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Mycological Assessment of Karfas Beach in Chios, Greece: Focus on Filamentous Fungi in the Sand

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The author LE was responsible for creating the study, writing the protocol, preparing the materials, taking samples, laboratory work, analyzing data, and also wrote the first draft of the manuscript. LE and MNI wrote and revised the paper. The authors read and approved the final manuscript.

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Abstract:
Among the most interesting habitats for studying microorganisms are coastal beaches, often associated with an arid environment, but which also exhibit rich microbial biodiversity. Karfas, a beach located on the island of Chios in Greece, is a key site for studying filamentous fungi due to its fluctuating geographical location. Beach sands constitute dynamic reservoirs of microbial communities with important ecological and public health implications. The samples were collected on June 3, 2024. This study evaluated the presence and diversity of filamentous fungi and yeasts in sand samples collected from Karfas beach, Chios, Greece. Sand samples were obtained from the dry area of the beach, and 1 gram of sand was spread in triplicate on each of the following plates: Sabouraud dextrose agar (SDA), Rose Bengal agar (RBA), Sabouraud dextrose-chloramphenicol agar (SDCA), Mycosel agar, and Hardy CHROM™ Candida. These were incubated for 7 to 14 days at 25°C and Hardy CHROM ™ Candida samples were incubated at 35°C for 48 hours. Negative and positive controls were prepared for each culture medium. Colony-forming units (CFU) were counted, and the average was calculated for each medium. Species were isolated in tubes containing the same culture medium. They were incubated at the same temperature as the plates. Each isolate was identified microscopically using lactophenol cotton blue. Fungal isolates were identified by macroscopic and microscopic characteristics and chromogenic reactions for yeasts. Eight fungal genus were detected (*Aspergillus, Penicillium, Fusarium, Candida, Cladosporium, Ascomycetes, Chaetomium,* and *Cephalosporium*), with *Aspergillus* being the dominant genus. The most frequently isolated species were *A. niger, A. fumigatus, A. terreus, A. flavus, Cladosporium elatum, Penicillium restrictum, P. chrysogenum, Candida albicans* and *Fusarium oxysporum.* The overall mean fungal load was 14 CFU/g, indicating that the sand has an average microbiological quality according to Portuguese and INSA guidelines. The detection of potentially pathogenic species highlights the importance of routine monitoring of beach sand to assess environmental quality and potential health risks, especially in coastal areas with high visitor traffic.

Keywords: Filamentous fungi, *Candida*, sand, pathogens, beaches.

INTRODUCTION

The Mediterranean basin is one of the most popular travel destinations in the world, and its islands draw a lot of interest because of their rich natural, cultural, and historical legacy (Chatzi *et al.*, 2025). Karfas Beach (Figure 1) is located on the island of Chios, Greece, one of the islands in the Aegean archipelago. Chios, situated near the Turkish coast, is known for its rich history, picturesque landscapes, and crystal-clear waters (McColl, 2025). Karfas, located on the southern part of the island, is one of the most popular beaches among tourists, famous for its golden sand and clear, shallow waters. The beach is surrounded by Mediterranean vegetation, which contributes to its natural charm. Karfas's proximity to the port of Chios Town (only about 7 km away) makes it easily accessible for both tourists and locals, which has fostered its development as a tourist destination without compromising its natural beauty (Terkenli *et al.*, 2019). Although tourism has major socioeconomic advantages, it also puts a lot of strain on coastal and marine habitats, which are already affected by concentrated human activities including urban growth, industrial discharge, and maritime traffic (Godovykh *et al.*, 2025).

Sandy beach communities are among the most basic and dynamic transitional ecosystems shaped by natural processes and human driven activities, hosting diverse macrobenthic communities that serve as key indicators of ecological health (Bozzeda *et al.*, 2025). The coastal environment of Karfas is also an important habitat for various marine organisms, including a rich variety of microorganisms, making it an area of interest for microbiological studies. Several studies in marine microbiology have highlighted the importance of coastal areas as reservoirs of microbial biodiversity, with beaches like Karfas being ideal locations for exploring the microbial composition of saline environments and their interaction with local ecosystems. These studies have identified a variety of microorganisms present in the waters and sediments of the area, including bacteria, fungi, and other microscopic organisms that play crucial roles in the region's biogeochemical cycles (Echevarría, 2019; Echevarría, 2022; Echevarría and Iqbal, 2021; Ioannis *et al.*, 2025).

Beach nourishment (replenishment) should be taken into consideration as the first possible adaptation option, at least for beaches with high socio-economic significance, given the socio-economic significance of beaches and the ineffectiveness of hard coastal defenses to protect the beach carrying capacity for recreation under rising sea levels (Semeoshenkova and Newton, 2015; Summers *et al.*, 2018). However, beach nourishment in island settings depends on the disposal of suitable filling sediments, preferably from local sources (Hasiotis *et al.*, 2021). In order to estimate how future temperature changes may affect visitors' comfort levels and, in turn, their willingness to travel to particular locations, it is crucial to understand the climate preferences of tourists (Georgopoulou *et al.*, 2019).

In the specific case of fungi, microbiological studies conducted in other coastal areas of the Aegean have demonstrated the presence of fungal species capable of adapting to saline conditions, opening a field of research into their role in the decomposition of organic matter and their influence on water quality (Landy and Jones, 2006; Meziti and Kormas, 2024; Polemis *et al.*, 2020; Sipman and Raus, 2015). These microbiological studies are essential not only for understanding microbial biodiversity but also for monitoring the ecological health of beaches and the potential impact of human activities on these sensitive ecosystems (Ashraf and Iqbal, 2022; Iqbal *et al.*, 2019). The combination of natural beauty and microbiological potential makes Karfas beach an ideal site for investigating coastal microbial ecology in the Mediterranean context (Poli *et al.*, 2022).

In this study, we will explore the mycological aspects of Karfas beach sand, paying particular attention to sand quality, fungal and yeast species, and their relationship to changes in beach conditions due to tourism and human activity.

MATERIAL AND METHODS

Sand samples were collected on June 3, 2024, at Karfas Beach, Chios, Greece, specifically in the dry beach area. Sampling was performed at three equidistant points along the shoreline (Figure 1), yielding approximately 100 g of sand (Echevarría, 2022). The sampling depth was approximately 5 cm from the surf zone (Frenkel *et al.*, 2022). For each analysis, 1 g of sand was weighed and spread evenly onto plates containing the selected culture media, in triplicate (Echevarría, 2019).

Fig. 1. Karfas Beach, Chios Island, Greece.

The media used were Sabouraud dextrose agar (SDA), Rose Bengal agar (RBA), Mycosel agar, Sabouraud dextrose chloramphenicol agar (SDCA), and Hardy CHROM™ Candida agar (Echevarría, 2017). The plates containing SDA, RBA, SDCA, and Mycosel were incubated at 25°C for 7 to 14 days (Echevarría, 2022), while the Hardy CHROM™ Candida plates were incubated at 35°C for 48 h (Montes *et al.*, 2019; Tamura *et al.*, 2022).

Positive and negative controls were performed to verify the efficiency and sterility of each culture medium. The positive control for filamentous fungi consisted of inoculating *A. fumigatus* onto the plates containing SDA, RBA, SDCA, and Mycosel media, while *C. albicans* was used for yeasts on Hardy CHROM™ Candida. Negative controls were performed using uninoculated plates, ensuring sterility. All controls were incubated under the same conditions as the samples, with growth observed only on the positive controls (Echevarría, 2022).

After incubation, the colony-forming units (CFU) of each plate were counted, and the average was calculated for each culture medium. The resulting isolates were transferred to tubes containing the same medium for identification the same temperature (Black, 2020; Meyer *et al.*, 2021; Scharmann *et al.*, 2020). The final CFU calculation allowed for the determination of the total fungal load and the quality of the sand, using table (1) and the maximum values recommended by INSA and the National Institute of Health of Portugal as a reference (Brandão *et al.*, 2011; Pereira *et al.*, 2013).

Table 1. Recommended maximum values of filamentous fungi in beach sand.

Recommended maximum values for filamentous fungi in beach sand		
>MVA	**>MRV**	**≤ MAV**
Poor quality	Average Quality	Good Quality
CFU/g=85	CFU/g = 5	CFU/g=5

Values recommended by the Instituto National de Saúde Riardo and National Institute of Health in Portugal (Pereira *et al.,* 2013), Maximum recommended values: Instituto Nacional de Saúde Ricardo Jorge INSA – National Health Institute on Portugal (Brandão *et al.,* 2011).

Fungal identification was performed by macroscopic observation (color, surface texture, and reverse side of the colonies) and microscopic observation, using Lactophenol reagent and a Nikon Eclipse Ci microscope. Taxonomic determination was performed by comparing morphological characteristics with fungal keys. For samples in Hardy CHROM™ Candida, identification was based on the color change of the medium (Echevarría, 2022; Scharmann *et al.*, 2020).

RESULTS

Both the negative and positive controls for each sample yielded the expected results. The positive controls for fungi and yeasts showed colony growth on the culture media for the fungus *A. fumigatus* and on the culture medium for the yeast *Candida albicans*. The negative controls for each medium showed no growth. From the isolated samples, eight (8) fungal genus were identified: *Aspergillus, Penicillium, Fusarium, Candida, Cladosporium, Ascomycetes, Chaetomium,* and *Cephalosporium*. The genus with the highest growth rate among the isolates was *Aspergillus*. The identified species were: *A. niger, A. fumigatus, A. terreus, A. flavus, Cladosporium elatum, Penicillium restrictum, P. chrysogenum, Candida albicans* and *Fusarium oxysporum* (Table 2). Species such as *Aspergillus* are considered pathogenic to humans. Table 2 lists the fungal species isolated in this study along with their ecological and clinical characteristics.

Table 2. Ecological and clinical characteristics and references of selected fungi.

Fungus	Natural environment	Diseases in humans or animals	Impact on the ecosystem	Reference
Fusarium oxysporum	Soil, rhizosphere, plant remains.	Opportunistic fusariosis; keratitis, onychomycosis, systemic infections.	Important phytopathogen; alters soil microbiomes and reduces agricultural productivity.	(Leslie *et al.,* 2006)
Cladosporium elatum	Air, soil, plants, damp Wood.	Respiratory allergies, rhinitis; rare skin infections.	Decomposition of plant matter; dominant component of the aerobiome.	(Bensch *et al.,* 2012)
Aspergillus terreus	Soil, compost, dust.	Invasive aspergillosis, otitis, sinusitis.	Carbon recycling; degradation of plant remains.	(Lass-Flörl *et al.,* 2021)
Aspergillus niger	Soil, hay, stored food.	Otomycosis, pulmonary aspergillosis, allergies.	Decomposer; food spoilage.	(Schuster *et al.,* 2002)
Aspergillus fumigatus	Compost, soil, plant remains.	Invasive, allergic, and chronic aspergilosis.	Nutrient recycling; high production of aerial spores.	(Latgé and Chamilos, 2019)
Aspergillus flavus	Soil, grains, seeds.	Aspergillosis; aflatoxin production.	Crop contamination; food risk.	(Amaike and Keller, 2011)
Penicillium restrictum	Soil, air, food.	Allergies; rare infections.	Saprophyte; organic degradation.	(Pitt and Hocking, 2009)
Penicillium chrysogenum	Flooring, interiors, food.	Rare infections; allergies.	Decomposer; penicillin producer.	(Houbraken and Samson, 2011)
Chaetomium spp.	Soil, straw, cellulose-rich remains.	Phaeohyphomycosis, opportunistic infections.	Cellulose degradation.	(Ahmed *et al.,* 2016)
Ascomicetos (Ascomycota)	All ecosystems.	It includes human and animal pathogens.	Dominant group in biogeochemical cycles.	(Schoch *et al.,* 2009)
Candida albicans	Human microbiota.	Mucosal and systemic candidiasis.	Interaction with microbiota; ecological balance.	(Calderone and Clancy, 2011)
Cephalosporium spp.	Soil, vegetation.	Not well documented.	Environmental saprophyte.	(Bensch *et al.,* 2012)

The colony-forming units (CFU) for each culture medium were as follows: SDA 49 CFU/g, SDACA 13 CFU/g, RBA 11 CFU/g, Mycolse 0 CFU/g, and Hardy CHROM™ Candida 20 CFU/g. The average for filamentous fungi and yeasts was 14 CFU/g (Table 3). The predominant species was *Candida albicans*. This indicates that the sand quality, according to the sand quality scale used, is classified as average. Based on these data, the sand quality at Karfas Beach in Chios, Greece, according to the parameters in Table 1, is classified as average (>CFU/g = 5).

Table 3. Average growth of filamentous fungal colonies (CFU) in different culture media.

Culture medium	CFU/g
SDA	49
SDACA	13
RBA	11
Mycolse	0
Hardy CHROM TM Candida	20
Average	14

DISCUSSION

This research is one of the few studies documenting the composition of filamentous fungi and yeasts in sand from Aegean beaches, specifically Karfas Beach (Chios, Greece), providing evidence of the presence of environmentally relevant and, in some cases, clinically significant fungal genus. The results confirm that the sand of this beach harbors a diverse fungal community dominated by saprophytic fungi, with a predominance of the genus *Aspergillus,* a pattern that has been widely reported in coastal environments in different regions of the world (Brandão *et al.*, 2011; Echevarría, 2017; Echevarría, 2019; Pereira *et al.*, 2013).

The predominance of *Aspergillus* observed in this study coincides with research conducted on beaches in Portugal, Brazil, Puerto Rico, and Mediterranean regions, where this genus is described as one of the most frequent in both dry and wet sand (Brandão *et al.*, 2011; Echevarría, 2022; Echevarría and Bello, 2025). This abundance is explained by the high capacity of these species to produce resistant spores, tolerate variations in salinity and temperature, and colonize nutrient-poor substrates - characteristics that favor their persistence in coastal environments.

The identification of *Aspergillus fumigatus, A. niger,* and *A. flavus* is of particular public health importance, as these species are associated with invasive aspergillosis, allergic aspergillosis, and mycotoxin production, particularly aflatoxins in the case of *A. flavus* (Amaike and Keller, 2011; Echevarría, 2022; Echevarría and Bello, 2025; Latgé and Chamilos, 2019). Although the presence of these fungi does not necessarily imply an immediate risk to the general population, it does represent a potential concern for immunocompromised individuals, children, and people with respiratory illnesses, especially on beaches with high tourist traffic.

The isolation of *Candida albicans* as the predominant yeast species also aligns with previous studies in urban and peri-urban beach sands, where its presence has been linked to human activities, indirect wastewater discharge, and direct contact by beachgoers (Brandão *et al.*, 2011; Calderone and Clancy, 2011). *C. albicans* is part of the human microbiota, so its detection in sand suggests a possible anthropogenic footprint, a phenomenon observed on beaches with high tourist traffic.

The detection of *Fusarium oxysporum* and species of the genus *Penicillium* supports the role of sand as a reservoir for fungi typically associated with soil and plant debris. This genus is recognized decomposers of organic matter and actively participate in carbon and nitrogen cycles, contributing to the biogeochemical dynamics of the coastal ecosystem (Leslie *et al.*, 2006; Pitt and Hocking, 2009). However, both genus include opportunistic species capable of causing infections in humans, reinforcing the need for periodic microbiological surveillance.

The average value of 14 CFU/g of filamentous fungi and yeasts obtained in this study places the sand of Karfas Beach within the average quality category, according to the criteria established by the Portuguese National Institute of Health and INSA (Brandão *et al.*, 2011; Pereira *et al.*, 2013). This number is less than the median found by the Mycosands initiative, which comprised 91 sampling locations and determined a reference value of 89 CFU/g in freshwater and coastal beach sediments (Brandão *et al.*, 2021). This classification is consistent with reports from beaches with moderate to high tourist activity during the summer months, where a seasonal increase in fungal load has been observed in dry sand (Echevarría, 2022).

From an ecological perspective, the fungal community detected reflects a dynamic system dominated by saprophytic organisms that perform essential functions in the degradation of organic waste and the maintenance of microbial balance. However, the coexistence of potentially pathogenic species underscores the dual nature of these ecosystems: biologically functional but susceptible to alterations associated with anthropogenic pressure (Ashraf and Iqbal, 2021; Ashraf and Iqbal, 2022; Echevarría and Bello, 2025; Iqbal *et al.*, 2019; King and Leonard, 2023).

Overall, the results suggest that Karfas Beach maintains acceptable microbiological quality, although with indicators of human influence that justify the implementation of continuous monitoring programs. Longitudinal studies incorporating seasonal variation, molecular analysis, and correlation with physicochemical parameters of the sediment would allow for a more comprehensive evaluation of the sanitary and ecological status of this beach.

CONCLUSION

1. The sand at Karfas Beach harbors a diverse community of filamentous fungi and yeasts dominated by environmental saprophytic species.

2. The fungal genus found were: *Aspergillus, Penicillium, Fusarium, Candida, Cladosporium, Ascomycetes, Chaetomium,* and *Cephalosporium*.

3. The isolated species were: *A. niger, A. fumigatus, A. terreus, A. flavus, Cladosporium elatum, Penicillium restrictum, P. chrysogenum, Candida albicans* and *Fusarium oxysporum.*

4. The predominance of the genus *Aspergillus* is consistent with international reports for marine beaches.

5. The presence of *A. fumigatus, A. flavus*, and *Candida albicans* suggests a possible anthropogenic influence.

6. The microbiological quality of the sand was classified as average.

7. It is recommended to implement periodic monitoring programs and seasonal analysis.

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CONFLICT OF INTEREST

The authors declare that this article content has no conflict of interest.

GENERATIVE AI STATEMENT

The author(s) declare that no Generative AI was used in the creation of this manuscript.

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REFERENCES

Ahmed, S.A., Khan, Z., Wang, X.-w., Moussa, T.A., Al-Zahrani, H.S., Almaghrabi, O.A., Sutton, D.A., Ahmad, S., Groenewald, J.Z., Alastruey-Izquierdo, A., 2016. *Chaetomium*-like fungi causing opportunistic infections in humans: a possible role for extremotolerance. Fungal Divers., 76(1): 11-26.

Amaike, S., Keller, N.P., 2011. *Aspergillus flavus*. Ann. Rev. Phytopathol., 49(1): 107-133.

Ashraf, A., Iqbal, M.N., 2021. Fungi in the Sands of Egyptian Pyramids is a Concern for Public Health. PSM Biol. Res., 6(1): 19-21.

Ashraf, A., Iqbal, M.N., 2022. Beach Sand and Sea Water as Reservoir of Potentially Pathogenic Microbes. PSM Microbiol., 7(1): 37-39.

Bensch, K., Braun, U., Groenewald, J.Z., Crous, P.W., 2012. The genus *Cladosporium*. Stud. Mycol., 72: 1-401.

Black, W.D., 2020. A comparison of several media types and basic techniques used to assess outdoor airborne fungi in Melbourne, Australia. PLoS One., 15(12): e0238901.

Bozzeda, F., Fanini, L., Costantini, F., Mikac, B., Colangelo, M.A., 2025. Disentangling the effects of sandy beach management on intertidal macrobenthic fauna: A path analysis approach. Estuar., Coast. Shelf Sci., 319: 109254.

Brandão, J., Gangneux, J.-P., Arikan-Akdagli, S., Barac, A., Bostanaru, A., Brito, S., Bull, M., Çerikçioğlu, N., Chapman, B., Efstratiou, M., 2021. Mycosands: Fungal diversity and abundance in beach sand and recreational waters—Relevance to human health. Sci. Total Environ., 781: 146598.

Brandão, J., Silva, C., Ferreira, F., Costa, C., Cunha, M., Moura, I., Veríssimo, C., Vergikosiki, B., Parada, H., Falcão, L., 2011. Monitorização da qualidade das areias em zonas balneares. Instituto Nacional de Saúde Dr. Ricardo Jorge Lisboa.

Calderone, R.A., Clancy, C.J., 2011. *Candida* and candidiasis. American Society for Microbiology Press.

Chatzi, E., Derdemezi, E.-T., Tsilimigkas, G., 2025. The impact of Built-Up area dispersion on the cultural heritage of the region of the South Aegean, Greece. ISPRS Int. J. Geo-Inf., 14(3): 97.

Echevarría, L., 2017. Diversidad de hongos filamentosos en la arena de las playas: en la Costa Norte de Puerto Rico. Editorial Académica Española.

Echevarría, L., 2019. Preliminary Study to identify Filamentous Fungi in Sands of Three Beaches of the Caribbean. PSM Microbiol., 4(1): 1-6.

Echevarría, L., 2022. Inventory of Filamentous Fungi and Yeasts Found in the Sea Water and Sand of the Beach of Pier in Arecibo Puerto Rico. PSM Microbiol., 7(1): 4-11.

Echevarría, L., Bello, F., 2025. Variety of Filamentous Fungi and Yeast Species Found on the White Sands of Crystal Beach in the Bahamas: Swimming with the Pigs. PSM Microbiol., 10(1): 1-10.

Echevarría, L., Iqbal, M.N., 2021. Identification of Fungi and Yeasts from the Sands of the Pyramids of Giza, in Cairo, Egypt. PSM Biol. Res., 6(1): 13-18.

Frenkel, M., Serhan, H., Blum, S.E., Fleker, M., Sionov, E., Amit, S., Gazit, Z., Gefen-Halevi, S., Segal, E., 2022. What is hiding in the Israeli Mediterranean seawater and beach sand. J. Fungi., 8(9): 950.

Georgopoulou, E., Mirasgedis, S., Sarafidis, Y., Hontou, V., Gakis, N., Lalas, D.P., 2019. Climatic preferences for beach tourism: an empirical study on Greek islands. Theor. Appl. Climatol., 137(1): 667-691.

Godovykh, M., Fyall, A., Pizam, A., 2025. Exploring the impacts of tourism on the well-being of local communities. Sustainability., 17(13): 5849.

Hasiotis, T., Gazis, I.-Z., Anastasatou, M., Manoutsoglou, E., Velegrakis, A.F., Kapsimalis, V., Karditsa, A., Stamatakis, M., 2021. Searching for potential marine sand resources to mitigate beach erosion in island settings. Mar. Georesources Geotechnol., 39(5): 527-542.

Houbraken, J., Samson, R., 2011. Phylogeny of *Penicillium* and the segregation of *Trichocomaceae* into three families. Stud. Mycol., 70(1): 1-51.

Ioannis, M., Panagiotis, K., Emmanouela, S., Theodoros, T., Anna, O., Efstratios, D., Alexandros, T., 2025. The Quality of Greek Islands' Seawaters: A Scoping Review. Appl. Sci., 15(16): 9215.

Iqbal, M.N., Ashraf, A., Iqbal, A., 2019. Filamentous Fungi in Beach Sands: Potential Pathogens for Infectious Diseases. Int. J. Mol. Microbiol., 2(3): 63-65.

King, N., Leonard, M., 2023. A review of the human health risks from microbial hazards in recreational beach sand. Report No. FW23015. Wellington, New Zealand: Prepared by the Institute of Environmental

Science and Research Limited (ESR) for New Zealand Ministry of Health Manatū Hauora, 10.

Landy, E.T., Jones, G.M., 2006. What is the fungal diversity of marine ecosystems in Europe? Mycologist, 20(1): 15-21.

Lass-Flörl, C., Dietl, A.-M., Kontoyiannis, D.P., Brock, M., 2021. *Aspergillus terreus* species complex. Clin. Microbiol. Rev., 34(4): e00311-20.

Latgé, J.P., Chamilos, G., 2019. *Aspergillus fumigatus* and Aspergillosis in 2019. Clin. Microbiol. Rev., 33(1).

Leslie, J.F., Summerell, B.A., Bullock, S., 2006. The Fusarium laboratory manual, 2. Wiley Online Library.

McColl, L., 2025. Chios: Island and Polis in the Archaic and Classical Periods.

Meyer, V., Cairns, T., Barthel, L., King, R., Kunz, P., Schmideder, S., Müller, H., Briesen, H., Dinius, A., Krull, R., 2021. Understanding and controlling filamentous growth of fungal cell factories: novel tools and opportunities for targeted morphology engineering. Fungal Biol. Biotechnol., 8(1): 8.

Meziti, A., Kormas, K., 2024. Microbial Life in the Aegean Sea. In: Anagnostou, C.L., Kostianoy, A.G., Mariolakos, I.D., Panayotidis, P., Soilemezidou, M., Tsaltas, G. (Eds.), The Aegean Sea Environment: The Biodiversity of the Natural System. Springer Nature Switzerland, Cham, pp. 77-87.

Montes, K., Ortiz, B., Galindo, C., Figueroa, I., Braham, S., Fontecha, G., 2019. Identification of *Candida* species from clinical samples in a Honduran tertiary hospital. Pathogens., 8(4): 237.

Pereira, E., Figueira, C., Aguiar, N., Vasconcelos, R., Vasconcelos, S., Calado, G., Brandão, J., Prada, S., 2013. Microbiological and mycological beach sand quality in a volcanic environment: Madeira archipelago, Portugal. Sci. Total Environ., 461: 469-479.

Pitt, J.I., Hocking, A.D., 2009. Fungi and food spoilage, 519. Springer.

Polemis, E., Fryssouli, V., Daskalopoulos, V., Zervakis, G.I., 2020. Basidiomycetes associated with *Alnus glutinosa* habitats in Andros Island (Cyclades, Greece). Divers., 12(6): 232.

Poli, A., Varese, G.C., Garzoli, L., Prigione, V., 2022. Seagrasses, seaweeds and plant debris: An extraordinary reservoir of fungal diversity in the Mediterranean Sea. Fungal Ecol., 60: 101156.

Scharmann, U., Kirchhoff, L., Chapot, V.I.S., Dziobaka, J., Verhasselt, H.L., Stauf, R., Buer, J., Steinmann, J., Rath, P.M., 2020. Comparison of four commercially available chromogenic media to identify *Candida albicans* and other medically relevant *Candida* species. Mycoses., 63(8): 823-831.

Schoch, C., Wang, Z., Townsend, J., Spatafora, J., 2009. Geoglossomycetes cl. nov., Geoglossales ord. nov. and taxa above class rank in the Ascomycota Tree of Life. Persoonia-Molecular Phylogeny and Evolution of Fungi, 22(1): 129-138.

Schuster, E., Dunn-Coleman, N., Frisvad, J., Van Dijck, P., 2002. On the safety of *Aspergillus niger* – a review. Appl. Microbiol. Biotechnol., 59(4): 426-435.

Semeoshenkova, V., Newton, A., 2015. Overview of erosion and beach quality issues in three Southern European countries: Portugal, Spain and Italy. Ocean Coast. Manag., 118: 12-21.

Sipman, H.J., Raus, T., 2015. Lichens and lichenicolous fungi from the island of Chios (Aegean Sea, Greece). Herzogia, 28(2): 496-519.

Summers, A., Fletcher, C.H., Spirandelli, D., McDonald, K., Over, J.-S., Anderson, T., Barbee, M., Romine, B.M., 2018. Failure to protect beaches under slowly rising sea level. Clim. Change., 151(3): 427-443.

Tamura, T., Alshahni, M., Makimura, K., 2022. Evaluation of CHROMagarTM Candida Plus chromogenic agar for the presumptive identification of *Candida auris*. Microbiol. Immunol., 66.

Terkenli, T., Skowronek, E., Tucki, A., Kounellis, N., 2019. Toward understanding tourist landscape. a comparative study of locals' and visitors' perception in selected destinations in Poland and Greece. Quaest. Geogr., 38: 81-93.