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INTERACTIONS BETWEEN SELECTED GEOPHILIC FUNGI AND PATHOGENIC DERMATOPHYTES

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Interactions between selected geophilic fungi (keratinolytic and keratinophylic species) and pathogenic dermatophytes were examined in dual cultures on Sabouraud glucose agar (SGA). It was demonstrated that Trichophyton mentagrophytes var. mentagrophytes *together with* T. mentagrophytes var., quinceanum *are the species most sensitive to the influences of the geophilic fungi. Microsporum persicolor was found to be more resistant to these influences. Only a few geophilic species inhibited the growth of M. canis on SGA. Keratinophilic species, unable to initiate hair decomposition but utilize the products of this process, exerted the larger inhibitory effect on the pathogenic dermatophytes than keratinolytic fungi.*

INTRODUCTION

The growth and survival of selected pathogenic dermatophytes on the hair laid on the surface of sediment and sludge samples were examined in a previous paper [3]. *Later* [4], another experiment to determine the growth curves of these dermatophytes inside the above mentioned materials was performed. In this article, it is intended to complete the above investigation presenting the data on the interactions between the geophilic fungi and the dermatophytes growing on an artificial medium.

MATERIAL AND METHODS

The pathogenic dermatophytes tested were the following: *Microsporum canis* (4 strains), *M. persicolor* (2 strains), *Trichophyton mentagrophytes var. mentagrophytes* (11 strains), and *T. mentagrophytes var. quinceanum* (1 strain). Except for *M. persicolor*, these strains were isolated from human sources. *M. persicolor* was recovered from polluted sediments [4].

The following geophilic species were examined: *Trichophyton ajelloi* (TAJ; 6 strains), *T. terrestre* complex (TTER; 4 strains), *Microsporum gypseum* (MGYP; 2 strains), *M. cookei* (MCO; 1 strain), *Chrysosporium keratinophilum* (CKER; 3 strains), *Myceliophthora vellerea* (MVEL; 3 strains), *Ch. pennicola* (CPAN; 2 strains), *Ch.* an *Arthroderma cerreyi* (ACUR; 1 strain), *Ch. indicum* (CIND; 1 strain), *A. multifidum* (AMUL; 2 strains), *Pseudallescheria boydii* (PBOY; 2 strains), *Dichotomomyces cejpii* (DIC; 1 strain), *Mortierella sp.* (MORT; 1 strain), *Paecilomyces lilacinus* (PLIL; 1 strain), and *Geomyces pannorum* (GPAN; 1 strain). The species from TAJ to AMUL are strongly keratinolytic while the species from PBOY to GPAN are characterized by the weak keratinolytic properties. All strains were isolated from polluted sediments and sewage sludge by means of the hair baiting method [6].

The interactions between the geophilic fungi and dermatophytes were examined in dual cultures in 90 mm *Petri* dishes with *Sabouraud* glucose agar (SGA). The inoculations were performed at the opposite sites of the *Petri* dishes, exactly in the same places in each two strain combination. Controls were single cultures of each strain. Incubation was carried out in the dark at 25°C for 4 weeks. After 2 and 4 weeks, the interactions between the strains were evaluated. The experiment was verified 5 times.

The following numerical system (INI=inhibition index) to determine the interactions between the strains was introduced: 0 – no inhibition or mutual equalized inhibition (M); 1 (-1) – weak inhibition; 2 (-2) – strong inhibition; 3 (-3) – very strong inhibition of one of the two colonies. When antibiosis (appearance of inhibition zone) or colony overlapping was clearly observed, 0,5 (-0,5) was added to the index. The INI maximal (minimal) value is 4 (-4). Its positive values testified about the inhibitory effect of the geophilic strains against the pathogenic dermatophytes. Subsequently, the negative values testified about the inhibition of the growth of the geophilic strains.

The INI system chiefly based on the evaluation of the growth superiority of the colonies in each two-strain combination. It is realized that this system does not reflect all the particulars associated with the interactions between fungal strains growing on *Petri* dishes. However, it is relatively simple and provides us the most important information on the subject.

RESULTS

In general, the geophilic species exerted the greatest inhibitory effect on the growth of TQ and TMEN (Tab. I). Their inhibitory potential against MPER was much smaller. MCAN was the only species the mean INI value of which was negative. This testifies about its antagonistic potential against the geophilic fungi.

Table I. The INI ranges and means for the interactions between geophilic fungi and pathogenic dermatophytes

Pathogenic dermatophytes	N	Min.	Max.	Mean	St. Err.
T. mentagrophytes var. quinceanum	32	–3	3,5	1,95	0,26
T. mentagrophytes var. mentagrophytes	106	–2,5	3,5	1,58	0,14
M. persicolor	33	–3	3,5	0,84	0,29
M. canis	48	–4	3	–0,70	0,23

Most of the geophilic fungi significatively inhibited the growth of TQ (Fig. 1). The only species with a distinctly smaller inhibitory effect was MVEL. The influence of CKER in TQ showed a high degree of differentiation. Mutual inhibition (M) was noticed between MVEL and CKER with TQ. One of the highest inhibitory effect on TQ was that of DIC and PLIL. In the case of TTER and PLIL, antibiosis (A) and colony overlapping (o) were clearly seen.

The largest inhibitory effect on TMEN was that of CIND, DIC, PLIL, GPAN, and CKER with antibiosis and colony overlapping noticed (Fig. 2). TMEN inhibited the growth of MVEL and MORT. Mutual inhibition was observed between TMEN and TAJ, TTER, MORT.

CIND, MORT, PLIL, and PBOY strongly inhibited the growth of MPER with antibiosis observed (Fig. 3). In the case of PBOY, however, the inhibitory effect

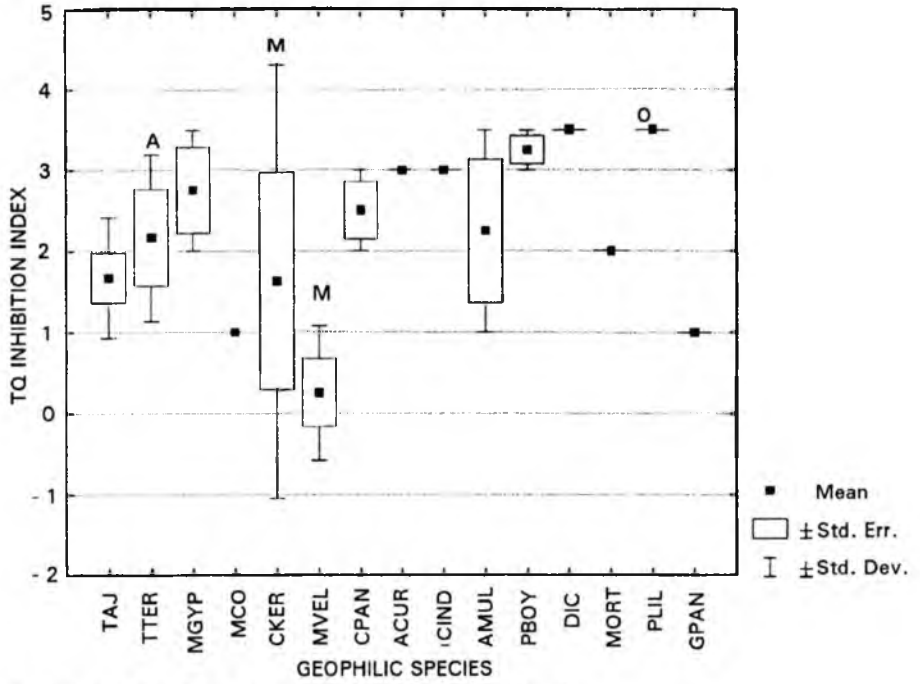

Fig. 1. The TQ inhibition index values for geophilic fungi

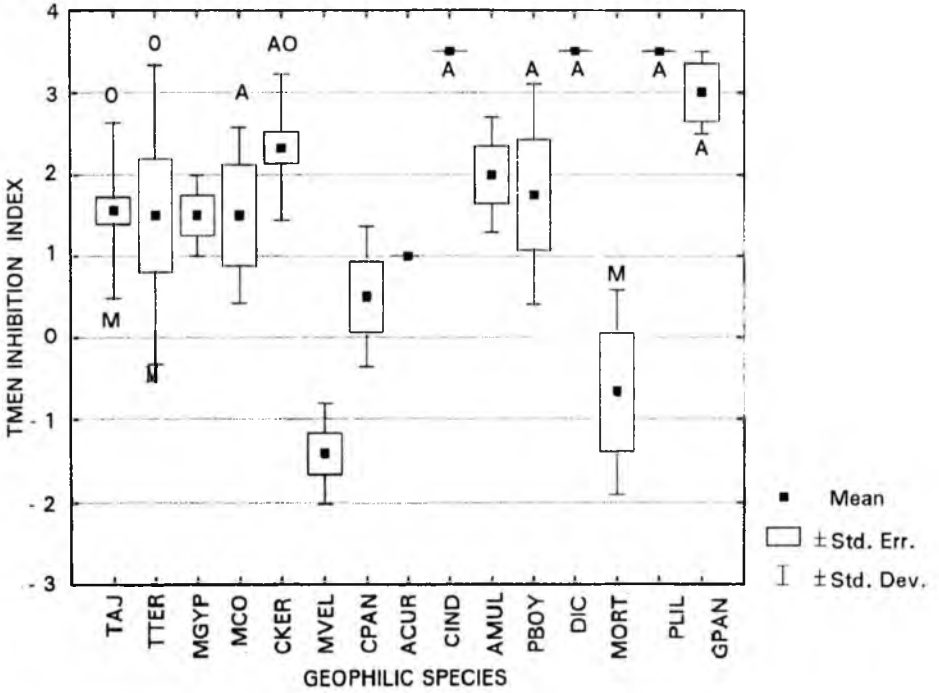

Fig. 2. The TMEN inhibition index values for geophilic fungi

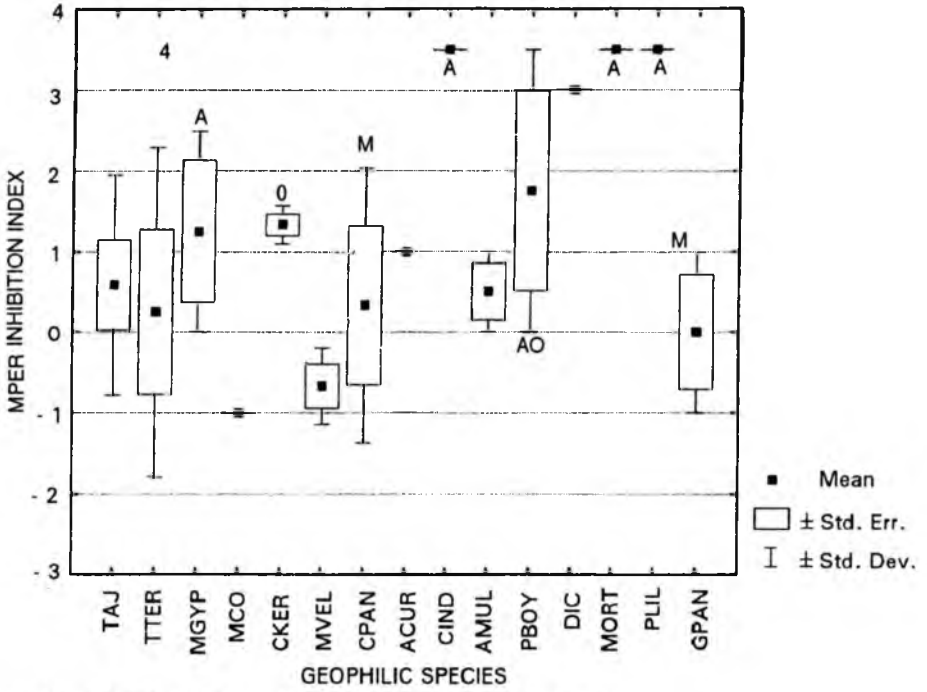

Fig. 3. The MPER inhibition index values for geophilic fungi

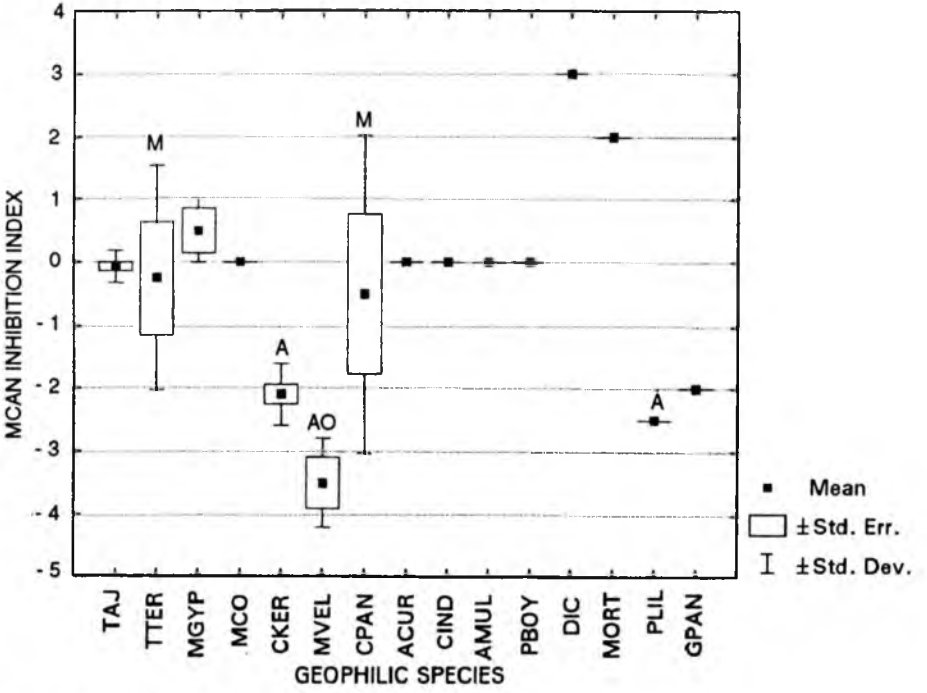

Fig. 4. The MCAN inhibition index values for geophilic fungi

showed a high degree of differentiation. No or weak influence was noticed in the case of GPAN. MCO and MVEL displayed the weak inhibitory effect on MPER. Mutual inhibition was observed between MPER and CPAN, GPAN.

DIC and MORT were found to be two species that strongly inhibited the growth of MCAN on SGA (Fig. 4). The growth of MVEL, PLIL, CKER, and GPAN were inhibited by MCAN with antibiosis and overlapping seen. The remaining species showed no or weak interactions with MCAN. Mutual inhibition was noticed between MCAN and TTER, CPAN.

The mean INI values for keratinophilic fungi were higher than those of keratinolytic species (Tab. II).

Table II. The mean INI values for the interactions between keratinolytic and keratinophilic fungi with pathogenic dermatophytes

Pathogenic dermatophytes	The mean INI value for	
	Keratinolytic fungi	Keratinophilic fungi
T. mentagrophytes var. quinceanum	1,76	2,75
T. mentagrophytes var. mentagrophytes	1,53	1,92
M. persicolor	0,55	1,92
M. canis	–0,82	0,08

DISCUSSION

The inhibitory effect of the fungi tested maybe due to different diffusable mycostatic substances produced by them. These mycostatic substances maybe volatile and non-volatile metabolites, toxins, pH-changing substances, and organic acids [1].

It was demonstrated in a previous article [3] that, on the hair laid on sediment and sludge samples, *M. persicolor* and *T. mentagrophytes var. mentagrophytes* better growth and longer survival periods than *T. mentagrophytes var. quinceanum* and *M. canis.* Our later experiment [4] confirmed this finding and displayed that *M. canis* has no adaptive abilities to survive in the sediment and sludge environment. The present results are in certain disagreement with the previously obtained data. They indicate that *T. mentagrophytes var. mentagrophytes* together with *T. mentagrophytes var. quinceanum* are the species most sensitive to the influences of the geophilic fungi. *M. persicolor* was found to be more resistant to these influences. Finally, only a few geophilic species inhibited the growth of *M. canis* on SGA.

The disagreement noted maybe explained in the following way: The physico-chemical properties and, probably, bacteriological activity [unpublished data] in the environment can considerably change the conditions of fungal growth and survival. The conclusion can be drawn that the results obtained on artificial media alone are of low value in the determination of the real abilities of the pathogenic fungi to survive in the environment.

Our findings generally fit the data obtained by *Prochacki* [2] as regards the antibiotic properties of *M. canis*. However, this author demonstrated its antibiotic properties in

relation to *M. gypseum* and *M. cookei*. In our study, no clear interactions between *M. canis* and these geophilic dermatophytes were observed.

As mentioned earlier, the geophilic species under examination can be divided into two groups: The first includes strongly keratinolytic species and the second the species with weaker keratinolytic properties. Within the second group, the species are not able to initiate strong hair decomposition but can utilize the products of the above process. It is noteworthy that the mean INI values for the second group were higher that those for the first one. Of course, the species examined in the study do not represent all the population of microscopic fungi that can grow on hair bait. Nevertheless, it can be hypothesized that the fungi from the second group may play an important may play an important role in determining the conditions of the survival of the pathogenic dermatophytes on keratin remains in the environment. In particular, it concerns the habitats influenced by human activity (sludge, sediments, municipal solid wastes).

The *ex situ* data on the growth and survival of pathogenic fungi in both natural habitats and artificial media is, undoubtedly, of medical (epidemiological) significance. In order to complete this information, however, *in situ* experiments should be performed. In addition, a selective method to isolate the dermatophytes and other pathogenic fungi from different habitats must also be elaborated.

K. Ulfig

WZAJEMNE ODDZIAŁYWANIA POMIĘDZY WYBRANYMI GRZYBAMI GEOFILNYMI I PASOŻYTNICZYMI DERMATOFITAMI

Streszczenie

Na pożywce *Sabourauda* (SGA) przebadano wzajemne oddziaływania pomiędzy wybranymi grzybami geofilnymi (gatunkami keratynofilnymi i keratynolitycznymi) i pasożytniczymi dermatofitami. Wykazano, że *Trichophyton mentagrophytes var. mentagrophytes* oraz *T. mentagrophytes var. quinceanum* są gatunkami najwrażliwszymi na wpływ grzybów geofilnych. *Microsporum persicolor* był bardziej odporny na ten wpływ. Tylko kilka gatunków geofilnych hamowało wzrost *M. canis* na SGA. Grzyby keratynofilne, niezdolne do zainicjowania rozkładu włosów ale wykorzystujące produkty tego rozkładu, wykazywały większy wpływ na dermatofity pasożytnicze niż gatunki o silnych właściwościach keratynolitycznych.

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