rituals and located in the center of the bath, the floor of the bath, the basins (marble basin in which the bathing water is filled), slippers, the floor of the dressing areas, special clothes (loincloth-pestemal) used in the bath by using sterile cotton swabs moistened with sterile saline suspension. While taking the sample, special attention was paid to circulate the swaps in an area of at least 10 cm^2.

Identification of Fungi

The samples were inoculated on Sabouraud dextrose agar, Potato dextrose agar and mycobiotic agar media. Two media were used for each sample. One of the cultured medium pairs was incubated at room temperature (26 °C) and the other in an oven (37 °C). The cultures, which were incubated for four weeks, were checked for fungal growth twice a week. The fungal agents grown as a result of the culture were identified macroscopically and microscopically by conventional methods (gram stain, lactophenol cotton blue preparation, urease test).

Results

For this study, a total of 407 swab samples from various materials used in hairdressers and 435 swab samples were taken from various areas of the Turkish baths. Fungal growth was detected in 107 (26.28%) of the hairdresser samples and 238 (54.71%) of the Turkish bath samples.

Hair brushes and nail files in hairdressers were the materials with which fungi were isolated the most. In general, it was determined that the most frequently isolated fungus was *Aspergillus* sp. mold. Distribution of fungi isolated from the hairdresser samples is shown in Table 1 (Sesli et al.,2020).

It was determined that the most fungal growth in the samples taken from Turkish baths was on the floor of the dressing rooms and slippers. No fungal growth was detected in the navel stone, basin and loincloth (pestemal) samples. Yeast of the genus *Candida* sp. was the most commonly isolated fungus (15.17%) in the Turkish bath samples. Distribution of fungi isolated from Turkish bath samples is shown in Table 2 (Sesli et al., 2020). Fungal diversity of hairdressers and Turkish baths is shown in Figure 1.

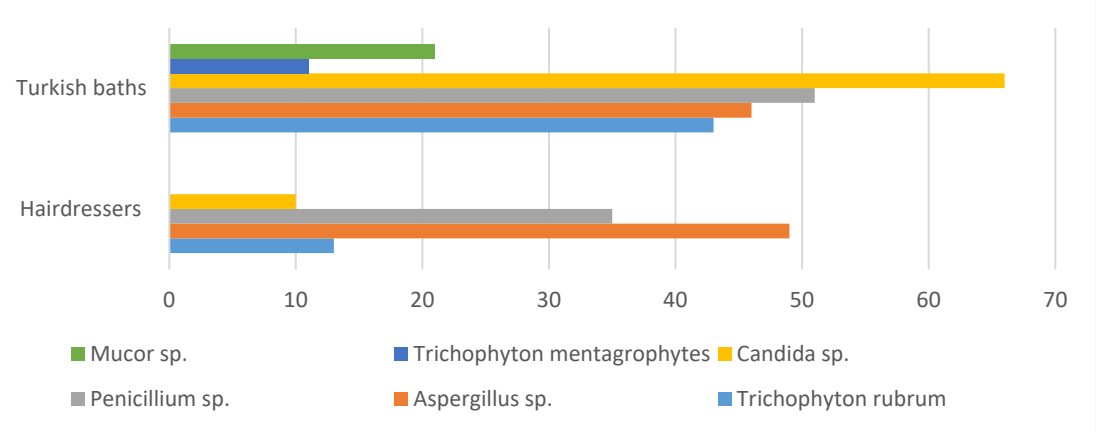
Table 1. Distribution of fungi isolated from the hairdressers samples

Fungi	Sampled Surfaces (number)							Total %
	Coombs (n:82)	Hairbrushes (n:97)	Clippers (n:44)	Nail files (n:38)	Tweezers (n:54)	Nail clippers (n:32)	Towels (n:60)	
Trichophyton rubrum (Castell.) Sabour. (In Turkish: Atletayak)	0	4	0	9	0	0	0	3.19
***Aspergillus* sp.** (P.Micheli) (In Turkish: Asper)	9	15	0	14	0	0	11	12.03
***Penicillium* sp.** (Link) (InTurkish:Penisilyum)	2	17	1	8	0	0	7	8.59
***Candida* sp.** (Berkhout) (In Turkish: Kandida)	0	1	2	7	0	0	0	2.45

Table2. Distribution of fungi isolated from the Turkish bath samples

Fungi	Sampled surfaces (number)							Total %
	Walls (n:86)	Navel stone (n:37)	Hammam floor (n:94)	Basins (n:30)	Slippers (n:126)	Dressing areas floor (n:28)	Loinclothes (n:34)	
Trichophyton rubrum	0	0	0	0	24	19	0	9.88
Trichophyton mentagrophytes (C.P. Robin) sabour (In Turkish: Kasık atletayağı)	0	0	0	0	11	0	0	2.52
***Aspergillus* sp.**	12	0	4	0	13	17	0	10.57
***Penicillium* sp.**	5	0	6	0	27	13	0	11.72
***Mucor* sp.** (P.Micheli) (In Turkish: Ekmekküfü)	1	0	3	0	9	8	0	4.82
***Candida* sp.**	7	0	13	0	21	25	0	15.17

Figure 1. Fungal diversity of hairdressers and Turkish baths



Discussions

Mycoses are fungal infections that can occur in humans, ranging from simple infections such as tinea pedis or athlete's foot to deep infections associated with morbidity and mortality (Hay, 2006). The incidence of fungal infections is increasing worldwide. The increase in

the number of individuals with weakened immune systems for various reasons has brought along an increase in the number of individuals at risk for fungal infections (Lockhart and Guarner, 2019). Fungal infections are named according to the area where they appear on the body. For example, tinea capitis is an infection of the scalp and hair caused by dermatophyte fungi, while onychomycosis is an infection of the nails (Uslu et al., 2008; Ghannoum and Isham, 2014). Contact with pathogenic fungi has an important role in increasing the prevalence of superficial fungal infections (Gräser.et al., 2018). The fact that fungal arthroconidia remains contagious for more than 1 year in inanimate environments increases the possibility of dermatophyte infections. Fungal spores can be transmitted from person to person with common objects such as combs, brushes, towels and slippers that are contaminated with the skin or hair of infected people (Faway et al., 2018; Winge et al., 2009).

Hairdressers are one of the occupational groups with the lowest awareness about health issues, which are a serious threat to public health, and which have the risk of contagious diseases (Vurucuoglu et al., 2018). If hygiene rules are not followed adequately, hairdressers and Turkish baths can be risky areas in terms of fungal infections like many infections. Moreover, there are many studies reporting that fungal agents are common in hairdressers and Turkish baths (Ozaras et al., 2013; Erdogan and Arslan, 2015; Tanıs,2021, Benammar et al., 2017; El Ouardi et al., 2013; Savci and Sahin, 2019; Uslu et al., 2008; Gogsugur et al., 2006; Soyinka, 1978).

Müller et al. (2021), reported that tinea capitis and/or barbae developed in 18 young men who received service from the same hairdresser and found that these infections were caused by inadequate disinfection of hair cutting tools. Coulibaly et al. (2015), investigated dermatophyte contamination in the tools used in hairdressing salons and found that the contamination was seriously high. Uslu et al. (2008), investigated fungal contaminations in different barber materials and reported that non-dermatophytic molds such as *Aspergillus* sp. (40.2%) and *Penicillium* sp. (21.8%) were isolated at a very high rate. In the same study, it was reported that *Trichophyton rubrum* was isolated at a rate of 5.7% and *Candida sp* at a rate of 4.5%. In our study, 3.19% of *Trichophyton rubrum*, 8.59% *Penicillium* sp., 12.03% of *Aspergillus* sp*.,* and finally 2.45% of *Candida* sp*.* were found in hairdresser samples. It is understood that fungal isolation rates were lower in our study. In terms of preventing the risk of contamination in hairdressers, it is very important for employees to be aware of the transmission routes of fungi. In a study on this subject (Ozaras et al, 2013), it was seen that the rate of those who know that nail fungus can be transmitted from person to person by close contact is only 27%. However, the increase in compliance with the hygiene rules in general with the Covid-19 pandemic may have contributed to the creation of more hygienic environments in hairdressers. This may have contributed to our isolation of fungi at a lower rate.

Despite the opinion that Turkish baths are not suitable for fungal colonization due to their high temperature and humid environment, there are publications stating the opposite (Tanıs, 2021; Goksugur et al., 2006). Benammar et al. (2017), reported that baths are environments that threaten public health in terms of the risk of pathogenic fungal contamination. In related studies, *Penicillium* sp. and *Aspergillus* sp. positivity are reported at high rates in general (Tanıs, 2021; Benammar et al., 2017; Goksugur et al., 2006). For example, Goksugur et al. (2006), reported *Penicillium* sp. and *Aspergillus* sp. positivity at a rate of 25% in their study.

Microorganisms are an indicator of indoor air quality. At this point, fungal spores in the air pose a health threat. For example, most *Penicillium* species can produce multiple mycotoxins, and the type and amount of mycotoxin produced can be affected by factors such as ambient temperature and humidity (Koteswara et al., 2016). A study on this topic reported that the most isolated fungus from the air and surfaces in traditional public baths was Penicillium (Tabatabaei. Et al., 2020). *Aspergillus* sp., one of the saprophytic fungi, is a genus of fungi that can adapt to variable temperatures, pH, water and nutritional conditions. A range of clinically relevant consequences, from asymptomatic colonization to invasive infection, can occur when humans acquire *Aspergillus* spores (Thompson and Young, 2021). In our study, it was determined that *Penicillium* sp*.* and *Aspergillus* sp. isolation rates in both Turkish baths and hairdressers were quite low compared to similar studies.

In our study, one of the most frequently isolated fungi, especially in Turkish baths, is *Candida* species. *Candida* species, a normally non-pathogenic commensal yeast, are opportunistic fungal pathogens and cause superficial and invasive infections associated with significant morbidity and mortality, especially in immunocompromised individuals (Wang et al., 2016). Our study results show that the frequency of *Candida* sp. isolation is also lower than other studies. Similarly, another type of fungus that we isolate from hammams and hairdressers at a lower rate than other studies are dermatophyte fungus species (Tanıs, 2021; Benammar et al., 2017; Uslu et al., 2008; Goksugur et al., 2006).

When the results are evaluated, it is understood that the riskiest environments for both *Candida* sp*.* and

dermatophyte fungi are slippers, dressing room floors and nail files.

The results of our study in which we examined fungal contamination in Turkish baths and hairdressing salons demonstrate that although it is understood that these environments are risky in terms of fungal infections, the contamination rates are lower compared to previous studies. As the cause for this situation, the first probability that comes to mind is the global positive effect of the Covid-19 pandemic on personal and general hygiene habits. However, the minimization of the existing risk can be possible with raising the awareness of the public and the workers of the aforementioned sectors regarding the transmission of infections and maintaining hygiene.

Author contributions

The authors have equal contribution.

Conflicts of interest

The authors declare no competing interests.

Ethical Statement: It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited (Hayrunisa HANCI, Hakan IGAN)

References

Araya, S., Tesfaye, B. and Fente, D., (2020). Epidemiology of Dermatophyte and non-dermatophyte fungi infection in Ethiopia. *Clin. Cosmet. Investig. Dermatol.* 8(13) 291-297.

Benammar. L., Menasria, T., Chergui, A. And Benfiala, S., (2017). Indoor fungal contamination of traditional public baths (Hammams). *Int. Biodeterior. Biodegradation.* 117 115-122.

Coulibaly, O., Thera, M.A., Piarroux, R., Doumbo, O.K. and Ranque, S., (2015) High dermatophyte contamination levels in hairdressing salons of a West African suburban community. *Mycoses*. 58(2) 65-68.

El Ouardi, A., Senouci, S., El Habib, F. and Ennaji, M., (2013). *Pseudomonas aeruginosa* in water of hamam or Turkish bath: Serotyping and antibiotic susceptibility. *Middle-East. J. Sci. Res.* 15(4) 487-492.

Erdogan, H. and Arslan, H., (2015). Colonization of *Legionella* species in Turkish baths in hotels in Alanya, Turkey. *Environ. Monit. Assess.* 187(5) 235.

Faway, É., Lambert de Rouvroit, C. and Poumay, Y., (2018). In vitro models of dermatophyte infection to investigate epidermal barrier alterations. *Exp. Dermatol.* 27(8) 915-922.

Ghannoum, M. and Isham, N., (2014). Fungal nail infections (onychomycosis): a never-ending story? *PLoS. Pathog*. 10(6) e1004105.

Goksugur, N., Karabay, O. And Kocoglu, E., (2006). Mycological flora of the Hammams, traditional Turkish bath. *Mycoses*. 49(5) 411-414.

Gräser, Y., Monod, M., Bouchara, J.P., Dukik, K., Nenoff, P., Kargl, A., Kupsch, C., Zhan, P., Packeu, A., Chaturvedi, V., de Hoog, S., (2018). New insights in dermatophyte research. *Med. Mycol*. 56(1) 2-9.

Hay, R.J., (2006). Fungal infections. *Clin. Dermatol*. 24 201–212.

Hayette, M.P. and Sacheli, R., (2015). Dermatophytosis, trends in epidemiology and diagnostic approach. *Curr. Fungal. Infect*. Rep. 9(3) 164.

Koteswara Rao, V., Girisham, S. and Madhusudhan Reddy, S., (2016). Prevalence of toxigenic *Penicillium* species associated with poultry house in Telangana, India. *Arch. Environ. Occup. Health*. 71(6) 353-361.

Lockhart, S.R. and Guarner, J., (2019). Emerging and reemerging fungal infections. Semin. *Diagn. Pathol*., 36(3) 177-181.

Müller, V.L., Kappa-Markovi, K., Hyun, J., Georgas, D., Silberfarb, G., Paasch, U., UhrlaB, S., Nenoff, P., Schaller, J., (2021). Tinea capitis et barbae caused by *Trichophyton tonsurans*: A retrospective cohort study of an infection chain after shavings in barber shops. *Mycoses*. 64(4) 428-436.

Ozaras, F., Calıskan, E. and Ozturk, C.E., (2013). The review of knowledge level about hygiene/infectious diseases and the investigation of blood-transmitted diseases and onychomycosis of the ladies hairdresser and beauty center workers. *Viral. Hepat. J.* 19 (3) 115-118.

Ramaraj, V., Vijayaraman, R.S., Rangarajan, S. and Kindo, A.J., (2016). Incidence and prevalence of dermatophytosis in and around Chennai, Tamilnadu, India. *Int. J. Res. Med. Sci.* 4(3) 695700.

Savcı, U. and Sahin, M., (2019). Investigation of fungal flora in hammams, Turkish baths: A field study. *J. Surg. Med*. 3(9) 640-643.

Sesli, E., Asan, A. ve Selçuk, F. (edlr.) Abacı Günyar, Ö., Akata, I., Akgül, H., Aktaş, S., Alkan, S., Allı, H., Aydoğdu, H., Berikten, D., Demirel, K., Demirel, R., Doğan, H.H., Erdoğdu, M., Ergül, C.C., Eroğlu, G., Giray, G., Halikî Uztan, A., Kabaktepe, Ş., Kadaifçiler, D., Kalyoncu, F., Karaltı, İ., Kaşık, G., Kaya, A., Keleş, A., Kırbağ, S., Kıvanç, M., Ocak, İ., Ökten, S., Özkale, E., Öztürk, C., Sevindik, M., Şen, B., Şen, İ., Türkekul, İ., Ulukapı, M., Uzun, Ya., Uzun, Yu.,Yoltaş, A. (2020). *Türkiye Mantarları Listesi.* İstanbul: Ali Nihat Gökyiğit Vakfı Yayınları.

Soyinka, F., (1978). Epidemiologic study of dermatophyte infections in Nigeria (clinical survey and laboratory investigations). *Mycopathologia*. 63(2) 99-103.

Strickland, A.B., Shi, M., (2021). Mechanisms of fungal dissemination. Cell. Mol. Life. Sci., 78(7) 3219-3238.

Tabatabaei, Z., Rafiee, A., Abbasi, A., Mehdizadeh, A., Morovati, R. and Hoseini, M., (2020). Investigation of fungal contamination in indoor air and on surfaces of traditional public baths in a historical city. *J Environ Health Sci Eng*. 18 (2): 925-932.

Tanıs, H., (2021). Pathogenic fungal flora of the Turkish hammams (Bath). *Rev. Argentina. de Clin. Psicol.* 30(2) 60-64.

Thompson, G.R.3rd. and Young, J.H., (2021). *Aspergillus* Infections. *N. Engl. J. Med*. 385(16) 1496-1509.

Uslu, H., Uyanik, M. and Ayyildiz, A., (2008). Mycological examination of the barbers' tools about sources of fungal infections. *Mycoses*. 51(5) 447-450.

Vurucuoğlu, A,, Özdemir Güngör, D., Camuz Berber, İ. and Kıdak, L.B., (2018). Information levels of hairdresser and beauty centre workers about infectious diseases and applied protection methods. *Izmir Democracy Universıty Health Sciences Journal.* 1(1) 27-38.

Wang, X., van de Veerdonk, F.L. and Netea, M.G., (2016). Basic Genetics and immunology of *Candida* infections. *Infect. Dis. Clin. North. Am*. 30(1) 85-102.

Winge, M.C., Chryssanthou, E. and Wahlgren, C.F., (2009). Combs and hair-trimming tools as reservoirs for dermatophytes in juvenile tinea capitis. *Acta. Derm. Venereol*. 89(5) 536-537.