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Characterization of biodiversity of filamentous fungi in the soil of public spaces in João Pessoa, Northeast of Brazil

Caracterização da biodiversidade de fungos filamentosos do solo de espaços públicos de João Pessoa, Nordeste do Brasil

Caracterización de la biodiversidad de hongos filamentosos en el suelo de espacios públicos en João Pessoa, Noreste de Brasil

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Abstract
Fungi are ubiquitous eukaryotic microorganisms with presence of cell wall, being found mainly on soil, vegetables, water and in the air. Fungi play an important role to the decomposition cycle of organic matter. Public environments such as squares and parks, intended for the population leisure, are places where a large number of people and animals also circulate daily. This study aims to evaluate the presence of filamentous fungi in the soil of public squares and parks from João Pessoa city, Northeast of Brazil. Soil samples from six squares/parks were collected and then processed and cultivated. In addition, keratinophilic fungi were isolated using sterile hair as substrate. Filamentous fungi were isolated from all samples. The most frequent genus was *Aspergillus* (100% of the samples) followed by *Trichophyton* (66.7%) and *Penicillium* (33.3%). *Aspergillus* section Nigri was isolated in 66.7% of the samples, followed by *Aspergillus* section Flavi, *Aspergillus* section Terrei and *Trichophyton rubrum*, which were isolated from 50% of the samples). Several genera and species with pathogenic potential to the humans were isolated from all selected points. These findings reinforce the importance of the knowledge of the soil composition of the spaces intended to the public use, contributing to information to the population, especially the most vulnerable individuals, regarding the conscious use of these environments for recreational activities.
Keywords: Public spaces; Filamentous fungi; Soil; Fungal infections.

Resumo
Os fungos são microrganismos eucarióticos ubíquos com presença de parede celular, sendo encontrados principalmente no solo, vegetais, água e no ar. Os fungos desempenham um papel importante no ciclo de decomposição da matéria orgânica. Ambientes públicos como praças e parques, destinados ao lazer da população, são locais onde também circula diariamente um grande número de pessoas e animais. Este estudo teve como objetivo avaliar a presença de fungos filamentosos no solo de praças e parques públicos da cidade de João Pessoa, Nordeste do Brasil. Amostras de solo de seis praças/parques foram coletadas e então processadas e cultivadas. Além disso, fungos queratinofílicos foram isolados usando cabelo estéril como substrato. Fungos filamentosos foram isolados de todas as amostras. O gênero mais frequente foi *Aspergillus* (100% das amostras), seguido por *Trichophyton* (66,7%) e *Penicillium* (33,3%). *Aspergillus* seção Nigri foi isolada em 66,7% das amostras, seguido por *Aspergillus* seção Flavi, *Aspergillus* seção Terrei e *Trichophyton rubrum*, que foram isoladas em 50% das amostras). Vários gêneros e espécies com potencial patogênico ao homem foram isolados de todos os pontos selecionados. Esses achados reforçam a importância do conhecimento da composição do solo dos espaços destinados ao uso público, contribuindo com informações à população, principalmente aos mais vulneráveis, quanto ao uso consciente desses ambientes para atividades recreativas.
Palavras-chave: Espaços públicos; Fungos filamentosos; Solo; Infecções fúngicas.

Resumen
Los hongos son microorganismos eucariotas ubicuos con la presencia de una pared celular, que se encuentran principalmente en el suelo, los vegetales, el agua y el aire. Los hongos juegan un papel importante en el ciclo de descomposición de la materia orgánica. Los entornos públicos como plazas y parques, destinados al ocio de la población, son lugares por los que circula a diario un gran número de personas y animales. Este estudio tuvo como objetivo evaluar la presencia de hongos filamentosos en el suelo de plazas y parques públicos de la ciudad de João Pessoa, noreste de Brasil. Se recolectaron muestras de suelo de seis plazas / parques y luego se procesaron y cultivaron. Además, se aislaron hongos queratinofílicos utilizando cabello estéril como sustrato. Se aislaron hongos filamentosos de todas las muestras. El género más frecuente fue *Aspergillus* (100% de las muestras), seguido de *Trichophyton* (66,7%) y *Penicillium* (33,3%). Se aisló *Aspergillus* sección Nigri en el 66,7% de las muestras, seguido de *Aspergillus* sección *Flavi*, *Aspergillus* sección Terrei y *Trichophyton rubrum*, que se aislaron en el 50% de las muestras. Se aislaron varios géneros y especies con potencial patógeno para el hombre de todos los puntos seleccionados. Estos hallazgos refuerzan la importancia de conocer la composición del suelo en los espacios destinados al uso público, brindando información a la población, especialmente a los más vulnerables, sobre el uso consciente de estos ambientes para actividades recreativas.
Palabras clave: Espacios públicos; Hongos filamentosos; Suelo; Infecciones por hongos.

1. Introduction

Fungi are eukaryotic micro-organisms that are widely found in various environments, such as soil, water and air (da Silva & Malta, 2017; Magalhães, et al., 2016). In general, fungi are organized into two different groups, the yeasts, with a single rounded to oval morphology and filamentous fungi, with multiple cells joined in an elongated shape (da Silva & Malta, 2017; Gellen, et al., 2018; Rosa, 2016; Steinberg, et al., 2017).

In nature, fungi plays an essential role in the decomposition processes of organic matter, collaborating in the process of reuse of these compounds (da Silva & Malta, 2017; Spatafora, et al., 2017; Vidal, et al., 2017).

Although fungi develop beneficial actions for the environment and the vast majority have limited pathogenicity, in certain circumstances, these microorganisms may cause infections in humans, ranging from superficial lesions on the skin, hair and nails, even cases pulmonary diseases and disseminated infections, which can lead to individual to death (Barbieri & Ishida, 2016; Farges, et al., 2020).

Regarding the fungi that cause infections, the majority come from the environment, and the infection can occur mainly through inhalation of their propagules, ingestion, traumatic inoculation or through direct contact with injuries. Furthermore, mycoses may also be developed from fungi that are present in an individual's transient microbiota, such as by transient colonizers of the respiratory tract (dos Reis, et al., 2018; Rodrigues, et al., 2020; Wotiye, 2020).

These mechanisms contribute to fungal infections. Superficial mycoses affect the outer layers of the skin such as for example, pityriasis versicolor. Subcutaneous mycoses like chromoblastomycosis infects deeper layers of the skin and systemic infections that can affect deep regions of the organism and through of lymphohematogenous dissemination reaching multiple organs. The lung is usually the initial contact with the fungal structures because of the point of entry through inhalation. Examples of systemic infections include histoplasmosis and coccidioidomycosis (Almeida Filho, et al., 2020; Azar, et al., 2020; Kimes, et al., 2020).

A variety of public settings such as squares and parks are visited daily by people and animals and in most cases, these habitats have exposure areas to soil and soil-borne fungi may be in contact with humans and animals. These fungi may cause a number of infections, such as dermatomycosis, which may affect human and animal health (Vidal, et al., 2017).

Anemophic fungi are micro-organisms able to disperse in atmospheric air and can be influenced by geographical location, seasons, temperature changes, humidity, among other factors (Blango, et al., 2020; de Souza, et al., 2019). The interaction of anemophilous fungi with humans may have differing degrees of symptom expression, which may induce allergic reactions in immunocompetent individuals, or even develop systemic infection in people with compromised immune systems (de Souza, et al., 2019). Several studies on the presence of fungi in air were developed to provide information on air quality from different environments and thus contribute to the prevention of potential infections (de Oliveira, et al., 2020; Lima, et al., 2019; Prakash, et al., 2020).

There are few studies in the literature which mention the assessment of fungi in the soil of urban areas in north-eastern Brazil. The aim of the study was to characterize the biodiversity of filamentous fungi in the soil of public squares and parks in the city of João Pessoa, capital of Paraiba state, a town belonging to the Brazilian tourist hub.

2. Methodology

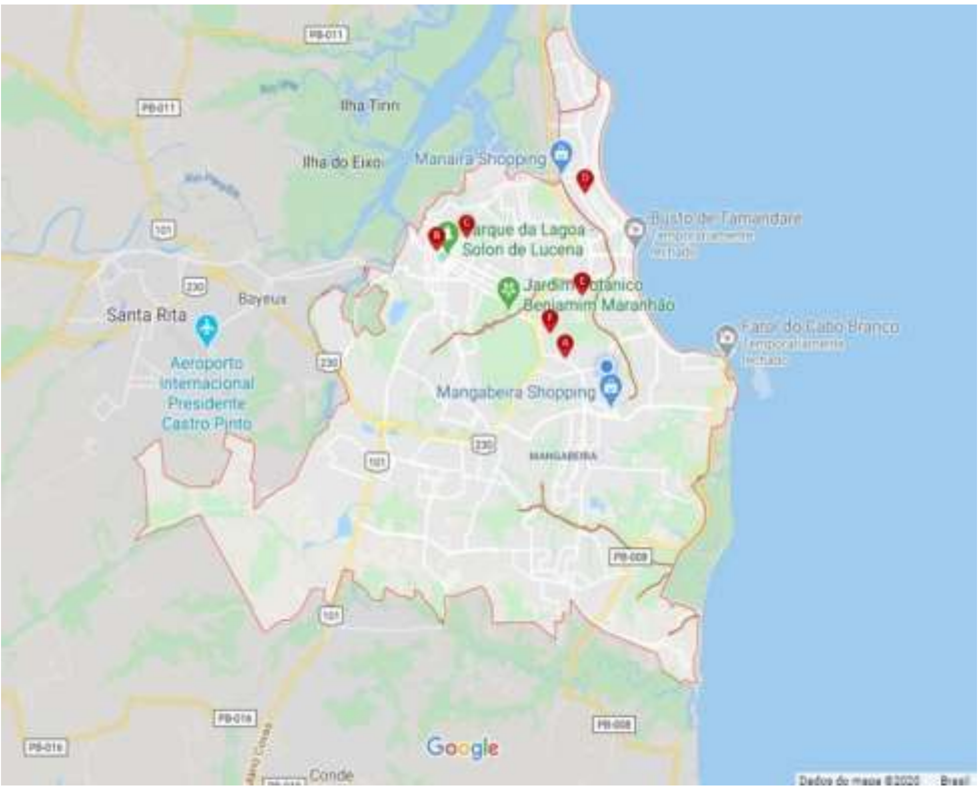
Type of study

The present study as an investigative, exploratory and laboratorial research

Locations for the collection of soil samples

Squares and parks located in the João Pessoa city, located in different neighborhoods, have been chosen. The inclusion criteria were based on environments where the soil was exposed and human and animal traffic was frequent. The locations selected should necessarily encompass all areas of the city (north, south, east and west), Figure 1.

Figure 1 – Map of the city of João Pessoa with location of sampling points. A- Peace square; B - Sólon de Lucena park; C - Independence square; D - Alcides Carneiro square; E - José Alves de Souza square; F - Happiness square (UFPB).



Source: Authors.

The collections took place between February and March 2020 in the chosen square/park. Three samples were collected at different locations on the ground surface at depths of 7.5 and 15 cm. The soil was collected with a pre-sterilized trowel (ICAL). The three samples of each square/park were homogenized forming a pool and stored in universal collectors

(J.PROLAB). The samples were numbered from 1 to 6. The temperature of the soil was measured using a thermometer (INCONTERM).

Sample processing and culture conditions

For processing, 1 gram of each soil sample was weighed and then added to a conical centrifugal tube containing 9 mL of sterile saline (0.9% w/v). The tubes were then mechanically agitated over a tube agitator (model PHOENIX AP56) for 10 minutes. The samples were then decanted for fifteen minutes. The supernatants (100 µL) were seeded pure and diluted 1:100 by spreading method, using a sterile Drigalsky loop, on the surface of Petri dishes (90x150mm) with Sabouraud Dextrose agar plus 0.05 mg/mL chloramphenicol. Mycosel agar plates (Himedia ™) were also used. The samples were incubated at room temperature (25ºC) and growth was monitored daily for 7 days (Pontes, et al., 2013; Garcia-Quitanda, Zaror, & LEIVA, 1997; Lacaz, et al., 2002).

In addition to the seedling in ASD, the samples were also treated using the Hair-Bait method, described by Vanbreuseghem (Vanbreuseghem, 1952) which involves dispensing soil samples in sterile petri dishes, then adding sterilized hair, humidifying the soil with sterile distilled water in order to stimulate the growth of keratinophilic fungi. Five grams of each sample and 2 ml of distilled water were used. After the fungal growth on the surface of the hair strands, they were gently removed from the soil with sterile forceps and sown on the ASD surface.

Purification of fungal isolates

A conical tube with 9 ml sterile saline solution (0.9%) was used to purify the colony, in which a small piece of the fungal colony was added using a metallic handle. Then a tube agitator (model PHOENIX: AP56) was used for shaking, releasing fungal particles into the saline solution. After stirring, a bacteriological loop (OLEN Reference: K30-0110) was used to spread the supernatant over the surface of the DSA by exhaustion. Subsequently, the plates were stored at room temperature (25ºC) for fungal growth.

Microculture of filamentous fungi

From the growth of the purified colonies, microculture was performed on filamentous fungi. Small fragments of the colony were sown along the sides of square cuttings (0.5 x 0.5 cm) of potato dextrose agar (Potato Infusion 500 mL, Dextrose 10g, Bacteriological Agar 15g, Distilled Water qsp 1000 mL), which were placed on the surface of sterilized microscopy slides. Flaming coverslips were placed on the middle surface. The samples were incubated in a sterile humid chamber, at room temperature for up to seven days. After the incubation period, the coverslips were gently removed and observed on objective lenses at 400x magnification (EDUTEC A006750) (Brasil, 2013; Lacaz et al., 2002). The filamentous fungi were identified according to the descriptions obtained in the identification key used in the classical taxonomy (de Hoog & Guarro, 1995).

3. Results

Climatic conditions at sample collection point

During the collection of soil samples, the climatic features of the environment were documented. All collections were carried out during the summer season (between February and March), with high atmospheric temperatures and the occurrence of rapid and intense rains (Brasil, 2020). The collection performed in place 1, had as climatic condition the cloudy weather, with occasional rains. The soil temperature was 27ºC.

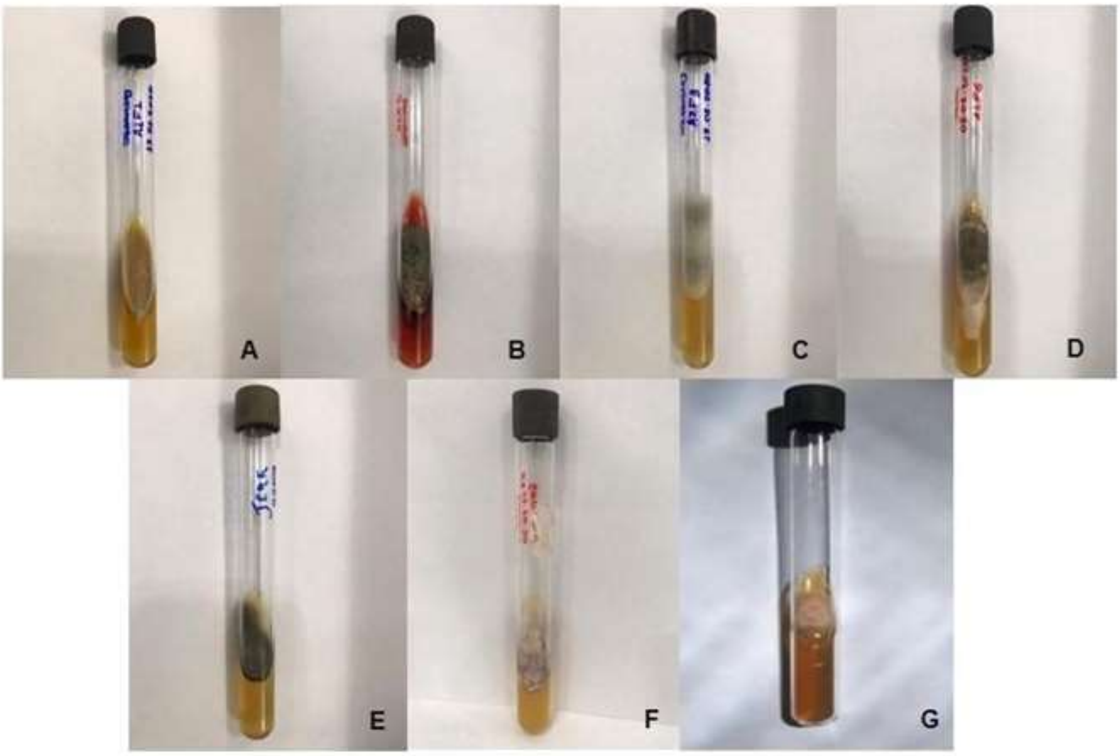
During the collection of Square 2, the weather was sunny and the soil temperature was 36°C. At Square 3, the weather was clear and the soil had a temperature of 31°C. In the collection carried out in square 4, the weather was cloudy and rainy occasionally. The soil temperature was 31°C.

Regarding collections in squares 5 and 6, the weather was cloudy and with occasional rains. The soil temperature was 30°C for the two environments.

Isolation of non-dermatophyte filamentous fungi

Non-dermatophyte filamentous fungi were isolated at all six collection points, representing a 100% recovery rate. With regard to isolated fungal genera in all the squares where the samples were collected, the most frequent was *Aspergillus*, found in all samples (100%, Figure 2-A), *Penicillium* (2 samples, 33.3%, Figure 2-B), *Rhizopus* (2 samples, 33.3%, Figure 2-C); *Paecilomyces* (1 sample,16.7%, Figure 2-D), *Curvularia* (1 sample, 16.7%, Figure. 2-E), *Acremonium* (1sample, 16.7%, Figure 02-F), *Fusarium* (1 sample, 16.7%, Figure 2-G). Figure 2 shows the colonies of the genera that were isolated from the survey.

Figure 2 – Fungal isolates. A: *Aspergillus*, B: *Penicillium*, C: *Rhizhopus*, D: *Paecilomyces*, E: *Curvularia*, F: A*cremonium* and G: *Fusarium*.



Fonte: Dados da pesquisa (2020).

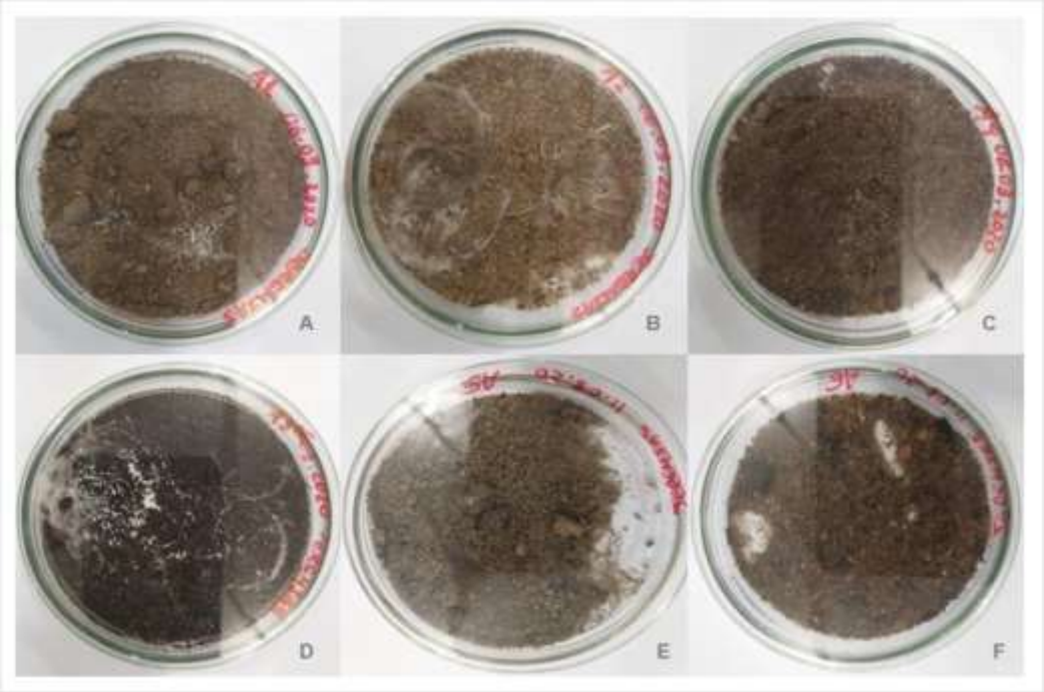
As regards the distribution of isolates from the samples analysed, the species grouped in *Aspergillus* section Nigri were the most common, observed in 4 samples (66.7%), followed by *Aspergillus* section Terrei (3 samples, 50%), *Aspergillus* section Flavi (3 samples, 50%), *Aspergillus* spp. (2 samples, 33.3%), *Penicillium* spp. (2 samples, 33.3%), *Rhizopus oryzae* (2 samples, 33.3%), *Curvularia lunata* (1 sample, 16.6%), *Penicillium rugulosum* (1 sample, 16.6%), *Aspergillus* section Fumigati (1 sample, 16.6%), *Penicillium marneffei* (1 sample, 16.6%), *Paecilomyces marquandii* (1 sample, 16.6%), *Acremonium strictum* (1 sample, 16.6%), *Fusarium* sp. (1 sample, 16.6%).

Isolation of dermatophytes fungi

Filamentous keratinophilic fungi were isolated at four of the six collection points, representing a recovery rate of 66.7%.

As for the dermatophyte fungi, only the genus *Trichophyton* was isolated in the four positive samples. In terms of species, *Trichophyton rubrum* was the primary isolate (3 samples, 75%, Figure 3 - A, B and C), followed by *Trichophyton mentagrophytes* (1 sample, 25%, Figure 3-D). The distribution of dermatophyte isolates are described in Table 1.

Figure 3 – Isolation of dermatophyte fungi from soil sample using the Hair Bait method. A) *Trichophytom rubrum*, Sample 1. B) *Trichophytom rubrum*, Sample 2. C) *Trichophytom rubrum*, Sample 4. D) *Trichophytom mentagrophytes*, Sample 3. E) Sample 5 without fungal growth. F) Sample 6 without fungal growth.



Fonte: Dados da pesquisa (2020)

Table 1 - Distribution of non-dermatophyte and dermatophyte filamentous fungi isolated from public squares and parks in the city of João Pessoa – PB

	Square 1	Square 2	Square 3	Square 4	Square 5	Square 6	Total
Acremonium strictum	x						**1**
Aspergillus* Section *Flavi	x		x			x	**3**
Aspergillus* Section *Fumigati				x			**1**
Aspergillus* Section *Nigri		x	x		x	x	**4**
Aspergillus* Section *Terrei		x	x	x			**3**
***Aspergillus* spp.**				x		x	**2**
Curvularia lunata			x				**1**
***Fusarium* sp.**				x			**1**
Mycelia sterilia	x			x			**2**
Paecilomyces marquandii	x						**1**
Penicillium marneffei	x						**1**
Penicillium rugulosum	x						**1**
***Penicillium* spp.**	x					x	**2**
Rhizopus oryzae		x				x	**2**
Trichophyton mentagrophytes			x				**1**
Trichophyton rubrum	x	x		x			**3**
Total of isolates	**8**	**4**	**5**	**6**	**1**	**5**	

Source: Authors.

Distribution of environmental isolates in relation to collection sites

Regarding the distribution of environmental strains in relation to the places where the collections were carried out, the region with the highest number of isolates was eastern (16 isolates, 59.3%) followed by the North with 6 isolates (22.2%) and the South with 5 isolates (18.5%).

When analysing the distribution of isolates according to the squares and public parks from which the samples were collected, it was found that Praça da Alegria, located in the premises of the Federal University of Paraiba, in the eastern region, presented the highest percentage of isolates (7 species, 25.9%), followed by Praça da Paz (5 isolates, 18.5%), Praça Alcides Carneiro (5 isolates, 18.5%), Parque Sólon de Lucena (5 isolates, 18.5%) José Alves de Souza Square (4 isolated, 14.8%), and Independence Square (1 isolated, 3.7%).

4. Discussion

The present study aimed to carry out an epidemiological survey of non-dermatophyte and dermatophyte filamentous fungi in public places in the city of João Pessoa-PB.

There was recovery of non-dermatophyte filamentous fungi in all samples analyzed. This result is due to the fact that isolated genera in the study, such as Aspergillus, Penicillium and Fusarium, are considered as ubiquitous, and the open environment is also a factor that contributes to the aerial dispersion of fungi, such as anemophiles, and can therefore also be found in the soil. (Souza, et al., 2013).

In addition, the city of João Pessoa is located in the coastal region of north-east Brazil, with a humid climate and an average annual temperature above 18 ºC, that was observed at all collection points considered in this study. These climate factors contribute to the growth of fungi (Brasil, 2002).

The genus Aspergillus was the most isolated in the collected samples, occurring at all assessed locations. There have been increasing cases of invasive infections caused by species of the genus Aspergillus, mainly in individuals with some type of immunological deficiency (Breuer, et al., 2020). Species that make up Aspergillus section Nigri, Aspergillus section Flavi and Aspergillus section Fumigati, all isolated from this study are among those causing the majority of invasive aspergillosis (Perez-Cantero, et al., 2020).

Although considered as opportunistic infection agents, some species of the genus Aspergillus have been highlighted as a result of the development of antifungal resistance. Aspergillus section Fumigati, isolated from this study, is the most isolated in invasive pulmonary aspergillosis cases (Perez-Cantero, et al., 2020; Satterlee, et al., 2020), and, in some cases, with resistance to treatment with antifungal drugs of the azole class (Wiederhold & Verweij, 2020).

In addition, it is important to highlight the importance of Aspergillus genus in the novel coronavirus (SARS-CoV-2) pandemic scenario (Chen, et al., 2020; Koehler, et al., 2020; Zhu, et al., 2020). A key feature of coronavirus disease 2019 (COVID-2019) is the damage to the lung region (Arastehfar, et al., 2020). The affected individual may have a high chance of developing infections caused by Aspergillus, since conidia dispersed in the air can access the pulmonary cavities left by COVID-19 and in these micro-environments find favorable conditions for their development (Carrasco-Zuber, et al., 2016; Munir, et al., 2017; Russell, et al., 2020; Wu & McGoogan, 2020). A study carried out in a hospital in France by Alanio and Collaborators (Alanio, et al., 2020), in the assessment of 27 COVID-19 patients admitted to the ICU, 33% were also diagnosed with invasive pulmonary aspergillosis.

Penicillium was one of the genera found in the current study, and was identified in two samples (33.3%). Species of this genus can cause infections in various parts of the body such as nails, esophagus, lung and eyes, making the result relevant since these infections can trigger severe conditions, especially in immunocompromised individuals (Almeida Filho, et al., 2020). Penicillium marnefei, now named Talaromyces marnefei, has been isolated. This species is common in Southeast Asia and is responsible for causing infections known as talaromycosis or penicilliosis marnefeii (Quindos, 2018).

In the present study, the Fusarium genus was isolated in one sample. Species in this genus are typically associated with infections at several anatomical sites (Slowik, et al., 2015; Thomas, et al., 2020). Often, Fusarium species can be isolated in the routine of mycological diagnosis in cases of onychomycosis (Thomas, et al., 2020). A study conducted by Lima (Lima, 2018), with 224 clinical samples of patients with lesions suggesting onychomycosis, 14 samples (11.76%) were diagnosed with Fusarium spp. It is important to highlight these data, since the presence of such genus in the soil of the place where it has been isolated, warns of the basic care necessary to avoid fungal infections in the nails. The square in which the Fusarium genus was isolated, is an environment with an intense flow of people, who usually practice sports on the ground, with their feet unprotected, therefore favourable for the development of onychomycosis.

In addition to the cases of onychomycosis, the species of the genus Fusarium are aetiological agents of keratitis and can, on certain occasions, influence reduction in visual acuity (Puig, et al., 2020), or even vision loss (de Oliveira, et al., 2020). Several risk factors can influence the development of the infection, including the use of contact lenses, trauma to the ocular surface (mainly with plant fragments or objects contaminated with soil) and topical use of corticosteroids are the most observed (Niu, et al., 2020). Thus, practices of different activities in environments with the possibility of spreading fungal structures through soil dust and reaching the ocular surface, need to be reassessed by individuals who have one or more risk factors.

Species of the genus Curvularia are demeaceous fungi, present in the soil and are generally associated with the development of phaeohyphomycosis, such as superficial infections, allergic lung disease, sinusitis and in more severe cases, with blood dissemination (Chang, et al., 2019). In the present study, Curvularia lunata was detected in one of the samples. Bordoloi et al. (Bordoloi, et al., 2015) describe Curvularia as an agent of subcutaneous infection, which usually occurs as a result of traumatic inoculation, following contact with contaminated soil or plant fragments (Barvosa & Biancalana, 2016; Vasquez-del-Mercado, et al., 2013).

In two samples there was isolation of the species Rhizopus oryzae which belongs to the order Mucoral, which is widely present in nature (Fatemizadeh, et al., 2020). Species of this genus may be associated with the development of rhinocerebral, pulmonary and skin infections (Rodriguez-Lobato, et al., 2017), mainly in immunocompromised or diabetic individuals (Shibata et al., 2020). Rodríguez-Lobato et al. (Rodriguez-Lobato, et al., 2017) describe a case of primary cutaneous mucormycosis caused by Rhizopus oryzae in a diabetic patient after a skin injury. This data may show the importance of this result since Brazil is among the countries where the prevalence of people with diabetes is highest and that public recreation environments may be visited by individuals who come in contact with fungal structures (Diabetes, 2019).

In four of the six soil samples analyzed, fungi that degrade keratin (keratinophiles) and cause superficial infections known as dermatophytoses were isolated (Dalla Lana, et al., 2016; Gellen, et al., 2018). The isolation of dermatophyte fungi at four collection sites may be associated with the fact that in environments where people and animals are present, residues of keratin may be present as a nutrient substrate contributing to the presence of this fungal genus in the soil (Pontes, et al., 2013).

The species Trichophyton rubrum was the most isolated among dermatophytes. In a study by Brondani (Brondani, et al., 2016), analysis of soil samples from public squares in Porto Velho-RO found that the most common species was Trichophyton tonsurans (38.1%), followed by Trichophyton rubrum (9.5%).

In addition, the current study was not similar to data from Pontes and Collaborators (Pontes, et al., 2013), which analyzed the presence of dermatophytes in soils of urban and rural areas of cities of Paraíba state, and found that of the 48 dermatophytes isolated from the samples of the the soil of the city of João Pessoa, Trichophyton mentagrophytes was the most isolated specie.

In public areas for recreation, such as squares and parks, direct contact of children and adults with the soil is very common, whether through sports, recreational activities, as well as picnics. These activities can eventually cause abrasions on the skin, which acts as a bridge to the implantation of fungal propagules, enabling the development of dermatophytosis (Anane, et al., 2015).

In the present study, in addition to T. rubrum, the species T. mentagrophytes was also isolated. Although isolated in a single sample, it may be considered relevant since this fungus is the second largest cause of dermatophytosis, causing in most cases lesions on the scalp, eyebrows and also causing damage to the hair strands due to its parasitism (Dalla Lana, et al., 2016). In addition, the presence of animals in the sites analysed strengthens the finding, given the zoophilic aspect of T. mentagrophytes (Salas-Ocampo, et al., 2020).

A study by Tuesta Bacon (Tuesta Bacon, 2020) analysed the clinical epidemiological characteristics of superficial mycosis in children at Hospital II-2 Santa Rosa in Peru, and found that of the 68 cases evaluated, 34 (50%) had infections on the scalp (Tinea capitis) and 13 (19.12%) in the foot region (Tinea pedis). This shows the meaning of the majority percent of T. rubrum, considering that this species was the majority among dermatophytes and that it has the foot region as one of the main anatomical sites of infection (Tuesta Bacon, 2020; Zhan & Liu, 2017).

Praça da Alegria was the site of the largest fungal isolation. This discovery may be relevant, since this place is located in the university and has an intense flow of people and animals (dogs and cats) throughout the week. In addition, the square is located near an environmental reserve area which may contribute to the presence of more species, given the large availability of decaying organic matter in its territory (Behera, et al., 2014; Mello, Ribeiro, & Fortes, 2007).

In Praça da Paz, in addition to the opportunistic species, Trichophyton mentagrophytes has been isolated, which is important, as this fungus is among the agents responsible for dermatophytosis in children (da Silva, 2019) and considering that the environment has a playground in an exposed soil area, this finding should also be considered relevant for the study.

4. Conclusion

The soil of the squares and parks that were analyzed in the city of João Pessoa-PB has a wide fungal biodiversity with a wealth of species of the genus Aspergillus, Trichophyton and Penicillium. The distribution of fungi was generally diverse, covering both genuinely pathogenic and opportunistic species. These data demonstrate the importance of carrying out studies to analyse soil fungal composition in public recreational environments and provide information to the community and health authorities; in order to draw attention to the need to consciously use recreational spaces. The future perspective is a mapping of risk points in public areas and that these are demarcated and the population is made aware of possible health risks when using these spaces.

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