A PRELIMINARY STUDY ON THE OCCURRENCE OF KERATINOPHILIC FUNGI IN SOILS OF JAMAICA

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SUMMARY

This report represents the first study of keratinophilic fungi present in soils of Jamaica. Out of the 40 soil samples examined from different habitats, 30 (75%) were positive for the presence of keratinophilic fungi, yielding 36 isolates of keratinophilic fungi. Microsporum gypseum complex (represented by 16 isolates of M. gypseum, and four of M. fulvum) was most frequent, being present in 50% of the samples. A very high occurrence of this dermatophyte in Jamaican soil is of public health significance. The remaining isolates of keratinophilic fungi were represented by Chrysosporium spp (mainly C. indicum and C. tropicum) and Sepedonium sp.

KEYWORDS: Keratinophilic fungi; Microsporum gypseum; M. fulvum; Chrysosporium spp; Soil; Jamaica.

INTRODUCTION

Keratinophilic fungi are a group of fungi that colonize various keratinous substrates degrading them to components of low molecular weight. These include a variety of filamentous fungi comprising mainly hyphomycetes and several other taxonomic groups3. Hyphomycetes include dermatophytes and a variety of non-dermatophytic keratinophilic fungi3,10. Most species of dermatophytes are anthropophilic or zoophilic in their natural habitat, while some occur in soil as saprophytes and are termed geophilic, for example, Microsporum gypseum and Trichophyton terrestris3,10,19. Non-dermatophytic keratinophilic fungi, including species of Chrysosporium and other genera of fungi, are known to occur as saprobes in soil; some of them are potential pathogens of humans and animals3,10. Studies on keratinophilic fungi of soils of varying habitats in different countries have demonstrated frequent occurrence of Chrysosporium spp and dermatophytes like Microsporum gypseum complex (M. gypseum and M. fulvum), Trichophyton terrestris, and Trichophyton ajelloi3,10,19. Other dermatophytes known to occur infrequently or sporadically in soil in some countries are M. cookei, M. vanbreuseghemii, and T. gloriae3. Trichophyton simii, T. mentagrophytes, M. nanum and M. persicolor, well-known zoophilic dermatophytes, have also been frequently recovered from soil in some countries3,11,15,18,19,22.

Information on the prevalence of keratinophilic fungi in the West Indies is scanty and limited to only a few reports, one each from Abaco Island in Bahamas3, Cubal6, and St. Kitts and Nevis12. There is no report on isolation of keratinophilic fungi including dermatophytes from Jamaican soil. Thus it was considered of interest to investigate the occurrence of keratinophilic fungi in soils from different kinds of habitats in Jamaica.

MATERIAL AND METHODS

Area of study: Jamaica lies between the latitudes 17° and 19° N, and longitudes 76° and 7° W. Jamaica is a limestone plateau, with an average elevation of about 460 m (1500 ft). The interior of the island is mountainous and peaks of over 2100 m (7000 ft) are found in the Blue Mountains, which dominate the eastern part of the island. The coastal plains are largely alluvial and the largest plains areas lie along the south coast. The climate in Jamaica is largely tropical with hot humid weather, although higher inland regions are relatively temperate. Jamaica can be divided into 14 parishes. Samples were collected from localities in some of the parishes, viz. May Pen in the parish Clarendon, New Green, Northern Caribbean University (NCU) in Mandeville in the Manchester parish in the Middlesex county, from Montego Bay in the Saint James Parish, and Beach soil in Saint Elizabeth parish in the Cornwall County, and Kingston Harbor in the parish Kingston Surrey county. These areas are warm tropical with a relative humidity of approximately 70-80%. The temperature in the greater part of the year is 22-30 °C. Jamaica receives annual rainfall of 811 mm.

Collection of soil samples: Soil samples were collected from a depth of approximately 4-6 inches in zip polythene bags during December 2011 to February 2012, with the help of a stainless steel spatula, 6” inch long and 2” wide disinfected with 70% isopropyl alcohol each time before and after use. The polythene bags were sterilized with 70% isopropyl alcohol and left to dry for 3-4 minutes. Following this, the inside of each bag was rubbed with a sterile swab, which was then rolled on a plate of Sabouraud dextrose agar (SDA) (HiMedia Laboratories, Mumbai, India). The SDA plates were incubated at room temperature for 4-5 days. No growth of molds occurred; however, in some of the plates single bacterial colonies were observed. Thus the sterility of the zip polythene bags was

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Species of keratinophilic fungi recovered from soils of different habitats in Jamaica

| Locality/habitat                      | Sampled | M. gypseum | M. fulvum | C. indicum | C. tropicum | C. keratin | Chrys. sp | Seped. sp |
|--------------------------------------|---------|------------|-----------|------------|-------------|------------|-----------|-----------|
| New Green Manchester                 |         | 3          | 2         | 2          | 2           |            |           |           |
| Cedar grove, Hat field Maypen         |         | 2          |           | 1          | 1           | 1          | 2         | 1         |
| Osborne stone Hat field               |         | 15         | 7         | 4          | 3           | 1          | 1         | 2         |
| Manchester, Georges Dulke, Dembigh    |         | 2          |           | 1          | 1           | 1          | 2         | 1         |
| Mandville, Dorus                      |         | 3          | 2         | -          | -           | -          | -         | 1         |
| Beach soil                           |         | 3          | 1         | -          | -           | -          | -         | -         |
| Ensula, St. Elizabeth, Wonto Bay      |         | 2          | -         | -          | -           | -          | -         | -         |
| Maypen                                |         | 2          |           | -          | -           | -          | -         | -         |
| Banana plantation                    |         | 2          | 1         | -          | -           | -          | -         | -         |
| NCU, Bonitocres, Ingle side          |         | 4          | 1         | 1          | 1           |            |           |           |
| Bamboo Trees                          |         | 2          |           | -          | -           | -          | -         | -         |
| Kingston                              |         | 2          | 1         | -          | -           | -          | -         | -         |
| NCU, Manchester                       |         | 2          | 1         |            |             |            |           |           |
| NCU, Manchester                       |         | 2          | 1         |            |             |            |           |           |
| Total                                 |         | 40         | 16 (40%)  | 3 (10%)    | 4 (10%)     | 1 (2.5%)   | 2 (5%)    | 2 (5%)    |

Samp. - samples; exam. - examined; M. - Microsporum; C. - Chrysosporium; Chrys. - Chrysosporium; Seped. - Sepedonium

Processing of soil samples and identification of isolates: Samples were processed in the Microbiology laboratory of Windsor University School of Medicine, Cayon, St. Kitts. The well-known hair-baiting technique of VANBREUSEEHM31 was employed. For this, pieces of human hair 0.6 to 1.6 cm in length (sterilized by autoclaving), were spread on the soil samples in sterile Petri dishes. Small quantities of sterile distilled water (10-15 mL) were poured on the hair-baited plates. The plates were incubated at room temperature on the laboratory bench under normal light. Sterile water was added periodically to provide moisture needed for fungal growth. Fungal growths appearing on hair baits after 2-4 weeks of incubation were microscopically examined and cultured on slopes of Mycobiotic agar (Neogen Corporation, Lansing, Michigan, USA) to get pure cultures. Identification of the isolates was accomplished by studying the colonial and microscopical characters of the isolates in detail and comparing them with descriptions of suspected fungi in standard books and manuals3,17,15,20.

RESULTS

The distribution of keratinophilic fungi recovered from soil samples collected from different habitats is shown in the Table 1. Thirty of the 40 samples were positive for keratinophilic fungi with mixed growth in six of the samples, thus yielding a total of 36 isolates. Microsporum gypseum complex was the most frequently isolated keratinophilic fungus being present in 50% of the samples. The majority of the isolates of this species complex originated from soil samples collected from habitats of cows, goats, pigs, dogs and horses. Out of the 20 isolates of the M. gypseum complex, 16 of them were identified as M. gypseum, and the remaining four as M. fulvum. The differentiation of M. gypseum and M. fulvum was based on phenotypic characteristics. The isolates of M. gypseum formed buff to cinnamon-colored colonies with yellow-brown pigment on the reverse. Microscopic examination of lactophenol blue mounds of growth demonstrated characteristic thin, rough-walled macroconidia with slightly rounded terminal ends, and truncated proximal ends (Fig. 1), characteristic of M. gypseum.17,15. The isolates of M. fulvum formed buff to pinkish-buff colored colonies with the reverse colorless to yellow-brown. Microscopically numerous, thin, rough-walled, and relatively longish and bullet shaped macroconidia (Fig. 2), characteristic of the species17,15 were observed in lactophenol blue mounds of the growth. Abundant pyriform to clavate microconidia were also seen in both species of the complex.

Chrysosporium was represented by 14 isolates, seven identified as C. indicum, four as C. tropicum, one as C. keratinophilum, and two as unidentified Chrysosporium sp. Two isolates were identified as Sepedonium sp. Chrysosporium species formed moderately fast growing, cream-colored colonies, dense or powdery at the center. Conidia were hyaline, smooth-walled sessile or on short protrusions or short branches. Species differentiation was done according to characteristics of conidia17,20. C. indicum isolates were characterized by sub-hyaline, smooth, thin-walled, obovoid, ellipsoidal conidia, frequently elongated,
less than 3 µm broad with a concave upper surface; intercalary, conidia were also observed. C. tropicum isolates formed pyriform, smooth-walled conidia of 6-8 µm. The conidia of the isolate of C. keratinophilum were subhyaline, thick-walled obovoid with conspicuous basal scars, smooth-walled or slightly rough-walled. Sepedonium sp. formed yellowish orange colored colonies; microscopically characteristic globose spiny macroconidia were observed.

DISCUSSION

Investigators from several countries have reported on the occurrence of a variety of keratinophilic fungi including dermatophytes in soils of varying habitats. The predominant keratinophilic fungi reported in most studies include Chrysosporium spp (mainly C. indicum, C. tropicum and C. keratinophilum) and the dermatophyte M. gypseum. There have been only a few studies on the geophilic keratinophilic fungi from the Caribbean region. One study dealt with the recovery of a few isolates of M. gypseum, M. nanum, Trichophyton mentagrophytes, T. terrestris, and C. indicum from soil in Abaco Island in the Commonwealth of the Bahamas\textsuperscript{2,4}, and another reported the isolation of Chrysosporium indicum and C. evolceanui from the soil of Cuba\textsuperscript{16}. The third one was a comprehensive investigation on the distribution of M. gypseum and other keratinophilic fungi in soils of varying habitats in St. Kitts and Nevis\textsuperscript{13}. The present study is the first of its kind from Jamaica. A very high incidence of M. gypseum complex demonstrated in the soils of Jamaica (50%) is a noteworthy finding of public health significance. A similar high incidence (40%) of M. gypseum complex has been recorded in the soils of Nevis\textsuperscript{14}. M. gypseum has also been found to occur frequently in soils of Brazil, 20.8% in one survey\textsuperscript{2}, and 19.2% in another very recent study of 692 samples from different geographic regions of the country\textsuperscript{4}. The distribution of geophilic dermatophytes is influenced by soil pH and climatic factors. In a study from Kenya, the majority of the isolates of dermatophytes including M. gypseum were recovered from soils with acidic pH\textsuperscript{14}. In another study from Brazil\textsuperscript{2}, the majority of the isolates of M. gypseum were recovered from soils with almost neutral pH i.e. 7.0-7.09. A high prevalence of M. gypseum complex in soils of Nevis and Jamaica can be attributed mainly to tropical humid climate, a temperature of 22-30 ºC for most of the year and the acidic pH of the soils in these islands.

The frequent occurrence of Chrysosporium as a geophilic keratinophilic fungus in Jamaican soil is in agreement with that recorded in surveys of keratinophilic fungi of soils in several other countries\textsuperscript{5,10-12}. Our knowledge of ecology and epidemiology of dermatophytes and the factors influencing their transmission has helped us understand better the natural history of dermatophytes. Human infections due to the geophilic dermatophyte, M. gypseum complex are infrequently or rarely known, particularly in the Caribbean region. In one study of the etiological agent of tinea capitis in Jamaica during 1998-2002, M. gypseum was represented by only one isolate\textsuperscript{6}. Also in a similar study in Haiti, only one of the 55 isolates of dermatophytes was identified as M. gypseum\textsuperscript{17}. Comprehensive studies may reveal many more cases of skin and scalp infections due to M. gypseum.

RESUMO

Estudo preliminar sobre a ocorrência de fungos queratinofílicos em solos da Jamaica

Esta comunicação representa o primeiro estudo sobre fungos queratinofílicos presentes em solos da Jamaica. De 40 amostras de solo examinadas de diferentes localidades, 30 (75%) foram positivas para a presença de fungos queratinofílicos permitindo 36 isolamentos dos mesmos. O complexo Microsporum gypseum (representados por 16 isolamentos de M. gypseum e quatro de M. fulvum) foi o mais frequente, estando presente em 50% das amostras. A muito alta ocorrência deste dermatofíto no solo da Jamaica é significante para a saúde pública Os isolados remanescentes de fungos queratinofílicos foram representados pelo Chrysosporium spp (principalmente C. indicum e C. tropicum) e Sepedonium sp.

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